Fishery Data Series No. 07-80

Auke Creek Weir Studies: 2005

by

Carrie L. Hoover

December 2007

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

Measures (fisheries)

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

Mathematics, statistics

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

FISHERY DATA SERIES NO. 07–80

AUKE CREEK WEIR STUDIES: 2005

by
Carrie L. Hoover
Alaska Department of Fish and Game, Division of Sport Fish, Douglas

Alaska Department of Fish and Game
Division of Sport Fish, Research and Technical Services
333 Raspberry Road, Anchorage, Alaska, 99518-1565

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 Projects F-10-20 and 21, R-1-2.

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.

Carrie L. Hoover [a]
Alaska Department of Fish and Game, Division of Sport Fish
802 3rd St., Douglas, AK 99824, P.O. Box 110024, Juneau, AK 99811 USA

[a] *Person to whom all correspondence should be addressed: roger.harding@alaska.gov*

This document should be cited as:
Hoover, C. L. 2007. Auke Creek weir studies: 2005. Alaska Department of Fish and Game, Fishery Data Series No. 07-80, Anchorage.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

ABSTRACT

A weir on Auke Creek was operated from February 28 through October 28, 2005, to count pink *Oncorhynchus gorbuscha*, chum *O. keta*, coho *O. kisutch*, and sockeye *O. nerka* salmon; steelhead *O. mykiss* and cutthroat trout *O. clarki*; and Dolly Varden *Salvelinus malma*. Age, weight and length data was collected from emigrant coho and sockeye salmon, and coded wire and passive integrated transponder (PIT) tagging were conducted on coho salmon and cutthroat trout, respectively. Length distributions were determined for emigrant cutthroat trout and estimated for Dolly Varden as well. Returning adult coho salmon were sampled for age, sex, and length data, and a length distribution was determined for immigrant cutthroat trout. A total of 4,287 coho smolts were successfully given a coded wire tag and released downstream. An estimated 67% (SE = 2%) were age-1 and 33% (SE = 2%) were age-2. During the emigration, 133 cutthroat trout, 3,544 Dolly Varden, 8,513 sockeye smolt, 87,927 pink fry, 191 chum fry, and 12 steelhead juveniles were counted through the weir. Average fork length of emigrant Dolly Varden was 235 mm (SE = 3). Fork lengths of emigrant cutthroat trout averaged 253 mm and had a standard deviation of 53 mm. During the immigration period, 138 cutthroat trout, 2,795 Dolly Varden, 2,879 adult sockeye salmon, 10,010 pink salmon, 944 chum salmon, 450 adult coho salmon, and 20 juvenile steelhead were enumerated. Fork lengths of immigrant cutthroat trout averaged 238 mm and had a standard deviation of SD = 49 mm. Auke Creek contributed an estimated 327 (SE = 49) adult coho salmon to marine fisheries in 2005, yielding an exploitation rate of 42% (SE = 3.6%). Smolt-to-adult survival for the 2004 coho smolt emigration was estimated at 17% (SE = 1.1%). Counts during both the emigration and immigration periods are lower than their 25-year historical averages for all species.

Key words: Alaska, Auke Lake, Auke Creek, cutthroat trout, Dolly Varden, steelhead, coho salmon, sockeye salmon, pink salmon, chum salmon, smolt, sea-run, weir, length distribution, timing, PIT, CWT, tag retention, exploitation, survival

INTRODUCTION

The Alaska Department of Fish and Game, Division of Sport Fish (ADF&G), the University of Alaska, Fairbanks (UAF), and the National Marine Fisheries Service (NMFS) cooperatively fund and operate the NMFS Auke Creek weir on the outlet of Auke Lake, near Juneau, Alaska (Figure 1).

The weir is a permanent structure designed to capture all emigrant and immigrant fish at Auke Creek. It is operated from March 1 through June 30 to intercept all emigrating species. The weir is then converted around June 30 and is operated through November 1 to collect, count, and sample immigrating salmonids.

A weir has been operated at Auke Creek since 1963 and the present permanent structure was installed during spring 1980. In 1997 further modifications were made to capture, in addition to several other species, all immigrant Dolly Varden and cutthroat trout. Since installation of the permanent structure, Auke Creek weir has provided consistent, long-term information on all emigrating and immigrating species, and it provides the most complete database for several anadromous species in Southeast Alaska (Lum and Taylor 2004).

Researchers at ADF&G, UAF, and NMFS use information gathered at the Auke Creek weir in a variety of projects aimed at understanding long-term trends. Weir counts and coded wire tag (CWT) data also provide indicators for local stocks and are used by managers to assess the exploitation by and contribution to various fisheries, thus helping guide fishery management decisions for the Juneau area. Studies initiated at the weir have provided important insights into developmental processes, the genetic composition of runs, marine survival estimates, life history strategies, age composition, maturity, run timing, and growth of several species present in Auke Lake and Auke Creek (Gharrett and Smoker 1991; Gharrett et al. 1999; Gilk et al. 2004; Goddard 1995; Hebert et al. 1998; Hoover 2005; Lum et al. 1998–2002; Lum and Taylor 2004; Neimark 1984a-b; Taylor and Lum *Unpublished-a-g*; Wang 2004).

OBJECTIVES

The goal of this study is to collect and provide information necessary for Division of Sport Fish managers in the Juneau area to make informed management decisions regarding Dolly Varden, cutthroat trout, and several species of salmon. In the past, Auke Creek's long-term data set has contributed useful information to the management of local fisheries, e.g., Auke Creek coho salmon serve as an indicator stock in northern Southeast Alaska. The Division of Sport Fish also uses data collected by this project to better understand sea-run life history forms of cutthroat trout, and this information has contributed to several Alaska Board of Fish management decisions.

Our objectives at the Auke Creek weir between March 1 and June 30, 2005, were to:

1. Determine the length distribution of emigrant sea-run cutthroat trout and estimate length distribution of Dolly Varden;
2. Enumerate all emigrating cutthroat trout, Dolly Varden, juvenile steelhead sockeye smolt, pink fry and chum fry, and enumerate and CWT all emigrating coho salmon smolt;
3. Estimate length and age composition of emigrating coho salmon smolt, and estimate the number of emigrants by freshwater age; and,
4. Estimate mean weight- and length-at-age of emigrating coho salmon smolt.

Our objectives between July 1 and November 1, 2005, were to:

1. Determine the length distribution of immigrating sea-run cutthroat trout;
2. Enumerate all immigrating cutthroat trout, Dolly Varden, juvenile steelhead sockeye, pink, chum, and coho adults, and estimate sex composition of immigrant pink salmon;
3. Estimate length, age, and sex composition of immigrating coho salmon adults and jacks, and estimate the number of immigrants by age class; and,
4. Estimate the marine harvest, total abundance, smolt-to-adult marine survival, and exploitation rate of adult coho salmon bound for Auke Creek in 2005.

STUDY AREA

Auke Lake is located approximately 19.2 km north of Juneau, Alaska (53°23´, 134°37´), on the Juneau road system (Figure 1). It is 1.6 km long and 1.2 km wide with a surface area of approximately 67 ha. The lake is fed by five tributaries and drains a mainland watershed of approximately 1072.5 ha, and its biggest tributary, Lake Creek, drains 647.5 ha. Auke Lake's depth is 31.4 m, and it has an elevation of approximately 19.1 m. The lake bottom is primarily mud with gravel areas off the inlet streams. The shoreline of the lake is bordered by forested terrain which varies from gentle slopes to steep-sided banks, and the shoreline zone of water consists of areas dominated by emergent vegetation of *Equisetum* spp. and *Nuphar* spp. Other areas of the lake are characterized by large numbers of submerged and floating conifers anchored to the lakeshore and bottom by their large root wads. At least 50% of the shoreline has been urbanized by residential development (Lum and Taylor 2004).

Auke Creek is the outlet of Auke Lake. The weir on Auke Creek is located above mean tide level and about 400 m downstream from the outlet of Auke Lake. On average, Auke Creek supports annual migrations of about 700 coho salmon adults, 6,100 coho smolts, 3,400 sockeye salmon adults, and 17,300 sockeye smolts (Table 1). The Auke Lake system also supports migrating populations of about 5,000 Dolly Varden and 250 cutthroat trout (Table 1). The lake is closed to retention of sport caught Dolly Varden, but it supports a small sport fishery for cutthroat trout. Cutthroat trout are caught through the ice during the winter and from the beach or small boats during the remainder of the year. Anecdotal information suggests that the trout fishery in Auke Lake was once more productive than at present. The emigration of adult cutthroat from Auke Lake initially increased as enhancement efforts occurred in the lake (Lum and Taylor 2004), but migration numbers have been declining since 1996.

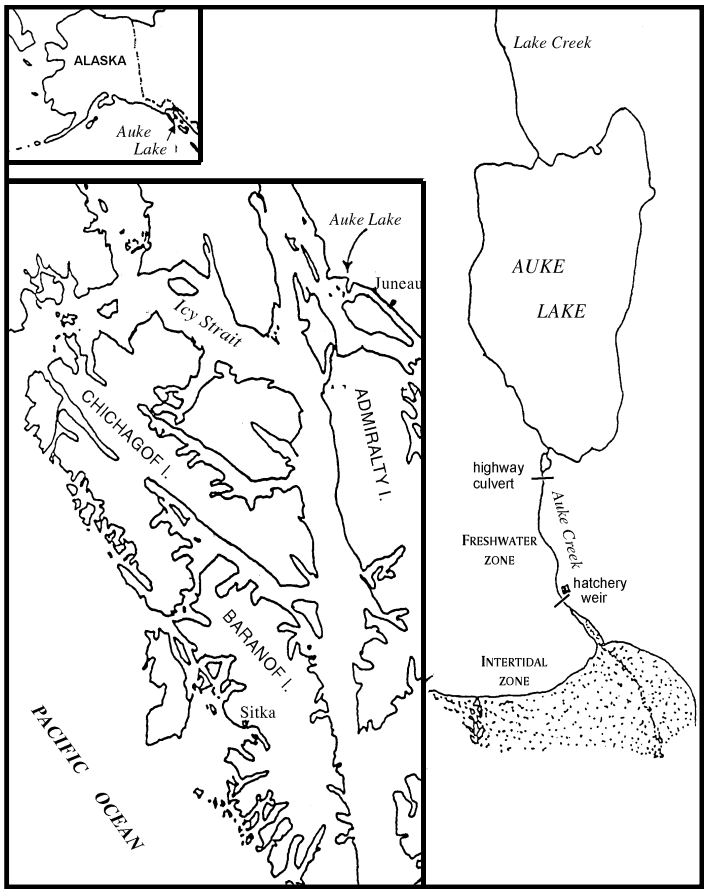

Figure 1.–The Auke Lake system in northern Southeast Alaska and location of the Auke Creek weir.

Table 1.–Average number of all migrating species counted at Auke Creek; spring and fall averages calculated from 1980–2004 immigrants and emigrants.

Migration period	Pink salmon	Coho salmon	Sockeye salmon	Chum salmon	Chinook salmon	Dolly Varden	Cutthroat trout	Juvenile steelhead
Spring	108,630	6,117	17,264	5,015	0	6,213	256	10[a]
Fall	10,996	732	3,419	1,256	231[b]	4,276[c]	228[c]	4[c]

[a] Average of 1990–2004 weir counts, when these species were tallied.

[b] Average of 1987–2004 weir counts; these (presumed hatchery strays) are killed at the weir.

[c] Average of 1997–2004 weir counts, when these species were tallied.

METHODS

EMIGRANT POPULATIONS

The Auke Creek weir was operated from February 28 through June 30, 2005, to intercept all emigrant salmonids. During this time fish could not move upstream through the weir. The weir is designed so that water spills through five inclined traps and vertical aluminum panels covered with 3 mm perforations that are effective at both high and low flows. Fish that exited the inclined traps were diverted through an aluminum trough to a fiberglass holding tank. Fish were sorted by species, counted, sampled, and released each day downstream of the weir.

All emigrating cutthroat trout were counted, measured to the nearest mm FL, examined for external marks or tags, and checked for passive

integrated transponder (PIT) tags. Fish that were not tagged had a PIT tag inserted just posterior to the cleithrum and received an adipose clip as a secondary mark to evaluate tag loss. All emigrating Dolly Varden were counted, and length composition was estimated using a systematic sampling procedure where every 10th Dolly Varden passed downstream was measured to the nearest 5 mm FL. The sample was taken by holding (placing in a basket) the 1st, 11th, 21st, etc. fish passed downstream; selected fish were measured after all fish were counted for the day. No conscious effort was made to select a fish by size. Dolly Varden and cutthroat trout mortalities found in the traps or on the weir were noted separately and included in the daily total. Cutthroat mortalities were sampled for otoliths, length, scales and sex, and the PIT tag, if present, was removed. Emigrating steelhead juveniles were also counted and measured for FL to the nearest mm.

Salmon smolts emigrating from Auke Creek were counted daily. Each captured coho salmon smolt was anesthetized in a solution of MS-222, injected in the snout with a full-length (1 mm) CWT, and marked by excising the adipose fin. Each week, a sample of coho smolt captured on one or more days was re-anesthetized, weighed to the nearest 0.01 g, measured for length to the nearest mm, scale sampled, and released downstream below the weir the following morning after being tested for tag retention. Either every smolt was sampled or a systematic (1 in x) procedure was used. Overall goals were to sample 75 to 175 fish per sample day, and to maintain an approximately proportional sample over time such that at least 300 fish were sampled. Scales were collected from the preferred area (Scarnecchia 1979) and sandwiched between two microscope slides that were taped together and labeled with location and sample date. Scales were then aged at a later time.

Sockeye salmon smolts were collected, anesthetized, weighed, measured, and sampled for scales in the same manner as coho smolt. There is no aging of sockeye scales at the current time, but they are collected for possible aging at a later date. Pink and chum salmon fry were also counted daily, and 50 pink salmon fry were collected every Monday, anesthetized with MS-222, weighed, measured for length (mm), and upon recovery, released downstream from the weir. Chum salmon fry were not measured or weighed.

IMMIGRANT POPULATIONS

The upstream weir was installed on June 30 and operated through October 28, 2005, to intercept and count all immigrating adult pink, chum, sockeye and coho salmon, as well as cutthroat and juvenile steelhead trout, and Dolly Varden. Adult Chinook salmon *O. tshawytscha* from releases of hatchery smolts in Auke Bay near the mouth of Auke Creek also returned during the immigration period. Because these are not indigenous to Auke Creek, they were counted by maturity (adult or jack, where jacks are defined as age-.0 fish) and killed at the weir.

The upstream weir was modified by installing vertical slotted aluminum panels (90 x 178 cm) into the structure to divert fish into the adult trap without restricting water flow. This allowed all fish moving upstream to be captured while blocking any downstream movement. Trout screens (45 x 90 cm) made out of perforated aluminum (1.5 x 10 cm) were also added to the slotted weir panels on the upstream side to prevent the movement of smaller-sized fish. Small fish migrating upstream were caught not only in the adult trap, but in two trout traps as well. These traps measured 1.5 x 2.4 x 0.8 m high and were attached to the upstream side of the weir. Pickets spaced 2.5 cm apart prevented larger salmonids from entering them. Plastic mesh netting (6 x 6 mm) was used to cover the walls of the trout traps, as well as the adult trap, to retain smaller fish.

All immigrating steelhead trout and Dolly Varden were counted and examined for external marks or tags prior to release upstream. Steelhead trout were also measured to the nearest mm FL. All cutthroat trout were counted, measured, and examined for external marks and the presence of a PIT tag. Cutthroat trout that were unmarked or without a PIT tag were given a red photonic mark on the anal fin to distinguish them from resident fish. Studies are conducted on cutthroat trout in Auke Lake, and this mark was used to identify sea-run fish captured in the lake. All cutthroat mortalities were sampled for otoliths, length, scales and sex, and the PIT tag removed if present.

All adult (1-ocean) and jack (0-ocean) sockeye and coho salmon passing the weir were counted, examined for external marks, and released upstream. Length (MEF) and sex were recorded, and scales were collected from a target 40 to 120 fish sampled on one or more days per week. Targets within sample days were to either sample every adult or adopt a systematic (1 in x) procedure. Overall sampling goals were to maintain an approximately proportional sample over time such that about 250 or more fish of each species were sampled. Adult coho salmon were stunned in an electroshock basket prior to sampling. Scales from jacks and adults (four per fish) were collected from the preferred area and placed on a gum card. Scales were pressed onto acetate cards and analyzed for age using a microfiche reader. Length, sex and heads were collected from adipose-clipped coho mortalities collected on the weir, and coded wire tags were removed and deciphered at the Auke Creek hatchery facility.

Adult pink and chum salmon returning to Auke Creek were counted, examined for marks and released upstream. While pink salmon adults were being counted, their sex was also noted. There were no hatchery returns to Auke Creek in 2005, however, marked fish will be returning in future years following releases of experimental fish resulting from collaborative efforts with UAF.

MARINE FISHERIES SAMPLING

Adult coho are harvested in various fisheries as they return to spawn. Recovery of tagged fish from troll, purse seine, and gillnet fisheries is done by ADF&G Commercial Fish Division port samplers, while the Sport Fish Division's creel survey program recovers tagged fish from sport fisheries. Recoveries of CWTs from adult coho salmon (identified by missing adipose fins) in sampled sport and commercial fisheries in 2005 were used to estimate the contribution of Auke Lake fish to these fisheries using methods described in Bernard and Clark (1996).

Commercial catch data for the analysis was summarized by ADF&G statistical week and district (for gillnet and seine fisheries), or by period and quadrant for troll fisheries Sport fish CWT recovery data was obtained from ADF&G Mark, Tag and Age Laboratory reports and summarized by biweek and fishery (e.g., biweek 16 during the Juneau Marine Creel Survey). Harvest estimates were obtained from ADF&G reports (e.g., Suchanek and Bingham 1992) and ADF&G computer summaries.

DATA ANALYSIS

Age, Length, and Sex Composition

Length composition of the emigrant Dolly Varden population passing the weir was estimated by:

$$\hat{p}_\ell = \frac{n_\ell}{n} \tag{1}$$

$$\mathrm{var}(\hat{p}_\ell) = \left[1 - \frac{n}{N}\right] \frac{\hat{p}_\ell(1-\hat{p}_\ell)}{n-1} \tag{2}$$

where $\hat{p}_\ell$ is the estimated proportion of the population in length group ℓ, n is the number of fish measured in the systematic (1 in 10) sampling, n_ℓ is the subset of n belonging to group ℓ, and N is the total weir count. A finite population correction factor (fpc) = (1 - n/N) is included because the population total is known and the sampling rate is relatively high. As all cutthroat trout were measured, size composition of cutthroat emigrants was known and did not need to be estimated.

Abundance of Dolly Varden in each length group in the population ($\hat{N}_\ell$) was estimated:

$$\hat{N}_\ell = \hat{p}_\ell N \tag{3}$$

$$\mathrm{var}(\hat{N}_\ell) = N^2 \mathrm{var}(\hat{p}_\ell) \tag{4}$$

Age composition ($\hat{p}_a$) of the migrant coho salmon (smolt, adult, and jack) populations passing the weir were estimated using a temporally stratified sampling design:

$$\hat{p}_{a,h} = \frac{n_{a,h}}{n_h} \tag{5}$$

$$\text{var}(\hat{p}_{a,h}) = \left[1 - \frac{n_h}{N_h}\right] \frac{\hat{p}_{a,h}\left(1-\hat{p}_{a,h}\right)}{n_h - 1} \quad (6)$$

$$\hat{p}_a = \frac{1}{N}\sum_h N_h \ \hat{p}_{a,h} \quad (7)$$

$$\text{var}(\hat{p}_a) = \sum_h W_h^2 \text{var}(\hat{p}_{a,h}) \quad (8)$$

Where $\hat{p}_{a,h}$ is the estimated proportion of the population in age group *a* and temporal strata *h*, n_h is the number of fish successfully aged in strata *h*, $n_{a,h}$ is the subset of n_h belonging to group *a*, and N_h is the total count at the weir in stratum *h*. Sampling weights were defined as $W_h = N_h/N$, and $N = \sum N_h$. Strata were defined as weeks. Abundance at age $\hat{N}_a$ was estimated as in (3) and (4), using $\hat{p}_a$ rather than $\hat{p}_\ell$.

Sex composition in each age group was estimated using the same temporally stratified design:

$$\hat{p}_{a,sex,h} = \frac{n_{a,sex,h}}{n_{a,h}} \quad (9)$$

$$\text{var}(\hat{p}_{a,sex,h}) = \left[1 - \frac{n_{a,h}}{\hat{N}_{a,h}}\right] \frac{\hat{p}_{a,sex,h}\left(1-\hat{p}_{a,sex,h}\right)}{n_{a,h} - 1} \quad (10)$$

$$\hat{p}_{a,sex} = \frac{1}{\hat{N}_a}\sum_h \hat{N}_{a,h} \ \hat{p}_{a,sex,h} \quad (11)$$

$$\text{var}(\hat{p}_{a,sex}) \approx \sum_h \hat{W}_{a,h}^2 \text{var}(\hat{p}_{a,sex,h}) + \frac{\sum_h \text{var}(\hat{N}_{a,h})\left(\hat{P}_{a,sex,h} - \hat{P}_{a,sex}\right)^2}{\hat{N}_a{}^2} \quad (12)$$

where ($\hat{p}_{a,sex,h}$) is the estimated proportion being sex=male or sex=female at age *a* in strata *h*, $n_{a,h}$ is the number of age *a* fish successfully sexed in strata *h*, $n_{a,sex,h}$ is the subset of $n_{a,h}$ being male or female, and $\hat{N}_{a,h}$ is calculated as in (3), but by stratum using (5) and N_h. Because sampling weights are estimated, variance (12) was approximated using the delta method (Seber 1982).

Abundance by age and sex was calculated:

$$\hat{N}_{a,sex} = \hat{p}_a \ \hat{p}_{a,sex} \ N \quad (13)$$

$$\text{var}(\hat{N}_{a,sex}) \approx N^2[\hat{p}_a^2 \text{var}(\hat{p}_{a,sex}) + \hat{p}_{a,sex}^2 \text{var}(\hat{p}_a) - \text{var}(\hat{p}_{a,sex})\text{var}(\hat{p}_a)] \quad (14)$$

Equivalently, the product $\hat{p}_a \ \hat{p}_{a,sex}$ in (13) could simply be defined as $\hat{p}_{a,sex}$ = the proportion at age and sex, and (14) would simplify accordingly (setting $\text{var}(\hat{p}_a)$ =0). Mean lengths and weights of coho migrants at age were also estimated using the temporally stratified design. For length at age (ℓ_a), where i denotes an individual fish,

$$\hat{\bar{l}}_{a,h} = \frac{1}{n_{a,h}} \sum_i l_{a,h,i} \quad (15)$$

$$\text{var}\left(\hat{\bar{l}}_{a,h}\right) = \left[1 - \frac{n_{a,h}}{\hat{N}_{a,h}}\right] \sum_i \frac{\left(l_{a,h,i} - \hat{\bar{l}}_{a,h}\right)^2}{n_{a,h}\left(n_{a,h} - 1\right)} \quad (16)$$

$$\hat{\bar{l}}_a = \frac{1}{\hat{N}_a}\sum_h \hat{N}_{a,h} \ \hat{\bar{l}}_{a,h} \quad (17)$$

$$\text{var}(\hat{\bar{l}}_a) \approx \sum_h \hat{W}_{a,h}^2 \text{var}\left(\hat{\bar{l}}_{a,h}\right) + \frac{\sum_h \text{var}(\hat{N}_{a,h})\left(\hat{\bar{l}}_{a,h} - \hat{\bar{l}}_a\right)^2}{\hat{N}_a^2} \quad (18)$$

where $n_{a,h}$ is the number of age *a* fish successfully measured in strata *h*. Equations 15–

18 above were modified for estimating mean lengths and weights at age by sex, by adding notation for sex (i.e., $\ell_{a,sex,h,i}$, $\hat{\bar{\ell}}_{a,sex,h}$, $\hat{\bar{\ell}}_{a,sex}$, $n_{a,sex,h}$, $\hat{N}_{a,sex,h}$, $\hat{N}_{a,sex}$, $\hat{W}^2{}_{a,sex,h}$). Mean lengths and weights without respect to age by sex were also computed; in this case notation for age (a) is dropped, N_h, N, and W_h are not estimates (as in equations 6–8), and the very rightmost term in (18) is dropped.

Marine Harvest, and Adult Return, Survival and Exploitation

Because all smolt emigrating from Auke Creek were presumed marked with a coded wire tag, we assumed all returning jacks and adults that originated from Auke Creek had been tagged (and marked with an adipose finclip) when estimating harvest. The fraction of jacks (from 2004) and adults (in 2005) passing the weir with an adipose finclip were used to evaluate this assumption. Any unmarked, mature coho salmon captured at the weir were treated as strays from nearby hatchery enhancement efforts and from streams with natural production.

Total abundance of adult coho salmon returning to Auke Creek was calculated by summing the estimated marine harvest and the escapement of adipose-clipped and coded wire tagged fish counted through the weir,

$$\hat{N}_R = \hat{T} + N_e \tag{19}$$

$$\mathrm{var}\left(\hat{N}_R\right) = \mathrm{var}\left(\hat{T}\right) \tag{20}$$

where $\hat{N}_R$ is the estimated abundance of adult coho salmon returning to Auke Creek, N_e is the escapement count of adult coho returning to Auke Creek in 2005, and $\hat{T}$ is the estimated marine harvest of adult Auke Creek coho salmon in 2005.

Smolt-to-adult marine survival $\hat{S}$ was calculated by dividing the estimated total adult abundance by the number of coho salmon smolts that were counted, tagged, and released alive in 2004,

$$\hat{S} = \frac{\hat{N}_R}{C} \tag{21}$$

$$\mathrm{var}\left(\hat{S}\right) = \left(\frac{1}{C}\right)^2 \mathrm{var}\left(\hat{N}_R\right) \tag{22}$$

where C is the number of smolt counted, tagged, and released alive from Auke Creek in 2004.

The exploitation rate $\hat{E}$ for adult coho salmon was calculated by:

$$\hat{E} = \frac{\hat{T}}{\hat{N}_R} \tag{23}$$

$$\hat{\mathrm{var}}\left(\hat{E}\right) = \frac{\hat{\mathrm{var}}\left(\hat{T}\right) N_e^2}{\hat{N}_R^4} \tag{24}$$

Physical Data

Water temperature (°C) was recorded by hand everyday at the Auke Creek weir from February 28 through October 28, 2005. Water temperature was also recorded automatically (January 1–December 31) by a HOBO®[1] Temperature Logger (LCD Temp/RH Ext [H14-002]) placed in the creek.

RESULTS

MIGRANT CUTTHROAT TROUT

A total of 133 cutthroat trout emigrated in spring 2005 (Table 2, Figure 2). The migrant counts for cutthroat trout in the Auke Lake drainage have been trending downward since 1996 and this was the fourth lowest count since 1980 and about half the 25-year average of 256 (Table 1, Figure 3). The first emigrant was captured on April 12 and the last on June 21 (Appendix A1). The midpoint of emigration (date on which 50% of fish passed the weir) was April 29.

Of these 133 emigrant cutthroat trout, 44 were missing adipose fins and 89 were not marked or tagged. Only 41 of the 44 fish missing an adipose fin had a PIT tag, suggesting a 7% rate of PIT tag

[1] Product names used in this report are included for scientific completeness, but do not constitute a product endorsement.

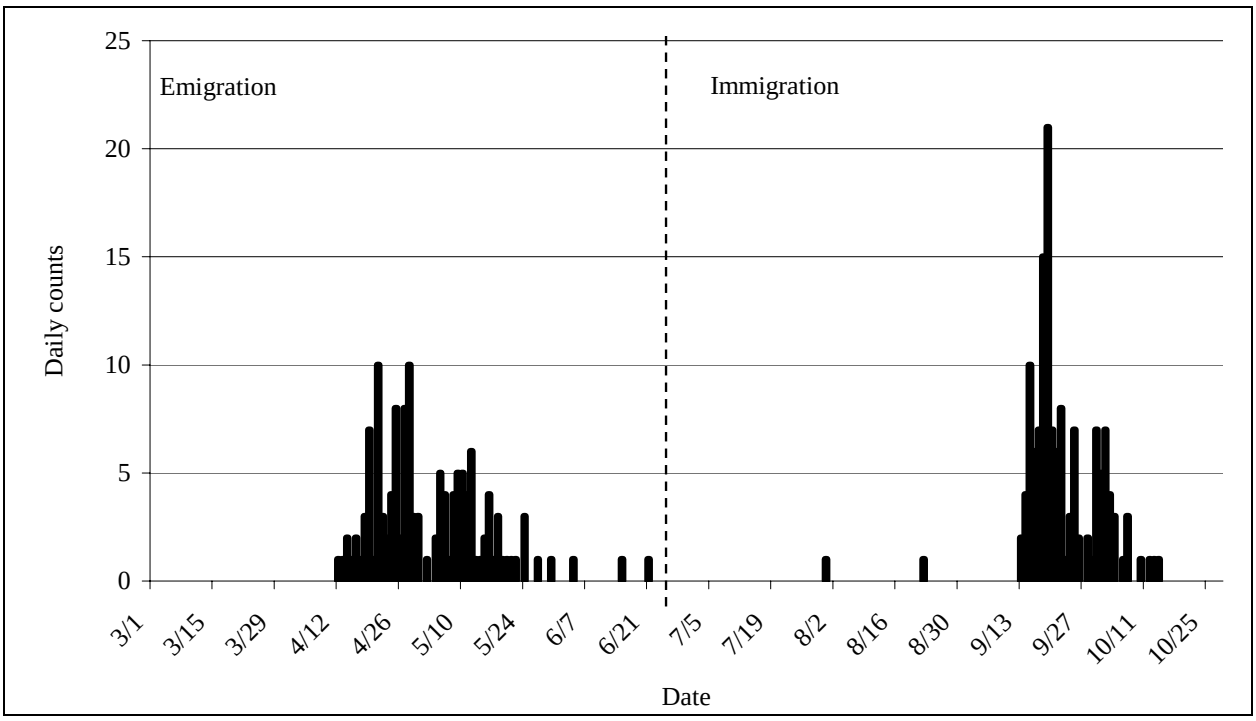

Figure 2.–Spring emigration and fall immigration counts for cutthroat trout at Auke Creek in 2005.

loss. Of the 89 unmarked fish, 22 (25%) had red dye marks on their anal fins, indicating they were sea-run fish seen at the weir the previous fall. Fork lengths for emigrants averaged 253 mm, had a standard deviation of 53 mm, and ranged in size from 128 to 383 mm (Table 2, Figure 4). Length of emigrants declined over time (Figure 5).

A total of 138 cutthroat trout immigrated into Auke Creek in fall 2005 (Table 2, Figure 2). This is the fourth lowest count seen since 1997 (when immigrants were first counted), and is about 60% of the historical average of 228 (Table 1). Most (119) of the immigrants appeared to be "new" to the system, as they displayed no external marks or PIT tags. Of 19 adipose-clipped fish captured, 18 had an operating PIT tag.

The first cutthroat trout trying to immigrate in 2005 was seen on July 31; however 98% of migrants were not passed upstream until after September 13 (Appendix A2) because some cutthroat trout are not ready to remain in fresh water when captured at the weir early in the immigration. This leads to biased upstream run timing data, but there is no way to avoid this as releasing fish above the weir too early results in high mortality (Lum and Taylor 2004). Fork length of immigrant cutthroat trout averaged 238 mm, had a standard deviation of 49 mm, and ranged from 156 to 406 mm (Table 2, Figure 4, Figure 6).

Table 2.–Length composition and abundance at length for emigrating and immigrating cutthroat trout at Auke Creek in 2005.

Length, mm FL	Spring emigrants	Fall immigrants
<120	0	0
121–140	1	0
141–160	6	1
161–180	1	12
181–200	10	22
201–220	20	22
221–240	22	29
241–260	19	17
261–280	17	13
281–300	8	6
301–320	10	4
321–340	13	4
341–360	3	4
361–380	2	3
381–400	1	0
401–420	0	1
n =	133	138

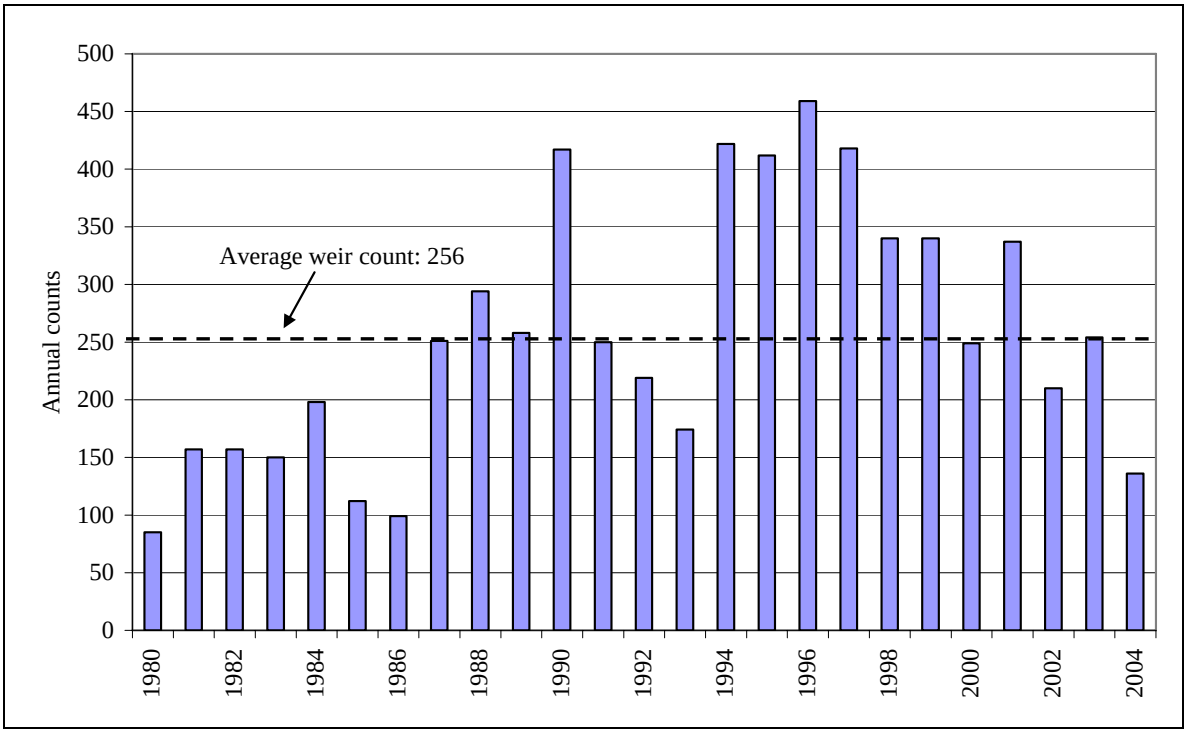

Figure 3.–Annual emigration counts of cutthroat trout at Auke Creek, 1980–2004.

Cutthroat trout marine residence and growth was determined for fish with PIT tags that emigrated from and then immigrated back into Auke Creek in 2005. PIT-tagged cutthroat returning to Auke Creek in 2005 had an average hiatus of 137 d (SE = 4, range = 102-161 d). There was no relationship between emigration and immigration timing (Figure 7), but there was a relationship between date of emigration and the duration of marine residence (R^2 = 0.64) such that fish that emigrated earlier remained in marine waters longer (Figure 8). Average growth during the hiatus was 74 mm (SE = 5 mm) and ranged from 45 to 102 mm. The average growth rate during the hiatus was 0.55 mm/d (SE = 0.04), and the growth rate tended to decrease as the size of the fish got larger (Figure 9)

MIGRANT DOLLY VARDEN

A total of 3,544 Dolly Varden emigrated in 2005, which was below the 25-year average of 6,213 (Table 1, Figure 10). This is the third lowest count since 1980, and continues the downward trend seen since 1995. The first Dolly Varden was captured on March 13 and the last on June 12 (Appendix A1); the midpoint of emigration occurred on April 29 (Figure 11). Average fork length of emigrating Dolly Varden was 235 mm (SE = 3 mm) and ranged from 110 to 420 mm (n = 361). Length of emigrants declined over time (Figure 12). The estimated length composition of the emigration suggests that less than 16% of the run was over 300 mm (Table 3, Figure 13), which is the smallest length at which Dolly Varden are estimated to be mature (ADF&G 1994).

The Dolly Varden immigration began on June 30, the same day the weir was converted and the upstream trap was installed, and lasted until October 27 (Appendix A2). A total of 2,795 Dolly Varden immigrated in 2005, and midpoint of the immigration occurred on September 7 (Figure 11). This was below the eight-year average of 4,276 (Table 1) and was the second lowest number of Dolly Varden counted upstream through the weir.

SALMON SMOLT COUNTS, CODED WIRE TAGGING, AGE, WEIGHT, AND LENGTH

Coho smolt began their emigration from Auke Creek on April 21, 2005. The migration lasted

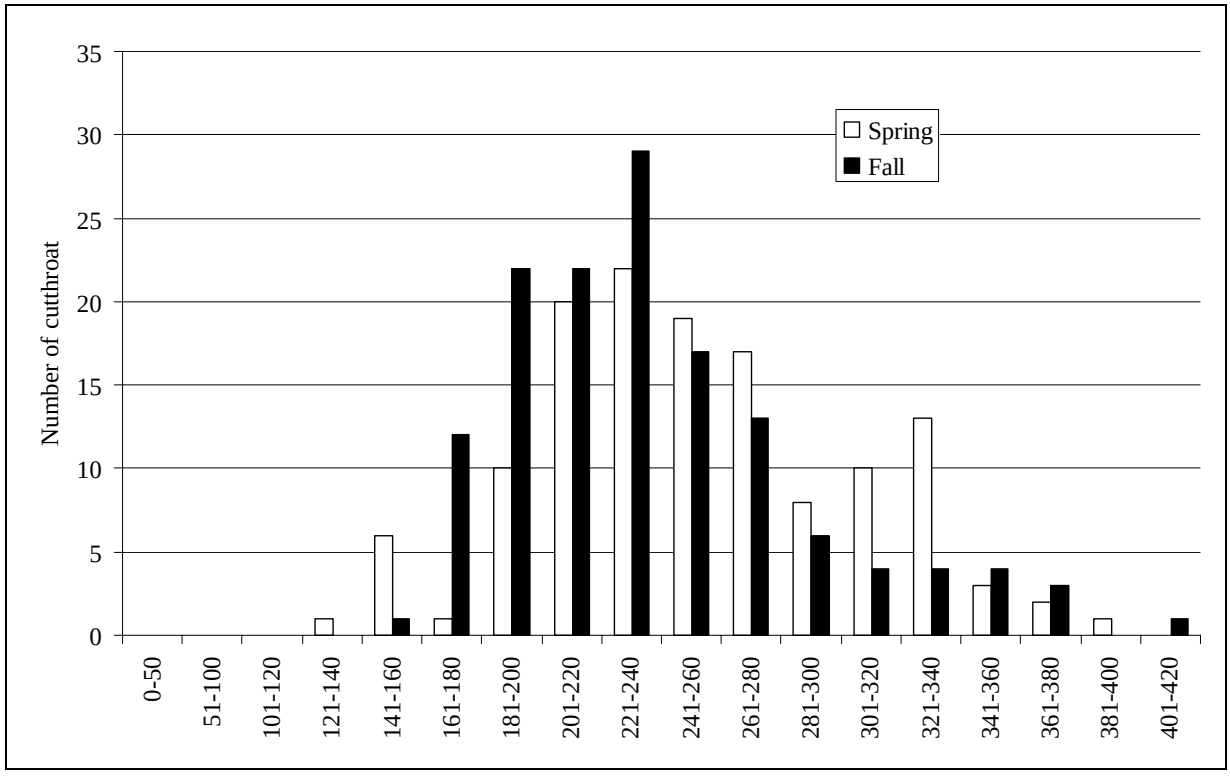

Figure 4.–Lengths of cutthroat trout, pooled by 20-mm groups, during the spring emigration and the fall immigration at the Auke Creek weir in 2005.

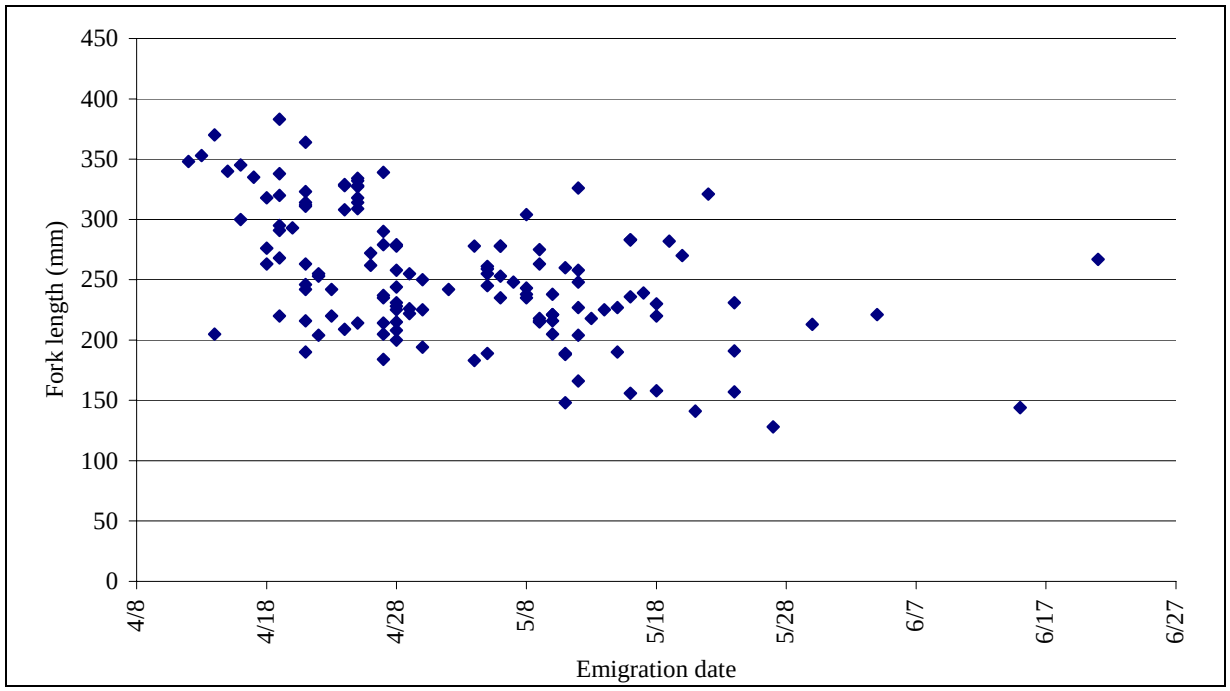

Figure 5.–Cutthroat trout lengths versus emigration date at Auke Creek in 2005.

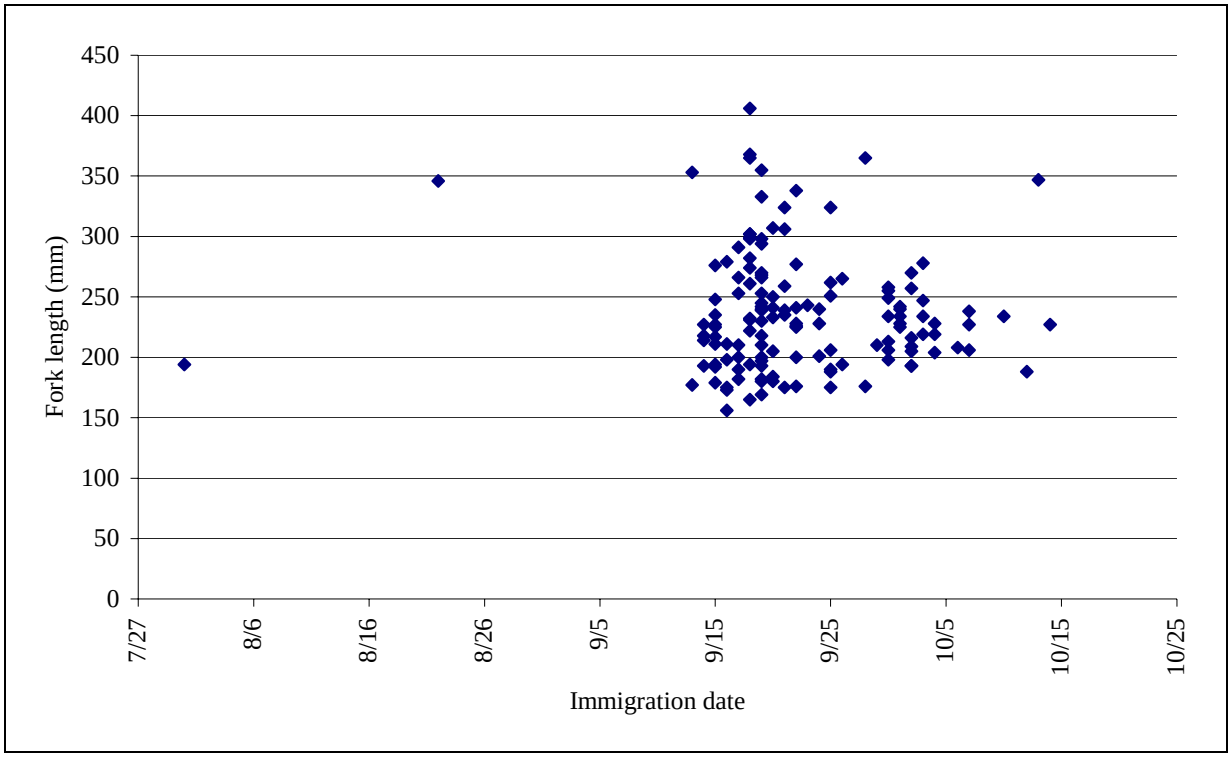

Figure 6.–Cutthroat trout lengths versus immigration date at Auke Creek in 2005.

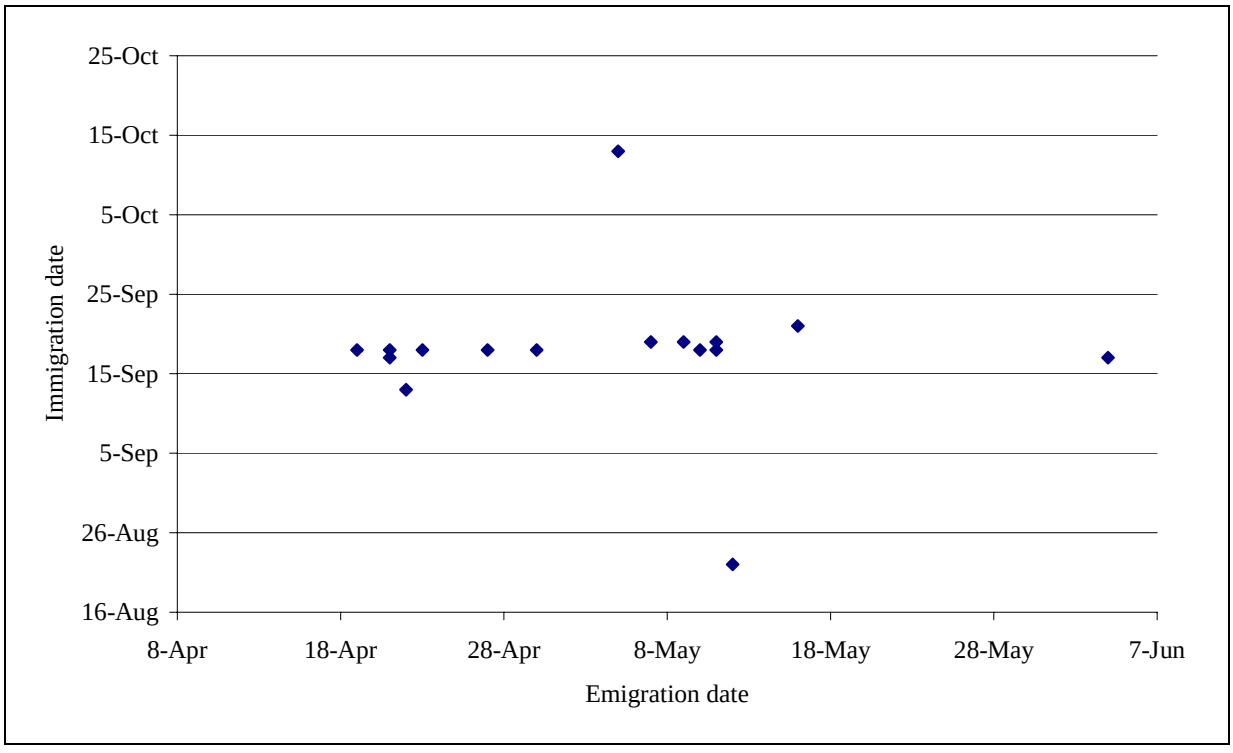

Figure 7.–Emigration and immigration dates for tagged cutthroat trout at Auke Creek in 2005.

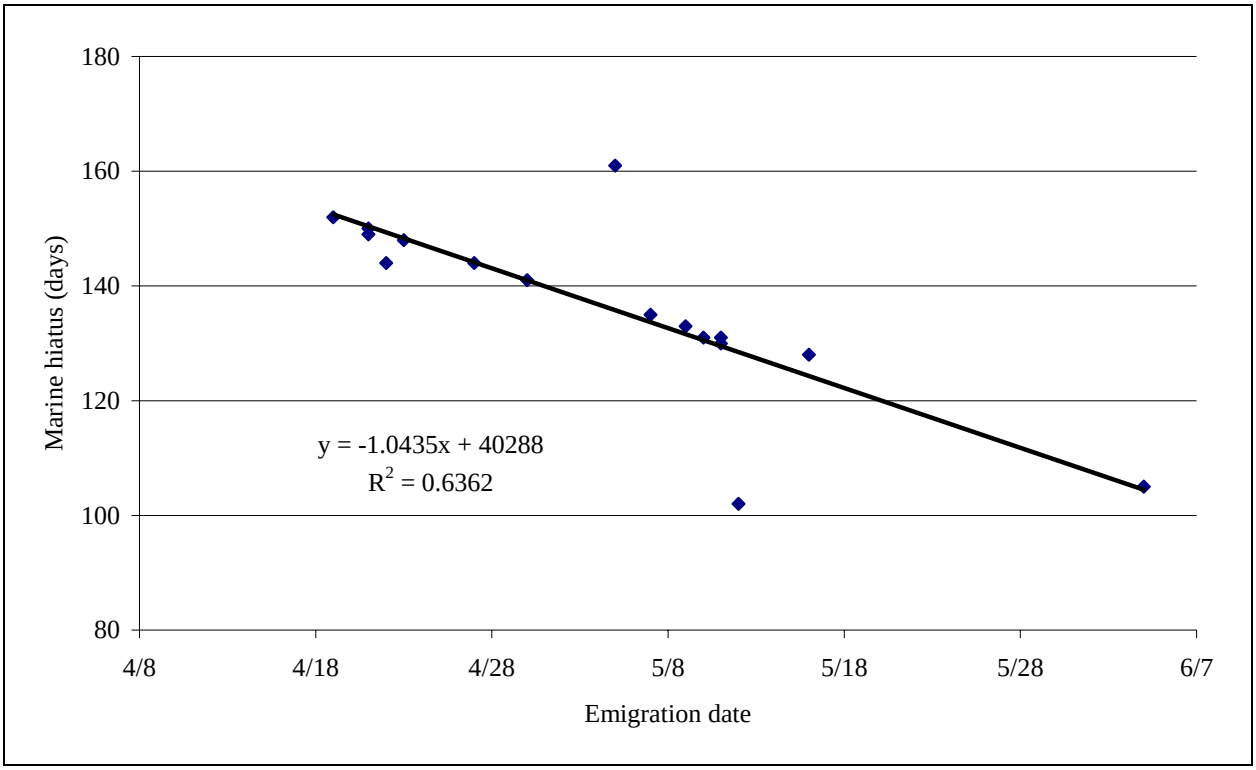

Figure 8.–Relationship between emigration date of tagged cutthroat trout from Auke Creek and the duration of their hiatus from the lake in 2005.

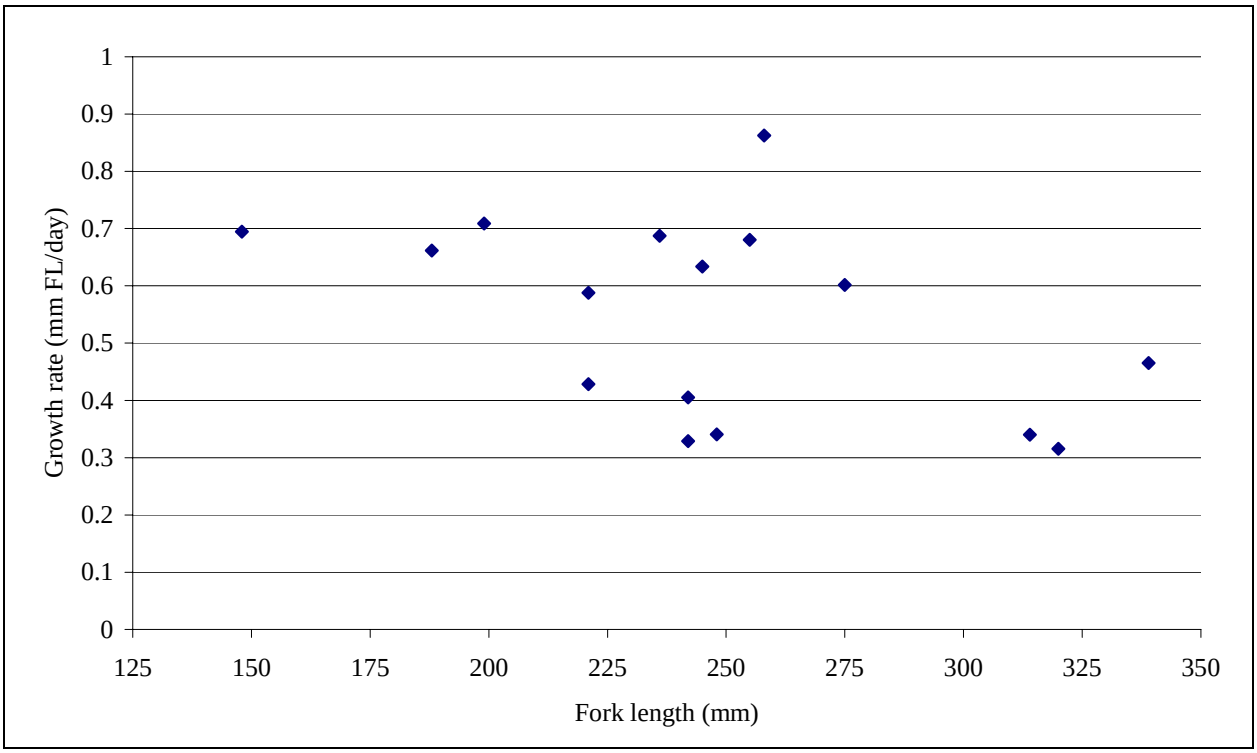

Figure 9.–Growth rate of tagged cutthroat trout between emigration and immigration in 2005 versus length at emigration from Auke Lake.

Table 3.–Length composition and estimated abundance at length for emigrating Dolly Varden at Auke Creek in 2005. Number sampled (n_ℓ), proportion ($\hat{p}_\ell$), abundance ($\hat{N}_\ell$), and standard error (SE) are shown for each 20-mm length class.

Length, mm FL	n_ℓ	$\hat{p}_\ell$	SE($\hat{p}_\ell$)	$\hat{N}_\ell$	SE($\hat{N}_\ell$)
< 100	0	0.00	0.00	0	0
101–120	8	0.02	0.01	79	27
121–140	19	0.05	0.01	186	42
141–160	24	0.07	0.01	236	47
161–180	23	0.06	0.01	226	46
181–200	32	0.09	0.01	314	53
201–220	63	0.17	0.02	618	71
221–240	49	0.14	0.02	481	64
241–260	36	0.10	0.02	353	56
261–280	23	0.06	0.01	226	46
281–300	28	0.08	0.01	275	50
301–320	18	0.05	0.01	177	41
321–340	11	0.03	0.01	108	32
341–360	14	0.04	0.01	137	36
361–380	5	0.01	0.01	49	22
381–400	6	0.02	0.01	59	24
401–420	2	0.01	0.00	20	14
421–440	0	0.00	0.00	0	0
441–460	0	0.00	0.00	0	0
461–480	0	0.00	0.00	0	0
481–500	0	0.00	0.00	0	0
n =	361		N =	3,544	

through June 26 (Appendix A1), and its midpoint was May 11. A total of 4,318 coho smolt were captured, 4,287 of which were successfully released downstream with a coded wire tag and adipose finclip. This is less than the 25-year historical average of 6,117 (Table 1) and is the fourth lowest number of fish seen during that time.

An estimated 67% of coho smolts emigrating in 2005 were age-1 and 33% were age-2 (Table 4). The mean length and weight for all smolts sampled was 115 mm (SE = 0.5 mm) and 14.4 g (SE = 0.19 g). Age-1 smolts averaged 110 mm (SE = 0.5 mm) and 12.5 g (SE = 0.17 g), while age-2 smolts averaged 126 mm (SE = 0.6 mm) and 18.2 g (SE = 0.29 g). Age-1 smolt lengths ranged from 82 to 128 mm, and age-2 smolt lengths ranged from 108 to 155 mm (Figure 14). Age-1 weights ranged from 5 to 20 g, while age-2 smolts ranged from 12 to 32 g (Figure 15).

Sockeye smolt began their emigration from Auke Creek on April 24, 2005. The migration lasted through June 28 (Appendix A1), and its midpoint was May 12. A total of 8,513 sockeye smolt were captured in 2005. This is the fourth lowest count ever recorded and is less than half the 25-year historical average of 17,264 (Table 1). An estimated 28% of sockeye smolts in 2005 were age-1 and 72% were age-2. Age-1 smolts averaged 79 mm and 4.3 g, while age-2 smolts averaged 117 mm and 14 g (Taylor *Unpublished*).

ESCAPEMENT, AGE, SEX AND LENGTH

The jack coho salmon immigration began on September 8, ended on October 14 (Appendix A2), and the midpoint was September 25. A total of 246 coho jacks were counted at the weir in 2005, 74 of which were sampled for length and scales. The estimated age composition of jacks was 20% age-1.0 and 80% age-2.0 (Table 5). About 24% of the scales sampled were not readable. The average length of age-1.0 jacks was 329 mm MEF (SE = 11 mm); it was 326 mm MEF (SE = 3 mm) for age-2.0 fish (Table 6).

The adult coho salmon immigration began on September 12, ended on October 23 (Appendix A2), and the midpoint was September 21. This starting date is skewed, however, as many fish captured at the weir early in the immigration were not ready to remain in freshwater, so they were placed back downstream. There is no way to avoid this as releasing fish above the weir too early results in high mortality. A total of 450 coho adults were counted at the weir in 2005, 227 of

Table 4.–Estimated freshwater age composition and abundance, and mean length and weight-at-age of coho salmon smolt emigrating from Auke Creek in 2005.

	Brood year and freshwater age			
	2003 Age-1	2002 Age-2	2001 Age-3	All smolt
n	291	141	0	432
Age composition	0.671	0.329		
SE (age composition)	0.020	0.020		
Abundance	2,896	1,422	0	4,318
SE (abundance)	88	88		0
n	291	141	0	447
Mean length (mm)	110.1	125.9		115.4
SE (mean length)	0.5	0.6		0.5
n	291	141	0	447
Mean weight. (g)	12.5	18.2		14.4
SE (mean weight)	0.17	0.29		0.19

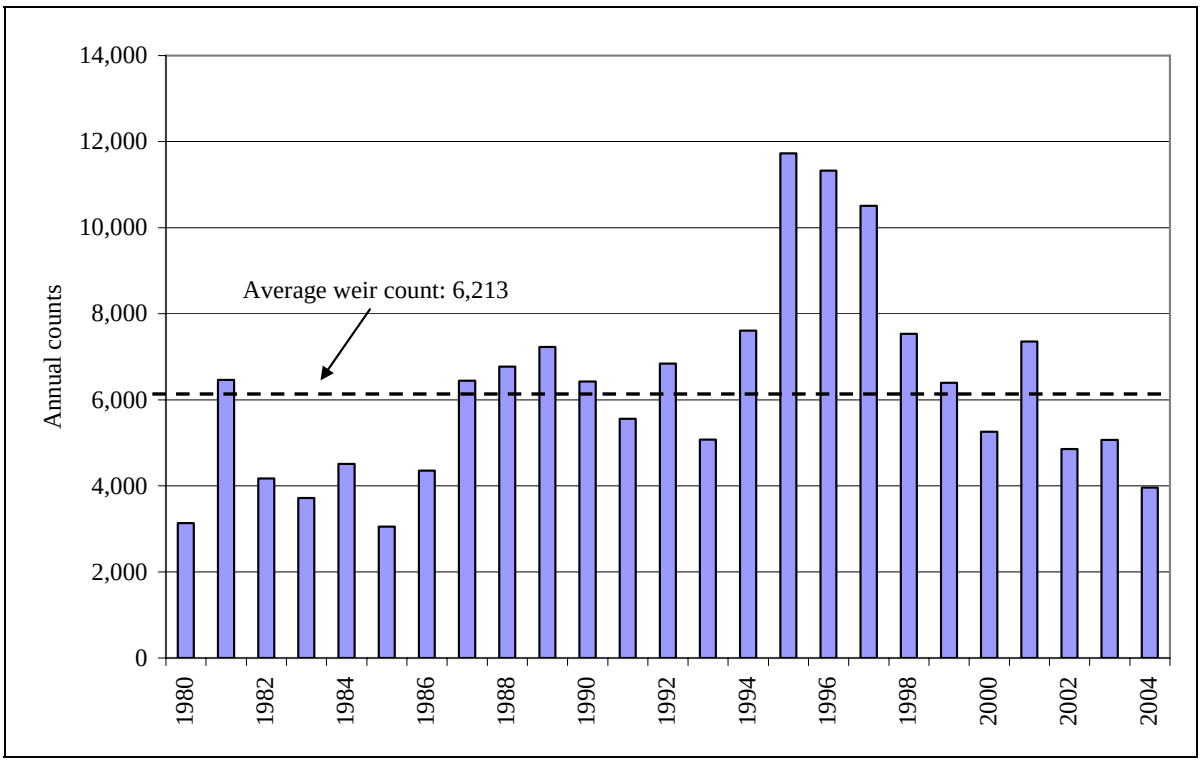

Figure 10.–Annual emigration counts of Dolly Varden at Auke Creek, 1980–2004.

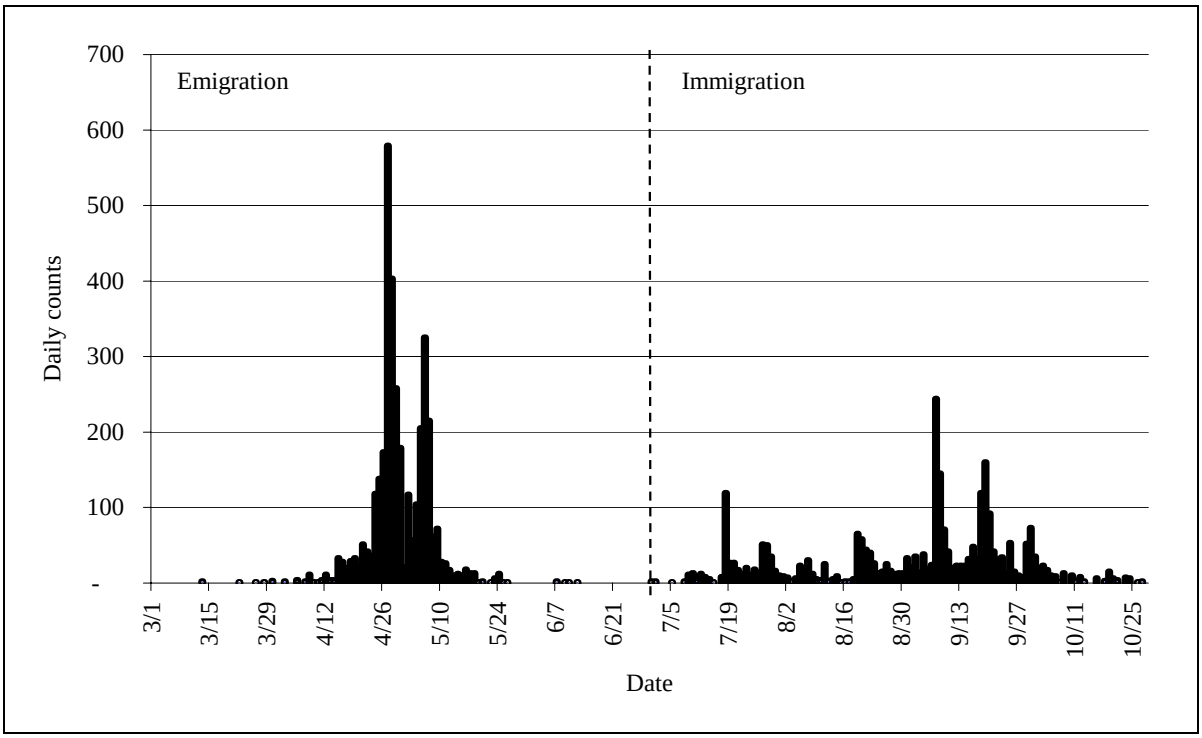

Figure 11.–Emigration and immigration counts of Dolly Varden at Auke Creek in 2005.

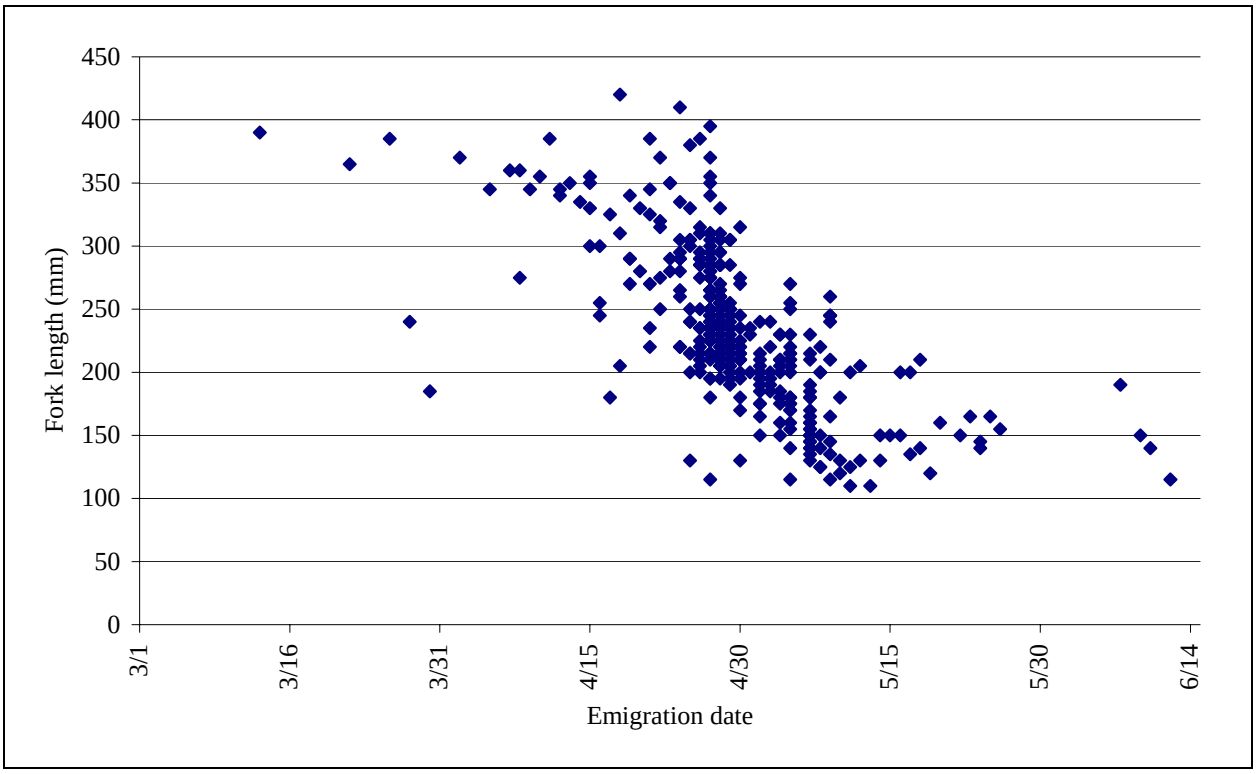

Figure 12.–Dolly Varden lengths versus date during the spring emigration at Auke Creek in 2005.

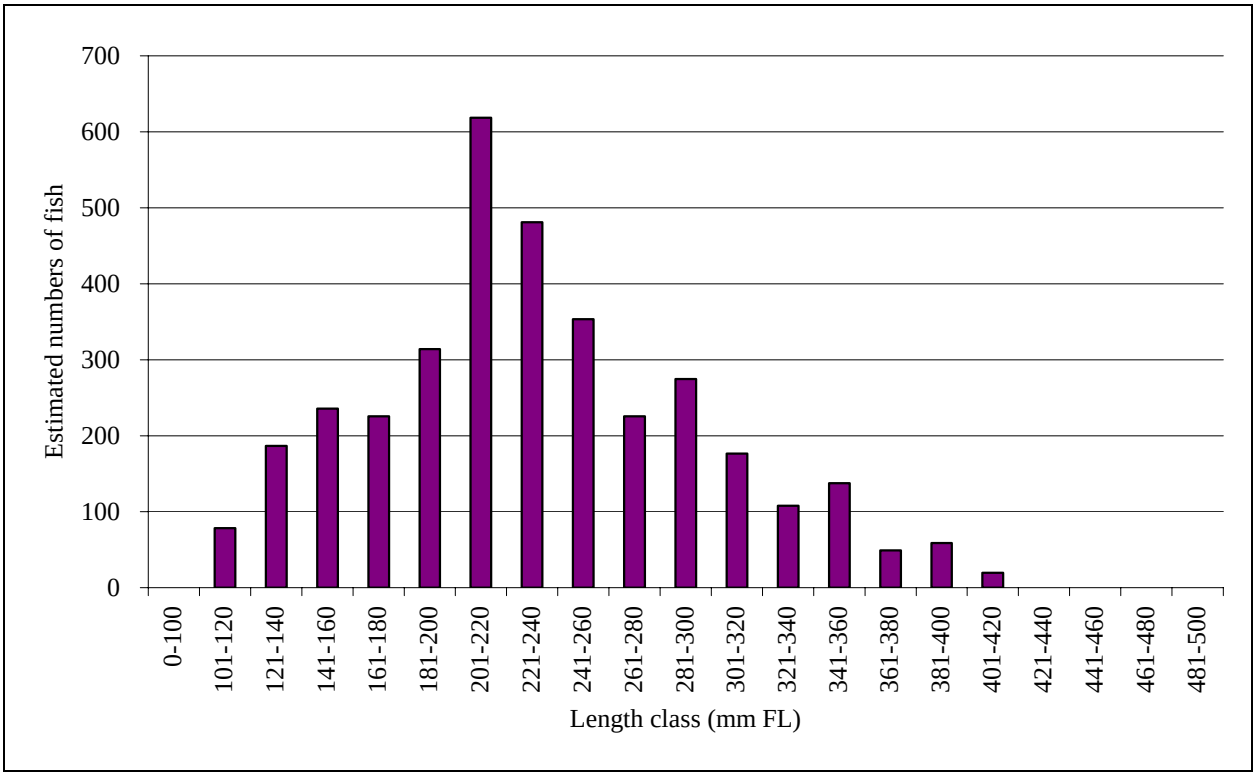

Figure 13.–Estimated length composition of emigrating Dolly Varden at Auke Creek in 2005**.**

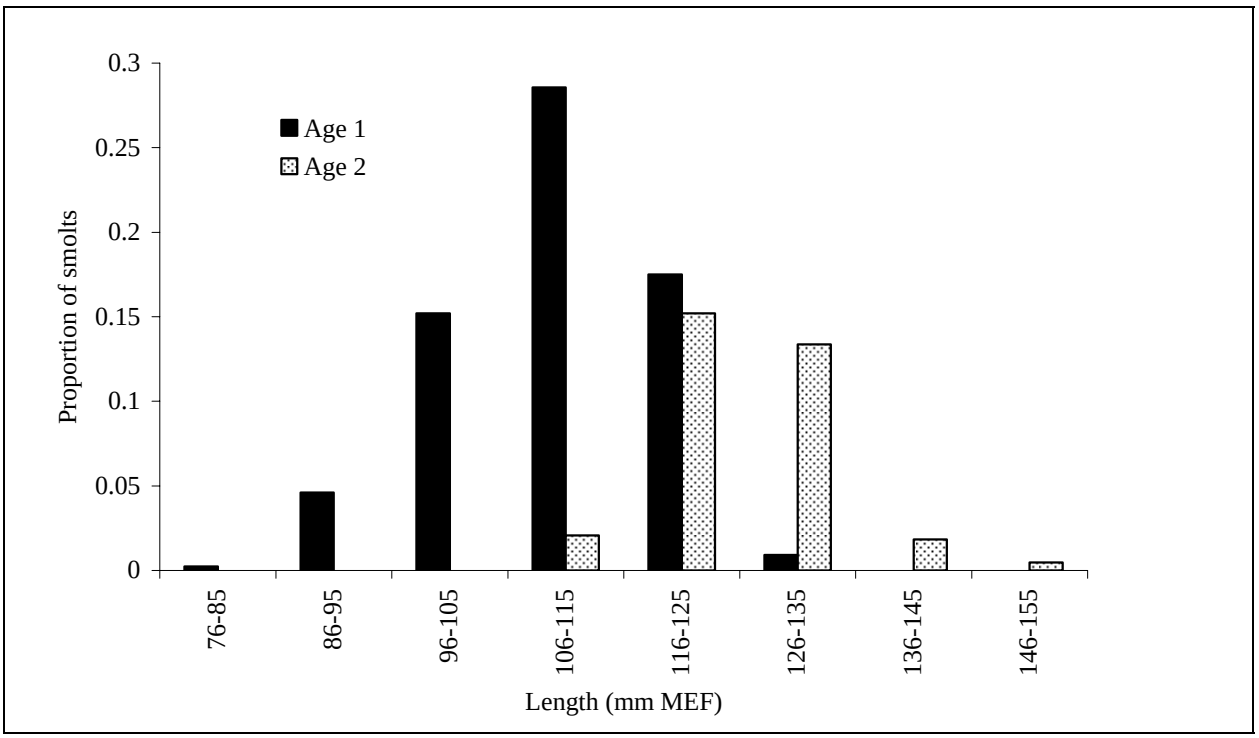

Figure 14.–Length distribution of coho salmon smolts sampled at Auke Creek in 2005.

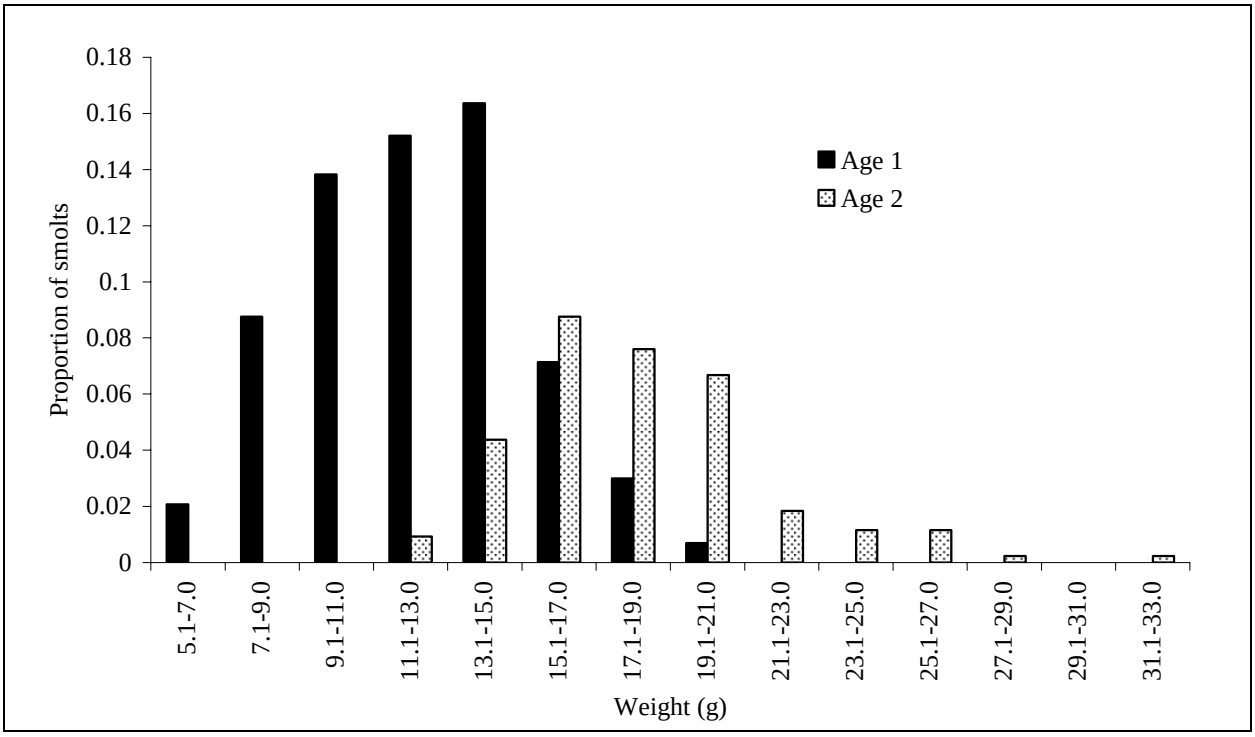

Figure 15.–Weight distribution of coho salmon smolts sampled at Auke Creek in 2005.

which were sampled for sex, length, and scales. This number of immigrants is less than the 25-year historical average of 732 (Table 1) and is the sixth lowest count seen since 1971.

The estimated age composition of adults was 66% age-1.1 and 34% age-2.1 (Table 7). About 23% of the total scales sampled were not readable. Based on sex alone, an estimated 49% of adult coho salmon were males and 51% were females. Estimates of sex composition based on summing abundance by sex at age (Table 7) are slightly different (52% male, 48% female). The average length for all adult coho salmon sampled was 596 mm MEF (SE = 3 mm), 586 mm MEF (SE = 4 mm) for age-1.1 fish, and 615 mm MEF (SE = 5 mm) for age-2.1 fish (Table 8, Figure 16). Females averaged 602 mm MEF (SE = 4 mm) and males averaged 589 mm MEF (SE = 4 mm), Table 8, Figure 17.

The adult sockeye salmon immigration began on June 30 and ended on September 18 (Appendix A2), and the midpoint was July 18. A total of 2,879 sockeye adults and 145 jacks were counted at the weir in 2005. This is less than the 25-year historical average of 3,419 adults (Table 1) and is the twelfth lowest count seen since 1963.

MARINE HARVEST, TOTAL ABUNDANCE, MARINE SURVIVAL & EXPLOITATION

A total of 69 Auke Creek coded wire tags were recovered from commercial fisheries in 2005, and 12 CWTs were recovered from sport fisheries during this same time (Appendix B1). Expanding these tag recoveries results in an estimated 327 (SE = 49) Auke Creek adult coho salmon harvested in 2005 (Appendix B1). Combining this harvest with the number counted at the weir yields a total return of 777 (SE = 49) Auke Creek adult coho salmon in 2005.

Coho salmon smolt-to-adult marine survival at Auke Creek was estimated to be 17% (SE = 1.1%) for all coho tagged in 2004 (4,550; CWT Release Report Form). The exploitation rate of Auke Creek coho salmon was estimated to be 42% (SE =3.6%) in 2005 marine fisheries.

Table 5.–Estimated age composition and abundance of jack coho salmon returning to Auke Creek in 2005.

	Brood year and age class			
	2003	2002	2001	
	1.0	2.0	3.0	All
n	11	45	0	74
Fraction male	1.0	1.0		1.0
n	11	45	0	56
Age composition	0.203	0.797		
SE (age composition)	0.060	0.060		
Escapement	50	196	0	246
SE (escapement)	15	15		0

Table 6.–Estimated mean length-at-age of jack coho salmon returning to Auke Creek in 2005.

	Brood year and age class			
	2003	2002	2001	
	1.0	2.0	3.0	All
n	11	45	0	74
Mean length (mm)	329.0	325.6	0.0	325.4
SE (mean length)	11.1	2.9	0.0	2.2

Table 7.–Estimated age and sex composition and abundance of adult coho salmon returning to Auke Creek in 2005.

	Brood year and age class			
	2002	2001	2000	
	1.1	2.1	3.1	All
All Fish				
n	115	59	0	174
Age composition	0.659	0.341		
SE (age composition)	0.032	0.032		
Escapement	296	154	0	450
SE (escapement)	15	15		0
Males				
n	60	30	0	115
Fraction male	0.527	0.471		0.489
SE (fraction male)	0.042	0.061		0.026
Escapement	156	72	0	220[a]
SE (escapement)	15	12		12[a]
Females				
n	55	29	0	112
Fraction female	0.473	0.529		0.511
SE (fraction female)	0.042	0.061		0.026
Escapement	140	81	0	230[a]
SE (escapement)	14	12		12[a]

[a] Sex composition based on all fish sexed differs from that based on aged fish. Thus, total numbers by sex differ from totals based on sums by sex over age; see text for details.

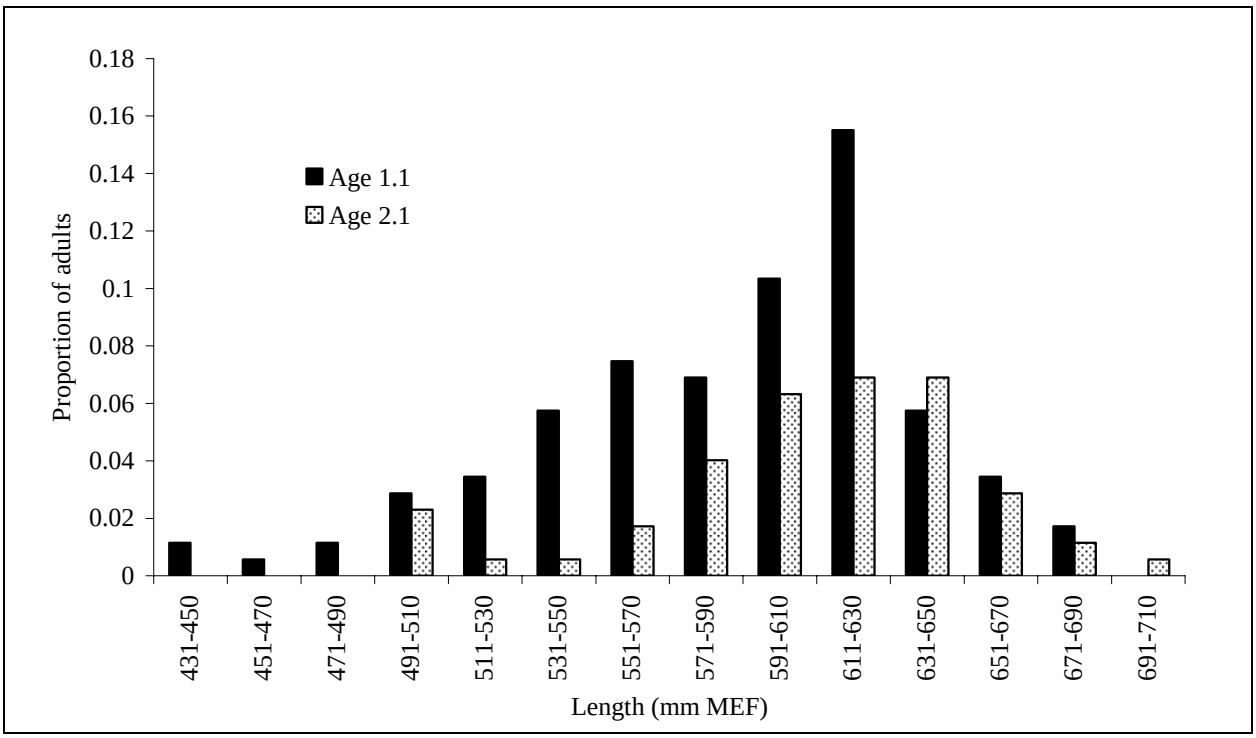

Figure 16.–Length distribution by age of adult coho salmon at Auke Creek in 2005.

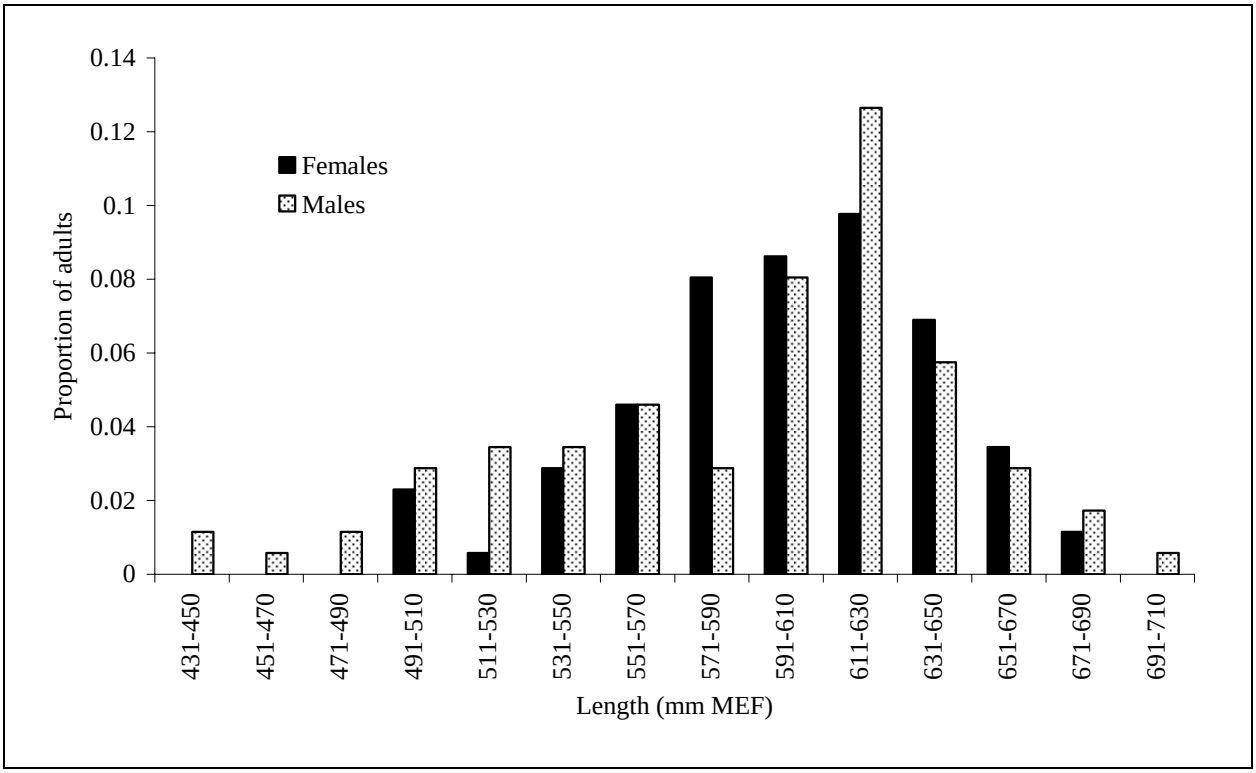

Figure 17.–Length distribution by sex of adult coho salmon at Auke Creek in 2005.

Table 8.–Estimated mean length-at-age (MEF) by sex of adult coho salmon returning to Auke Creek in 2005.

	Brood year and age class			
	2002	2001	2000	
	1.1	2.1	3.1	All Adults
All Fish				
n	115	59	0	227
Mean length (mm)	586	615		596
SE (mean length)	4	5		3
Males				
n	60	30	0	115
Mean length (mm)	576	617		589
SE(mean length)	7	7		4
Females				
n	55	29	0	112
Mean length (mm)	597	613		602
SE (mean length)	5	7		4

OTHER SPECIES

Pink salmon fry began their emigration from Auke Creek on March 1, 2005. The migration lasted through May 20 (Appendix A1) and its midpoint was April 14. A total of 87,927 pink salmon fry were counted; this is less than the 25-year historical average of 108,630 (Table 1). Pink salmon adults began their immigration on July 17, and the migration lasted through September 22 (Appendix A2). The midpoint of immigration was August 21, and 10,010 pink salmon adults were seen. Of these, 52% (SE = 0.48%) were estimated to be males and 48% (SE = 0.52%) were females.

Chum salmon fry began emigrating on March 7, 2005. The migration lasted through June 15 (Appendix A1), its midpoint was May 2, and a total of 191 chum salmon fry were seen. This is less than the 25-year historical average of 5,015 (Table 1) and is the fourth lowest number of fish seen during that time. Chum salmon adults began their immigration on July 22 and the migration lasted through September 6 (Appendix A2). The midpoint of immigration was August 2, and 944 chum salmon adults were seen. This count is less than the 25-year historical average of 1,256 (Table 1).

Juvenile steelhead were counted during both the emigration and immigration periods in 2005. A total of 12 steelhead emigrated from Auke Lake beginning on May 5 and ending on May 20, and a total of 20 immigrated to the lake beginning on September 22 and ending on October 27. Unlike those for other species, both counts were above the 25-year historical average.

PHYSICAL DATA

Water temperatures at the Auke Creek weir throughout 2005 ranged from 0.8°C to 19.9°C (mean = 8.8°C). During the emigration period temperatures ranged from 1.6°C to 18.6°C (mean = 10.0°C, Appendix A1), and during immigration temperatures were between 6.6°C and 19.9°C (mean = 13.8°C, Appendix A2).

DISCUSSION

The number of fish emigrating from and immigrating to Auke Creek has been trending downward, and all counts in 2005, except for steelhead, were below the 25-year historical average. The reason for the recent decline is not known. Two hypotheses involve the addition of hydrocarbons by watercraft, and changing streambed and flow characteristics of Lake Creek, Auke Lake's biggest tributary.

Studies are being conducted by NMFS Auke Bay Laboratory on the effects of additional hydrocarbons being introduced to the lake by increased motorized personal watercraft use (Moles and Marty 2005; Rice et al. *In press*). Only anecdotal information about changes to the streambed and flow characteristics of Lake Creek exists are available, however. Lake Creek has long been recognized as an important spawning area (Bishop *Unpublished*; Bethers et al. 1995), so any changes within it could have impacted the numbers of fish successfully recruited to the system. With instream flow rates in Lake Creek seemingly lower than in previous years, and the build-up of a delta at its mouth, spawner access to and success within the stream is questionable. The stream is also believed to possibly freeze-out during the winter, which could also be contributing to declines in fish populations.

Because the Auke Creek weir and Auke Lake system have such a long and complete historical data set, information about abundance, survival, growth, migration timing, and other life history information for the species present in this system is important. Results of the project contribute to other research efforts on the system, help guide management decisions and planning during Board of Fisheries meetings, and enable long-term

monitoring as urban development in the area continues.

ACKNOWLEDGMENTS

I would like to thank Bob Marshall for his help with the operational plan, data analysis, and review of this manuscript. Thanks to Jerry Taylor for his assistance, knowledge and expertise at the weir, as well as Kurt Konzela, Ryan Briscoe, Roger Harding, Dave Love, and Peter Bangs for their help with weir installation and fish counting. John Der Hovanisian provided critical review and Judy Shuler prepared the final manuscript for publication.

REFERENCES CITED

ADF&G (Alaska Department of Fish and Game). 1994. ADF&G Wildlife Notebook Series. Alaska Department of Fish and Game, Public Communications Section, Juneau.

Bernard, D. R., and J. E. Clark. 1996. Estimating salmon harvest based on return of coded-wire tags. Canadian Journal of Fisheries and Aquatic Sciences 53:2323-2332.

Bethers, M., K. Munk, and C. Seifert. 1995. Juneau fish habitat assessment. Alaska Department of Fish and Game, Division of Sport Fish, Douglas.

Bishop, D. M. Unpublished. Review of information concerning sockeye spawning habitats in Auke Lake. 1987. ENVIRONAID, 12175 Mendenhall Loop Road, Juneau, Alaska 99801.

Gharrett, A. J., and W. W. Smoker. 1991. Two generations of hybrids between even- and odd-year pink salmon (*Oncorhynchus gorbuscha*): a test for outbreeding depression. Canadian Journal of Fisheries and Aquatic Sciences 48(9):1744-1749.

Gharrett, A. J., W. W. Smoker, R. R. Reisenbichler, and S. G. Taylor. 1999. Outbreeding depression in hybrids between odd- and even-brood year pink salmon. Aquaculture 173:117-129.

Gilk, S. E., I. A. Wang, C. L. Hoover, W. W. Smoker, S. G. Taylor, A. K. Gray, and A. J. Gharrett. 2004. Outbreeding depression in hybrids between spatially separated pink salmon, *Oncorhynchus gorbuscha*, populations: marine survival, homing ability, and variability in family size. Environmental Biology of Fishes 69:287-297.

Goddard, P. L. 1995. Quantitative genetic analysis of a fitness related life history character, development rate, in odd- and even-brood year populations of pink salmon (*Oncorhynchus gorbuscha*). Master's thesis. University of Alaska Fairbanks, Fairbanks.

Hebert, K., P. L. Goddard, W. W. Smoker, and A. J. Gharrett. 1998. Quantitative genetic variation and genotype by environment interaction of embryo development rate in pink salmon (*Oncorhynchus gorbuscha*). Canadian Journal of Fisheries and Aquatic Sciences 55(9):2048-2057.

Hoover, C. L. 2005. Effects of outbreeding depression on meristics and bilateral asymmetry in hybrids of spatially separated populations of pink salmon (*Oncorhynchus gorbuscha*). Master's thesis. University of Alaska Fairbanks, Fairbanks.

Lum, J. L., J. D. Jones, K. Kondzela, and S. G. Taylor. 1999. Dolly Varden and cutthroat trout populations in Auke Lake, Southeast Alaska, during 1998. Alaska Department of Fish and Game, Fishery Data Series No. 99-32, Anchorage. http://www.sf.adfg.state.ak.us/FedAidPDFs/fds99-32.pdf

Lum, J. L., J. D. Jones, K. Kondzela, and S. G. Taylor. 2000. Dolly Varden and cutthroat trout populations in Auke Lake, Southeast Alaska, during 1999. Alaska Department of Fish and Game, Fishery Data Series No. 00-30, Anchorage. http://www.sf.adfg.state.ak.us/FedAidPDFs/fds00-30.pdf

Lum, J. L., J. D. Jones, and S. G. Taylor. 2001. Dolly Varden and cutthroat trout populations in Auke Lake, Southeast Alaska, during 2000. Alaska Department of Fish and Game, Fishery Data Series No. 01-33, Anchorage. http://www.sf.adfg.state.ak.us/FedAidPDFs/fds01-33.pdf

Lum, J. L., J. D. Jones, and S. G. Taylor. 2002. Dolly Varden and Cutthroat Trout migrations at Auke Creek in 2001, and abundance of Cutthroat Trout in Auke Lake Southeast Alaska. Alaska Department of Fish and Game, Fishery Data Series No. 02-21, Anchorage. http://www.sf.adfg.state.ak.us/FedAidPDFs/fds02-21.pdf

Lum, J. L., K. Kondzela, J. D. Jones, and S. G. Taylor. 1998. Dolly Varden char and sea-run cutthroat trout populations at Auke Lake, Southeast Alaska, during 1997. Alaska Department of Fish and Game, Fishery Data Series No. 98-43, Anchorage. http://www.sf.adfg.state.ak.us/FedAidPDFs/fds98-43.pdf

REFERENCES CITED (Continued)

Lum, J. L., and S. G. Taylor. 2004. Dolly Varden and cutthroat trout migrations at Auke Creek in 2002, and abundance of cutthroat trout in Auke Lake, Southeast Alaska. Alaska Department of Fish and Game, Fishery Data Series No. 04-12, Anchorage. http://www.sf.adfg.state.ak.us/FedAidPDFs/fds04-12.pdf

Moles, A., and G. D. Marty. 2005. Physiological changes in prickly sculpin (Cottus asper) inhabiting a lake used by jet-propelled watercraft. Bulletin of Environmental Contamination and Toxicology. 74: 1151-1158.

Neimark, L. M. 1984a. Enhancement of the recreational fishing opportunities in the Juneau area. Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Performance Report, 1983-1984, Project F-9-16, 25 (G-III-A), Juneau. http://www.sf.adfg.state.ak.us/FedAidPDFs/FREDf-9-16(25)G-III-A.pdf

Neimark, L. M. 1984b. Fish migration studies in Southeast Alaska. Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Performance Report, 1983-1984, Project F-9-16, 25 (G-II-D), Juneau. http://www.sf.adfg.state.ak.us/FedAidPDFs/FREDf-9-16(25)G-II-D.pdf

Rice, S. D., L. Holland, and A. Moles. *In press*. Seasonal increases in Polycyclic Aromatic Hydrocarbons in a small Alaskan lake related to two-stroke engine use. Lake and Reservoir Management.

Scarnecchia, D. L. 1979. Variation of scale characteristics of coho salmon with sampling location on the body. Progressive Fish Culturist 41(3):132-135.

Seber, G. A. F. 1982. On the estimation of animal abundance and related parameters, second edition. Griffin and Company, Ltd. London.

Suchanek, P. M., and A. E. Bingham. 1992. Harvest estimates for selected enhanced roadside sport fisheries near Juneau, Alaska, during 1991. Alaska Department of Fish and Game, Fishery Data Series No. 92-42, Anchorage. http://www.sf.adfg.state.ak.us/FedAidPDFs/fds92-42.pdf

Taylor, S. G. Unpublished. Auke Creek weir 2005 Annual Report, operations, fish counts, and historical summaries. 2006. National Marine Fisheries Service. Auke Bay Laboratory, 11305 Glacier Highway, Juneau, Alaska.

Taylor, S. G., and J. L. Lum. Unpublished-a. Annual report Auke Creek weir 1998, operations, fish counts, and historical summaries. 1999. National Marine Fisheries Service. Auke Bay Laboratory, 11305 Glacier Highway, Juneau, Alaska 99801-8626.

Taylor, S. G., and J. L. Lum. Unpublished-b. Annual report Auke Creek weir 1999, operations, fish counts, and historical summaries. 2000. National Marine Fisheries Service. Auke Bay Laboratory, 11305 Glacier Highway, Juneau, Alaska 99801-8626.

Taylor, S. G., and J. L. Lum. Unpublished-c. Annual report Auke Creek weir 2000, operations, fish counts, and historical summaries. 2001. National Marine Fisheries Service. Auke Bay Laboratory, 11305 Glacier Highway, Juneau, Alaska 99801-8626.

Taylor, S. G., and J. L. Lum. Unpublished-d. Auke Creek weir 2001 Annual Report, operations, fish counts, and historical summaries. 2002. National Marine Fisheries Service. Auke Bay Laboratory, 11305 Glacier Highway, Juneau, Alaska 99801-8626.

Taylor, S. G., and J. L. Lum. Unpublished-e. Auke Creek weir 2002 Annual Report, operations, fish counts, and historical summaries. 2003. National Marine Fisheries Service. Auke Bay Laboratory, 11305 Glacier Highway, Juneau, Alaska 99801-8626.

Taylor, S. G., and J. L. Lum. Unpublished-f. Auke Creek weir 2003 Annual Report, operations, fish counts, and historical summaries. 2004. National Marine Fisheries Service. Auke Bay Laboratory, 11305 Glacier Highway, Juneau, Alaska 99801-8626.

Taylor, S. G., and J. L. Lum. Unpublished-g. Auke Creek weir 2004 Annual Report, operations, fish counts, and historical summaries. 2005. National Marine Fisheries Service. Auke Bay Laboratory, 11305 Glacier Highway, Juneau, Alaska.

Wang, I. A. 2004. Effects of outbreeding on embryonic development timing of pink salmon (*Oncorhynchus gorbuscha*). Master's thesis. University of Alaska Fairbanks, Fairbanks.

APPENDIX A

Appendix A1.–Daily count of spring emigrants at Auke Creek, 2005.

	Cutthroat Trout	Dolly Varden	Sockeye smolt	Pink fry	Chum fry	Coho smolt	Juvenile steelhead	Water temp
February 28	0	0	0	0	0	0	0	1.6
March 1	0	0	0	35	0	0	0	1.9
2	0	0	0	42	0	0	0	2.0
3	0	0	0	111	0	0	0	2.0
4	0	0	0	79	0	0	0	2.0
5	0	0	0	59	0	0	0	2.0
6	0	0	0	38	0	0	0	2.0
7	0	0	0	71	1	0	0	2.0
8	0	0	0	91	0	0	0	2.0
9	0	0	0	89	0	0	0	2.1
10	0	0	0	91	3	0	0	2.0
11	0	0	0	194	0	0	0	2.0
12	0	0	0	136	0	0	0	2.0
13	0	2	0	119	0	0	0	2.0
14	0	0	0	115	0	0	0	2.1
15	0	0	0	125	0	0	0	2.1
16	0	0	0	150	3	0	0	2.3
17	0	0	0	125	1	0	0	2.5
18	0	0	0	153	4	0	0	2.5
19	0	0	0	111	0	0	0	2.3
20	0	0	0	139	0	0	0	2.4
21	0	0	0	98	0	0	0	2.7
22	0	1	0	166	3	0	0	2.8
23	0	0	0	270	0	0	0	2.9
24	0	0	0	273	0	0	0	3.0
25	0	0	0	281	0	0	0	3.0
26	0	1	0	243	0	0	0	3.2
27	0	0	0	469	0	0	0	3.4
28	0	1	0	468	0	0	0	3.3
29	0	0	0	526	0	0	0	3.3
30	0	3	0	501	0	0	0	3.5
31	0	0	0	599	0	0	0	3.4
April 1	0	0	0	648	0	0	0	3.4
2	0	2	0	610	0	0	0	3.5
3	0	0	0	874	0	0	0	3.5
4	0	0	0	1,425	1	0	0	3.7
5	0	4	0	1,326	0	0	0	3.9
6	0	0	0	1,851	1	0	0	3.9
7	0	2	0	2,213	0	0	0	3.9
8	0	11	0	2,829	0	0	0	4.1
9	0	1	0	3,463	0	0	0	4.2
10	0	1	0	2,107	1	0	0	4.3
11	0	4	0	5,417	5	0	0	4.3
12	1	11	0	6,364	4	0	0	4.7
13	1	4	0	3,941	3	0	0	4.8
14	2	4	0	5,838	5	0	0	5.2
15	1	33	0	7,395	3	0	0	5.9
16	2	28	0	7,185	3	0	0	6.5
17	1	20	0	8,955	5	0	0	6.7
18	3	29	0	4,959	0	0	0	6.9
19	7	33	0	4,812	3	0	0	6.6

-continued-

Appendix A1.–Page 2 of 3.

	Cutthroat Trout	Dolly Varden	Sockeye smolt	Pink fry	Chum fry	Coho smolt	Juvenile steelhead	Water temp
April 20	1	19	0	3,641	0	0	0	6.1
21	10	51	0	3,145	0	3	0	6.2
22	3	42	0	1,429	3	1	0	6.1
23	2	36	0	239	0	4	0	6.9
24	4	118	1	203	1	3	0	8.6
25	8	138	1	119	0	4	0	10.0
26	2	173	1	98	0	7	0	10.4
27	8	579	0	234	0	11	0	11.6
28	10	403	4	377	10	13	0	12.3
29	3	258	12	112	13	21	0	12.1
30	3	179	4	16	3	19	0	10.9
May 1	0	21	4	13	1	13	0	10.6
2	1	117	6	39	21	20	0	10.8
3	0	57	6	21	6	15	0	10.8
4	2	104	6	14	12	43	0	11.3
5	5	205	20	4	10	122	1	11.4
6	4	325	75	0	10	92	0	12.2
7	1	215	131	1	4	244	0	13.4
8	4	61	206	1	3	209	0	14.0
9	5	72	684	8	10	539	1	14.8
10	5	28	1445	1	5	473	0	15.3
11	4	26	918	4	5	380	1	15.1
12	6	17	887	4	1	309	1	14.7
13	1	10	197	4	2	145	0	14.4
14	1	12	228	6	0	161	0	14.6
15	2	10	483	1	1	162	2	14.1
16	4	18	243	4	1	134	0	14.5
17	1	13	172	3	3	81	1	14.4
18	3	13	174	0	2	139	0	15.3
19	1	1	91	5	1	37	3	14.9
20	1	2	69	2	1	83	2	14.7
21	1	0	70	0	1	53	0	14.6
22	1	1	90	0	1	79	0	14.7
23	0	6	228	0	0	74	0	15.2
24	3	12	438	0	2	67	0	15.2
25	0	1	151	0	0	19	0	15.3
26	0	1	149	0	0	45	0	15.7
27	1	0	30	0	0	21	0	15.8
28	0	0	49	0	1	20	0	15.6
29	0	0	60	0	1	26	0	15.9
30	1	0	81	0	0	26	0	15.8
31	0	0	104	0	0	48	0	15.8
June 1	0	0	89	0	0	24	0	15.9
2	0	0	151	0	0	17	0	15.8
3	0	0	85	0	0	46	0	15.9
4	1	0	91	0	0	15	0	15.8
5	0	0	162	0	3	64	0	16.0
6	0	0	158	0	1	77	0	16.8
7	0	2	95	0	0	46	0	17.3
8	0	0	26	0	0	28	0	17.8

-continued-

Appendix A1.–Page 3 of 3.

	Cutthroat Trout	Dolly Varden	Sockeye smolt	Pink fry	Chum fry	Coho smolt	Juvenile steelhead	Water temp
June 9	0	1	19	0	1	8	0	18.0
10	0	1	10	0	1	1	0	17.7
11	0	0	12	0	0	0	0	17.6
12	0	1	3	0	0	1	0	17.5
13	0	0	10	0	0	1	0	17.4
14	0	0	2	0	0	1	0	16.9
15	1	0	11	0	1	0	0	16.2
16	0	0	1	0	0	0	0	16.3
17	0	0	2	0	0	0	0	17.2
18	0	0	24	0	0	6	0	18.2
19	0	0	4	0	0	1	0	17.7
20	0	0	6	0	0	1	0	17.1
21	1	0	2	0	0	1	0	16.3
22	0	0	7	0	0	4	0	16.5
23	0	0	8	0	0	6	0	16.4
24	0	0	4	0	0	2	0	16.7
25	0	0	4	0	0	0	0	17.6
26	0	0	5	0	0	2	0	18.2
27	0	0	1	0	0	0	0	18.6
28	0	0	2	0	0	0	0	18.2
29	0	0	0	0	0	0	0	17.9
30	0	0	1	0	0	0	0	17.8
Totals	133	3,544	8,513	87,927	191	4,317	12	

Appendix A2.–Daily count of summer/fall immigrants at Auke Creek, 2005.

	Cutthroat trout	Dolly Varden	Sockeye adults	Pink adults	Chum adults	Coho adults	Coho jacks	Juvenile steelhead	Water temp
June 30	0	2	76	0	0	0	0	0	17.8
July 1	0	2	5	0	0	0	0	0	17.3
2	0	0	0	0	0	0	0	0	16.8
3	0	0	0	0	0	0	0	0	16.5
4	0	0	0	0	0	0	0	0	16.6
5	0	1	22	0	0	0	0	0	17.3
6	0	0	2	0	0	0	0	0	17.5
7	0	0	0	0	0	0	0	0	17.4
8	0	2	19	0	0	0	0	0	17.1
9	0	11	328	0	0	0	0	0	17.3
10	0	13	12	0	0	0	0	0	17.1
11	0	4	4	0	0	0	0	0	16.9
12	0	12	0	0	0	0	0	1	16.8
13	0	8	0	0	0	0	0	0	16.7
14	0	5	0	0	0	0	0	0	16.5
15	0	1	0	0	0	0	0	0	16.7
16	0	0	0	0	0	0	0	0	17.0
17	0	8	548	3	0	0	0	0	16.8
18	0	119	665	0	0	0	0	0	16.8
19	0	27	125	0	0	0	0	0	17.0
20	0	27	20	0	0	0	0	0	17.5
21	0	17	35	0	0	0	0	0	17.6
22	0	12	14	0	3	0	0	0	17.5
23	0	20	117	1	9	0	0	0	17.9
24	0	11	72	1	15	0	0	0	17.9
25	0	18	50	2	27	0	0	0	17.6
26	0	14	23	0	46	0	0	0	17.1
27	0	51	157	0	162	0	0	0	16.8
28	0	50	129	63	103	0	0	0	16.7
29	0	35	39	27	25	0	0	0	16.7
30	0	16	30	110	9	0	0	0	16.7
31	1	10	49	315	28	0	0	0	16.3
August 1	0	9	19	235	43	0	0	0	16.5
2	0	7	23	124	44	0	0	0	16.9
3	0	3	17	108	35	0	0	0	16.5
4	0	6	52	180	37	0	0	0	15.7
5	0	23	53	831	57	0	0	0	15.3
6	0	19	31	664	42	0	0	0	15.6
7	0	30	18	339	41	0	0	0	16.0
8	0	12	7	222	35	0	0	0	16.9
9	0	5	7	60	8	0	0	0	18.2
10	0	4	7	32	3	0	0	0	18.5
11	0	25	4	38	5	0	0	0	19.2
12	0	3	8	32	1	0	0	0	19.7
13	0	5	3	22	0	0	0	0	19.9
14	0	9	5	61	0	0	0	0	19.8
15	0	1	1	10	1	0	0	0	19.4
16	0	2	2	26	0	0	0	0	18.6
17	0	2	0	31	4	0	0	0	18.2
18	0	5	5	40	2	0	0	0	17.6

-continued-

Appendix A2.–Page 2 of 3.

	Cutthroat trout	Dolly Varden	Sockeye adults	Pink adults	Chum adults	Coho adults	Coho jacks	Juvenile steelhead	Water temp
19	0	65	29	726	71	0	0	0	17.0
20	0	58	13	623	34	0	0	0	16.5
21	0	44	9	468	29	0	0	0	16.1
22	1	40	6	446	10	0	0	0	15.7
23	0	26	6	423	2	0	0	0	15.4
24	0	13	2	88	1	0	0	0	15.3
25	0	15	5	121	1	0	0	0	14.9
26	0	25	1	526	2	0	0	0	14.7
27	0	16	0	603	1	0	0	0	14.7
28	0	12	0	112	3	0	0	0	15.0
29	0	13	1	122	0	0	0	0	14.9
30	0	13	1	385	1	0	0	0	14.2
31	0	33	1	652	1	0	0	0	13.7
September 1	0	21	0	329	0	0	0	0	13.4
2	0	35	0	165	1	0	0	0	13.4
3	0	14	0	59	0	0	0	0	13.8
4	0	38	0	76	1	0	0	0	13.9
5	0	19	0	73	0	0	0	0	14.0
6	0	24	0	53	1	0	0	0	13.3
7	0	244	1	207	0	0	0	0	13.0
8	0	145	0	79	0	0	45	0	13.1
9	0	71	0	20	0	0	16	0	13.2
10	0	42	0	11	0	0	10	0	13.5
11	0	20	0	15	0	0	20	0	13.4
12	0	23	0	9	0	18	18	0	13.3
13	2	23	0	5	0	3	5	0	13.1
14	4	23	0	7	0	2	3	0	13.1
15	10	32	0	11	0	4	7	0	13.5
16	6	48	0	8	0	1	5	0	13.7
17	7	32	0	6	0	3	6	0	13.0
18	15	119	1	3	0	41	21	0	12.4
19	21	160	0	1	0	114	26	0	11.8
20	7	92	0	0	0	28	6	0	11.4
21	6	42	0	1	0	27	7	0	11.4
22	8	31	0	0	0	15	2	4	11.4
23	1	34	0	0	0	13	3	0	11.4
24	3	12	0	0	0	12	3	1	11.2
25	7	53	0	0	0	17	4	1	11.0
26	2	15	0	0	0	10	3	1	11.0
27	0	10	0	0	0	8	6	0	10.7
28	2	8	0	0	0	26	4	0	10.6
29	1	52	0	0	0	17	2	0	10.2
30	7	73	0	0	0	20	5	1	10.1
October 1	5	35	0	0	0	12	1	0	10.0
2	7	20	0	0	0	12	4	1	9.8
3	4	23	0	0	0	11	1	0	9.5
4	3	17	0	0	0	3	2	0	9.7

-continued-

Appendix A2.–Page 3 of 3.

	Cutthroat trout	Dolly Varden	Sockeye adults	Pink adults	Chum adults	Coho adults	Coho jacks	Juvenile steelhead	Water temp
October 5	0	10	0	0	0	2	1	0	9.5
6	1	9	0	0	0	4	1	0	9.5
7	3	1	0	0	0	3	1	1	9.4
8	0	13	0	0	0	5	0	0	9.4
9	0	0	0	0	0	4	4	0	9.4
10	1	10	0	0	0	3	1	4	9.1
11	0	3	0	0	0	3	0	1	9.0
12	1	8	0	0	0	5	1	0	8.6
13	1	2	0	0	0	0	0	1	8.6
14	1	0	0	0	0	1	2	0	8.6
15	0	0	0	0	0	0	0	0	8.2
16	0	6	0	0	0	1	0	0	8.2
17	0	0	0	0	0	0	0	0	7.8
18	0	3	0	0	0	0	0	0	7.8
19	0	15	0	0	0	1	0	1	7.8
20	0	6	0	0	0	0	0	0	7.8
21	0	4	0	0	0	0	0	0	7.8
22	0	0	0	0	0	0	0	0	7.6
23	0	7	0	0	0	1	0	0	7.4
24	0	6	0	0	0	0	0	0	7.4
25	0	0	0	0	0	0	0	0	7.0
26	0	1	0	0	0	0	0	1	7.0
27	0	2	0	0	0	0	0	1	6.7
28	0	0	0	0	0	0	0	0	6.6
Totals	138	2,795	2,879	10,010	944	450	246	20	

APPENDIX B

Appendix B1.–Harvest sampling statistics and estimated harvest of Auke Creek adult coho salmon in 2005. See key at bottom of table for key to the variables.

Fishery, quadrant	Stat. week, bi-week or (period)	N_i	n_i	a_i	a_i'	t_i	t_i'	m_{ij}	$\hat{r}_{ij}$	$\text{var}(\hat{r}_{ij})$	$SE(\hat{r}_{ij})$
Drift, NE	40	6,777	2252	61	59	56	56	2	6	13	3.6
Hatchery Cost Recovery, NE	41	9,937	246	32	32	28	28	1	40	1591	39.9
Troll, NW	29	155,608	38,291	478	473	334	333	2	8	25	5.0
Troll, NW	31	68,285	19,900	244	236	183	182	3	11	27	5.2
Troll, NW	32	65,637	24,743	299	293	229	229	7	19	32	5.6
Troll, NW	33	64,278	23,107	306	304	226	224	4	11	20	4.5
Troll, NW	34	118,955	32,604	408	400	305	302	5	19	51	7.1
Troll, NW	35	88,495	22,597	294	294	241	241	11	43	126	11.2
Troll, NE	36	23,180	5,099	75	75	62	62	1	5	16	4.0
Troll, NW	36	79,896	23,927	359	354	290	290	6	20	48	6.9
Troll, NW	37	108,629	23,512	359	356	295	295	13	61	221	14.9
Troll, NW	38	109,794	28,570	512	505	403	403	9	35	101	10.0
Troll, NW	39	29,586	10,845	225	224	168	168	5	14	24	4.9
Elfin Cove Sport	15	1,690	325	4	4	3	3	1	5	22	4.7
Juneau Sport	16	4,841	4,841	39	39	22	22	3	3	0	0.0
Juneau Sport	17	3,679	1,341	19	18	17	17	3	9	15	3.9
Gustavus Sport	17	1,044	606	10	10	10	10	1	2	1	1.1
Juneau Sport	18	4,165	1,176	23	22	19	19	3	11	29	5.4
Elfin Cove Sport	18	2,065	413	11	11	8	8	1	5	20	4.5
Totals		946,541	264,395	3,758	3,709	2,899	2,892	81	327	2,381	48.8

N_i = harvest in fishery strata i; n_i = number inspected for CWTs; a_i = number missing an adipose fin; a_i' = number of heads that arrive at the lab; t_i = number of heads with CWTs detected; t_i' = number of CWTs that are dissected from heads and decoded; m_{ij} = number of CWTs with code(s) j of interest; θ_j = fraction of the cohort tagged with code(s) j of interest; r_{ij} = estimated contribution in straum i by code j.

APPENDIX C

Appendix C1.–Computer data files containing Auke Creek data for Auke Creek in 2005. All files are organized on the Region 1-Douglas Sport fish Server under G:\Trout-SF\AUKEDATA\05_FDS.

File Name	Description
AC_Historical_05.xls	Historical information for counts of all species at Auke Creek.
Auke_water_temp_05.xls	Water temperature information collected both by hand and by HOBO at Auke Creek in 2005.
Carrie2005AukeCohoAdAge.xls	Excel file which SAS program reads from and writes to for coho salmon adults sampled in 2005.
Carrie2005AukeCohoJkAge.xls	Excel file which SAS program reads from and writes to for coho salmon jacks sampled in 2005.
Carrie2005AukeCohoSmAge.xls	Excel file which SAS program reads from and writes to for coho salmon smolts sampled in 2005.
Coho_CWT_Info.xls	List of coded-wire tags and related information used historically at Auke Creek.
CT_and_SH_05.xls	Length, sex, and PIT tag codes for cutthroat trout seen in 2005. Lengths of juvenile steelhead seen in 2005.
DV_Length_Date_05.xls	Length information for Dolly Varden sampled during spring emigration in 2005.
Harvest_estimates_05_Auke.xls	Tag lab harvest expansion report and marine harvest calculations for fish caught in 2005 commercial and recreational fisheries.
Length_Composition_05.xls	Length composition and calculations for Dolly Varden emigrants in 2005.
Scale_sampling_05.xls	Age, weight and length of coho salmon smolts, adults, and jacks sampled in 2005.
Scale_temp_05.xls	Graphs and additional work done with Scale_sampling_05.xls.
Strat Age Len Wt Sex.sas	SAS program used to analyze data from coho salmon adults, jacks, and smolts sampled in 2005.
Weir_Counts_05	Emigrant and immigrant counts of all species seen at Auke Creek in 2005.