

Fishery Data Series No. 07-75

Coho and Chinook Salmon Smolt Releases into Cook Inlet, Prince William Sound, and Resurrection Bay, Alaska, 2004

by

Diane P. Loopstra

and

Patricia A. Hansen

December 2007

Alaska Department of Fish and Game

Divisions of Sport Fish and Commercial Fisheries



FISHERY DATA SERIES NO. 07-75

**COHO AND CHINOOK SALMON SMOLT RELEASES INTO COOK
INLET, PRINCE WILLIAM SOUND, AND RESURRECTION BAY,
ALASKA, 2004**

by
Diane Loopstra
Division of Sport Fish, Anchorage
and
Patricia A Hansen
Division of Sport Fish, Research and Technical Services, Anchorage

Alaska Department of Fish and Game
Division of Sport Fish, Research and Technical Services
333 Raspberry Road, Anchorage, Alaska, 99518-1599

December 2007

Development and publication of this manuscript were partially financed by the Federal Aid in Sport fish Restoration Act (16 U.S.C.777-777K) under Project F-10-20, Job No. S-2-12.

The Division of Sport Fish Fishery Data Series was established in 1987 for the publication of technically oriented results for a single project or group of closely related projects. Since 2004, the Division of Commercial Fisheries has also used the Fishery Data Series. Fishery Data Series reports are intended for fishery and other technical professionals. Fishery Data Series reports 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.

*Diane Loopstra,
Alaska Department of Fish and Game, Division of Sport Fish,
333 Raspberry Road, Anchorage, Alaska 99518-1599, USA
and*

*Patricia A. Hansen
Alaska Department of Fish and Game, Division of Sport Fish, Research and Technical Services
333 Raspberry Road, Anchorage, Alaska 99518-1599, USA*

This document should be cited as:

Loopstra, D., and P. A. Hansen. 2007. Coho and Chinook salmon smolt releases into Cook Inlet, Prince William Sound, and Resurrection Bay, Alaska, 2004. Alaska Department of Fish and Game, Fishery Data Series No. 07-75, Anchorage.

The Alaska Department of Fish and Game (ADF&G) 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 (ADA) 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 please write:

ADF&G ADA Coordinator, P.O. Box 115526, Juneau AK 99811-5526

U.S. Fish and Wildlife Service, 4040 N. Fairfax Drive, Suite 300 Webb, Arlington VA 22203

Office of Equal Opportunity, U.S. Department of the Interior, Washington DC 20240

The department's ADA Coordinator can be reached via phone at the following numbers:

(VOICE) 907-465-6077, (Statewide Telecommunication Device for the Deaf) 1-800-478-3648, (Juneau TDD) 907-465-3646, or (FAX) 907-465-6078

For information on alternative formats and questions on this publication, please contact:

ADF&G, Sport Fish Division, Research and Technical Services, Anchorage AK 99518 (907)267-2375.

TABLE OF CONTENTS

	Page
LIST OF TABLES.....	ii
LIST OF FIGURES.....	ii
LIST OF APPENDICES.....	ii
ABSTRACT.....	1
INTRODUCTION.....	1
METHODS.....	2
Smolt Marking.....	2
Coded Wire Tagging.....	2
Thermal Marking.....	6
Coho Salmon.....	6
Chinook Salmon.....	6
Smolt Enumeration.....	6
Tagging Inventory.....	6
Hatchery Inventory Estimates.....	9
Volumetric Estimates.....	9
Size Estimation.....	10
RESULTS.....	10
Smolt Marking.....	10
Coded Wire Tagging.....	10
Thermal Marking.....	10
Smolt Releases.....	10
Smolt Enumeration.....	11
Size Estimation.....	12
DISCUSSION.....	12
Smolt Marking.....	12
Coded Wire Tagging.....	12
Thermal marking.....	12
Smolt Enumeration.....	13
Size Estimation.....	15
RECOMMENDATIONS.....	15
ACKNOWLEDGMENTS.....	15
REFERENCES CITED.....	16
APPENDIX A.....	17

LIST OF TABLES

Table	Page
1. Total number of fish stocked at 15 locations in Cook Inlet, Prince William Sound, and Resurrection Bay in 2004.	3
2. Summary of Chinook salmon and coho salmon thermal marks (hatch codes) for smolt stocked at 10 locations in Cook Inlet, 3 locations in Prince William Sound, and 2 locations in Resurrection Bay in 2004.	7
3. Summary of coded wire tagging data and smolt release estimates for coho and Chinook salmon stocked in Cook Inlet, 2004.	11
4. A comparison of hatchery inventory and water volume population estimation results to a physical count for four release groups of Chinook salmon reared at Elmendorf and Fort Richardson hatcheries.	12
5. The percentage of coho and Chinook salmon in CWT release groups from Fort Richardson and Elmendorf hatcheries in 2004 that are within, smaller than, and larger than the production goal’s target size range.	13

LIST OF FIGURES

Figure	Page
1. Proper placement of a coded wire tag in a small fish.	5
2. Image of a thermal mark applied to Chinook salmon released in Cook Inlet, 2004.	8
3. Thermal marking temperature profile for Chinook salmon released into Cook Inlet in 2004 with a thermal mark (hatch code) of 2,3H.	8
4. Weight distributions, mean weights, and production goal target weight range, for coho and Chinook salmon reared at Fort Richardson and Elmendorf hatcheries and released in 2004.	14

LIST OF APPENDICES

Appendix	Page
A1. Historical releases of coho salmon that were adipose-clipped and tagged with coded wire tags, and/or thermally marked.	18
A2. Historical releases of Chinook salmon that were adipose-clipped and tagged with coded wire tags, and/or thermally marked.	22

ABSTRACT

Approximately 962,814 coho salmon *Oncorhynchus kisutch* and 1,726,124 Chinook salmon *O. tshawytscha* smolt were released in Cook Inlet, Prince William Sound, and Resurrection Bay in 2004. All 24 release groups were thermally marked to identify the area of release from returning adults. Of these, about 63,906 coho salmon (26.2% of one release group) and all 328,133 Chinook salmon from four release groups were also marked with an adipose-clip and a coded wire tag. Tag retention for individual release groups ranged from 91.7 to 99.9%. Fish size distribution at time of release was estimated for all five release groups with coded wire tags. Two of the four coded wire tag Chinook salmon release groups achieved a Chinook salmon production goal of 80% of smolt within a 5.1-15.0 g target size range. Approximately 50% of the smolt in the other two release groups were larger than the production goal target size range. The production goal for coho salmon is to have 80% of the smolt within a 15.1-25.0 g target size range. The percentage of coho salmon smolt within the target size range for the one coded wire tag release group was 75.7%.

The number of Chinook salmon in the four release groups with adipose-clips and coded wire tags was obtained during tagging. Hatchery inventory methods were used to estimate the number of all six coho salmon release groups and nine Chinook salmon release groups that did not receive adipose-clips and coded wire tags. Water volume inventory methods were used to estimate the number of Chinook salmon in five release groups.

Key words: hatchery, adipose-clip, coded wire tags, thermal marking, otolith, Chinook salmon, *Oncorhynchus tshawytscha*, coho salmon, *Oncorhynchus kisutch*, tag retention, size composition.

INTRODUCTION

Southcentral Alaska receives the vast majority of the state's sport fishing effort (Jennings et al. 2004). Chinook salmon *Oncorhynchus tshawytscha* and coho salmon *O. kisutch* smolt reared at Fort Richardson Hatchery (FRH) and Elmendorf Hatchery (EH) have been stocked in numerous locations throughout Southcentral Alaska to improve or create terminal sport fisheries and relieve pressure on wild stocks (Appendices A1 and A2). One element of the coho and Chinook salmon hatchery smolt stocking projects in Cook Inlet, Prince William Sound, and Resurrection Bay is the use of thermal marks (TM) to identify fish. Some salmon smolt are also marked with an adipose-clip and coded wire tag (CWT). TMs and CWTs can be used to estimate the contribution of hatchery stockings to commercial fisheries, marine and freshwater recreational fisheries, and personal use fisheries. They can also be used to estimate spawning escapement in stocked streams, and estimate straying of stocked coho and Chinook salmon.

The accuracy of hatchery contribution estimates from CWT recoveries is highly dependent upon the accuracy of unmarked fish estimates in the release groups. Estimating the number of unmarked fish is not needed when using TMs because all fish are marked. However, determining the number of fish in each release group is still necessary. The methods used at FRH and EH for determining the number of unmarked fish and/or total number of fish in release groups include a tagging inventory (TI) count, hatchery inventory (HI) estimates, and a water volume displacement (WV) estimate.

Another important element of hatchery smolt stocking programs is fish size. Weight and length of smolt at release are indicators of quality (Peltz and Starkey 1993). If smolt are too small at release, then ocean survival will be poor; and if smolt are too large at release, then ocean residence will be reduced, thus shifting age composition of returns to younger, smaller fish (Sweet and Peltz 1994). To maximize ocean survival of hatchery smolt and maintain the age composition of an existing population, Peltz and Starkey (1993) recommend that 80% of coho smolt released weigh between 15.1 and 25.0 g, and Chinook salmon weigh between 5.1 and 15.0 g.

This project documented the release of Chinook and coho salmon with TMs and CWTs in Cook Inlet, Prince William Sound, and Resurrection Bay in 2004. Specific objectives for this project were:

1. To estimate the long-term (>30 days) tag retention rate of each smolt release group marked with CWTs;
2. Verify the thermal mark applied to otoliths in each coho and Chinook salmon release group;
3. To estimate the weight distribution of each smolt release group marked with CWTs.

A task associated with this project was to compare smolt abundance using HI and WV estimates to the TI count for all Chinook salmon release groups marked with an adipose clip and CWT. Another task was to compare Chinook smolt abundance estimates using two different HI techniques for one release group.

Our tagging goal was to mark at least 60,000 coho from one release group, and all Chinook in four release groups with an adipose clip and a CWT. A second goal was to mark all fish in all release groups with a thermal mark.

Included in this report are recommendations for future marking and collecting of smolt release data. All data for this report are held and archived by Research and Technical Services, Sport Fish Division, Alaska Department of Fish and Game (ADF&G).

METHODS

Coho salmon broodstock from Bear Lake, Ship Creek (Little Susitna River), and Eklutna Tailrace (Jim Creek) were raised at FRH. Chinook salmon broodstock from Deception Creek, Ship Creek, Crooked Creek, and Ninilchik River were raised at both EH and FRH. Fish from 24 release groups were stocked at 10 locations in Cook Inlet, 3 locations in Prince William Sound, and 2 locations in Resurrection Bay (Table 1).

SMOLT MARKING

Coded Wire Tagging

All Chinook salmon smolt in four release groups were adipose-clipped and injected with a CWT. Because only a portion of the coho salmon smolt from one release group was adipose-clipped and injected with a CWT, a systematic sampling procedure was used to obtain a representative sample for tagging. During sampling, fish were crowded and held at one end of a raceway and dipnetted. Approximately every third to fourth dip net of fish was weighed and placed in an area designated for tagging. Fish not tagged were returned to the raceway. All tagged fish were adipose-clipped and injected with a CWT. If a particular release group was in more than one raceway, then we attempted to tag the same proportion of fish in each raceway (Peltz and Miller 1990). Unique tag codes were used for all release groups marked with CWTs.

To determine which head mold sizes would provide the best tag placement, a length frequency distribution was obtained by measuring the fork length (to the nearest millimeter) of at least 510 fish from each of the four broodstock within 7 days of tagging. Two or three head mold sizes that fit at least 80% of the length distribution were selected for tagging (Peltz and Hansen 1994).

Table 1.-Total number of fish stocked at 15 locations in Cook Inlet, Prince William Sound, and Resurrection Bay in 2004.

Release Area	Release Location	Broodstock	Inventory method used	Number of fish in Release Group
Elmendorf Hatchery				
<u>Chinook Salmon</u>				
Cook Inlet	Deception Creek	Deception Creek	tagging inventory	99,047
Cook Inlet	Homer Spit	Ninilchik River	volumetric	25,706
Cook Inlet	Seldovia	Ninilchik River	volumetric	88,682
Cook Inlet	Ship Creek	Ship Creek	hatchery inventory	111,166
Resurrection Bay	Seward Lagoon	Crooked Creek	volumetric	109,600
Prince William Sound	Fleming Spit	Deception Creek	volumetric	58,000
Prince William Sound	Whittier	Deception Creek	volumetric	20,906
Fort Richardson Hatchery				
Cook Inlet	Crooked Creek	Crooked Creek	tagging inventory	80,601
Cook Inlet	Deception Creek	Deception Creek	tagging inventory	113,523
Cook Inlet	Eklutna Tailrace	Ship Creek	hatchery inventory	215,165
Cook Inlet	Halibut Cove	Ninilchik River	hatchery inventory	103,771
Cook Inlet	Homer Spit	Ninilchik River	hatchery inventory	143,037
Cook Inlet	Ninilchik River	Ninilchik River	tagging inventory	51,303
Cook Inlet	Ship Creek	Ship Creek	hatchery inventory	209,060
Resurrection Bay	Lowell Creek	Crooked Creek	hatchery inventory	89,388
Prince William Sound	Valdez, Old Town Site	Deception Creek	hatchery inventory	99,464
Prince William Sound	Whittier	Deception Creek	hatchery inventory	107,705
<u>Coho Salmon</u>				
Cook Inlet	Bird Creek	Ship Cr (Little Susitna River)	hatchery inventory	109,949
Cook Inlet	Campbell Creek	Ship Cr (Little Susitna River)	hatchery inventory	85,790
Cook Inlet	Eklutna Tailrace	Eklutna Tailrace (Jim Creek)	hatchery inventory	131,979
Cook Inlet	Homer Spit	Ship Cr (Little Susitna River)	hatchery inventory	130,243
Cook Inlet	Ship Creek	Ship Cr (Little Susitna River)	hatchery inventory	241,066
Resurrection Bay	Lowell Creek	Bear Lake	hatchery inventory	131,989
Resurrection Bay	Seward Lagoon	Bear Lake	hatchery inventory	131,798
Total				2,688,938

All fish were graded and tagged accordingly with a full-length CWT (1.1 mm) using a Northwest Marine Technology¹ Mark IV tag injector.

Fish were anesthetized with MS-222 before tagging. The adipose fin was excised at the base using surgical scissors. Tags were then injected into the noses of the fish, and the fish were sent through a Quality Control Device (QCD). The QCD detected the magnetized tag and separated the fish with tags from those without tags. All fish without tags were injected again. Quality control checks for tag placement were conducted following initial daily startup, and following a change in head mold size or a change in tagging personnel. During each quality control check, a

¹ Use of a company's name does not constitute endorsement.

minimum of two tagged fish were dissected to determine tag placement (Moberly et al. 1977; Figure 1). Head mold or wire placement adjustments were made when necessary. The fish dissected to determine tag placement were not included in the tagged fish counts.

After tagging, all fish were held in net pens overnight to determine short-term mortality and short-term tag retention rates. All overnight mortalities were counted and recorded. Short-term retention rates were estimated daily by passing a random sample of 200 fish through the QCD. Daily tag retention rate (D_i) of surviving smolt was estimated as a binomial proportion:

$$\hat{D}_i = \frac{n_i}{n_{ti}}, \quad (1)$$

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 ,

and a variance of:

$$Var(\hat{D}_i) = \frac{\hat{D}_i(1 - \hat{D}_i)}{n_{ti} - 1}. \quad (2)$$

Tagged and untagged smolt were combined following overnight mortality checks and held until release. Fish mortality was monitored daily and all adipose-clipped and non adipose-clipped mortalities were recorded.

Long-term tag retention was estimated for all release groups at least 30 days after tagging (Blankenship 1990). At least 750 adipose-clipped fish were randomly sampled from the population and checked for tag retention using a hand-held CWT detector. Long-term tag retention rate (D_j) of surviving smolt, and its variance, was also estimated as a binomial proportion (equations 1 and 2) for each release group,

where:

- n_i = number of smolt in the sample that retained the tag; and
- n_{ti} = total number of tagged smolt in the sample.

The number of fish released with CWTs (\hat{T}_j) was estimated as:

$$\hat{T}_j = (N_j - M_j)\hat{D}_j, \quad (3)$$

and its variance as:

$$Var(\hat{T}_j) = (N_j - M_j)^2 Var(\hat{D}_j), \quad (4)$$

where:

- N_j = number of fish injected with a tag in group j ,
- \hat{D}_j = long-term tag retention of release group j , and
- M_j = total number of mortalities of tagged fish in group j .

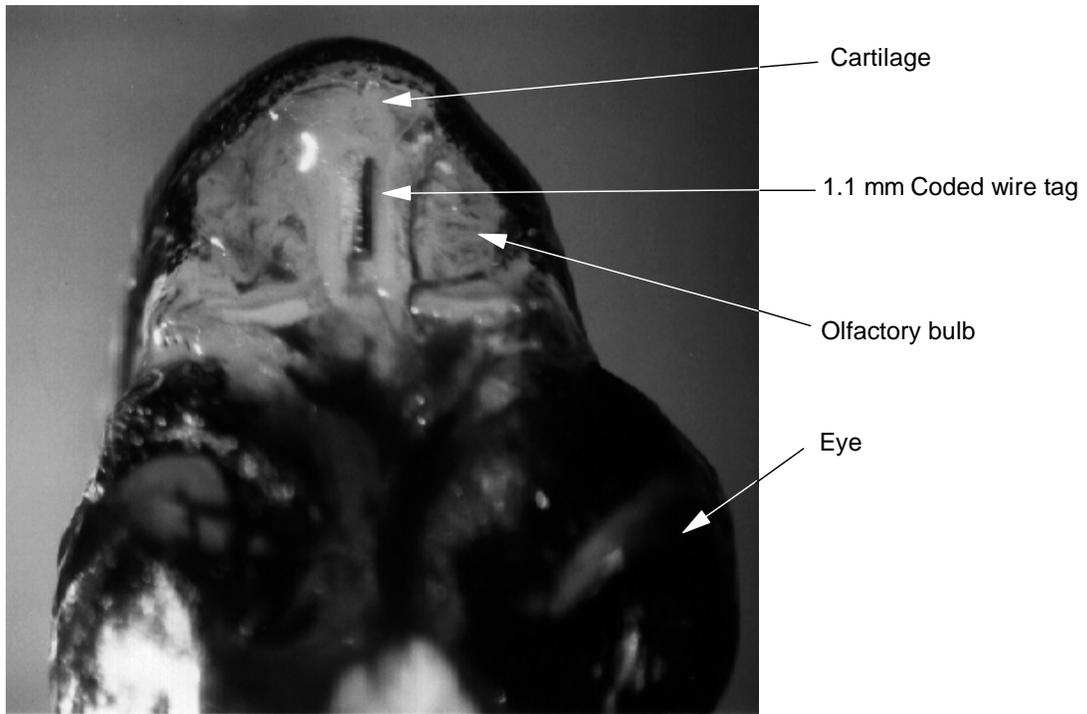
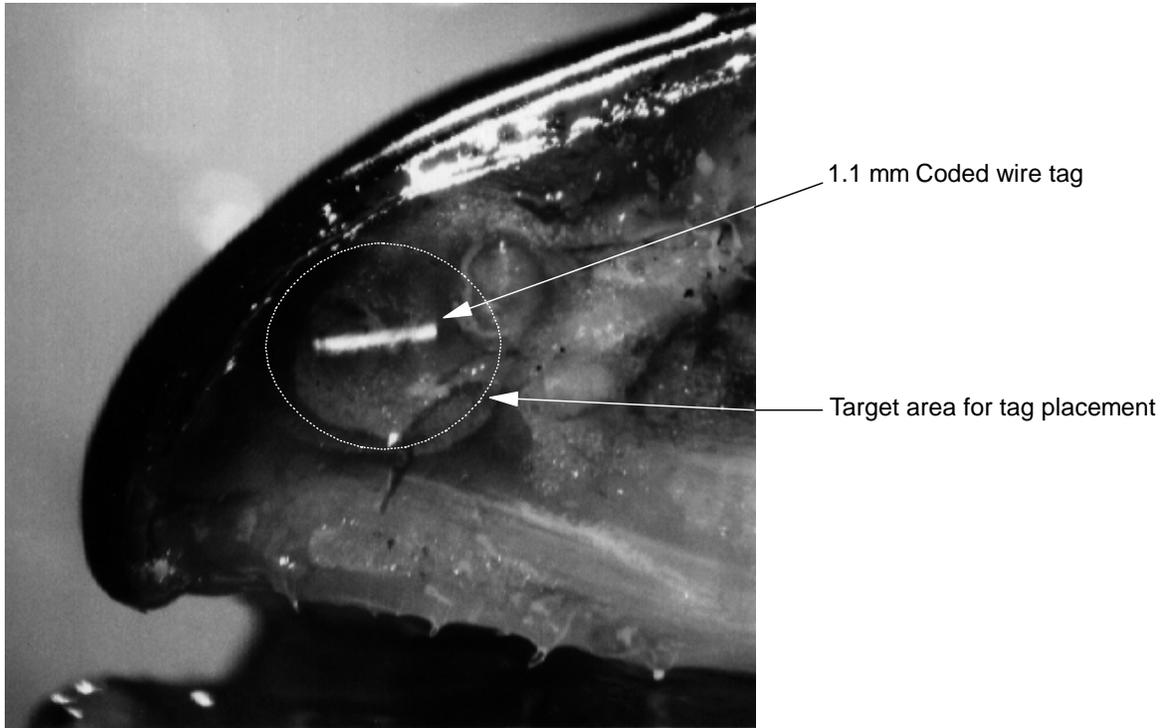


Figure 1.-Proper placement of a coded wire tag in a small fish.

Thermal Marking

Thermal marks were applied to all coho and Chinook salmon embryos before hatching. Thermal mark patterns were assigned by the Mark, Tag, and Age Laboratory operated by ADF&G Division of Commercial Fisheries (Table 2). At approximately 310 CTUs (centigrade temperature units) for coho salmon and 360 CTUs for Chinook salmon, otoliths were developed enough to accept a mark, as verified by the Mark, Tag, and Age Laboratory. Embryos were exposed to a series of 4-5°C water temperature changes (both increases and decreases), with each temperature decrease resulting in the deposit of a dark protein ring on the developing otolith (Monk *Unpublished*). Water temperature changes were scheduled every 24 hours, with a 72-hour warm water exposure occurring between bands of rings for Chinook salmon. The assigned patterns of dark protein rings applied to the otoliths (Figure 2) are used to identify the area of release from returning adult salmon. Onset Stowaway XTI data loggers recorded incubation water temperature every 15 minutes throughout the marking period to generate thermal profiles for each mark type (Figure 3).

Voucher samples containing approximately 50 fish from each egg lot were collected before moving fish to the raceways (ponding) and submitted to the Mark, Tag, and Age Laboratory for mark verification.

Coho Salmon

Coho salmon were thermally marked in 2002. Different TMs were applied to identify the fish as belonging to a Cook Inlet release group (1 band of 5 rings, or 5H) or to a Resurrection Bay release group (1 band of 4 rings, or 4H) (Table 2). Thermal marking was completed before hatching occurred.

Chinook Salmon

Chinook salmon were thermally marked in 2002 and 2003 (Table 2). Different TMs consisting of 2 bands were applied to identify the fish as belonging to a Cook Inlet (2,3H), Prince William Sound (2,4H), or Resurrection Bay (2,5H) release group. The first band consisted of 2 rings for all Chinook release groups, and the second band consisted of 3 rings for Cook Inlet, 4 for Prince William Sound, and 5 for Resurrection Bay.

SMOLT ENUMERATION

The number of fish in all 24 release groups was estimated (before release) using the TI counts, the HI abundance estimates, and/or the WV abundance estimates. The TI counts were compared to the HI and WV estimates to determine the precision of the HI and WV estimates. If the HI or WV estimates differed more than 10% from the TI count, then the estimations would be reviewed.

Tagging Inventory

A TI count was obtained from the tag counter on the Mark IV CWT injector for the four Chinook salmon release groups 100% injected with CWTs. Thus, the number of injected tags equaled the number of fish in a release group. For these release groups, fish mortality was monitored daily and subtracted from the original TI count to yield a final fish count for each release group. A TI count was not done for the one coho salmon release group injected with CWTs, because only a portion of the release group was tagged.

Table 2.-Summary of Chinook salmon and coho salmon thermal marks (hatch codes) for smolt stocked at 10 locations in Cook Inlet, 3 locations in Prince William Sound, and 2 locations in Resurrection Bay in 2004.

Release Area Mark Group(s)	Release Location	Hatch Code(s) ^a
<u>Chinook Salmon</u>		
Cook Inlet	Crooked Creek	2,3H
Cook Inlet	Deception Creek ^b	2,3H and 2,2,1H
Cook Inlet	Eklutna Tailrace ^c	2,3H and 1,3H
Cook Inlet	Ship Creek ^c	2,3H and 1,3H
Cook Inlet	Halibut Cove	2,3H
Cook Inlet	Homer Spit	2,3H
Cook Inlet	Ninilchik River	2,3H
Cook Inlet	Seldovia	2,3H
Resurrection Bay	Lowell Creek	2,5H
Resurrection Bay	Seward Lagoon	2,5H
Prince William Sound	Fleming Spit	2,4H
Prince William Sound	Valdez Harbor ^{d,e}	2,3,1H and 2,2,2H
Prince William Sound	Whittier Harbor ^{d,e}	2,4H and 2,3,1H and 2,2,2H
<u>Coho Salmon</u>		
Cook Inlet	Bird Creek	5H
Cook Inlet	Campbell Creek	5H
Cook Inlet	Eklutna Tailrace	5H
Cook Inlet	Homer Spit	5H
Cook Inlet	Ship Creek	5H
Resurrection Bay	Lowell Creek	4H
Resurrection Bay	Seward Lagoon	4H

^a Hatch codes shown in bold differ from the proposed release area hatch code.

^b Deception Creek BY2002 broodstock Cook Inlet mark lots 1,3 had a delayed temperature change before the last ring of band 2.

^c Ship Creek BY02 broodstock Cook Inlet mark lots 1 and 2 are missing the first ring of the first band.

^d Deception Creek BY02 broodstock PWS mark lot 4 had a delayed temperature change between rings 2 and 3 of the second band.

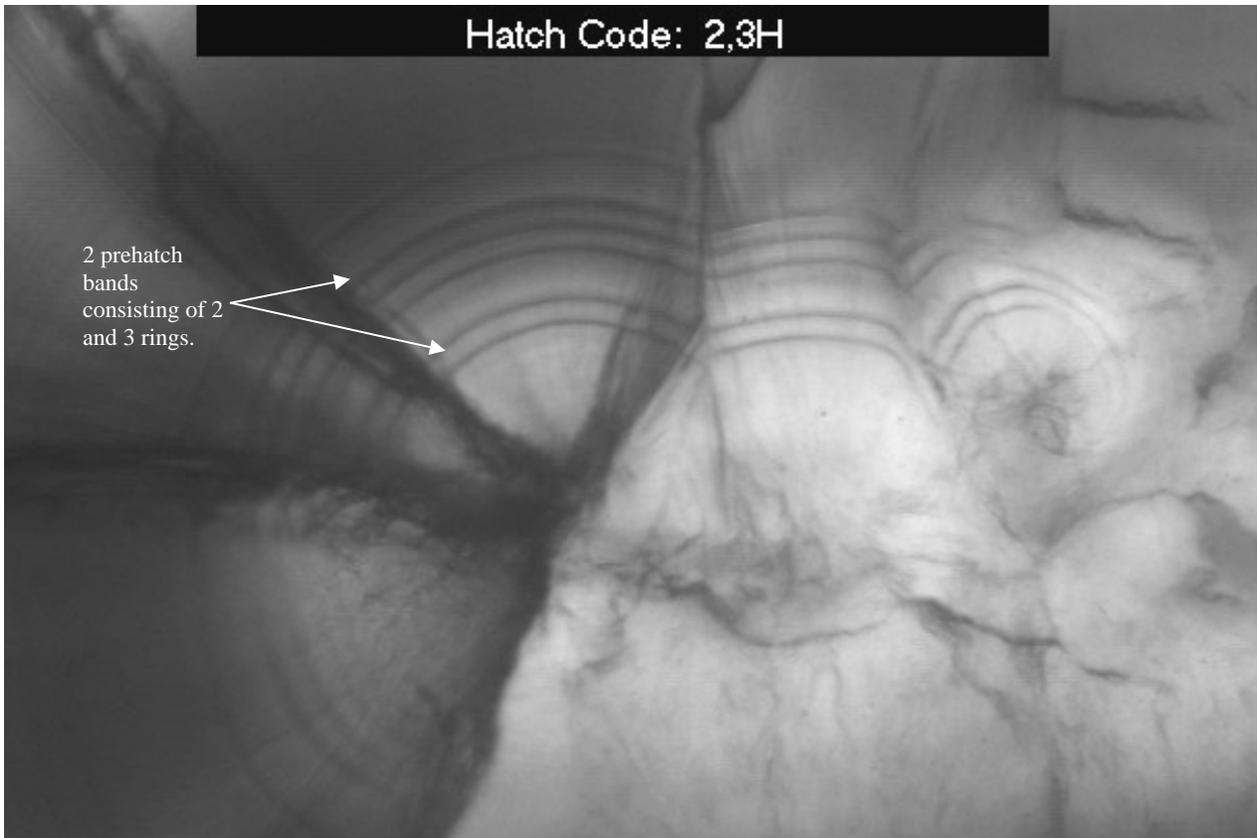


Figure 2.-Image of a thermal mark applied to Chinook salmon released in Cook Inlet, 2004.

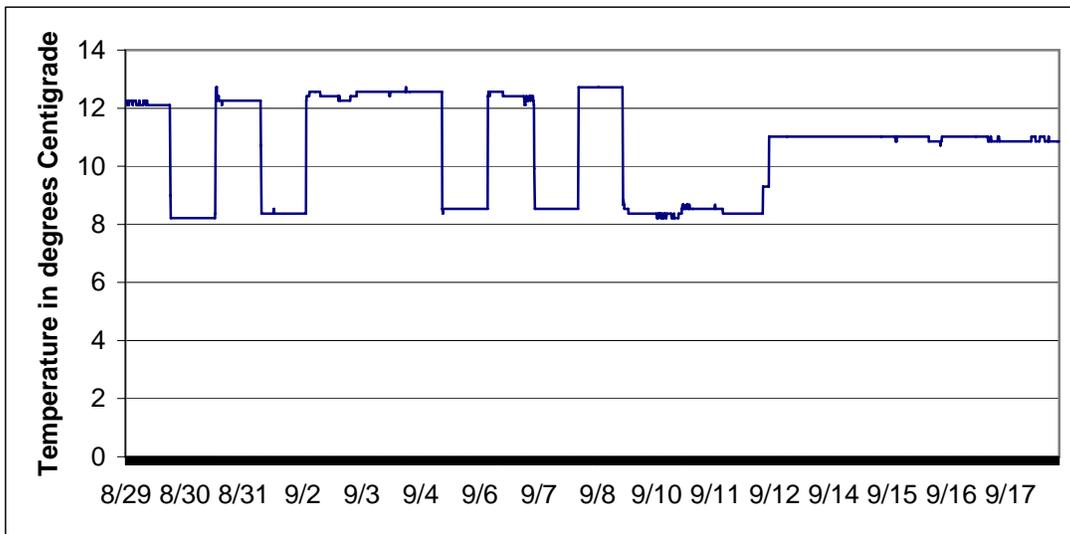


Figure 3.-Thermal marking temperature profile for Chinook salmon released into Cook Inlet in 2004 with a thermal mark (hatch code) of 2,3H.

Hatchery Inventory Estimates

One HI abundance technique used at EH was based on fry survival from the eyed-egg stage. At the eyed-egg stage all dead eggs were removed, and the number of live eggs was estimated using volumetric techniques. Three egg samples were collected during egg sorting and picking, and a standard egg measuring trough was used to estimate the number of eggs per ounce of displaced water. A measured amount of water was placed in a displacement container. Eggs were added until the amount of water displaced equaled the volume of eggs placed in each incubator. The number of eggs in each release group was then estimated by multiplying the number of eggs per ounce of water displaced by the total volume of water displaced for all incubators of eggs. At ponding, the number of dead eggs was estimated and subtracted from the number of eyed eggs to determine the number of fish put into the raceways. Abundance estimates obtained using this HI technique were determined for each release group at EH, but are not reported.

A second HI abundance technique used at EH was based on the weight of fish in a raceway. All fish were crowded to one end of a raceway, dipnetted, and weighed. Three randomly selected net loads of fish were weighed and hand counted from a bucket to obtain a mean fish weight. The total weight of fish was then divided by the mean fish weight to establish the HI abundance estimate for that raceway. This technique was used for one Chinook salmon release group.

The HI abundance technique used at FRH was also based on the weight of fish in a raceway. These estimates were obtained when fry were moved from small indoor raceways to large outdoor raceways. Approximately 10 randomly selected net loads of fish were used to estimate mean fish weight. Because a net full of fish was too large to enumerate (approximately 600-800 fish), the net was manually halved numerous times until 50-100 fish remained in the net. These fish were weighed and hand counted from a bucket to determine mean fish weight. The total weight of fish, obtained using the accumulative weight feature on the electronic scale, was then divided by the mean fish weight to establish the HI abundance estimate in that raceway. The number of fish released from an outdoor raceway equaled the original outdoor raceway estimate minus the fish stocked or transferred, and minus the mortalities from date of loading into the outdoor raceway to the date of release.

Volumetric Estimates

Fish abundance (number or weight) was also estimated volumetrically at both hatcheries using a transport tank when transporting fish to the release site. This estimate is a function of the tank volume (gallons), the ratio of the volume of water displaced in the tank sight gauge to the volume of water placed in the tank (mm/gallon), and the ratio of the number (or weight) of fish which displace a volume of water in the tank sight gauge (fish/mm or kg/mm).

For fish transport, each tank was filled with water and the water level on the tank sight gauge recorded to the nearest millimeter. Fish were then pumped from the raceway into each of the transport tanks. The water level on the tank gauge was recorded again after fish were loaded into each of the tanks. The millimeters of water displaced for each tank were determined, and using a known displacement value of kilograms of fish per millimeter, the total weight of fish in the tank was estimated. Total number of fish was estimated by dividing the total fish weight by the mean fish weight.

FRH estimated mean weight by obtaining fish samples from five nets of fish before loading the tanks. Each net of fish was split in half several times until the desired sample size (50-100 fish) was achieved. The fish were poured into a pre-weighed bucket of water, weighed to the nearest

gram, and counted out of the bucket. Mean weight was calculated for each of the five samples, and an overall mean weight was calculated by summing the five sample mean weights and dividing by the sum of the fish samples.

EH estimated mean weight by removing three dip net samples of (50-100) fish from the transport tanks on the transport vehicle. Each net of fish was held out of the water for several seconds to allow most of the water to drain out of the net. The fish from each sample were poured into a pre-weighed bucket of water, weighed to the nearest gram, and counted out of the bucket. Mean weights were calculated for each sample by dividing the sample weight by the number of fish in the sample, and an overall mean weight was calculated by summing the three sample mean weights and dividing by 3.

SIZE ESTIMATION

A sample of fish from each raceway containing CWTs was individually weighed and measured. Fish were crowded to one end of a raceway and a minimum of 510 were dipnetted and put into a small holding pen. Each fish in the holding pen was measured to the nearest millimeter and weighed to the nearest 0.1 g.

RESULTS

SMOLT MARKING

Coded Wire Tagging

In 2004, 63,222 coho salmon and 344,474 Chinook salmon smolt with an adipose clip and CWT were released in Cook Inlet (Table 3). The tagging goals of 60,000 coho salmon and 100% of the Chinook salmon release groups were achieved.

Long-term tag retention was determined 46-109 days after tagging (Table 3). Tag retention rates ranged from 91.7 to 99.9%. The percentage of marked fish per release group ranged from 26.2 to 100% (Table 3).

Thermal Marking

Thermal profiles indicated that all coho salmon release groups were marked with their proposed TM hatch code (Table 2). However, thermal profiles for Chinook salmon indicated that only 8 of the 13 release locations received the proposed TM hatch code. Delayed temperature changes affected the Cook Inlet TM (Deception Creek, Eklutna Tailrace, and Ship Creek) release groups and the Prince William Sound TM (Whittier and Valdez) release groups. Deception Creek, Eklutna Tailrace, Ship Creek, and Whittier release groups received some fish with the proposed TM and some with an altered mark. The Valdez release group received two different TMs, both were incorrect. All incorrectly applied TMs occurred in the 2002 brood year release groups.

SMOLT RELEASES

In 2004, 24 coho and Chinook salmon release groups were stocked in Cook Inlet, Prince William Sound, and Resurrection Bay release areas (Table 1). FRH released an estimated 962,814 coho salmon smolt at seven locations and an estimated 1,213,017 Chinook salmon smolt at 10 locations (Table 1). EH released an estimated 513,107 Chinook salmon smolt at seven locations. A delay during the transport of one release group (Fleming Spit) resulted in the mortality of an estimated 20,000 Chinook salmon smolt.

Table 3.-Summary of coded wire tagging data and smolt release estimates for coho and Chinook salmon stocked in Cook Inlet, 2004.

Release Location Parameter	Coho Salmon	Chinook Salmon				Totals
	Ship Creek ^a	Deception Creek ^b	Deception Creek ^b	Ninilchik River ^b	Crooked Creek ^b	
Tag Codes	31-02-81 31-03-15	31-02-75 31-02-76 31-01-27	31-02-77 31-02-78 31-03-16	31-03-18	31-02-79 31-02-80	
Total adipose-clipped and tagged	63,231	99,329	113,913	51,428	81,133	409,034
Mortalities	9	282	390	125	532	1,338
Adipose-clipped fish released	63,222	99,047	113,523	51,303	80,601	407,696
Tag retention sample size	1,523	847	772	750	762	
Tag retention at release	99.5%	98.6%	91.7%	99.9%	93.2%	95.9%
Tag retention variance	0.0003%	0.0017%	0.0099%	0.0002%	0.0084%	
Tagged fish released	62,906	97,660	104,101	51,252	75,120	391,039
Tagged fish variance	13,722	161,962	1,270,843	4,679	542,810	
Total fish released	241,066	99,047	113,523	51,303	80,601	585,540
Percent adipose-clipped	26.2%	100.0%	100.0%	100.0%	100.0%	
Tagging dates	3/23/2004 4/1/2004	2/2/2004 2/19/2004	2/23/2004 3/5/2004	3/16/2004 3/22/2004	3/6/2004 3/16/2004	
Date of tag retention check	5/21/2004	6/7/2004	6/7/2004	5/7/2004	6/2/2004	
Days elapsed	51	109	94	46	78	

^a Total fish released is a hatchery inventory estimate.

^b Total fish released was determined from a tagging inventory count.

Larger than planned for fish in the Fleming Spit and Seldovia release groups resulted in more biomass in each release group than the stocking truck could transport in a single trip. The excess fish were stocked at Whittier and Homer Spit.

SMOLT ENUMERATION

HI estimates were reported for all seven coho salmon and eight Chinook salmon release groups (Tables 1 and 3). Water volume displacement estimates were reported for five Chinook salmon release groups. TI counts were reported and compared to the results of HI and volumetric estimation techniques for the four TI Chinook salmon release groups (Table 4). The results of the two different HI techniques used at EH were compared to the volumetric estimate for one Chinook salmon release group (Ship Creek).

Table 4.-A comparison of hatchery inventory and water volume population estimation results to a physical count for four release groups of Chinook salmon reared at Elmendorf and Fort Richardson hatcheries.

Estimation Technique	Fort Richardson			Elmendorf	
	Deception Cr	Ninilchik R	Crooked Cr	Deception Cr	Ship Cr
Tagging Inventory	113,523	51,303	80,601	99,047	N/A
Hatchery Inventory (weight)	116,026	53,723	98,182	N/A	111,166
Hatchery Inventory (est. survival from eyed egg est)	ND	ND	ND	99,942	106,548
Displacement	113,377	51,370	80,316	100,548	107,765
Difference TI to HI	2.2%	4.5%	17.9%	0.9%	N/A
Difference TI to WV	-0.1%	0.1%	-0.4%	1.5%	N/A
Difference HI (weight) to WV	-2.3%	-4.6%	-22.2%	ND	-3.2%
Difference HI (weight) to HI (egg est)	ND	ND	ND	ND	-4.3%

ND= no data collected or reported.

SIZE ESTIMATION

The production goal for coho salmon was to have 80% of the fish weighing between 15.1 and 25.0 g. The one adipose-clipped and coded wire tagged (Ship Creek) release group nearly achieved this goal (75.7%, Table 5, Figure 4). The production goal for Chinook salmon was to have 80% of the fish weighing between 5.1 and 15.0 g. Two Chinook salmon release groups achieved the production goal (Ninilchik River = 88.5% and BY02 [brood year 2002] Deception Creek = 90.0%). Approximately 50% of the Chinook in the other two adipose-clipped and coded wire tagged release groups (Crooked Creek and BY03 Deception Creek) were larger than the target production goal size range (Table 5, Figure 4). Warm water used at EH accelerated growth of the Deception Creek fish beyond the desired size range, and the HI count overestimated the number of fish in the Crooked Creek release group resulting in overfeeding and increased growth rates.

DISCUSSION

SMOLT MARKING

Coded Wire Tagging

A point of emphasis for the CWT marking program has been to achieve good long-term CWT retention rates. Grading fish and using different head mold sizes for tagging is responsible for maintaining acceptable (>97%) long-term tag retention rates. Overall tag retention levels between 1994 and 2002 were steady at greater than 97% (Appendices A1 and A2). Overall retention dropped to 96.8% in 2003, and declined to 95.9% in 2004. Poor tag placement, a result of poor quality control monitoring, contributed to the lower than normal long-term tag retention rate for two BY02 Chinook salmon release groups (Deception Creek and Crooked Creek).

Thermal marking

Coho salmon were thermally marked at FRH, and Chinook salmon were marked at EH. Because scheduled temperature changes for thermal marking the Chinook salmon release groups in 2002

Table 5.-The percentage of coho and Chinook salmon in CWT release groups from Fort Richardson and Elmendorf hatcheries in 2004 that are within, smaller than, and larger than the production goal's target size range.

Release Group	Percent		
	Below	Within	Above
Coho Salmon - Ft. Richardson^a			
Ship Creek	15.3%	75.7%	9.0%
Chinook Salmon - Ft. Richardson^b			
Deception Creek	0.0%	90.0%	10.0%
Ninilchik River	0.0%	88.5%	11.5%
Crooked Creek	0.4%	50.1%	49.5%
Chinook Salmon - Elmendorf^b			
Deception Creek	0.0%	48.5%	51.5%

^a Production goal for coho salmon: 80% of smolt 15.1-25.0 g.

^b Production goal for Chinook salmon: 80% of smolt 5.1-15.0 g.

were not performed routinely throughout marking, some changes were missed or delayed. Thermal marking responsibilities were assigned in 2003, and all BY03 Chinook salmon received the desired TM.

SMOLT ENUMERATION

Beginning in 1997, improved techniques based on the weight of fish in each release group have made the HI inventory method as reliable as the mark-recapture method used at FRH and EH (Starkey et al. 1999). HI estimates were reported for 14 FRH release groups and for one Chinook salmon release group (Ship Creek) at EH.

An inventory error in one release group (Crooked Creek) at FRH resulted in a HI estimate approximately 18% higher than the TI count, and 22% higher than the WV estimate. The source of the error is unknown. However, the HI estimates for the two other Chinook salmon release groups at FRH were within 5% of the TI count. The TI count and WV estimates were within 0.5% of each other for all three Chinook salmon release groups at FRH. Improved transport tank loading techniques, such as eliminating excess water when transferring (loading) fish and taking accurate site gauge readings, may have increased the reliability of WV estimates at FRH.

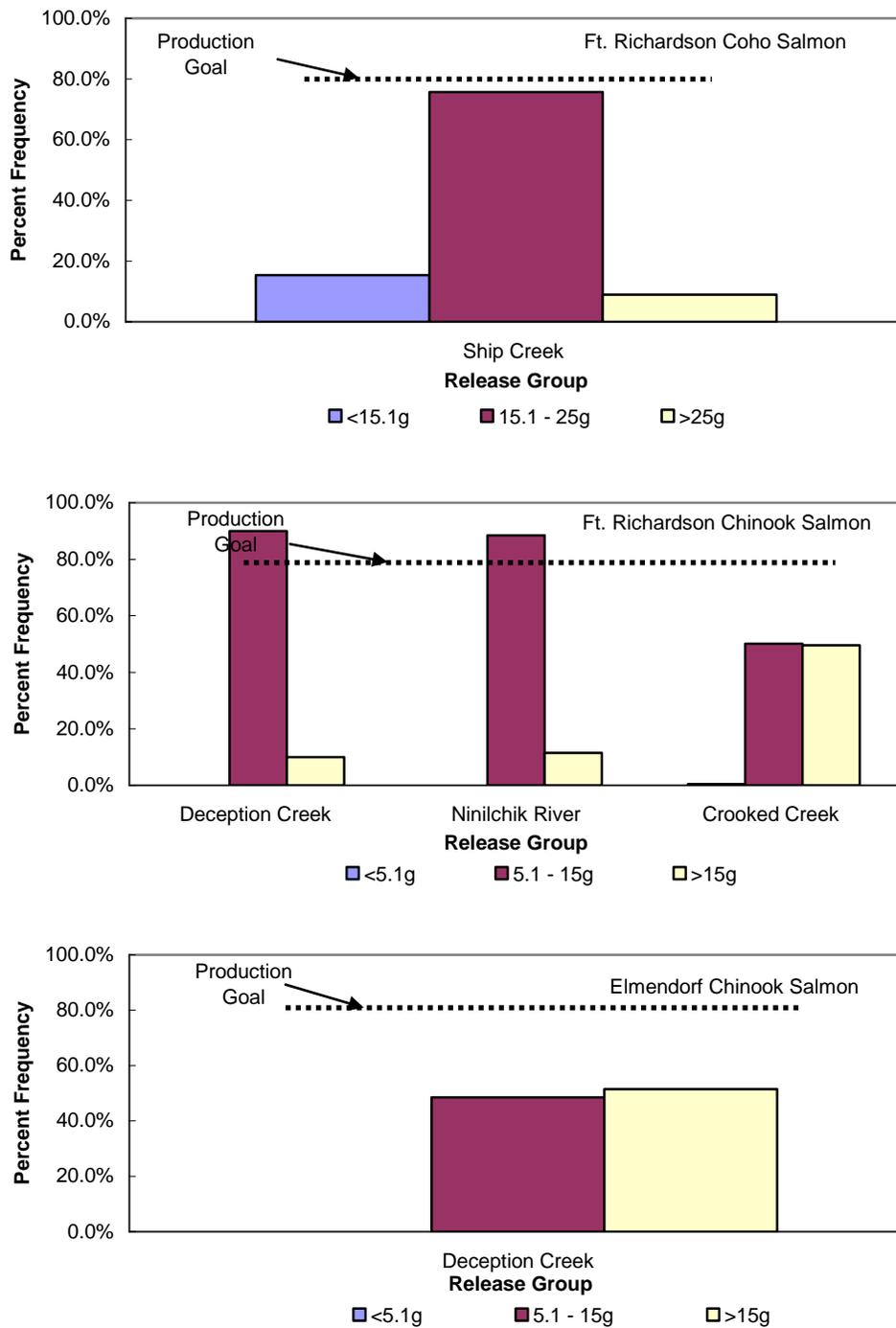


Figure 4.-Weight distributions, mean weights, and production goal target weight range, for coho and Chinook salmon reared at Fort Richardson and Elmendorf hatcheries and released in 2004.

In 2002, EH began reporting volumetric estimates for release groups that did not contain fish with CWTs. Peltz and Hansen (1994) reported that numerous sources of error associated with transport tank water displacement values make the water volume displacement method of estimating smolt populations unreliable. They recommended that this estimation technique be used only when other estimation techniques cannot be used or when accuracy is not important. The TI count for the one Chinook salmon release group (Deception Creek) at EH was within 1.5% of the HI and WV estimates. In previous years HI estimates were unreliable, but a change from electronically counting eyed eggs to using water displacement to estimate the number of eyed eggs may have made this estimation method more reliable. The reported number of fish stocked from five release groups at EH was based on a volumetric estimate of eyed eggs.

SIZE ESTIMATION

To maximize ocean survival and maintain the age composition of the population, Peltz and Starkey (1993) recommended that 80% of hatchery coho smolt weigh between 15.1 and 25.0 g, and hatchery Chinook salmon weigh between 5.1 and 15.0 g at release. The larger than recommended release size for two Chinook salmon release groups (BY03 Deception Creek and BY02 Crooked Creek) may result in an increase in the number of age-.1 jacks returning to those creeks in 2005.

RECOMMENDATIONS

1. All fish should be graded and tagged using the appropriate head mold sizes.
2. Use greater care in tag placement to increase or maintain acceptable long-term retention rates.
3. Temperature changes of 4–5°C should occur every 24 hours between rings, and every 72 hours between bands of rings while thermal marking.
4. Follow the production goal size at release recommendations of 80% of coho salmon weighing between 15.1 g and 25.0 g, and 80% of Chinook salmon weighing between 5.1 g and 15.0 g.
5. Individual bucket weights should be recorded when performing hatchery inventory procedures in case of electronic scale failure.

ACKNOWLEDGMENTS

We would like to thank Andrea Tesch and the staff at Fort Richardson Hatchery, and Darrell Keifer and the staff at Elmendorf Hatchery for their help and cooperation during thermal marking and coded wire tagging operations. We would also like to thank the members of the tagging crew.

REFERENCES CITED

- Blankenship, H. L. 1990. Effects of time and fish size on coded wire tag loss from chinook and coho salmon. *American Fisheries Society Symposium* 7:237-243.
- Jennings, G. B., K. Sundet, A. E. Bingham, and D. Sigurdsson. 2004. Participation, catch, and harvest in Alaska sport fisheries during 2001. Alaska Department of Fish and Game, Fishery Data Series No. 04-11, Anchorage. <http://www.sf.adfg.state.ak.us/FedAidPDFs/fds04-11.pdf>
- 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.
- Monk, K. M. Unpublished. Thermal marking manual: A guideline to the induction of thermal marks in otoliths for the purpose of mass-marking 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.
- Peltz, L., and P. A. Hansen. 1994. Marking, enumeration, and size estimation for coho and chinook salmon smolt releases into upper Cook Inlet, Alaska in 1993. Alaska Department of Fish and Game, Fishery Data Series No. 94-21, Anchorage. <http://www.sf.adfg.state.ak.us/FedAidPDFs/fds94-21.pdf>
- Peltz, L., and J. Miller. 1990. Performance of half-length coded wire tags in a pink salmon hatchery marking program. *American Fisheries Society Symposium* 7:244-252.
- Peltz, L., and D. Starkey. 1993. Summary and synthesis of production, marking, and release data for coho and chinook salmon smolt releases into upper Cook Inlet, Alaska in 1992. Alaska Department of Fish and Game, Fishery Data Series No. 93-51, Anchorage. <http://www.sf.adfg.state.ak.us/FedAidPDFs/fds93-51.pdf>
- 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.sf.adfg.state.ak.us/FedAidPDFs/fds99-01.pdf>
- Sweet, D. E., and L. R. Peltz. 1994. Performance of the chinook salmon enhancement program in Willow Creek, Alaska, 1985-1993. Alaska Department of Fish and Game, Fishery Manuscript No. 94-3, Anchorage. <http://www.sf.adfg.state.ak.us/FedAidPDFs/fm94-03.pdf>

APPENDIX A

Appendix A1.-Historical releases of coho salmon that were adipose-clipped and tagged with coded wire tags, and/or thermally marked.

Brood Year	Broodstock	Hatchery	Release		Total Released		Coded Wire Tagged			Thermal Marking	
			Year	CWT Code	Estimate	Type of Estimate ^a	Clipped Fish Released	Tagged Fish Released	Percent Tagged	Mark Group	Hatch Code
Anchorage Urban Streams^b											
1994	Little Susitna	Ft Richardson	1996	31-25-06	302,857	M-R	93,975	92,565	30.56%		
Bird Creek											
1990	Little Susitna	Ft Richardson	1992	31-20-02 31-20-03	95,377	M-R	44,903	37,629	39.50%		
1991	Little Susitna	Ft Richardson	1993	31-21-39	140,382	M-R	43,441	42,350	30.20%		
1992	Little Susitna	Ft Richardson	1994	31-23-02	84,643	M-R	45,220	44,686	52.80%		
1993	Little Susitna	Ft Richardson	1995	31-23-37	154,753	M-R	45,666	45,490	29.40%		
1994	Little Susitna	Ft Richardson	1996	31-25-04	147,618	M-R	46,528	45,411	30.80%		
1995	Little Susitna	Ft Richardson	1997	31-26-01	146,612	HI	45,901	45,488	31.03%		
1995	Little Susitna	Ft Richardson	1997	31-26-27	147,953	HI	45,836	45,469	30.73%		
1996	Little Susitna	Ft Richardson	1998	31-26-25	164,211	HI	46,140	46,094	28.07%		
1997	Ship Cr (Little Susitna)	Ft Richardson	1999	31-26-15	111,430	EC	37,344	36,746	32.98%		
1998	Ship Cr (Little Susitna)	Ft Richardson	2000	31-01-43	97,409	EC	40,114	39,392	40.44%		
2002	Ship Cr (Little Susitna)	Ft Richardson	2004		109,949	HI				Cook Inlet	5H
Campbell Creek^b											
1990	Little Susitna	Ft Richardson	1992	31-20-04 31-20-05	97,076	M-R	43,681	39,444	40.60%		
1991	Little Susitna	Ft Richardson	1993	31-21-38	140,797	M-R	43,440	42,916	30.50%		
1992	Little Susitna	Ft Richardson	1994	31-23-03	87,686	M-R	44,144	42,963	49.00%		
1993	Little Susitna	Ft Richardson	1995	31-23-36	157,241	M-R	45,655	44,995	28.60%		
1995	Little Susitna	Ft Richardson	1997	31-25-62	71,519	TI	45,840	45,290	63.33%		
1996	Little Susitna	Ft Richardson	1998	31-26-52	83,317	HI	22,453	22,296	26.76%		
1997	Ship Cr (Little Susitna)	Ft Richardson	1999	31-01-30	42,046	EC	20,879	20,378	48.47%		
1998	Ship Cr (Little Susitna)	Ft Richardson	2000	31-02-30	63,730	EC	19,948	19,549	30.67%		
1999	Ship Cr (Little Susitna)	Ft Richardson	2001	31-02-32	69,836	HI	21,568	20,813	29.80%		

-continued-

Appendix A1.-Page 2 of 4.

Brood Year	Broodstock	Hatchery	Release Year	CWT Code	Total Released		Coded Wire Tagged			Thermal Marking	
					Estimate	Type of Estimate ^a	Clipped Fish Released	Tagged Fish Released	Percent Tagged	Mark Group	Hatch Code
Campbell Creek^b (continued)											
2000	Ship Cr (Little Susitna)	Ft Richardson	2002	31-01-97	61,323	HI	22,789	21,672	35.34%	Cook Inlet	5H
2001	Ship Cr (Little Susitna)	Ft Richardson	2003		78,576	HI				Cook Inlet	5H
2002	Ship Cr (Little Susitna)	Ft Richardson	2004		85,790	HI				Cook Inlet	5H
Cottonwood Creek											
1990	Fish Creek	Big Lake	1992	31-20-08 31-21-09	53,900	M-R	35,341	32,938	61.10%		
1991	Fish Creek	Big Lake	1993	31-21-41	74,198	M-R	43,117	40,875	55.10%		
Eklutna Tailrace											
1996	Jim Creek	Ft Richardson	1998	31-26-27 31-26-54, 55,56	112,219	TI	112,219	111,882	99.70%		
1997	Jim Creek	Ft Richardson	1999	31-26-16	126,602	EC	44,073	42,663	33.70%		
1998	Jim Creek	Ft Richardson	2000	31-01-46	76,851	EC	40,514	40,149	52.24%		
1999	Eklutna Tailrace	Ft Richardson	2001	31-02-47	124,838	HI	43,713	43,494	34.84%		
2000	Eklutna Tailrace	Ft Richardson	2002	31-02-46	120,629	HI	44,518	44,295	36.72%	Cook Inlet	5H
2001	Eklutna Tailrace	Ft Richardson	2003		120,736	HI				Cook Inlet	5H
2002	Eklutna Tailrace	Ft Richardson	2004		131,979	HI				Cook Inlet	5H
Fish Creek											
1990	Fish Creek	Big Lake	1992	31-20-12 31-20-13	74,953	M-R	45,538	43,625	58.20%		
1991	Fish Creek	Big Lake	1993	31-21-40	67,934	M-R	44,050	43,257	63.70%		

-continued-

Appendix A1.-Page 3 of 4.

Brood		Hatchery	Release		Total Released		Coded Wire Tagged			Thermal Marking	
Year	Broodstock		Year	CWT Code	Estimate	Type of Estimate ^a	Clipped Fish Released	Tagged Fish Released	Percent Tagged	Mark Group	Hatch Code
Homer Spit											
1996	Bear Lake	Elmendorf	1998	31-26-28	130,219	M-R	42,057	41,926	32.20%		
1997	Bear Lake	Elmendorf	1999	31-01-40	129,602	M-R	44,405	43,020	33.19%		
	Bear Lake	Elmendorf	2000-01 ^c								
		Ft Richardson									
1999	Ship Cr (Little Susitna)	Ft Richardson	2001	31-01-36	100,280	HI	44,992	44,812	44.69%		
2000	Ship Cr (Little Susitna)	Ft Richardson	2002	31-01-98	95,648	HI	45,498	44,179	46.19%	Cook Inlet	5H
2000	Bear Lake	Ft Richardson	2002		120,707	HI				Cook Inlet	5H
2001	Ship Cr (Little Susitna)	Ft Richardson	2003		222,935	HI				Cook Inlet	5H
2002	Ship Cr (Little Susitna)	Ft Richardson	2004		130,243	HI				Cook Inlet	5H
Little Susitna at Houston											
1990	Little Susitna	Ft Richardson	1992	31-20-07	154,466	M-R	21,884	19,564	12.70%		
1991	Little Susitna	Ft Richardson	1993	31-21-37	148,282	M-R	21,404	20,312	13.70%		
Lowell Creek											
2000	Bear Lake	Ft Richardson	2002		119,512	HI				Resurrection Bay	4H
2001	Bear Lake	Ft Richardson	2003		124,389	HI				Resurrection Bay	4H
2002	Bear Lake	Ft Richardson	2004		131,989	HI				Resurrection Bay	4H
Nancy Lake											
1990	Little Susitna	Ft Richardson	1992	31-20-06	158,459	M-R	21,598	19,222	12.10%		
1991	Little Susitna	Ft Richardson	1993	31-21-37	131,591	M-R	21,001	19,930	15.20%		
1992	Little Susitna	Ft Richardson	1994	31-23-01	126,694	M-R	44,489	43,818	34.60%		
1993	Little Susitna	Ft Richardson	1995	31-23-39	151,985	M-R	46,261	45,245	29.80%		
Seward Lagoon											
2000	Bear Lake	Ft Richardson	2002		121,743	HI				Resurrection Bay	4H
2001	Bear Lake	Ft Richardson	2003		123,718	HI				Resurrection Bay	4H
2002	Bear Lake	Ft Richardson	2004		131,798	HI				Resurrection Bay	4H

-continued-

Appendix A1.-Page 4 of 4.

Brood Year	Broodstock	Hatchery	Release Year	CWT Code	Total Released		Coded Wire Tagged			Thermal Marking	
					Estimate	Type of Estimate ^a	Clipped Fish Released	Tagged Fish Released	Percent Tagged	Mark Group	Hatch Code
Ship Creek^b											
1990	Ship Creek	Elmendorf	1992	31-19-63 31-20-01	67,178	TI	44,086	38,443	57.20%		
1991	Ship Creek	Elmendorf	1993	31-21-36	54,764	TI	42,112	41,322	75.50%		
1992	Ship Creek	Elmendorf	1994	31-23-04	75,779	TI	44,031	41,722	55.10%		
1993	Little Susitna	Ft Richardson	1995	31-23-38	158,981	M-R	45,491	44,654	28.10%		
1995	Little Susitna	Ft Richardson	1997	31-25-63	232,066	TI,HI	45,925	45,741	19.71%		
1996	Little Susitna	Ft Richardson	1998	31-26-53 31-26-26	232,765	HI	67,812	66,997	28.78%		
1997	Ship Cr (Little Susitna)	Ft Richardson	1999	31-26-14 31-01-29	165,388	EC	48,299	45,380	27.44%		
1998	Ship Cr (Little Susitna)	Ft Richardson	2000	31-01-32 31-01-33	260,070	EC	61,640	58,989	22.68%		
1999	Ship Cr (Little Susitna)	Ft Richardson	2001	31-02-61	233,563	HI	64,165	61,663	26.40%		
2000	Ship Cr (Little Susitna)	Ft Richardson	2002	31-02-83	212,639	HI	67,959	63,678	29.95%	Cook Inlet	5H
2001	Ship Cr (Little Susitna)	Ft Richardson	2003	31-02-74, 31-02-69	234,716	HI	64,234	64,125	27.32%	Cook Inlet	5H
2002	Ship Cr (Little Susitna)	Ft Richardson	2004	31-02-81, 31-03-15	241,066	HI	63,222	62,906	26.09%	Cook Inlet	5H
Wasilla Creek											
1990	Fish Cr	Big Lake	1992	31-20-10 31-20-11	76,315	M-R	44,148	41,985	55.00%		
1991	Fish Cr	Big Lake	1992	31-21-42	77,174	M-R	43,001	41,711	54.10%		
1994	Little Susitna	Ft Richardson	1996	31-25-05	145,923	M-R	46,980	46,839	32.10%		

^a M-R is mark-recapture; TI is tagging inventory count; HI is hatchery inventory; EC is electronic count.

^b Campbell and Ship creeks were combined and termed "Anchorage Urban Streams" in 1996.

^c Stocking continued, but releases did not contain tagged or thermally marked fish.

Appendix A2.-Historical releases of Chinook salmon that were adipose-clipped and tagged with coded wire tags, and/or thermally marked.

Brood Year	Broodstock	Hatchery	Release Year	CWT Code	Total Released		Coded Wire Tagging			Thermal Marking	
					Estimate	Type of Estimate ^a	Clipped Fish Released	Tagged Fish Released	Percent Tagged	Mark Group	Hatch Code
Buskin River											
1994	Deception Cr	Elmendorf	1995	31-24-31	84,349	M-R	41,572	41,078	48.70%		
1995	Deception Cr	Elmendorf	1996	31-25-09	113,220	M-R	41,259	40,681	35.90%		
Crooked Creek											
1993	Crooked Cr	Elmendorf	1994	31-23-14	224,784	M-R	43,609	43,034	19.10%		
1994	Homer ^b	Elmendorf	1995	31-24-27	184,049	M-R	40,903	38,420	20.90%		
1995	Homer ^b	Elmendorf	1996	31-25-12	193,180	M-R	40,827	40,196	20.80%		
1996	Homer ^b	Elmendorf	1997	31-25-55	223,200	M-R	41,049	39,038	17.49%		
1997	Homer ^b	Elmendorf	1998	31-26-29	137,338	M-R	42,874	42,610	31.03%		
1998	Homer ^{b,c,d}	Elmendorf	1999	31-01-41	192,304	M-R	43,431	42,649	22.17%		
1999	Crooked Cr ^c	Elmendorf	2000	31-02-31, 31-01-34,35	108,507	TI	108,507	105,578	97.30%		
2000	Crooked Cr ^c	Elmendorf	2001	31-01-95, 31-02-36,37	109,201	TI	109,201	107,454	98.40%		
2001	Crooked Cr ^c	Elmendorf	2002	31-02-51,31-01-96,99	99,547	TI	99,547	98,452	98.90%	Crooked Cr	2,4H4 ^e
2002	Crooked Cr ^c	Ft Richardson	2003	31-02-72, 73, 68	98,800	TI	98,800	94,058	95.20%	Cook Inlet	2,3H
2002	Crooked Cr ^c	Ft.Richardson	2004	31-02-79, 80	80,601	TI	80,601	75,120	93.2%	Cook Inlet	2,3H

-continued-

Appendix A2.-Page 2 of 6.

Brood Year	Broodstock	Hatchery	Release Year	CWT Code	Total Released		Coded Wire Tagging			Thermal Marking	
					Estimate	Type of Estimate ^a	Clipped Fish Released	Tagged Fish Released	Percent Tagged	Mark Group	Hatch Code
Deception Creek											
1991	Deception Cr	Ft Richardson	1992	31-21-03	179,724	M-R	44,089	33,464	18.60%		
1992	Deception Cr	Ft Richardson	1993	31-21-60	160,194	M-R	42,782	39,420	24.60%		
1993	Deception Cr	Ft Richardson	1994	31-23-17	177,913	M-R	46,289	45,921	25.80%		
1994	Deception Cr	Ft Richardson	1995	31-24-34	184,740	M-R	46,807	46,256	25.00%		
1995	Deception Cr	Ft Richardson	1996	31-25-14	186,918	M-R	47,700	47,145	25.20%		
1996	Deception Cr	Ft Richardson	1997	31-26-03,04,05,06,07	209,644	TI	209,644	207,973	99.20%		
1997	Deception Cr	Ft Richardson	1998	31-25-32	197,392	TI	197,392	195,615	99.10%		
1998	Deception Cr	Ft Richardson	1999	31-26-17,18,19, 20 31-01-31	201,586	TI	201,586	199,722	99.08%		
1999	Deception Cr	Ft Richardson	2000	31-26-21, 31-01-44,31-02 33,34,35	206,496	TI	206,496	205,051	99.30%		
2000	Deception Cr	Ft Richardson	2001	31-02-41,42,43,44,45	207,465	TI	207,465	204,560	98.60%		
2001	Deception Cr	Ft Richardson	2002	31-01-92,31-02-52, 53,54,55	197,277	TI	197,277	196,608	99.66%	Deception Cr	2,5H
2002	Deception Cr	Ft Richardson	2003	31-02-70, 71, 31-01-94	101,181	TI	101,181	99,562	98.40%	Cook Inlet	2,3H
2002	Deception Cr	Ft Richardson	2004	31-02-77, 78, 31-03-16	113,523	TI	113,523	104,101	91.70%	Cook Inlet	2,3H ^f
2003	Deception Cr	Ft Richardson	2004	31-02-75, 76, 31-01-27	99,047	TI	99,047	97,660	98.60%	Cook Inlet	2,3H
Eagle River											
1993	Ship Creek	Elmendorf	1994	31-23-13	98,872	M-R	43,612	41,669	42.10%		
Eklutna Tailrace											
2001	Ship Creek	Elmendorf	2002		106,991	VOL				Eklutna Tailrace	2,3H3
2002	Ship Creek	Ft Richardson	2003		218,492	HI				Cook Inlet	2,3H
2002	Ship Creek	Ft Richardson	2004		215,165	HI				Cook Inlet	2,3H ^f

-continued-

Appendix A2.-Page 3 of 6.

Brood Year	Broodstock	Hatchery	Release Year	CWT Code	Total Released		Coded Wire Tagging			Thermal Marking	
					Estimate	Type of Estimate ^a	Clipped Fish Released	Tagged Fish Released	Percent Tagged	Mark Group	Hatch Code
Fleming Spit											
1998	Deception Cr	Ft Richardson	1999	31-26-23	49,773	TI	45,705	45,385	91.18%		
1999	Deception Cr	Elmendorf	2000	31-01-38	45,000	VIS	17,358	17,236	38.30%		
2000	Deception Cr	Elmendorf	2001	31-02-38	94,812	HI	40,659	40,415	42.63%		
2001	Deception Cr	Ft Richardson	2002	31-02-57	109,656	HI	40,054	39,573	36.09%	Prince William Sound	2,4H
2002	Deception Cr	Ft Richardson	2003		109,757	HI				Prince William Sound	2,4H
2003	Deception Cr	Ft Richardson	2004		58,000					Prince William Sound	2,4H
Halibut Cove											
1993	Crooked Creek	Elmendorf	1994	31-23-15	98,872	M-R	21,205	21,038	21.30%		
1994	Ninilchik River	Elmendorf	1995	31-24-30	37,577	M-R	36,944	36,700	97.70%		
1995	Ninilchik River	Elmendorf	1996	31-25-11	97,729	M-R	40,688	39,345	40.30%		
1996	Ninilchik River	Elmendorf	1997	31-25-58	78,133	M-R	40,919	39,487	50.54%		
1997	Ninilchik River	Elmendorf	1998	31-26-32	65,893	M-R	38,476	38,041	57.73%		
	Ninilchik River	Elmendorf	1999-01 ^g								
2001	Ninilchik River	Elmendorf	2002		106,279	VOL				Kachemak Bay	2,4H3
2002	Ninilchik River	Ft Richardson	2003		106,844	HI				Cook Inlet	2,3H
2002	Ninilchik River	Ft Richardson	2004		103,771	HI				Cook Inlet	2,3H
Homer Spit (early run)											
1993	Crooked Creek	Elmendorf	1994	31-23-16	163,963	M-R	26,003	25,615	15.60%		
1994	Homer ^b	Elmendorf	1995	31-24-32	216,026	M-R	41,650	40,291	18.70%		
1995	Homer ^b	Elmendorf	1996	31-25-07	204,085	M-R	40,868	39,017	19.10%		
1996	Homer ^b	Elmendorf	1997	31-25-60	217,773	M-R	41,112	38,810	17.82%		
1997	Homer ^b	Elmendorf	1998	31-26-33	177,730	M-R	40,012	39,652	22.31%		
1998	Homer ^b	Elmendorf	1999	31-01-45	163,170	M-R	42,561	40,423	24.77%		
	Ninilchik River	Elmendorf	2000-01 ^g								
2001	Ninilchik River	Elmendorf	2002		190,026	VOL				Kachemak Bay	2,5H3
2002	Ninilchik River	Ft Richardson	2003		206,292	HI				Cook Inlet	2,3H
2002	Ninilchik River	Ft Richardson	2004		143,037	HI				Cook Inlet	2,3H
2003	Ninilchik River	Elmendorf	2004		25,706	VOL				Cook Inlet	2,3H

-continued-

Appendix A2.-Page 4 of 6.

Brood		Hatchery	Release Year	CWT Code	Total Released		Coded Wire Tagging			Thermal Marking	
Year	Broodstock				Estimate	Type of Estimate ^a	Clipped Fish Released	Tagged Fish Released	Percent Tagged	Mark Group	Hatch Code
Homer Spit (late run)											
1992	Kasilof River	Crooked Creek	1994	31-23-19	56,920	M-R	22,612	22,383	39.30%		
1994	Homer ^h	Elmendorf	1995	31-24-33	123,048	M-R	41,054	40,466	32.90%		
1995	Homer ^h	Elmendorf	1996	31-25-13	108,204	M-R	40,615	38,787	35.80%		
1996	Homer ^h	Elmendorf	1997	31-25-61	100,933	M-R	41,028	39,264	38.90%		
1997	Homer ^h	Elmendorf	1998	31-26-34	112,100	HI	40,158	39,997	35.68%		
	Homer ^h	Elmendorf	1999 ^e								
Lowell Creek											
1996	Deception Cr	Elmendorf	1997	31-25-59	102,147	M-R	40,906	40,497	39.65%		
	Deception Cr	Elmendorf	1998-99 ^e								
	Crooked Creek	Elmendorf	2000-01 ^e								
2001	Crooked Creek	Elmendorf	2002		93,296	VOL				Resurrection Bay	2,5H3
2002	Crooked Creek	Ft Richardson	2003		110,331	HI				Resurrection Bay	2,5H
2002	Crooked Creek	Ft Richardson	2004		89,388	HI				Resurrection Bay	2,5H
Ninilchik River											
1991	Ninilchik River	Ft Richardson	1992	31-21-04	132,387	M-R	43,648	41,335	31.20%		
1992	Ninilchik River	Ft Richardson	1993	31-21-59	184,585	M-R	44,487	42,960	23.30%		
1993	Ninilchik River	Ft Richardson	1994	31-23-18	201,513	M-R	46,193	45,535	22.60%		
1994	Ninilchik River	Ft Richardson	1995	31-24-35	54,902	TI	54,902	54,353	99.00%		
1995 ^c	Ninilchik River	Ft Richardson	1996	31-25-15	51,688	TI	51,588	50,866	98.60%		
1996 ^c	Ninilchik River	Ft Richardson	1997	31-26-08	50,698	TI	50,698	50,292	99.20%		
1997	Ninilchik River	Ft Richardson	1998	31-26-35	48,798	TI	48,798	47,480	97.30%		
1998	Ninilchik River	Ft Richardson	1999	31-01-47	49,853	TI	49,853	48,906	98.10%		
1999	Ninilchik River	Ft Richardson	2000	31-02-48	51,298	TI	51,298	50,016	97.50%		
2000	Ninilchik River	Ft Richardson	2001	31-02-60	54,770	TI	54,770	54,441	99.40%		
2001	Ninilchik River	Ft Richardson	2002	31-02-82	54,631	TI	54,631	54,139	99.10%	Ninilchik River	2,3H
2002	Ninilchik River	Ft Richardson	2003	31-02-56, 31-01-83	47,997	TI	47,997	44,349	92.40%	Cook Inlet	2,3H
2002	Ninilchik River	Ft Richardson	2004	31-03-18	51303	TI	51,303	51,252	99.90%	Cook Inlet	2,3H

-continued-

Appendix A2.-Page 5 of 6.

Brood Year	Broodstock	Hatchery	Release Year	CWT Code	Total Released		Coded Wire Tagging			Thermal Marking	
					Estimate	Type of Estimate ^a	Clipped Fish Released	Tagged Fish Released	Percent Tagged	Mark Group	Hatch Code
Seldovia											
1993	Crooked Creek	Elmendorf	1994	31-23-11	107,246	M-R	46,754	45,439	42.40%		
1994	Homer ^b	Elmendorf	1995	31-24-29	116,165	M-R	41,609	40,678	35.00%		
1995	Ninilchik River	Elmendorf	1996	31-25-10	118,274	M-R	40,667	39,610	33.50%		
1996	Ninilchik River	Elmendorf	1997	31-25-57	103,757	M-R	41,279	39,834	38.39%		
1997	Ninilchik River	Elmendorf	1998	31-26-31	69,461	M-R	40,654	40,125	57.77%		
	Ninilchik River	Elmendorf	1999-01 ^g								
2001	Ninilchik River	Elmendorf	2002		83,045	VOL				Kachemak Bay	2,4H3
2002	Ninilchik River	Ft Richardson	2003		107,521	HI				Cook Inlet	2,3H
2003	Ninilchik River	Elmendorf	2004		88,682					Cook Inlet	2,3H
Shakespeare Creek											
1998	Deception Cr	Ft Richardson	1999	31-26-24	49,797	TI	45,023	43,897	88.21%		
1999	Deception Cr	Elmendorf	2000	31-01-39	119,389	M-R	43,551	42,898	35.93%		
Ship Creek											
1993	Ship Creek	Elmendorf	1994	31-23-12	199,830	M-R	44,138	42,864	21.50%		
1994	Ship Creek	Elmendorf	1995	31-24-28	218,487	M-R	40,764	38,570	17.70%		
1995	Ship Creek	Elmendorf	1996	31-25-08	231,444	M-R	41,221	40,109	17.30%		
1996	Ship Creek	Elmendorf	1997	31-25-56	326,371	M-R	40,522	40,319	12.36%		
1997	Ship Creek	Elmendorf	1998	31-26-30	204,741	M-R	42,073	41,565	20.30%		
1998	Ship Creek	Elmendorf	1999	31-01-42	197,168	M-R	44,265	42,262	21.44%		
	Ship Creek	Elmendorf	2000-01 ^g								
2001	Ship Creek	Elmendorf	2002		290,501	VOL				Ship Creek	2,4H4
2002	Ship Creek	Ft Richardson	2003		329,416	HI				Cook Inlet	2,3H
2002	Ship Creek	Ft Richardson	2004		209,060	HI				Cook Inlet	2,3H ^f
2003	Ship Creek	Elmendorf	2004		111,166	HI				Cook Inlet	2,3H

-continued-

Appendix A2.-Page 6 of 6.

Brood Year	Broodstock	Hatchery	Release Year	CWT Code	Total Released		Coded Wire Tagging			Thermal Marking	
					Estimate	Type of Estimate ^a	Clipped Fish Released	Tagged Fish Released	Percent Tagged	Mark Group	Hatch Code
Valdez Glacier Stream											
1998	Deception Cr	Ft Richardson	1999	31-26-22	49,353	PC	46,528	45,923	93.05%		
1999	Deception Cr	Elmendorf	2000	31-01-37	115,582	M-R	41,728	41,060	35.52%		
Valdez Harbor											
2000	Deception Cr	Elmendorf	2001	31-02-39	94,701	HI	44,418	43,974	46.43%		
2001	Deception Cr	Ft Richardson	2002	31-02-58	107,861	HI	43,833	42,650	39.54%	Prince William Sound	2,4H
2002	Deception Cr	Ft Richardson	2003		109,661	HI				Prince William Sound	2,4H
2002	Deception Cr	Ft Richardson	2004		99,464	HI				Prince William Sound	2,4H ^f
Whittier Harbor											
2000	Deception Cr	Elmendorf	2001	31-02-40	95,823	HI	42,800	42,458	44.31%		
2001	Deception Cr	Ft Richardson	2002	31-02-59	109,763	HI	45,854	44,799	40.81%	Prince William Sound	2,4H
2002	Deception Cr	Ft Richardson	2003		109,700	HI				Prince William Sound	2,4H
2002	Deception Cr	Ft Richardson	2004		107,705	HI				Prince William Sound	2,4H ^f
2003	Deception Cr	Elmendorf	2004		20,906	VOL				Prince William Sound	2,4H

^a M-R is mark-recapture; TI is tagging inventory count; HI is hatchery inventory, VIS is a visual estimate, VOL is volumetric estimate.

^b Homer (Crooked Creek).

^c Adjusted for holding mortality before release.

^d Corrections for release numbers reported in the 1999 report.

^e Release group missed last temperature decrease during thermal marking. Should have had hatch code of 2,4H5.

^f See 2004 Marking report for altered mark details.

^g Stocking continued, but releases did not contain tagged or thermally marked fish.

^h Homer (Kasilof River).