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Coho Salmon Smolt Production, Adult Harvest, and Escapement from Jordan and Duck Creeks, Southeast Alaska, 2003–2005

by

Ryan J. Briscoe,

Judith L. Lum,

and

David C. Love

April 2008

Alaska Department of Fish and Game **Divisions of Sport Fish and Commercial Fisheries**

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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

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by
Ryan J. Briscoe
Division of Commercial Fish, Juneau

and

Judith L. Lum
Division of Sport Fish, Douglas,

and

David C. Love
Division of Sport Fish, Douglas

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

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Ryan J. Briscoe[a]
Alaska Department of Fish and Game, Division of Commercial Fisheries
1255 West 8th St., Juneau, AK 99811, P.O. Box 115526, Juneau, AK 99811, USA

Judith L. Lum,
Alaska Department of Fish and Game, Division of Sport Fish
802 3rd St., Douglas, AK 99824, P.O. Box 110024, Juneau, AK 99811, USA

and
David C. Love
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] Author to whom all correspondence should be addressed: ryan.briscoe@alaska.gov

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ABSTRACT

We enumerated smolt production of coho salmon *Oncorhynchus kisutch* in Jordan and Duck Creek near Juneau, Alaska in 2003 and 2004 and estimated marine survival, exploitation rates, and harvest for these smolt groups. A total of 9,111 and 11,900 coho salmon smolts were tagged at Jordan Creek in 2003 and 2004, respectively. Fourteen smolts were tagged at Duck Creek in 2003 and 1,342 were tagged at Duck Creek in 2004. Low or no stream flows in Duck Creek precluded normal smolt emigration in both years.

Escapement counts of 227 and 562 adult coho salmon were obtained at Jordan Creek in 2004 and 2005, respectively. An estimated 76 (SE = 17) coho that originated from Macaulay Salmon Hatchery escaped into Jordan Creek in 2004, while an estimated 20 (SE = 11) Macaulay Hatchery coho contributed to the escapement in 2005. Estimated contribution of Jordan Creek coho salmon to the marine fisheries was 103 (SE = 21) in 2004 and 238 (SE = 29) in 2005. Estimated marine survival of Jordan Creek coho salmon was 2.8% (SE = 0.3%) in 2004 and 6.6% (SE = 0.3%) in 2005, lower than that of other nearby coho salmon stocks. Fifteen adult coho salmon were counted at Duck Creek in 2005. One Duck Creek coho salmon was sampled from marine fisheries in 2004 and 21 were sampled in 2005. The total number of coho salmon harvested in marine fisheries, marine survival, and exploitation rates could not be estimated for Duck Creek because of the unknown proportion of smolts tagged.

Key words: coded wire tag, production, abundance, harvest, contribution, marine survival, exploitation rate, troll fishery, gillnet fishery, seine fishery, recreational fishery, age composition, size composition, sex composition, length-at-age, smolt, PIT tag, coho salmon, *Oncorhynchus kisutch*, escapement, Jordan Creek, Duck Creek, Southeast Alaska, inclined-screen trap, picket weir, fyke net, Dolly Varden, *Salvelinus malma*, cutthroat trout, *Oncorhynchus clarki*, steelhead trout, pink salmon, chum salmon, sockeye salmon.

INTRODUCTION

Coho salmon *Oncorhynchus kisutch* are the target of many recreational marine anglers in the Juneau area. An estimated 26,273 coho salmon were harvested in the 2002 Juneau marine boat sport fishery (Hubartt and Jaenicke 2004). The Taku River, Berners River, and Macaulay Salmon Hatchery (operated by Douglas Island Pink and Chum, Inc., DIPAC) produce many of the coho salmon caught in this fishery. Many small systems contribute to this fishery as well (Jones III and McPherson 1997). Monitoring the escapement into these small systems, located along the Juneau roadside, is a management tool used by Alaska Department of Fish and Game (ADF&G). Jordan and Duck Creek are two small systems that contribute to the Juneau marine sport fishery and to northern Southeast Alaska commercial fisheries.

Prior to 2001, the only counts of coho salmon escapement into Jordan Creek were indices of partial escapement obtained through foot surveys (Table 1). These indices have been used annually since 1981, along with the indices of partial coho salmon escapement into four other creeks, to assess whether coho salmon escapement goals are achieved in the Juneau area (Jones III and McPherson 1997; Shaul et al. 2004, [in] Geiger and McPherson 2004). Minimum escapement goals for Jordan Creek coho salmon were not met for five consecutive years (1996–2000), leading to concerns about potentially declining smolt production (Shaul et al. 2004, [in] Geiger and McPherson 2004). Because of these concerns, ADF&G operated a smolt weir in 2001 to determine coho salmon smolt production during the spring emigration. A surprisingly large number of coho salmon smolts (25,990) were counted, indicating the importance of Jordan Creek as a rearing and overwintering site for juvenile coho salmon (B. Glynn, Juneau Area Management Biologist, ADF&G Sport Fish Division, Douglas, personal communication).

In 2001, the Federal Aviation Administration (FAA) funded the operation of adult coho salmon weirs on Jordan and Duck Creek as part of their environmental impact analysis for a planned airport expansion (SWCA and RTG 2001; Table 1). ADF&G also assessed the total smolt production of Jordan Creek in 2002 (8,171) and total adult return in 2003 (389, Lum and Glynn 2007).

Table 1.–Survey counts of adult coho salmon for Jordan and Duck Creeks from 1966, 1969, 1973, 1976–1978, and 1981–2005.

Survey year	Jordan Creek	Survey type[a]	Duck Creek	Survey type[a]
1966	na	na	500	F
1969	na	na	1	F
1973	na	na	120	F
1976	na	na	na	na
1977	na	na	na	na
1978	na	na	2	F
1981	482	F	na	na
1982	368	F	na	na
1983	184	F	13	F
1984	251	F	na	na
1985	72	F	na	na
1986	163	F	18	F
1987	250	F	17	F
1988	215	F	na	na
1989	133	F	3	F
1990	216	F	13	F
1991	322	F	na	na
1992	785	F	80	F
1993	322	F	21	F
1994	371	F	na	na
1995	77	F	na	na
1996	54	F	na	na
1997	24	F	na	na
1998	63	F	na	na
1999	47	F	na	na
2000	30	F	na	na
2001	119/525[b]	F/W	23[b]	W
2002	1,396	F	na	na
2003	78/389	F/W	na	na
2004	38/227	F/W	na	na
2005	94/562	F/W	na	na

[a] F = foot survey, W = weir survey, na = survey counts unavailable

[b] Weir numbers collected for the Federal Aviation Administration (SWCA and RTG 2001).

Prior to 2001, counts of adult coho salmon at Duck Creek were from foot surveys. Foot surveys of adult coho salmon at Duck Creek in 1966 and 1973 documented 500 and 120 adult coho salmon, respectively (Table 1). The status of Duck Creek coho salmon became a concern to resource agencies in the late 1970s and early 1980s when very few coho salmon were observed spawning in Duck Creek. By 1978, the count was down to two adult coho salmon at Duck Creek (Table 1). Five coho salmon smolt emigrations averaging 3,000 smolts were documented in the early 1990s at Duck Creek (K Koski, Coastal and Marine Ecologist, Alaska Chapter of the Nature Conservancy (TNC), Juneau, personal communication), indicating that juvenile coho salmon used the creek for rearing. Collaborative efforts to restore fish habitat within Duck Creek was spearheaded by the National Marine Fisheries Service (NMFS) in 1993.

This report includes results of two projects from a multiyear study that began at Jordan and Duck Creek in 2003 as a collaborative effort between NMFS and ADF&G. The first project was designed to investigate coho salmon smolt production in each creek. Smolt production and associated biological data were originally proposed as an indicator of the effectiveness of habitat restoration in Duck Creek and as an indicator of the current condition of fish habitat within Jordan Creek. This project was funded through the Southeast Sustainable Salmon Fund (SSSF). ADF&G obtained additional SSSF funding to collect immigrant fisheries data on both creeks starting in 2004. Jordan Creek foot survey counts were also compared to weir counts to determine the percentage of the escapement not accounted for in foot surveys. This report summarizes results from field work done in spring 2003 and 2004, and fall 2004 and 2005. Project objectives were to:

1. Count all coho salmon smolt leaving Duck and Jordan Creeks in 2003 and 2004.
2. Estimate the marine harvest of coho salmon from Duck and Jordan Creeks in 2004 and 2005.
3. Estimate the age composition of coho salmon smolt emigrating from Duck and Jordan Creeks in 2003 and 2004.
4. Estimate the mean length-at-age of coho salmon smolt emigrating from Duck and Jordan Creeks in 2003 and 2004.
5. Estimate the mean weight-at-age of coho salmon smolt emigrating from Duck and Jordan Creeks in 2003 and 2004.
6. Count escapements of coho salmon into Jordan Creek in 2004 and 2005 and estimate age and sex composition.

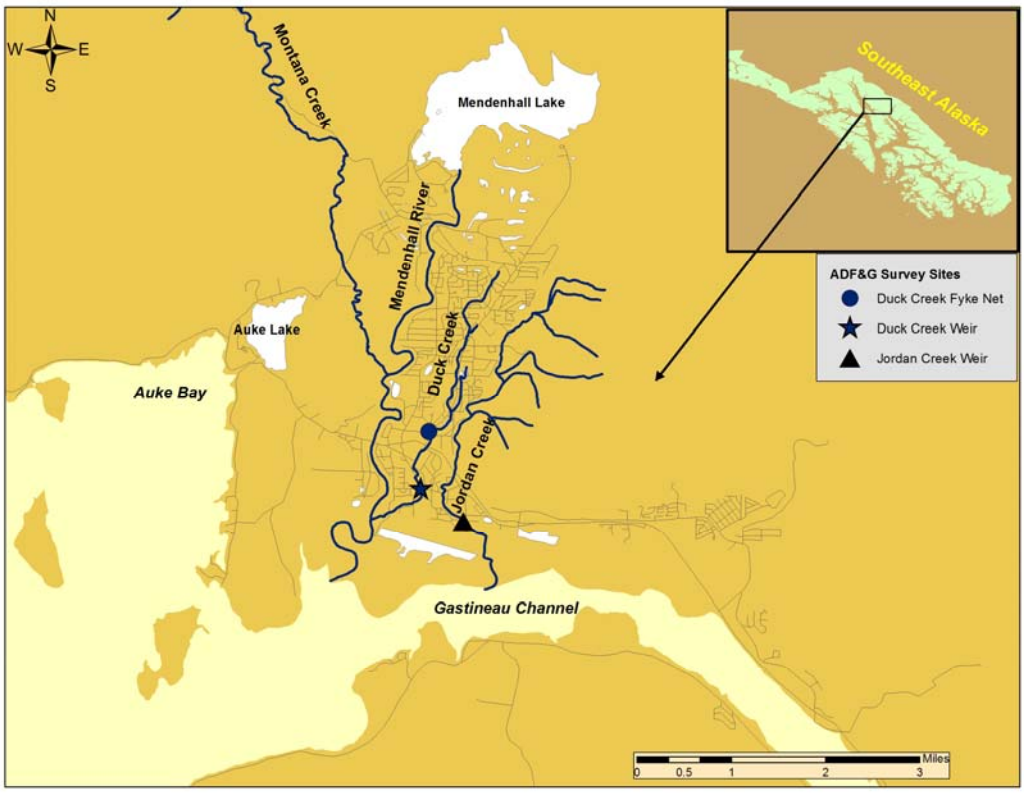

Figure 1.–Map of Mendenhall Valley showing the location of ADF&G weir and fyke net sites on Jordan and Duck Creeks.

STUDY SITE

Jordan and Duck Creeks (ADF&G Catalog Nos. 111-50-10620 and 111-50-10500-2002, respectively) are located approximately 11 km northwest of Juneau, Alaska, on the Juneau road system (Figure 1). Jordan Creek is about 4.8 km long and originates from a ground water source on the east side of the Mendenhall Valley. The upper section of Jordan Creek flows through a forest of spruce and hemlock, while the lower section flows through an industrialized area before draining into Gastineau Channel.

Duck Creek also originates from a ground water source and flows for about 4.8 km through residential and industrial areas in the center of the Mendenhall Valley before emptying into the Mendenhall River. Jordan and Duck Creeks have historically produced coho salmon, pink salmon *O. gorbuscha*, chum salmon *O. keta*, sockeye salmon *O. nerka*, cutthroat trout *O. clarki* and Dolly Varden char *Salvelinus malma*.

METHODS

SMOLT COUNTS AND CODED WIRE TAGGING

All emigrant fish at Jordan Creek were diverted into an incline-plane trap (Figures 2 and 3) and then into a holding box downstream. The trap was located about 50 m downstream from Yandukin Drive and was operated from April 8 through June 24, 2003, and from March 25 through June 17, 2004. A fyke net connected to a holding box (Figure 4) was placed at the upstream entrance of the culvert under the Mendenhall Mall Road to capture emigrant fish in Duck Creek. The fyke net was operated from April 15 through June 24, 2003 and from April 7 through June 13, 2004.

Each coho salmon smolt captured at Jordan and Duck creeks was counted, anesthetized in a water-based solution of MS-222 and sodium bicarbonate, adipose fin-clipped, and tagged with a coded wire tag (CWT) that had a unique code

Figure 2.–Upstream view of incline-plane trap used to capture emigrant fish in Jordan Creek.

Figure 3.–Downstream view of incline-plane trap used to capture emigrant fish in Jordan Creek.

Figure 4.–Downstream view of fyke net used to capture emigrant fish in Duck Creek.

for year and stream location. A coho salmon smolt was defined as being ≥50 mm FL in 2003 and ≥ 70 mm FL in 2004. The conservative size of 50 mm was chosen in 2003 until further evidence suggested that most coho salmon in the Jordan Creek system smolt at a larger size. Tagged smolts were passed through a quality control device (QCD) to ensure that all fish were tagged. All tagged smolt were placed in a holding box for 24 hrs to evaluate mortality and tag retention. After 24 hrs, a random sample of at least 50 smolts from the holding box was passed through the QCD to assess tag retention. If less than 98% of the sampled smolts possessed a CWT, then all smolts were passed through a QCD and smolt missing tags were retagged. Smolts were released downstream after confirming tag retention.

AGE COMPOSITION, AND MEAN LENGTH- AND WEIGHT-AT-AGE OF COHO SMOLT

A sample of tagged smolts from each creek was anesthetized, scale sampled, weighed to the nearest 0.1 g, and measured to the nearest mm FL. Scales were collected from the preferred area (Scarnecchia 1979) above the lateral line and posterior to the dorsal fin on the left side of the fish, pressed between two microscope slides, and aged using a microfiche reader with a 70x magnification lens. Approximately 9% of the total tagged smolts were randomly sampled throughout the 2003 Jordan Creek emigration. In 2004 at Jordan Creek, every 10th coho smolt was sampled through May 17 and every 20 th smolt was sampled beginning May 18. Every smolt, except one, was sampled during the 2003 emigration at Duck Creek. The first 300 smolt and every 10th smolt thereafter were sampled during the 2004 emigration at Duck Creek. Water levels fluctuated greatly during 2003 and 2004 at Duck Creek, creating a possibility that a portion of the smolt population was not captured using the fyke net. Therefore, inferences drawn from Duck Creek sample data were relevant only to the tagged population of smolts.

Two sample t-tests were used to determine if the length and weight data needed to be stratified because of the sampling rate changes. Chi-square tests were used to determine if the age data needed to be stratified. No stratification tests were used

with the 2003 Jordan Creek data because of the non-systematic collection of samples.

Proportions of emigrant coho salmon smolts in a specific age class (*a*) by creek and sample year were estimated using:

$$\hat{p}_a = \frac{n_a}{n} \quad (1)$$

$$\hat{\text{var}}(\hat{p}_a) = \frac{\hat{p}_a(1-\hat{p}_a)}{n-1} \quad (2)$$

where

$\hat{p}_a$ = estimated proportion of smolts in age class *a*,

n = number of smolts successfully aged,

n_a = subset of n belonging to class *a*.

Estimates of mean length- and weight-at-age along with their associated variances (Cochran 1977) were calculated with standard sample summary statistics. Length and weight distributions were visually analyzed for apparent trends.

ESCAPEMENT

An aluminum bipod and picket weir, including a 2.4 m^2 trap (Figure 5), was installed in Jordan Creek near the smolt trap site upstream of tidal influence to obtain an escapement count of adult coho salmon. A gap of 31 mm between pickets allowed coho salmon jacks, or ocean age-0 fish, and fish less than 400 mm TL to pass through the weir. Therefore the population inference for this study was the adult population, or ocean age-1 fish. The bottom and sides of the weir were sealed with sandbags and the weir was monitored daily. The weir was operated from September 1 through November 15, 2004 and from August 26 through November 1, 2005.

An adult weir was not operated in 2004 at Duck Creek; however, foot surveys were conducted weekly as soon as water flow was sufficient for fish passage. In 2005, a picket weir was operated from August 31 through November 1 at Duck Creek to obtain an estimate of escapement. The weir was located in the cement structure adjacent to the electrical substation inside the airport security fence off of Cessna Drive (Figure 1).

Figure 5.–Downstream view of bipod and picket weir used to capture immigrant fish in Jordan Creek.

All immigrant coho salmon captured at the weirs were counted, classified as adults or jacks inspected for missing adipose fins, and if not sampled for age, sex, and length (ASL), immediately released into the stream above the weirs. All fish were examined for other tags or marks. All other salmon species captured at the weir were counted and released.

Foot surveys were also conducted by management staff to obtain index counts of coho salmon escapement in Jordan Creek in 2004 and 2005. These foot survey counts were compared to weir counts to determine the efficiency of foot surveys for Jordan Creek.

AGE AND SEX COMPOSITION, AND MEAN LENGTH-AT-AGE OF COHO ADULTS

Initially, every other adult coho salmon returning to Jordan Creek was sampled for scales in 2004. The sampling rate was changed to every adult coho salmon beginning October 14, 2004 when it was obvious that the escapement numbers were low. In 2005, every other adult coho salmon was sampled for scales at Jordan Creek until a sufficient sample size was reached. The sampling rate at Jordan Creek was changed to every third coho salmon beginning September 29, 2005 to provide staff with adequate time to sample. Every coho salmon captured at Duck Creek in 2005 was sampled for scales. All scales were collected from the preferred area and placed on a gum card. Scales were then pressed onto acetate cards and analyzed for age using a microfiche reader with a lens of 70x magnification. The sex of each coho

salmon captured at both creeks was estimated by visually examining morphological differences described by Sandercock (Groot and Margolis 1991). Chi-square tests were used to determine if the age data needed to be stratified by date.

The proportions of adult coho salmon in a specific age or sex class (*a*) from each creek and sample year were estimated as in equation 1. The variance of the age proportions was estimated using equation 2.

Each adult coho salmon was measured to the nearest mm MEF at Jordan Creek in 2004 and at both creeks in 2005. The mean length-at-age for Jordan Creek adult coho salmon was calculated separately for each year for the following groups: all adults, age-1.1, age-2.1, females, and males. Length distributions for each age and each sex were visually analyzed for apparent trends.

INSTREAM ADULT CARCASS SAMPLING

Foot surveys were conducted at least once a week during the immigration to collect heads from coho salmon carcasses in and around Jordan Creek. Otoliths were removed from the heads of all coho salmon carcasses and analyzed for thermal marks to estimate the number of coho salmon that originated as smolts from Macaulay Hatchery but strayed into Jordan Creek as adults. Otoliths were sent to DIPAC for analysis in 2004 and to the ADF&G Mark, Tag and Age Laboratory (Tag Lab) in 2005. Heads from adipose-finclipped carcasses were labeled with a cinch tag and sent to the Tag Lab for CWT extraction and analysis. Adult coho salmon carcasses were separated into two categories (*i*): adipose-finclipped and unclipped. These categories were further organized into two subcategories (*j*): coho salmon originating from Jordan Creek and coho salmon originating from Macaulay Hatchery. Coho salmon with an unknown origin were assumed to be from Jordan Creek. Proportions of carcasses within these subcategories were estimated (by sample year) using:

$$\hat{p}_j = \frac{n_j}{n_i} \tag{3}$$

$$\hat{\mathrm{var}}\left(\hat{p}_j\right) = \frac{\hat{p}_j\left(1-\hat{p}_j\right)}{n_i - 1} \tag{4}$$

where

$\hat{p}_j$ = estimated proportion of adipose-finclipped or unclipped adult coho salmon carcasses in subcategory *j*,

n_i = number of sampled adult coho salmon carcasses in category *i*,

n_j = subset of n_i in subcategory *j*.

The estimated proportions of carcasses in each subcategory were multiplied by the escapement of all returning adult coho salmon in each category to estimate the escapement of adult coho salmon in each subcategory. The equation for this estimate was:

$$\hat{N}_{ej} = \hat{p}_j N_{ei} \tag{5}$$

$$\hat{\mathrm{var}}\left(\hat{N}_{ej}\right) = N_{ei}^2 \hat{\mathrm{var}}\left(\hat{p}_j\right) \tag{6}$$

where

$\hat{N}_{ej}$ = estimated escapement of adult coho salmon in subcategory *j*,

N_{ei} = escapement count of adult coho salmon in category *i*.

HARVEST

The harvest of Jordan Creek coho salmon in 2004 and 2005 was estimated using samples collected in the creek and from Southeast Alaska commercial and recreational fisheries according to the methods in Bernard and Clark (1996). Commercial catch data were summarized and stratified differently for various fisheries. Statistics for the troll fishery were stratified by troll fishing period and by fishery quadrant, the seine and gillnet fisheries by statistical week and fishing district, and the recreational fisheries by port/fishery and fortnight (or biweek). In most cases, CWTs of interest were recovered in only a few of the sport fish sampling strata (e.g., low/high use harbors, morning/evening periods, derby strata, charter/lodge contributions), which defined the fishery biweek. Assuming the harvests of fish with CWTs of interest were independent of sampling strata within fishery biweeks, harvests

and sampling information were totaled over the fishery biweek to estimate contributions. This procedure allowed comparisons between published biweekly harvests (*H*) and the CWT data, and minimized biases that could have resulted if estimates were derived from data obtained in minor strata where sampling rates were unusual. Estimated marine harvest and total abundance of Duck Creek coho salmon could not be determined because of the inability to determine the tagging rate and escapement.

RUN SIZE, EXPLOITATION RATE, AND MARINE SURVIVAL

Estimated total run size $\hat{N}_R$ for each year (harvest plus escapement of coho salmon returning to Jordan Creek above the weir) was the sum of the estimated harvest $\hat{T}$ and escapement $\hat{N}_e$ (of Jordan Creek origin):

$$\hat{N}_R = \hat{T} + \hat{N}_e \tag{7}$$

$$var\left[\hat{N}_R\right] = var\left[\hat{T}\right] + var\left[\hat{N}_e\right] \tag{8}$$

Estimates of harvest $\hat{r}_i$ were calculated for each stratum, then summed across strata and across fisheries to obtain the estimate of the total harvest $\hat{T}$:

$$\hat{T} = \sum_i \hat{r}_i \tag{9}$$

$$var\left[\hat{T}\right] = \sum_i var\left[\hat{r}_i\right] \tag{10}$$

An estimate of escapement $\hat{N}_e$ was calculated using the carcass samples (see equations 5 and 6) to determine and estimate the presence of hatchery fish, such that:

$$\hat{N}_e = \hat{N}_m + \hat{N}_u \tag{11}$$

where $\hat{N}_m$ is the estimated number of adipose-finclipped fish that could be attributed to Jordan Creek, and $\hat{N}_u$ is the number of unmarked, unclipped fish that were attributed to Jordan Creek. Variance of $\hat{N}_e$ was estimated by:

$$var\left[\hat{N}_e\right] = var\left[\hat{N}_m\right] + var\left[\hat{N}_u\right] \tag{12}$$

where $var\left[\hat{N}_m\right]$ and $var\left[\hat{N}_u\right]$ are the binomial sampling variances calculated in equation 6. Because the samples were non-random, it is assumed that the variance is a minimum variance. Likewise, there is no way to describe the possible bias from sampling carcasses.

The estimated fishery exploitation rate $\hat{E}$ was calculated:

$$\hat{E} = \frac{\hat{T}}{\hat{N}_R} \tag{13}$$

The delta method (Seber 1982) was used to approximate the variance of $\hat{E}$:

$$\text{var}[\hat{E}] \approx \frac{N_e^2}{\hat{N}_R^4} \text{var}[\hat{T}] \tag{14}$$

Smolt-to-adult survival was estimated by:

$$\hat{S} = \frac{\hat{N}_R}{N_S} \tag{15}$$

where N_S is the total smolt production: The variance of $\hat{S}$ is:

$$\text{var}\left[\hat{S}\right] = \frac{\text{var}\left[\hat{N}_R\right]}{N_S^2} \tag{16}$$

OTHER SPECIES

All migrant Dolly Varden and cutthroat trout captured in Jordan Creek were examined for external marks. Approximately every fourth Dolly Varden captured at Jordan Creek and almost all Dolly Varden captured at Duck Creek in spring 2003 were measured to the nearest 5 mm FL. Each Dolly Varden captured at Jordan Creek (except one) and almost all captured at Duck

Creek in spring 2004 were measured to the nearest 5 mm FL. All cutthroat trout captured were measured to the nearest 1 mm FL. Untagged emigrant cutthroat trout were injected with a passive integrated transponder (PIT) tag, adipose finclipped, and released. Previously PIT-tagged trout were measured and their unique PIT tag number recorded. All cutthroat trout mortalities were sampled for otoliths, length, scales, and sex; PIT tags, if present, were recovered. Pink salmon and chum salmon fry, sculpin, flounder, and three-spine stickleback were counted and released downstream. Adult immigrating steelhead were counted and measured to the nearest mm before being released upstream. Steelhead kelts were tagged with PIT tags as they emigrated from Jordan Creek. Adult pink, chum, Chinook, and sockeye salmon were counted at all weirs in the fall and released upstream.

PHYSICAL DATA

Water temperature (°C) was recorded almost every day at the Jordan Creek trap and weir site during the spring and fall operations. Water temperature was also recorded daily at the Duck Creek adult weir site from August 31 through November 1, 2005. Missing values of temperature were calculated by averaging the two values bracketing the missing value. Daily precipitation (mm) was collected in a rain gauge located at the Jordan Creek weir site from September 10 through November 15, 2004 and from August 26 through November 1, 2005. Additional values of total daily precipitation (mm) for spring 2004 and average water depth (ft) and average discharge (ft^3/s) for spring 2003 and 2004 and fall 2004 and 2005 were recorded at a United States Geological Survey (USGS) gauging station located in Jordan Creek on the downstream end of the Egan Drive culvert (USGS 2005).

RESULTS

SMOLT TAGGING, AGE, LENGTH, WEIGHT, AND ABUNDANCE

Jordan Creek 2003: The first smolt tagged was released April 17, the last smolt was released on June 27, and the midpoint of the emigration occurred on May 27 (Figure 6). A total of 9,111 emigrating coho salmon smolts were tagged and released (Appendix A1). An estimated 94.0% (SE = 0.8%) of the 889 smolts sampled with legible scales were age-1 and 6.0% (SE = 0.8%) were age-2 (Table 2). Five sampled smolts could not be aged because of illegible scales. The mean length and weight for all smolts sampled was 82 mm (SE = 0.5 mm) and 6.0 g (SE = 0.1 g, Table 2). Age-1 smolts averaged 80 mm (SE = 0.5 mm), and 5.6 g (SE = 0.1 mm), and age-2 smolts averaged 108 mm (SE = 1.1 mm) and 12.8 g (SE = 0.4 g, Table 2). Length and weight distributions at age for smolts sampled at Jordan Creek in 2003 are shown in Figures 7 and 8.

Jordan Creek 2004: The first smolt captured was tagged and released on March 30, the last smolt was released on June 16, and the midpoint of emigration occurred on May 17 (Figure 6). There were 11,900 smolts tagged and released in 2004 (Appendix A1). An estimated 97.6% (SE = 0.5%) of the 905 smolts sampled with legible scales were age-1 and 2.4% (SE = 0.5%) were age-2 (Table 2). Forty sampled smolts could not be aged because of illegible scales. A Chi-square test (p = 0.84) indicated that the proportions of age-1 coho salmon smolts were the same in samples prior to May 18 and after May 17. The mean length and weight of all smolts sampled was 85 mm (SE = 0.3 mm) and 6.3 g (SE = 0.1 g, Table 2). Age-1 smolts averaged 84 mm (SE = 0.3 mm) and 6.2 g (SE = 0.1 g), and age-2 smolts averaged 109 mm (SE = 3.0 mm) and 12.2 g (SE = 0.9 g, Table 2). A t-test indicated that the mean lengths (p= 0.01) and weights (p = 0.01) were statistically different in smolts sampled prior to May 18 and after May 17. However, the data were not stratified because the differences in mean length (84.1 mm vs. 85.9 mm) and mean weight (6.2 g vs. 6.6 g) were presumed to be biologically insignificant. Length and weight distributions at age for smolts sampled at Jordan Creek in 2004 are shown in Figures 9 and 10.

Duck Creek 2003: Only 14 coho salmon smolts were tagged and released from May 17 through June 21, 2003 (Figure 11). Releases were made into the Mendenhall River because of no flow in Duck Creek. Thirteen smolts were sampled for AWL. All smolts sampled were age-2 and averaged 134.5 mm in length and 22 g in weight (Table 3).

Table 2.–Age composition, mean length, and mean weight of coho salmon smolts sampled at Jordan Creek in 2003 and 2004.

	Age Class	Age Composition (%)	SE (%)	Length (mm FL)	SE (mm)	Weight (g)	SE (g)
2003	Age-1	94.0	0.8	80	0.5	5.6	0.1
	Age-2	6.0	0.8	108	1.1	12.8	0.4
	All ages	-	-	82	0.5	6.0	0.1
2004	Age-1	97.6	0.5	84	0.3	6.2	0.1
	Age-2	2.4	0.5	109	3.0	12.2	0.9
	All ages	-	-	85	0.3	6.3	0.1

Table 3.–Age composition, mean length, and mean weight of coho salmon smolts sampled at Duck Creek in 2003 and 2004.

Smolt year	Age class	Age composition (%)	SE (%)	Length (mm FL)	SE (mm)	Weight (g)	SE (g)
2003	Age-2	100.0	-	135	4.6	22.0	2.0
2004	Age-1	57.1	2.6	102	0.9	10.5	0.3
	Age-2	42.9	2.6	131	1.0	20.6	0.4
	All ages	-	-	115	1.0	15.0	0.3

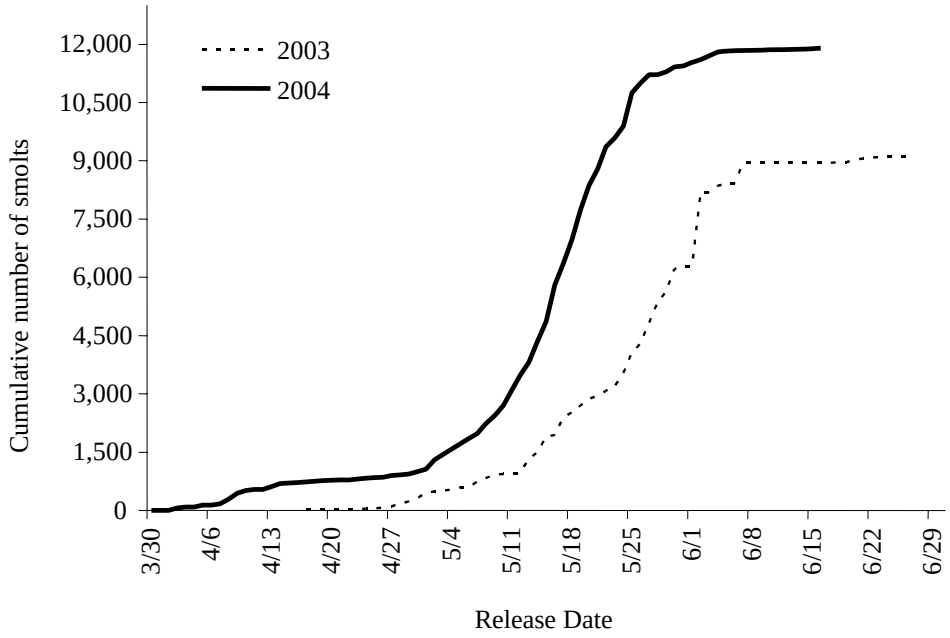

Figure 6.–Cumulative number of tagged coho salmon smolts released in 2003 and 2004 at Jordan Creek.

Duck Creek 2004: Low or no water limited the capture of fish out of Duck Creek. It was unlikely that the entire smolt emigration was tagged and impossible to determine the abundance of the actual smolt run from these partial counts. Again inferences can not be attributed to the entire population.

There were 1,342 coho salmon smolts tagged and released from April 9 through June 10, 2004 (Figure 11). Two coho salmon fry and 2 juvenile coho salmon were also captured and released. One recaptured smolt was tagged with a Jordan Creek tag in 2003, one was tagged with a Duck Creek tag in 2004, one was tagged with a Macaulay

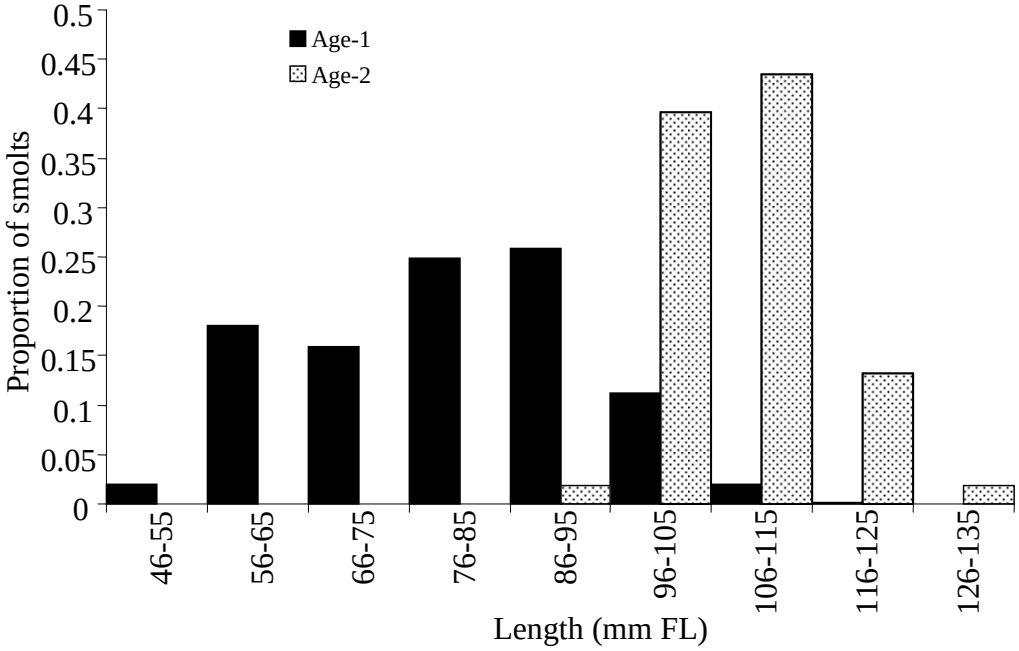

Figure 7.–Length distribution of age-1 and age-2 smolts sampled at Jordan Creek in 2003.

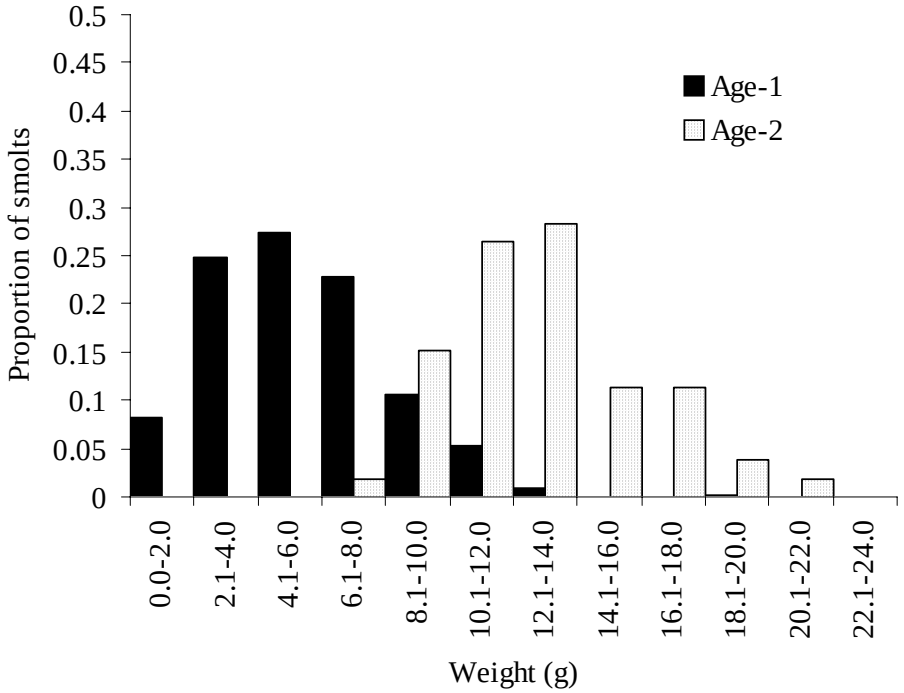

Figure 8.–Weight distribution of age-1 and age-2 smolts sampled at Jordan Creek in 2003.

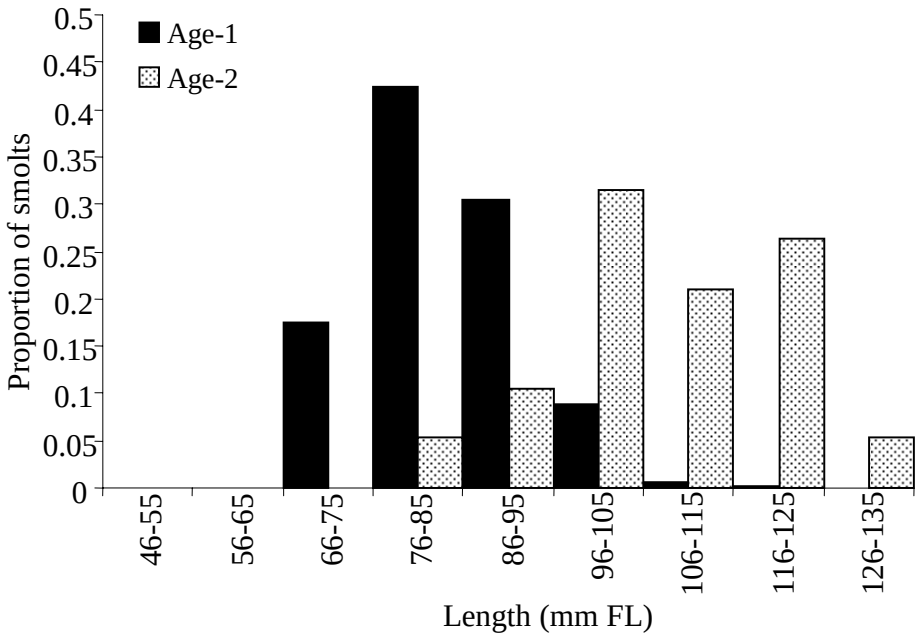

Figure 9.–Length distribution of age-1 and age-2 smolts sampled at Jordan Creek in 2004.

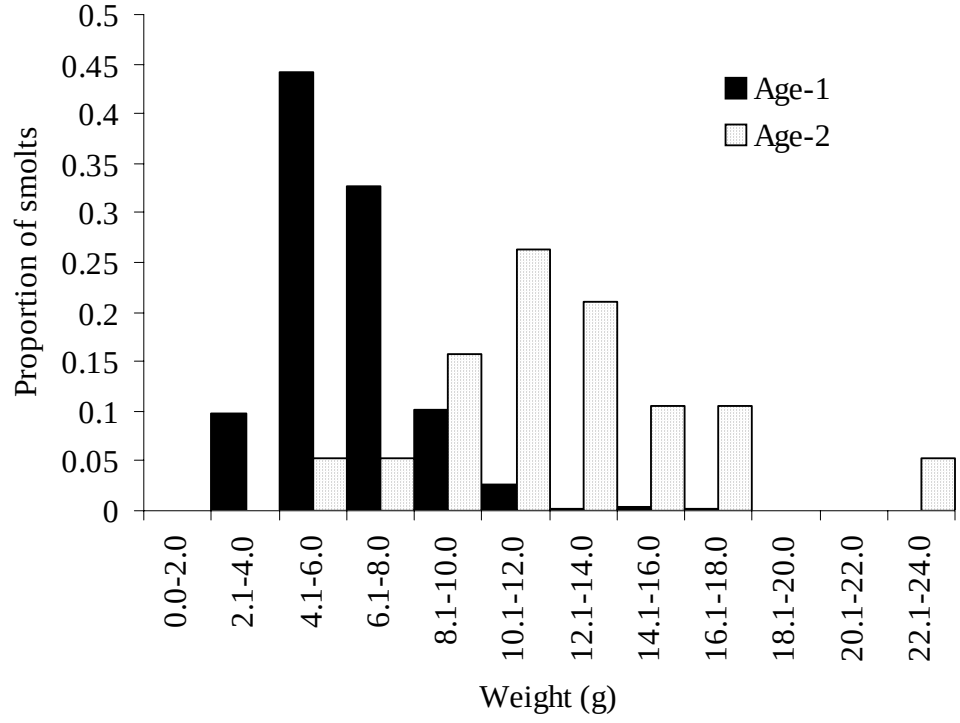

Figure 10.–Weight distribution of age-1 and age-2 smolts sampled at Jordan Creek in 2004.

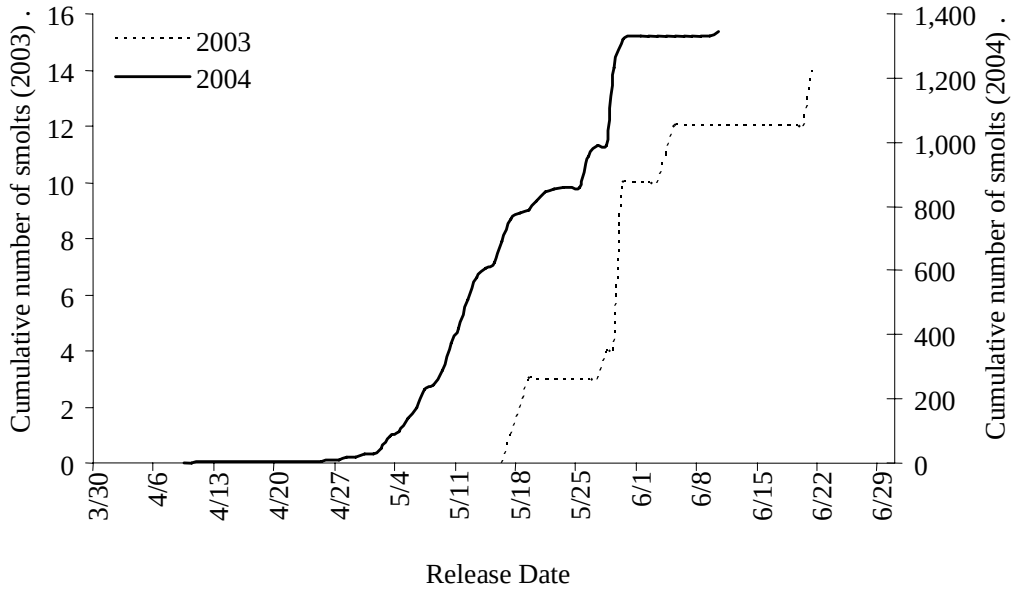

Figure 11.–Cumulative number of tagged coho salmon smolts released in 2003 and 2004 at Duck Creek.

Hatchery tag in 2003, and one did not have a tag. An estimated 57.1% (SE = 2.6%) of the 373 smolts sampled with legible scales were age-1 and 42.9% (SE = 2.6%, Table 3) were age-2. Thirty-three smolts had illegible scales and could not be aged. A Chi-square test (p = 0.45) indicated that the proportion of age-1 coho salmon smolts was the same in the first 300 smolts as it was in samples collected after the sampling rate change. The mean length and weight for all smolts sampled was 115 mm (SE = 1.0 mm) and 15.0 g (SE = 0.3 g, Table 3). Age-1 smolts averaged 102 mm (SE = 0.9 mm) and 10.5 g (SE = 0.3 g), and age-2 smolts averaged 131 mm (SE = 1.0 mm) and 20.6 g (SE = 0.4 g, Table 3). A t-test indicated that the mean lengths (p= 0.73) and weights (p = 0.61) were essentially the same in smolts sampled prior to and after the rate change. Length and weight distributions at age for smolts sampled at Duck Creek in 2004 are shown in Figures 12 and 13.

ESCAPEMENT AND CARCASS SAMPLING

Jordan Creek 2004: The adult coho salmon immigration began on September 15, ended on November 5, and the midpoint occurred on September 27 (Figure 14). There were 227 adults and 2 jacks captured and 145 (63.9%) of the adults were adipose-finclipped. There were 35 heads collected from Jordan Creek adult coho salmon carcasses: 17 (48.6%) from adipose-finclipped fish containing a CWT, and 18 (51.4%) from unclipped fish. Three additional heads, each containing a CWT, were collected from Jordan Creek jack coho salmon. Three (17.6%, SE = 9.5%) of the adult coho salmon with CWTs were tagged at Macaulay Hatchery in 2003 and 14 (82.4%, SE = 9.5%) were tagged at Jordan Creek (1 in 2002 and 13 in 2003). Two of the three adult coho salmon containing a Macaulay Hatchery CWT did not have a Macaulay Hatchery otolith mark. Of the 18 unclipped fish, 11 (61.1%, SE = 11.8%) contained thermal marks indicating they were released as smolts from Macaulay Hatchery in 2003 and 7 (38.9%, SE = 11.8%) had no marks. Expanding these carcass sample proportions to both the adipose-finclipped and unclipped numbers of adult coho salmon captured at the weir resulted in an estimated escapement of 76 (SE = 17) Macaulay Hatchery coho salmon and 151 (SE = 17) Jordan Creek coho salmon. Foot surveys counted a peak escapement of 38, about 17% of the total escapement through the weir. No adipose-finclipped carcasses were observed on Switzer Creek or Steep Creek.

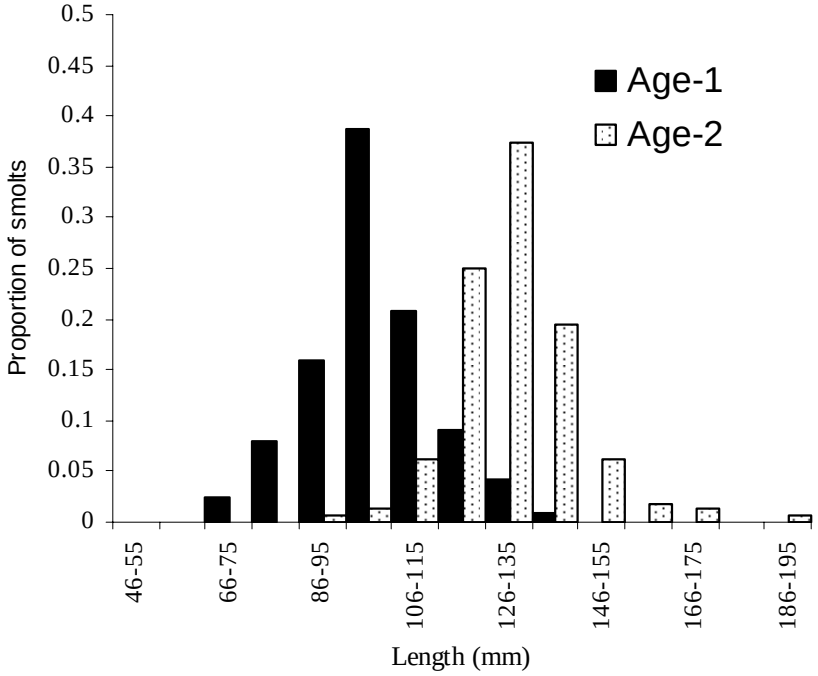

Figure 12.–Length distribution of age-1 and age-2 smolts sampled at Duck Creek in 2004.

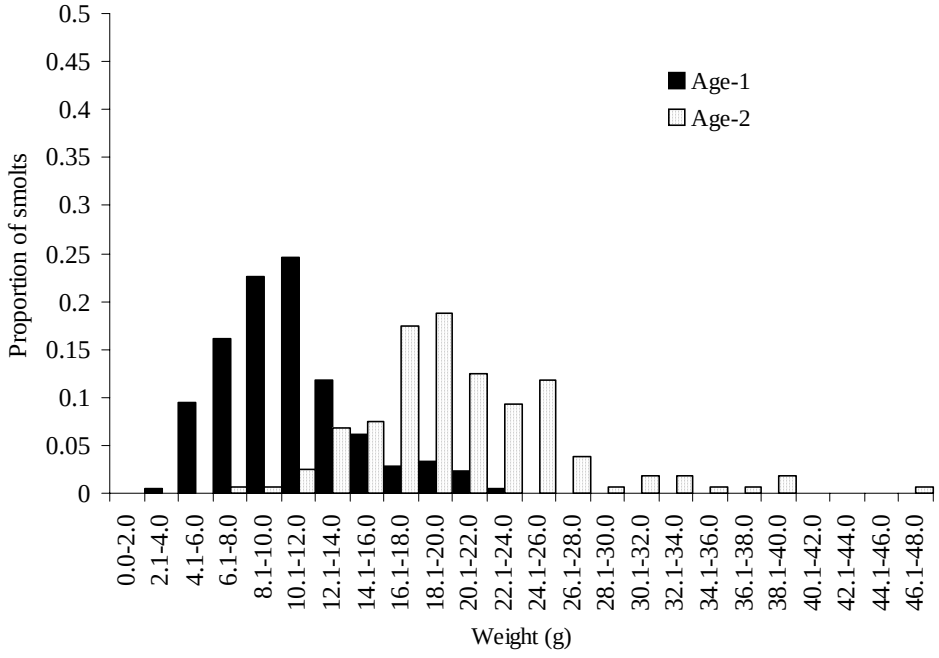

Figure 13.–Weight distribution of age-1 and age-2 smolts sampled at Duck Creek in 2004.

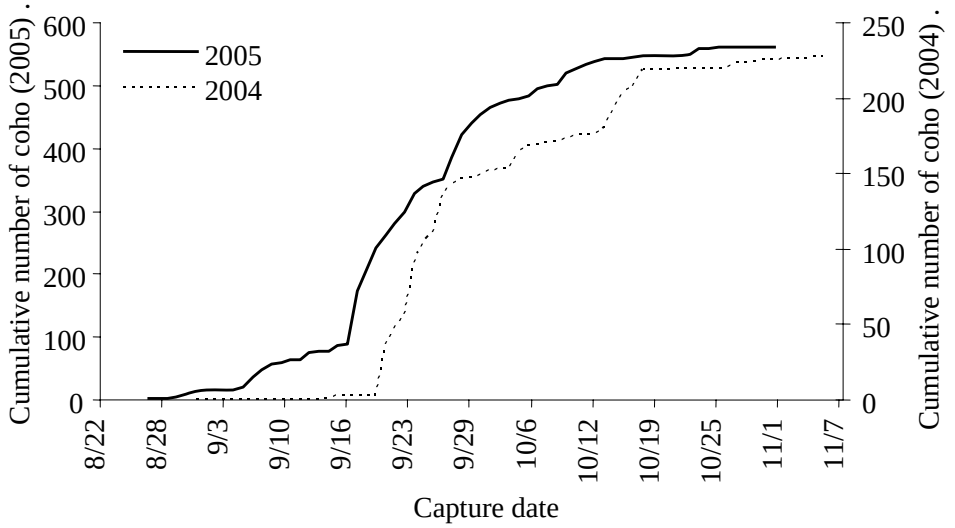

Figure 14.–Cumulative number of adult coho salmon captured at Jordan Creek in 2004 and 2005.

Jordan Creek 2005: The first immigrant coho salmon was captured on August 27, the last on November 1, and the midpoint occurred on September 22 (Figure 14). There were 562 adults captured, 323 (57.5%) of which had adipose finclips. The heads of 64 adult coho salmon carcasses were collected: 28 (43.8%) from adipose-finclipped fish, and 36 (56.2%) from unclipped fish. Three (10.7%, SE = 5.9%) of the adipose-finclipped carcasses contained no CWT and 25 (89.3%, SE = 5.9%) were tagged at Jordan Creek in 2004. Three of the 36 (8.3%, SE = 4.7%) unclipped fish had a thermal mark indicating they were released as smolts from Macaulay Hatchery (1 in 2003 and 2 in 2004) and 33 (91.7%, SE = 4.7%) had no marks. Expanding the carcass sample proportions to adult coho salmon captured at the weir resulted in an estimated escapement of 20 (SE = 11) unclipped Macaulay Hatchery coho salmon and 542 (SE = 29) Jordan Creek coho salmon. Foot surveys counted a peak escapement of 94, about 17% of the total escapement through the weir.

Duck Creek 2004: No live or dead adult coho salmon were observed during the foot surveys; therefore total adult abundance for this system was not estimated in 2004.

Duck Creek 2005: The first adult coho salmon was caught on September 8, the last on October 26, and a total of 15 were captured. Eight of these coho salmon were adipose-finclipped. Otoliths were collected from two unclipped adult coho salmon carcasses and a CWT was extracted from one clipped carcass. One of the unclipped carcasses had an otolith mark indicating it originated from Macaulay Hatchery in 2004 and the tagged carcass had a CWT indicating it originated from Jordan Creek in 2004.

AGE, SEX, AND LENGTH COMPOSITION OF ADULT RETURNS

Jordan Creek 2004: The estimated age composition of adult coho salmon was 90.2 % (SE = 2.7%) age-1.1 and 9.8 % (SE = 2.7%) age-2.1. A Chi-square test ($p > 0.975$) indicated that the proportions of age 1.1 coho salmon were the same in samples prior to October 14 and after October 13. About 12.8% (n = 18) of the total scales sampled were illegible. Scales confirmed that the two jacks were age-0.1. An estimated 54% of the 227 adult coho salmon were males and 46 % were females. The average length was 579 mm MEF (SD = 47 mm) for all adult coho salmon, 577 mm (SE = 4.6 mm) for age-1.1 fish, and 596 mm (SE = 10.7 mm) for age-2.1 fish (Figure 15). Females averaged 591 mm MEF (SD = 43 mm) and males averaged 565 mm (SD = 54 mm). The two jacks captured were 340 mm and 325 mm MEF.

Jordan Creek 2005: An estimated 89.2% (SE = 2.2%) of adult coho salmon were age-1.1 and

10.8% (SE = 2.2%) were age-2.1. A Chi-square test ($p > 0.25$) indicated that the proportions of age-1.1 coho salmon were the same in samples prior to September 29 and after September 28. About 23% (n = 58) of the total number of scales sampled were illegible. The sex ratio of adult coho salmon was similar to that in 2004 as 53% were males and 47% were females. The average length was 587 mm MEF (SD = 51 mm) for all adult coho salmon, 594 mm (SE = 3.5 mm) for age-1.1, 591 mm (SE = 15.0 mm) for age-2.1 (Figure 16), 587 mm (SD = 48 mm) for females, and 588 mm (SD= 55 mm) for males.

Duck Creek 2004: No samples were collected.

Duck Creek 2005: Six of the 15 coho salmon captured were age-1.1, five were age-2.1, three could not be aged, and scales were not collected from one that was the typical size of a jack. Eight of the coho salmon captured were females while seven were males. The length of adult coho salmon ranged from 314 mm to 667 mm MEF.

HARVEST, RUN SIZE, EXPLOITATION, AND MARINE SURVIVAL IN 2004 AND 2005

Jordan Creek: Twenty Jordan Creek coho salmon CWTs were recovered in the 2004 commercial fisheries (Table 4, Appendix A2) and 59 were recovered in 2005 (Table 5, Appendix A2). No Jordan Creek CWTs were recovered from coho salmon harvested in the 2004 sport fisheries, and two CWTs were recovered in the 2005 sport fisheries. One Jordan Creek CWT was recovered from a coho salmon captured in a 2005 hatchery cost recovery fishery. An estimated 103 (SE = 21) Jordan Creek coho salmon were harvested in 2004 (Table 4) and 238 (SE = 29) were harvested in 2005 (Table 5).

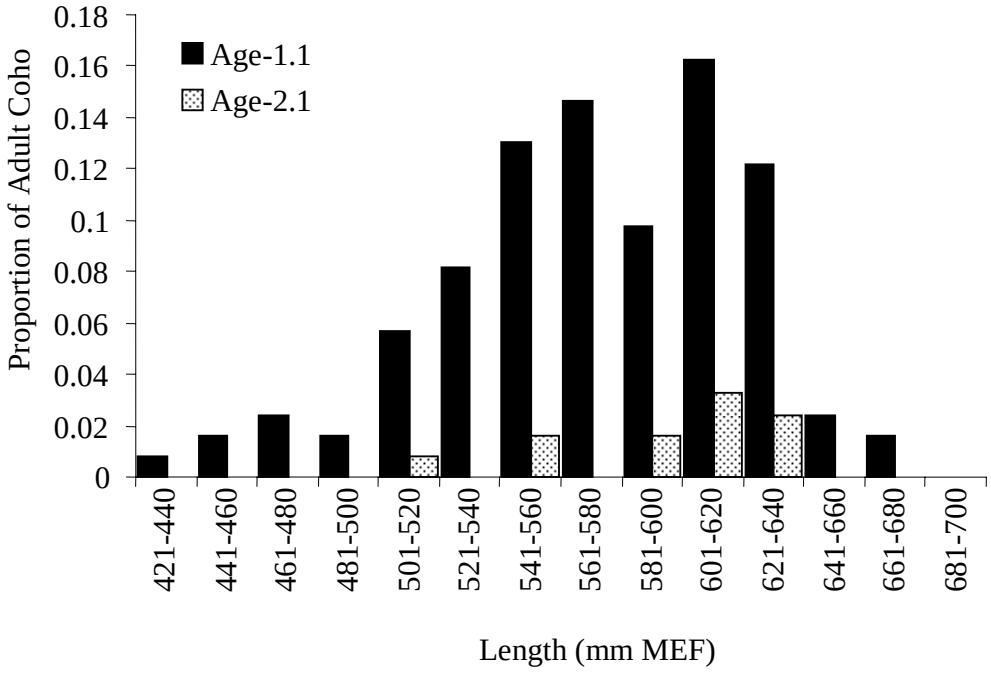

Figure 15.–Length distribution of adult coho salmon by age class at Jordan Creek in 2004.

Table 4.–Harvest sampling statistics and estimated harvest of Jordan Creek adult coho salmon in 2004 (terms defined in Bernard and Clark 1996, m_{ij} = tags recovered in fishery, $\hat{r}_{ij}$ = estimated number of fish harvested).

TROLL FISHERY (stratified by quadrant and period)										
Period	*Quadrant*	N_i	n_i	a_i	a_i'	t_i	t_i'	m_{ij}	$\hat{r}_{ij}$	$SE(\hat{r}_{ij})$
4	NW	690,256	149,828	2,760	2,710	2,229	2,228	13	61	14.9
GILLNET FISHERY (stratified by week and fishing district)										
Stat. week	*District*	N_i	n_i	a_i	a_i'	t_i	t_i'	m_{ij}	$\hat{r}_{ij}$	$SE(\hat{r}_{ij})$
38	115	20,314	3,071	142	142	135	135	1	7	6.1
39	115	12,126	2,000	92	92	87	87	3	18	9.6
SEINE FISHERY (stratified by week and fishing district)										
Stat. week	*District*	N_i	n_i	a_i	a_i'	t_i	t_i'	m_{ij}	$\hat{r}_{ij}$	$SE(\hat{r}_{ij})$
34	112	22,598	5,207	52	52	44	44	1	4	3.8
35	112	25,332	3,839	70	70	61	61	2	13	8.6
Totals		770,626	163,945	3,116	3,066	2,556	2,555	20	103	21

Table 5.–Harvest sampling statistics and estimated harvest of Jordan Creek adult coho salmon in 2005 (terms defined in Bernard and Clark 1996; m_{ij} = tags recovered in fishery, $\hat{r}_{ij}$ = estimated number of fish harvested).

TROLL FISHERY (stratified by quadrant and period)										
Period	*Quadrant*	N_i	n_i	a_i	a_i'	t_i	t_i'	m_{ij}	r_{ij}	$SE(r_{ij})$
3	NW	646,267	181,111	2,238	2,194	1,614	1,609	14	51	11.5
4	NW	405,055	102,640	1,420	1,404	1,131	1,128	17	68	14.2
5	NW	127,713	39,415	737	729	571	571	17	56	11.2
GILLNET FISHERY (stratified by week and fishing district)										
Stat. week	*District*	N_i	n_i	a_i	a_i'	t_i	t_i'	m_{ij}	r_{ij}	$SE(r_{ij})$
38	115	5,201	722	17	15	15	15	1	8	7.5
39	115	6,561	1,501	75	75	74	73	1	4	3.9
40	115	5,459	1,850	57	55	52	52	1	3	2.5
41	115	1,733	438	8	8	8	8	1	4	3.4
SEINE FISHERY (stratified by week and fishing district)										
Stat. week	*District*	N_i	n_i	a_i	a_i'	t_i	t_i'	m_{ij}	r_{ij}	$SE(r_{ij})$
30	114	3,614	693	11	11	8	8	1	5	4.7
34	112	16,253	3,887	54	54	42	41	1	4	3.7
35	112	21,406	2,266	47	47	39	39	2	19	12.6
RECREATIONAL FISHERY (stratified by biweek period)										
Biweek	*Area*	N_i	n_i	a_i	a_i'	t_i	t_i'	m_{ij}	r_{ij}	$SE(r_{ij})$
18	Juneau-Marine Boat	3,025	484	23	22	19	19	2	13	8.4
HATCHERY COST RECOVERY (stratified by week and fishing district)										
Stat. week	*Area*	N_i	n_i	a_i	a_i'	t_i	t_i'	m_{ij}	r_{ij}	$SE(r_{ij})$
41	Macaulay Hatchery-CR	609	246	32	32	28	28	1	2	1.9
Totals		1,242,896	335,253	4,719	4,646	3,601	3,591	59	238	29

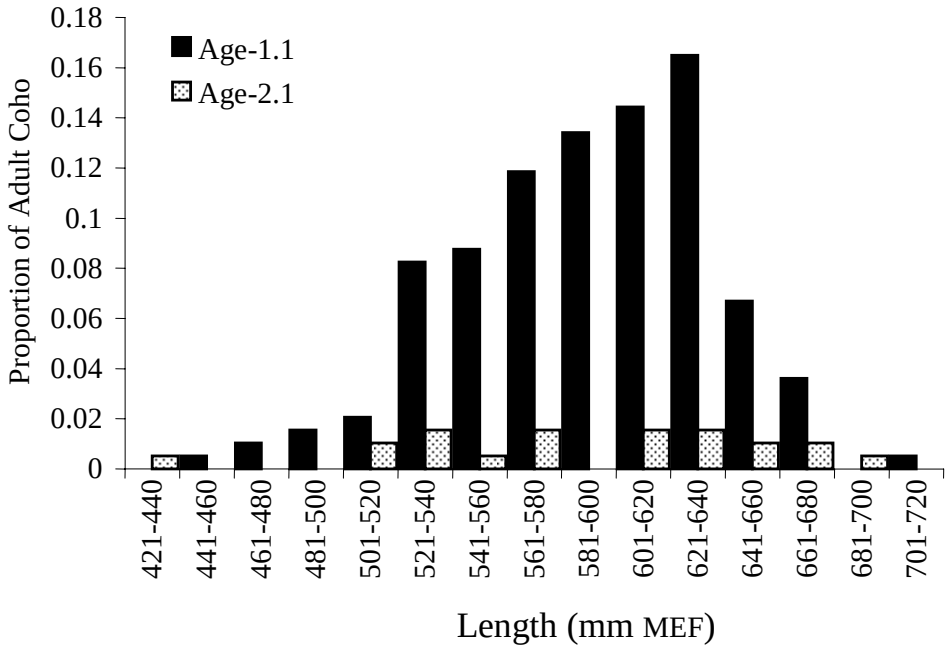

Figure 16.–Length distribution of adult coho salmon by age class at Jordan Creek in 2005.

An estimated 254 (SE = 26.9) Jordan Creek adult coho salmon returned in 2004 and 780 (SE = 41) returned in 2005. The exploitation rate of Jordan Creek coho salmon was estimated to be 40.5% (SE = 5.6%) in 2004 marine fisheries and 30.5% (SE =2.8%) in 2005 marine fisheries (Table 6). Coho salmon smolt-to-adult marine survival at Jordan Creek was estimated to be 2.8% (SE = 0.3%) for the 2003 smolt year and 6.6% (SE = 0.3%) for the 2004 smolt year (Table 6).

Table 6.–Marine survival and exploitation rates for coho salmon returning to Jordan Creek in 2004 and 2005.

	2004	2005
Marine Survival (%)	2.8	6.6
SE (%)	0.3	0.3
Exploitation Rate (%)	40.5	30.5
SE (%)	5.6	2.8

Duck Creek: One tagged Duck Creek coho salmon was recovered in commercial fisheries in 2004 and 21 were recovered in 2005 (15 in commercial fisheries, 6 in sport fisheries, Appendix A3). Escapement work was not completed on Duck Creek in 2004 and 2005, so the total return from the 2003 and 2004 smolt emigration could not be estimated because information on the ratio of marked to unmarked adult fish was not obtained.

OTHER SPECIES

Jordan Creek: During spring 2003 and 2004, Dolly Varden, pink, chum, and sockeye salmon fry, sockeye salmon smolt, cutthroat trout, sculpin, three-spine stickleback, and juvenile steelhead also emigrated past the Jordan Creek weir (Table 7). Of the 14 adult cutthroat trout captured in 2003, one was found dead the day after it was released, 11 were tagged with a new PIT tag, and two were recaptures that already had a PIT tag (Appendix A4). There were also nine adult steelhead that immigrated upstream at Jordan Creek in 2003 and two that immigrated in 2004 (Appendix A5). Two of the steelhead in 2003 emigrated back downstream through the weir and were tagged with a PIT tag (Appendix A5). The Dolly Varden ranged from 60 mm to 145 mm FL (mean = 111 mm, n = 45, SE = 3.7 mm) in 2003, and from 60 mm to 190 mm (mean = 116 mm, n = 76, SD = 19.9 mm) in 2004 (Figure 17). One adult sockeye salmon immigrated upstream through the weir in 2004. In 2005, 110 pink salmon, seven chum salmon, and one marked Chinook salmon were captured in Jordan Creek.

Table 7.–Emigrants other than coho salmon counted at Jordan Creek during spring 2003 and 2004.

Species	2003	2004
Dolly Varden	151	77
Pink salmon fry	444	250
Chum salmon fry	1,028	792
Sockeye salmon fry	23	-
Sockeye salmon smolt	2	-
Juvenile cutthroat	13	-
Adult cutthroat	14	7
Sculpin	1,323	414
Three spine stickleback	39	25
Juvenile steelhead	1	-

Duck Creek: Dolly Varden, adult cutthroat, juvenile cutthroat, sculpin, and three-spine stickleback were captured in a fyke net as they emigrated out of Duck Creek in 2003 and 2004. In 2003, 118 Dolly Varden and 39 three-spine stickleback were captured in a fyke net and counted. In 2004, 219 Dolly Varden (including 5 mortalities), five three-spine stickleback, 12 adult and one juvenile cutthroat trout, and two sculpin were counted. Dolly Varden ranged from 145 mm to 305 mm FL (mean = 208 mm, n = 117, SD = 25.1 mm) in 2003, and from 125 mm to 280 mm (mean = 203 mm, n = 213, SD = 28.4 mm) in 2004 (Figure 18). The adult cutthroat captured at Duck Creek in 2004 ranged in length from 190 mm to 295 mm FL and each was given a new PIT tag (Appendix A6). Three chum salmon, two sockeye salmon, and a sockeye salmon jack immigrated upstream at Duck Creek in 2005.

PHYSICAL DATA

Water temperatures at the Jordan Creek weir ranged from 4 °C to 15.8 °C in spring 2003 and from 3 °C to 14 °C in spring 2004 (Figure 19). Water temperatures at Jordan Creek weir ranged from 4 °C to 12 °C in fall 2004 and from 4 °C to 10 °C in fall 2005 (Figure 20). The water temperature at the Duck Creek adult weir in fall 2005 ranged from 5 °C to 11 °C (Figure 20).

Total daily precipitation measured at the Jordan Creek weir site ranged from zero to 53.8 mm in fall 2004 and from zero to 35.8 mm in fall 2005 (Figure 21). Total daily precipitation measured at the USGS site ranged from zero to 0.82 mm in spring 2004 (Figure 22).

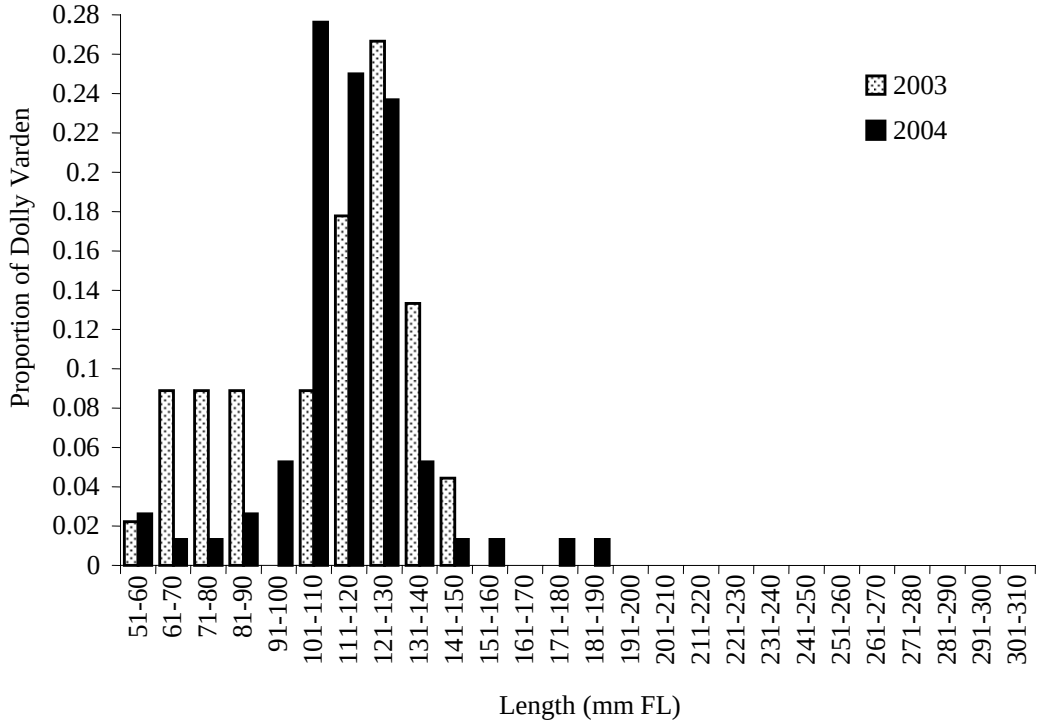

Figure 17.–Length distribution of Dolly Varden emigrating from Jordan Creek in 2003 and 2004.

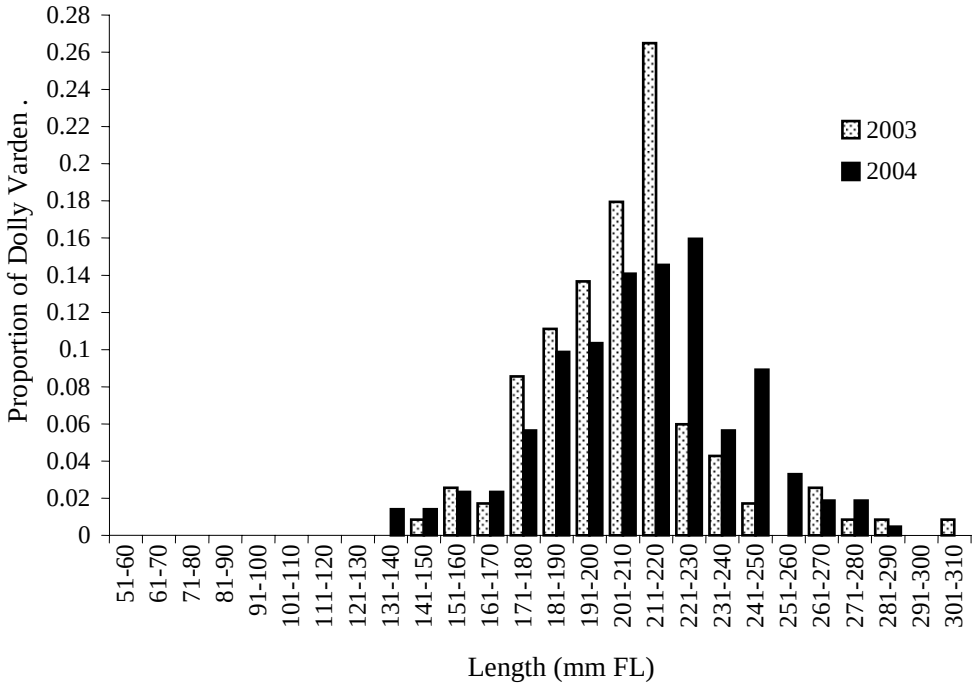

Figure 18.–Length distribution of Dolly Varden emigrating from Duck Creek in 2003 and 2004.

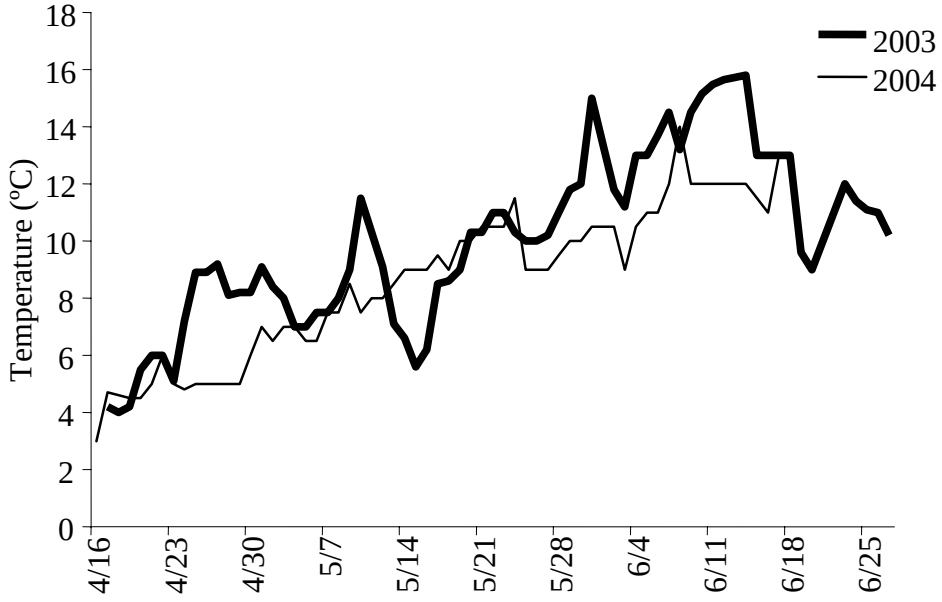

Figure 19.–Water temperature at Jordan Creek during spring 2003 and 2004.

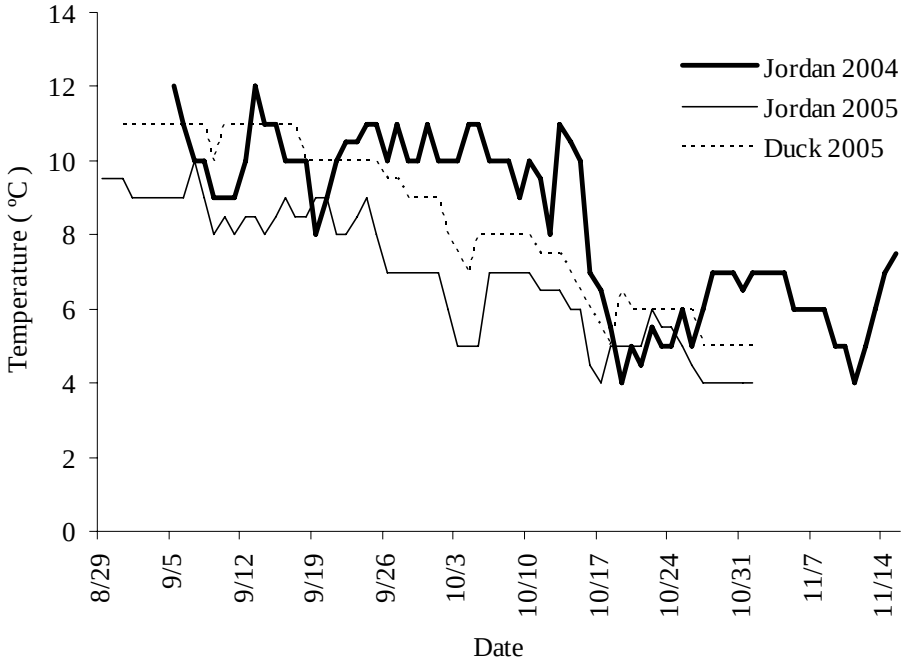

Figure 20.–Water temperature at Jordan Creek during fall 2004 and 2005 and Duck Creek during fall 2005.

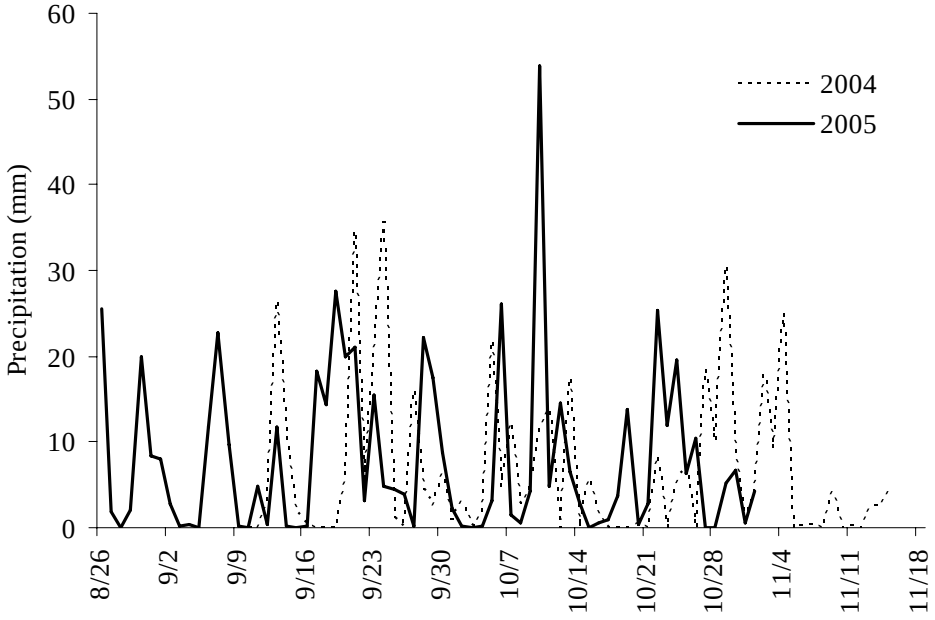

Figure 21.–Total daily precipitation (mm) at Jordan Creek (weir site) in fall 2004 and 2005.

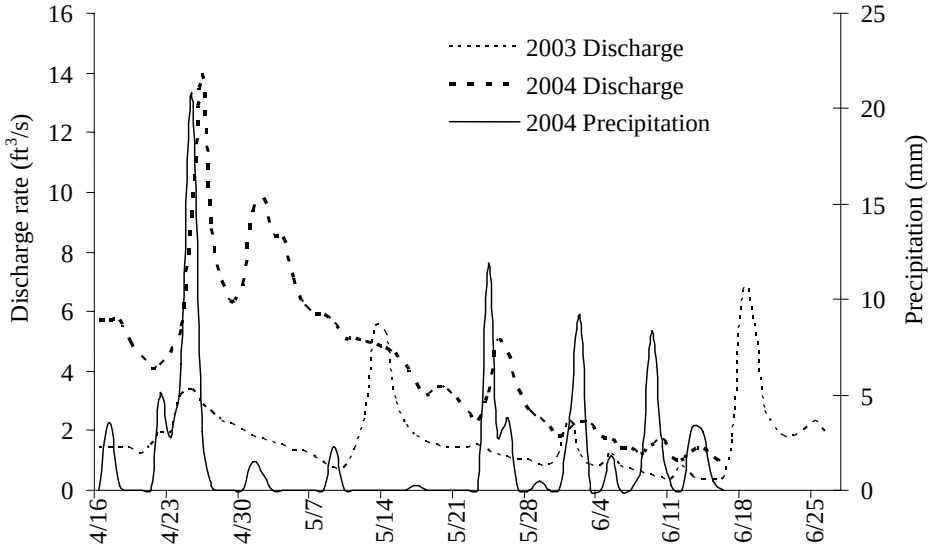

Figure 22.–Average daily stream discharge rates (ft^3/s) at Jordan Creek in spring 2003 and 2004 and total daily precipitation (mm) at Jordan Creek (USGS site) in spring 2004.

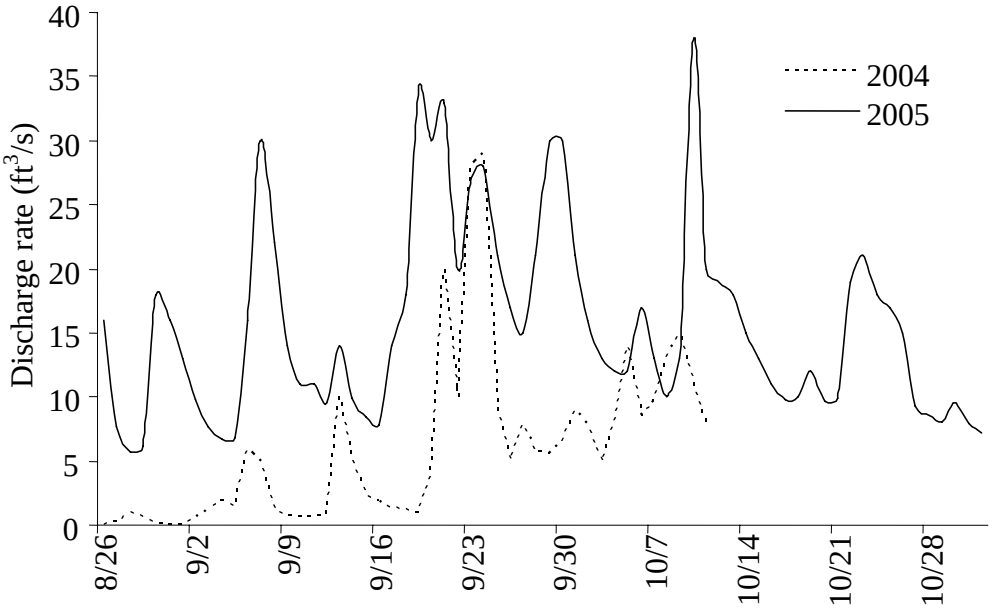

Figure 23.–Average daily stream discharge rates (ft^3/s) at Jordan Creek in fall 2004 and 2005.

The average daily discharge rate at Jordan Creek ranged from 0.34 ft^3/s to 6.7 ft^3/s in spring 2003 and from 0.9 ft^3/s to 14 ft^3/s in spring 2004 (Figure 22). Discharge rates during the fall ranged from 0.59 ft^3/s to 29 ft^3/s in 2004 and from 6.2 ft^3/s to 38 ft^3/s in 2005 (Figure 23).

Average daily stream depth measured at Jordan Creek ranged from 3.21 ft to 4.25 ft in spring 2004, 3.3 ft to 4.88 ft in fall 2004 (depth gauge readings were discontinued after October 11), and 3.85 ft to 5.42 ft in fall 2005.

DISCUSSION

Escapement numbers counted at the weir can be compared to foot counts in Jordan Creek for four return years (2001, 2003–2005), to show that actual escapement was on average 5.34 (SD = 0.77) times the observer stream count (Table 8). This is similar to the expansion factor of 5 assumed by Clark (1995) for Jordan Creek and several other streams on the Juneau road system. Although foot surveys for coho salmon can be unreliable for many reasons (Jones III et al. 1998), an expansion factor near 5 appears appropriate when counting conditions are good.

Jordan Creek coho salmon contributed significantly (an estimated 103 in 2004 and 238 in 2005) to the commercial and sport fish harvests in northern Southeast Alaska, and specifically Juneau. In comparison, however, nearby Auke Creek contributed more coho salmon to the fisheries (an estimated 320 in 2004 and 282 in 2005, Taylor and Lum *Unpublished 2005*; Taylor *Unpublished 2006*) even though it produced less smolt than Jordan Creek. Jordan Creek coho salmon also had a lower estimated marine survival (2.8% in 2004 and 6.6% in 2005) compared to that of neighboring coho salmon stocks (Figure 24), with the exception of the Taku River in 2005. Estimated marine survival was considerably higher for coho salmon returning to Auke Creek, Macaulay Hatchery, Berners River, and the Taku River in 2004.

Marine survival trends indicate that something in the estuary or marine environment may be limiting the number of adult coho salmon returning to Jordan Creek, an idea that has been suggested for other coho salmon populations (Beamish et al. 2000; Cole 2000; Coronado and Hilborn 1998). Some Jordan Creek smolts may have been predisposed to estuarine mortality if they were stressed from conditions (i.e. low dissolved oxygen, handling and tagging, high water temperatures, pollution, etc.) encountered prior to smolting. McCormick et al. (1998) discusses some of the negative impacts that pollution has on smoltification. Low water flows resulted in some fry and smolt mortalities and could have exacerbated some of these stressful conditions. Fish kills occurred in Jordan Creek near the trap site in 2003 and 2004 after heavy rainfall directly proceeded a relatively long (greater than one week) dry spell. Water samples were tested in 2004 for volatile organic compounds and excessive amounts of nitrogen since salmonids are sensitive to various levels of hydrocarbons (Moles et al. 1979; Moles 1980) and dissolved nitrogen (Dawley and Ebel 1975). Water was also tested for phosphorus. There was no conclusive evidence of pollution, but water samples were taken hours after the fish kill was noted, so inconclusive test results do not necessarily eliminate pollution as the cause of mortality.

Table 8.–Comparison of weir counts and stream survey counts of adult coho salmon at Jordan Creek.

Spawner Year	Weir Count	Stream Count	Expansion
2001	525	119	4.41
2003	389	78	4.99
2004	227	38	5.97
2005	562	94	5.98
Mean =			5.34
SD =			0.77

Some coho salmon that were below the minimum size threshold for tagging in 2003 and 2004 may have smolted after they were released downstream of the weir. Other studies have documented coho salmon fry emigrating from freshwater, residing in estuarine waters during the first summer, and then emigrating to sea in the first fall (Tschaplinski 1982; Murphy et al. 1984). This could partially explain why unmarked, unclipped coho salmon returned to Jordan Creek. These unmarked, unclipped coho salmon could have also emigrated as smolts when the weir was not in place or strayed as adults from neighboring coho salmon systems. If smolts emigrated while the weir was not operating, they would have probably emigrated between September and April during periods of high water flow. Marine survival and harvest estimates for Jordan Creek coho salmon would be biased if these untagged fish smolted.

Past research has indicated that adult coho salmon stray into Jordan Creek from nearby Switzer Creek and Macaulay Hatchery (Lum and Glynn 2007). Otoliths and CWTs from carcasses indicated that a higher proportion of Macaulay Hatchery coho salmon strayed into Jordan Creek in 2004 than in 2005. These differences in straying rates could be partially explained by the speculation that early returning salmon tend to

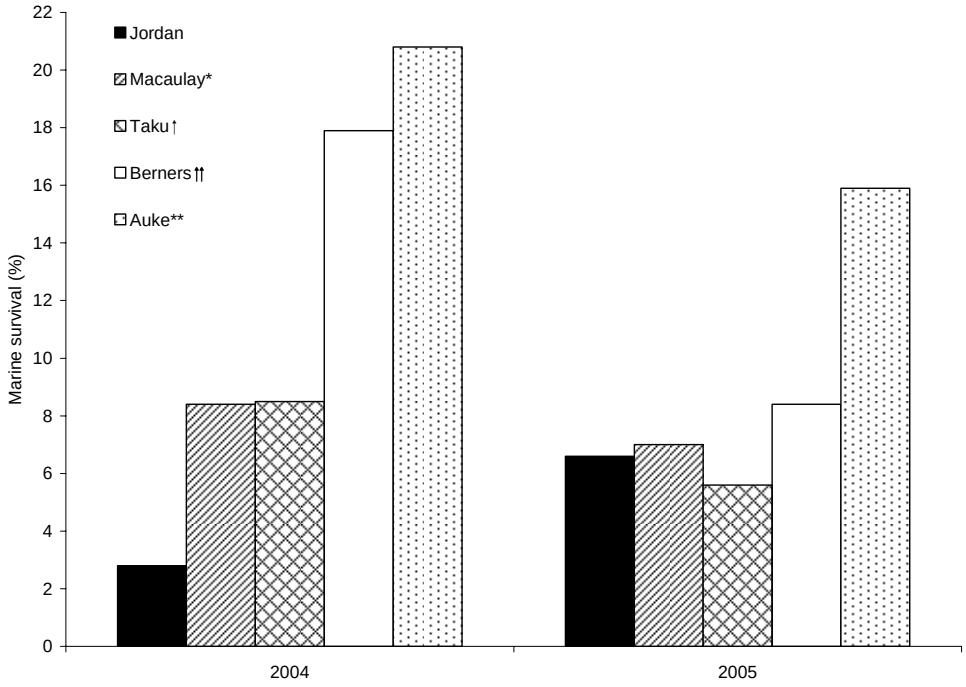

Figure 24.–Marine survival of coho salmon from Jordan Creek, Macaulay Hatchery, Taku River, Berners River, and Auke Creek for return years 2004 and 2005. *Data from R. Focht, Director of Research and Evaluation, DIPAC, Juneau; personal communication. †Data from Shaul et al. 2005 and E. Jones, Sport Fish Biologist, ADF&G, Douglas; personal communication. ††Data from Shaul et al. 2005 and L. Shaul, Commercial Fish Biologist, ADF&G, Douglas; personal communication. **Data from Taylor and Lum Unpublished 2005 and Taylor Unpublished 2006.

stray more when streamflows are low (Labelle 1992) such as they were in fall 2004. The recovery of two hatchery fish that had CWTs but no thermal marks indicates it is possible that some of the unclipped, unmarked carcasses were hatchery fish that did not have a visible thermal mark. Some of the hatchery strays may have been exploring Jordan Creek and may have migrated back out of the creek if there had been a two-way weir. This exploratory behavior has been previously documented for sockeye salmon (Burger et al. 1995; Griffith et al. 1999). Regardless of speculation, otolith and CWT data provides conclusive evidence that Macaulay Hatchery coho salmon contribute to the escapement of Jordan Creek coho salmon.

Significantly less coho salmon smolts were observed in Duck Creek than in Jordan Creek, and the number of smolts emigrating from Duck Creek in 2003 was considerably less than the number emigrating in 2004. These emigration numbers are likely biased estimates of Duck Creek coho salmon smolt production because the migration of smolts was not monitored year round and water stopped flowing early in the spring in 2003 and 2004. It is common for water in Duck Creek to cease flowing in early spring and not flow again until late summer or early fall. To account for intermittent water flows during April and May, Duck Creek coho salmon smolts may have adapted to migrate earlier or later than what is typical for a stream of its size and for this species in this geographical location. Results from previously tagged coho salmon smolts recaptured at Duck Creek in 2004 indicate that smolts moved in and out of the creek during periods when water was flowing but the fyke net was not in. Information from previously tagged coho salmon also indicates that smolts tagged in other systems relocate to Duck Creek to overwinter. Similar nomadic behavior was previously documented for a coho salmon smolt emigrating from Jordan Creek (Lum and Glynn 2007), two coho salmon

smolt emigrating from Berners River (R. Ericksen, Sport Fish Biologist, ADF&G, Haines, personal communication) and one coho salmon smolt immigrating to Auke Creek (C. Hoover, Sport Fish Biologist, ADF&G, Douglas, personal communication).

While our sample sizes are small, it appears Duck Creek produces a much higher proportion of age-2 smolts than Jordan Creek, and the average size of Duck Creek smolts is larger than that of Jordan Creek smolts for each age class. One explanation for the age difference could be that a significant portion of coho salmon emigrating from Duck Creek are nomads which traveled as age-1 smolts/presmolts from other systems in the previous year and then reinvaded Duck Creek to overwinter after spending a summer in the estuary. If estuarine waters produce more available food than freshwater, this nomadic scenario could explain the larger average size of Duck Creek smolts. Another explanation is that Duck Creek coho salmon juveniles that would typically smolt at age-1 are trapped in Duck Creek by low water flows until they can migrate a year later as an age-2 smolt. It is also interesting to note that the Dolly Varden were larger in Duck Creek than they were in Jordan Creek (Figures 17 and 18).

Some adult coho salmon escaped into Duck Creek in 2005, but it is not certain they successfully spawned. If they did spawn, it has been suggested that the eggs might not survive due to poor water quality (Koski and Lorenz 1999). Duck and Jordan creeks are both listed as impaired water bodies under section 303(d) of the Environmental Protection Agency's Clean Water Act (Alaska DEC 2003) as a result of poor water quality (i.e., deposits of silt and debris and low dissolved oxygen). Adequate stream flow is necessary to regulate the amount of sediment that settles in the gravel (Meyer et al. 2005) and guarantees the flushing of fine sediments from the creeks. Excessive accumulation of fine sediments in spawning gravel can be detrimental to egg survival, blocking the flow of dissolved oxygen required for egg development (Tagart 1984) and confining fry in redds longer than their yolk can sustain them (Koski 1966). Coho fry were observed in Duck Creek in 2003 and 2004, indicating that some successful spawning might have occurred in 2002 and 2003, but whether these fish survived to the smolt stage is hard to say. It is difficult to assess the effectiveness of restoration efforts on Duck Creek using coho smolt yields as the measurement of effectiveness, when the beneficial effects of restoration are probably masked by the negative impact of low water flows.

Land surface uplift may also be contributing to the chronic low water flows in both Jordan and Duck Creeks. Both of these systems are fed by ground water from an aquifer system in the Mendenhall Valley. Land surface uplift, or glacial rebound, caused by the rebound of the land as deglaciation occurs, could be disconnecting the surface streams from their subsurface aquifer. The Mendenhall Valley land surface was estimated to be rebounding at a rate of about 1.9 cm/yr during the period 1939–1959 (Hicks and Shofnos 1965) and 1.3 cm/yr for the period 1959–1979 (Hudson et al. 1982).

Even with low water flows, Jordan and Duck creeks have continued to provide important habitat for coho salmon. Results of this study emphasize how critical it is to understand the dynamics of many of the smaller coho salmon streams in the Juneau area because of the cumulative contribution of coho salmon from these streams to both the recreational and commercial fisheries.

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APPENDIX A

Appendix A1.–Total numbers of emigrating coho salmon captured in 2003 and 2004.

	2003	2004
Alive		
Tagged and released	9,111	11,900
Juveniles and Fry released	10,748	7,579
Mortalities		
Recaptured (previously tagged)	15	36
Pre-Tagging	249	265
Post-Tagging	96	199
Tagged with wrong code	-	78

Appendix A2.–Random recoveries of coded wire tagged coho salmon bound for Jordan Creek or recovered during the carcass survey at the stream location by date sample in 2004 and 2005.

Head number	Tag code	Gear class	Recovery date	Stat. week	Quadrant	District	Length	Survey site	Sample number
2004 RANDOM RECOVERIES									
538648	40798	DRIFT	9/16/2004	38	NE	115	760	EXCURSION INLET	4100131
539133	40798	DRIFT	9/21/2004	39	NE	115	651	JUNEAU	4040147
539139	40798	DRIFT	9/21/2004	39	NE	115	670	JUNEAU	4040147
25922	40798	DRIFT	9/21/2004	39	NE	115	690	JUNEAU	4040147
534947	40798	PURSE	8/17/2004	34	NE	112	584	PETERSBURG	4050746
538397	40798	PURSE	8/22/2004	35	NE	112	606	EXCURSION INLET	4100104
538446	40798	PURSE	8/26/2004	35	NE	112	524	EXCURSION INLET	4100114
262877	40798	TROLL	8/9/2004	33	NW	113	637	SITKA	4031119
274081	40798	TROLL	8/15/2004	34	NW	114	600	HOONAH	4110256
538344	40798	TROLL	8/15/2004	34	NW		740	EXCURSION INLET	4100086
274167	40798	TROLL	8/23/2004	35	NW	114	610	HOONAH	4110286
266750	40798	TROLL	8/24/2004	35	NW	114	610	PELICAN	4010076
538439	40798	TROLL	8/27/2004	35	NW	114	722	EXCURSION INLET	4100113
274394	40798	TROLL	8/30/2004	36	NW	154	600	HOONAH	4110316
267015	40798	TROLL	9/2/2004	36	NW		681	PELICAN	4010096
274566	40798	TROLL	9/4/2004	36	NW		590	HOONAH	4110345
266828	40798	TROLL	9/8/2004	37	NW	114	762	PELICAN	4010111
519478	40798	TROLL	9/9/2004	37	NW	114	705	ELFIN COVE	4020233
274715	40798	TROLL	9/10/2004	37	NW	114	655	HOONAH	4110367
274808	40798	TROLL	9/20/2004	39	NW	114	705	HOONAH	4110385
255217	35605	ESCAPE	10/27/04	44	NE	111		JUNEAU MISC.	04AJ2007
255201	40798	ESCAPE	9/16/2004	38	NE	111	613	JUNEAU MISC.	04AJ2001
255202	40798	ESCAPE	9/21/2004	39	NE	111	627	JUNEAU MISC.	04AJ2002
255203	40798	ESCAPE	9/21/2004	39	NE	111		JUNEAU MISC.	04AJ2002
255204	40798	ESCAPE	9/22/2004	39	NE	111		JUNEAU MISC.	04AJ2003
255205	40798	ESCAPE	9/22/2004	39	NE	111		JUNEAU MISC.	04AJ2003
255214	40798	ESCAPE	10/26/04	44	NE	111		JUNEAU MISC.	04AJ2006
255215	40798	ESCAPE	10/27/04	44	NE	111	620	JUNEAU MISC.	04AJ2007
255218	40798	ESCAPE	10/28/04	44	NE	111		JUNEAU MISC.	04AJ2008
255219	40798	ESCAPE	10/28/04	44	NE	111		JUNEAU MISC.	04AJ2008
255221	40798	ESCAPE	11/9/2004	46	NE	111		JUNEAU MISC.	04AJ2010
255222	40798	ESCAPE	11/10/04	46	NE	111		JUNEAU MISC.	04AJ2011

-continued-

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Head number	Tag code	Gear class	Recovery date	Stat. week	Quadrant	District	Length	Survey site	Sample number
2004 RANDOM RECOVERIES (Continued)									
255223	40798	ESCAPE	11/10/04	46	NE	111		JUNEAU MISC.	04AJ2011
255224	40798	ESCAPE	11/10/04	46	NE	111		JUNEAU MISC.	04AJ2011
255211	40799	ESCAPE	9/21/2004	39	NE	111	430	JUNEAU MISC.	04AJ2002
255206	40799	ESCAPE	9/23/2004	39	NE	111	425	JUNEAU MISC.	04AJ2004
255220	40799	ESCAPE	11/4/2004	45	NE	111		JUNEAU MISC.	04AJ2009
2005 RANDOM RECOVERIES									
25949	40799	DRIFT	9/16/2005	38	NE	115	709	JUNEAU	5040194
539767	40799	DRIFT	9/21/2005	39	NE	115	667	JUNEAU	5040203
529384	40799	DRIFT	9/28/2005	40	NE	115	688	JUNEAU	5040211
529316	40799	DRIFT	10/4/2005	41	NE	115	712	JUNEAU	5040216
222383	40799	NR	10/3/2005	41	NE	111	589	MACAULAY HATCHERY	5336013
93242	40799	PURSE	7/22/2005	30	NW	114	525	EXCURSION INLET	5100073
90783	40799	PURSE	8/20/2005	34	NE	112	595	EXCURSION INLET	5100146
91870	40799	PURSE	8/22/2005	35	NE	112	555	EXCURSION INLET	5100153
91884	40799	PURSE	8/26/2005	35	NE	112	657	EXCURSION INLET	5100158
59881	40799	TROLL	7/8/2005	28	NW	116	573	PELICAN	5010028
295387	40799	TROLL	7/21/2005	30	NW	114	615	HOONAH	5110143
295324	40972	TROLL	7/18/2005	30	NW		570	HOONAH	5110138
302255	40799	TROLL	7/30/2005	31	NW		573	SITKA	5031067
295448	40972	TROLL	7/27/2005	31	NW		500	HOONAH	5110160
295563	40799	TROLL	7/31/2005	32	NW		498	HOONAH	5110178
93827	40799	TROLL	7/31/2005	32	NW		540	PELICAN	5010092
295549	40799	TROLL	7/31/2005	32	NW		598	HOONAH	5110178
93268	40799	TROLL	7/31/2005	32	NW		652	EXCURSION INLET	5100095
295545	40799	TROLL	8/3/2005	32	NW		581	HOONAH	5110177
295568	40799	TROLL	8/4/2005	32	NW	114	605	HOONAH	5110179
288709	40799	TROLL	8/9/2005	33	NW	181	580	YAKUTAT	5140125
295654	40799	TROLL	8/10/2005	33	NW	114	457	HOONAH	5110207
295636	40799	TROLL	8/10/2005	33	NW		599	HOONAH	5110206
295829	40799	TROLL	8/23/2005	35	NW	114	662	HOONAH	5110244
295886	40799	TROLL	8/25/2005	35	NW		643	HOONAH	5110260
295855	40972	TROLL	8/25/2005	35	NW	116	624	HOONAH	5110254
225985	40972	TROLL	8/27/2005	35	NW	116	620	PELICAN	5010156

-continued-

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Head number	Tag code	Gear class	Recovery date	Stat. week	Quadrant	District	Length	Survey site	Sample number
2005 RANDOM RECOVERIES (Continued)									
27560	40798	TROLL	9/1/2005	36	NW	114	600	ELFIN COVE	5020287
295906	40799	TROLL	8/28/2005	36	NW		650	HOONAH	5110266
27570	40799	TROLL	9/2/2005	36	NW	114	585	ELFIN COVE	5020297
295925	40972	TROLL	8/29/2005	36	NW	114	532	HOONAH	5110270
288853	40799	TROLL	9/4/2005	37	NW	189	626	YAKUTAT	5140201
91929	40799	TROLL	9/5/2005	37	NW		590	EXCURSION INLET	5100168
27591	40799	TROLL	9/6/2005	37	NW	114	650	ELFIN COVE	5020307
27619	40799	TROLL	9/7/2005	37	NW	114	650	ELFIN COVE	5020324
299032	40799	TROLL	9/7/2005	37	NW	114	657	HOONAH	5110307
24025	40799	TROLL	9/7/2005	37	NW	189	689	YAKUTAT	5140210
299046	40799	TROLL	9/7/2005	37	NW		661	HOONAH	5110308
299071	40799	TROLL	9/9/2005	37	NW	114	660	HOONAH	5110310
288886	40799	TROLL	9/9/2005	37	NW		732	YAKUTAT	5140221
303701	40799	TROLL	9/10/2005	37	NW	114	639	SITKA	5031335
288923	40799	TROLL	9/11/2005	38	NW	189	665	YAKUTAT	5140226
27640	40799	TROLL	9/12/2005	38	NW	114	693	ELFIN COVE	5020345
299150	40799	TROLL	9/12/2005	38	NW		661	HOONAH	5110321
303758	40799	TROLL	9/13/2005	38	NW	113	562	SITKA	5031363
276915	40799	TROLL	9/15/2005	38	NW	189	613	YAKUTAT	5140262
299191	40799	TROLL	9/15/2005	38	NW		655	HOONAH	5110329
242049	40799	TROLL	9/16/2005	38	NW	114	612	PELICAN	5010215
27647	40972	TROLL	9/14/2005	38	NW	114	617	ELFIN COVE	5020351
299242	40799	TROLL	9/20/2005	39	NW		645	HOONAH	5110337
299247	40799	TROLL	9/20/2005	39	NW		660	HOONAH	5110337
299243	40799	TROLL	9/20/2005	39	NW		712	HOONAH	5110337
539660	40799	TROLL	9/21/2005	39	NW	114	587	JUNEAU	5040202
539669	40799	TROLL	9/21/2005	39	NW	114	645	JUNEAU	5040202
539664	40799	TROLL	9/21/2005	39	NW	114	658	JUNEAU	5040202
299235	40799	TROLL	9/21/2005	39	NW	114	656	HOONAH	5110336
299291	40799	TROLL	9/21/2005	39	NW		605	HOONAH	5110341
539207	40799	TROLL	9/23/2005	39	NW	113	560	JUNEAU	5040197
229469	40799	SPORT	9/4/2005	37	NE	111	650	JUNEAU	5045354
265640	40799	SPORT	9/11/2005	38	NE	111	580	JUNEAU	5045361

-continued-

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Head number	Tag code	Gear class	Recovery date	Stat. week	Quadrant	District	Length	Survey site	Sample number
2005 RANDOM RECOVERIES (Continued)									
255226	40799	ESCAPE	9/17/2005	38	NE	111		JUNEAU MISC.	05AJ2001
255227	40799	ESCAPE	9/19/2005	39	NE	111		JUNEAU MISC.	05AJ2002
255228	40799	ESCAPE	9/19/2005	39	NE	111		JUNEAU MISC.	05AJ2002
255229	40799	ESCAPE	9/24/2005	39	NE	111		JUNEAU MISC.	05AJ2003
255231	40799	ESCAPE	9/27/2005	40	NE	111		JUNEAU MISC.	05AJ2004
255232	40799	ESCAPE	9/28/2005	40	NE	111		JUNEAU MISC.	05AJ2005
255233	40799	ESCAPE	9/29/2005	40	NE	111		JUNEAU MISC.	05AJ2006
255234	40799	ESCAPE	9/30/2005	40	NE	111		JUNEAU MISC.	05AJ2007
255235	40799	ESCAPE	10/4/2005	41	NE	111		JUNEAU MISC.	05AJ2008
255302	40799	ESCAPE	10/11/2005	42	NE	111		JUNEAU MISC.	05AJ2016
255303	40799	ESCAPE	10/14/2005	42	NE	111		JUNEAU MISC.	05AJ2017
255304	40799	ESCAPE	10/14/2005	42	NE	111		JUNEAU MISC.	05AJ2017
255236	40799	ESCAPE	10/19/2005	43	NE	111		JUNEAU MISC.	05AJ2009
255238	40799	ESCAPE	10/19/2005	43	NE	111		JUNEAU MISC.	05AJ2009
255239	40799	ESCAPE	10/20/2005	43	NE	111		JUNEAU MISC.	05AJ2010
255240	40799	ESCAPE	10/21/2005	43	NE	111		JUNEAU MISC.	05AJ2011
255242	40799	ESCAPE	10/24/2005	44	NE	111		JUNEAU MISC.	05AJ2012
255243	40799	ESCAPE	10/24/2005	44	NE	111		JUNEAU MISC.	05AJ2012
255244	40799	ESCAPE	10/24/2005	44	NE	111		JUNEAU MISC.	05AJ2012
255245	40799	ESCAPE	10/25/2005	44	NE	111		JUNEAU MISC.	05AJ2019
255251	40799	ESCAPE	10/28/2005	44	NE	111		JUNEAU MISC.	05AJ2013
255252	40799	ESCAPE	10/28/2005	44	NE	111		JUNEAU MISC.	05AJ2013
255253	40799	ESCAPE	10/31/2005	45	NE	111		JUNEAU MISC.	05AJ2014
255230	40972	ESCAPE	9/27/2005	40	NE	111		JUNEAU MISC.	05AJ2004
255301	40972	ESCAPE	10/10/2005	42	NE	111		JUNEAU MISC.	05AJ2015
255241	40972	ESCAPE	10/21/2005	43	NE	111		JUNEAU MISC.	05AJ2011

Appendix A3.–Random recoveries of coded-wire tagged coho salmon bound for Duck Creek by date sampled in 2004 and 2005.

Head Number	Tag Code	Gear Class	Recovery Date	Stat. Week	Quad.	District	Length	Survey Site	Sample Number
2004 RANDOM RECOVERIES									
266353	40793	TROLL	8/10/2004	33	NW	116	725	PELICAN	4010051
2005 RANDOM RECOVERIES									
91864	40794	PURSE	8/22/2005	35	NE	112	732	EXCURSION INLET	5100152
295525	40794	TROLL	8/3/2005	32	NW	114	558	HOONAH	5110174
93866	40794	TROLL	8/5/2005	32	NW	114	619	PELICAN	5010110
27464	40794	TROLL	8/9/2005	33	NW	114	630	ELFIN COVE	5020202
295597	40794	TROLL	8/9/2005	33	NW	114	664	HOONAH	5110193
295649	40794	TROLL	8/10/2005	33	NW		598	HOONAH	5110206
27479	40794	TROLL	8/18/2005	34	NW	114	650	ELFIN COVE	5020216
205064	40794	TROLL	8/27/2005	35	NW	113	718	PELICAN	5010157
201978	40794	TROLL	9/7/2005	37	NW	114	658	PELICAN	5010179
232396	40794	TROLL	9/11/2005	38	NW	113	717	PELICAN	5010195
232395	40794	TROLL	9/11/2005	38	NW	114	678	PELICAN	5010194
299076	40794	TROLL	9/12/2005	38	NW		610	HOONAH	5110313
27664	40794	TROLL	9/15/2005	38	NW	114	675	ELFIN COVE	5020360
539685	40794	TROLL	9/21/2005	39	NW	114	538	JUNEAU	5040202
539671	40794	TROLL	9/21/2005	39	NW	114	708	JUNEAU	5040202
245343	40794	SPORT	7/29/2005	31	NE	111	720	JUNEAU	5045286
245349	40794	SPORT	8/1/2005	32	NE	111	685	JUNEAU	5045294
245367	40794	SPORT	8/27/2005	35	NE	112	610	JUNEAU	5045332
265636	40794	SPORT	9/3/2005	36	NE	111	510	JUNEAU	5045341
229471	40794	SPORT	9/9/2005	37	NE	111	620	JUNEAU	5045358
274952	40794	SPORT	9/10/2005	37	NE	111		JUNEAU	5045359

Appendix A4.–Length, sex, and PIT tag numbers of cutthroat trout captured at Jordan Creek in 2003 and 2004.

Date	Length (mm)	Sex	New PIT Tag Number.	Recap PIT Tag Number.	Date	Length (mm)	Sex	New PIT Tag Number.
04/23/03	231	M	133469615A		05/24/04	180	-	134445627A
05/14/03	240	-	133513180A		05/25/04	265	-	134722643A
05/15/03	318	F		133524516A[a]	05/25/04	214	-	133615735A
05/20/03	269	-	133453386A		06/03/04	266	-	133609374A
05/24/03	226	-	134629264A		06/11/04	255	-	134546565A
05/24/03	247	-	133718630A		06/14/04	270	-	133567363A
05/24/03	287	-	134549762A		06/14/04	234	-	134917126A
06/02/03	248	-	133446543A					
06/02/03	255	F	133473615A					
06/02/03	280	F	133462147A					
06/06/03	250	-	133472760A					
06/06/03	277	-	133417335A					
06/06/03	295	-		133527263A[a]				
06/15/03	231	-	133865483A[b]					

[a] Fish were tagged in Jordan Creek in 2002.

[b] This fish was found dead in the upstream trap on 6/16/03.

Appendix A5.–Length, sex, PIT tag numbers, and migration direction of adult steelhead captured at Jordan Creek in 2003 and 2004.

Date	Length (mm)	Sex	PIT Tag Number	Migration Direction
04/26/03	665	F	Not Tagged	upstream
04/26/03	660	M	Not Tagged	upstream
04/26/03	610	F	Not Tagged	upstream
04/26/03	605	F	Not Tagged	upstream
04/29/03	683	M	Not Tagged	upstream
04/29/03	612	F	Not Tagged	upstream
04/29/03	630	F	Not Tagged	upstream
05/01/03	600	F	Not Tagged	upstream
05/01/03	615	F	Not Tagged	upstream
05/12/03	610	F	133519650A	downstream
05/12/03	605	F	134433334A	downstream
05/03/04	710	F	Not Tagged	upstream
05/07/04	630	F	Not Tagged	upstream

Appendix A6.–Length, sex, and PIT tag numbers of adult cutthroat trout captured at Duck Creek in 2004.

Date	Length (mm)	Sex	New PIT Tag Number
04/09/04	285	-	133617264A
04/27/04	279	F	134464573A
04/28/04	245	F	133919377A
05/24/04	277	-	133547670A[a]
05/24/04	209	-	134723523A[a]
05/24/04	263	M	134525460A[a]
05/24/04	295	M	134521386A[a]
05/24/04	288	M	134674552A[a]
05/25/04	225	-	134976326A
05/28/04	286	-	133718353A
06/08/04	190	-	127677354A
06/09/04	294	-	133627272A

[a] These fish died the day after tagging.

Appendix A7.–List of computer data files archived from this study.

FILE NAME	DESCRIPTION
AWL03_Jordan.xls	Age, weight, and length of coho salmon smolts sampled in 2003.
Cutthroat03_Jordan.xls	Length, sex, and PIT tag codes of cutthroat trout captured in 2003.
Dollies03_Jordan.xls	Lengths of Dolly Varden captured in 2003.
Steelhead03_Jordan.xls	Length, sex, and PIT tag codes of steelhead captured in 2003.
Daily03_Jordan.xls	Master data file that includes stream depth, stream temperature, counts for all species, numbers of coho salmon tagged, mortalities, and comments.
AWL04_Jordan.xls	Age, weight, and length of coho salmon smolts sampled in 2004.
Cutthroat04_Jordan.xls	Length, sex, and PIT tag codes of cutthroat trout captured in 2004.
Dollies04_Jordan.xls	Lengths of Dolly Varden captured in 2004.
Steelhead04_Jordan.xls	Length, sex, and PIT tag codes of steelhead captured in 2004.
Daily04_Jordan.xls	Master data file that includes stream depth, stream temperature, counts for all species, numbers of coho salmon tagged, mortalities, and comments.
ASL04_Jordan.xls	Age, sex, and length data for adult coho salmon captured in 2004.
CWT and Otoliths04_Jordan.xls	Tag Lab CWT recovery data and otolith thermal mark data from 2004.
Harvest estimates04_Jordan.xls	Tag Lab harvest expansion report and marine harvest calculations for fish caught in commercial and recreational fisheries in 2004.
Master Data04_Jordan.xls	Daily and cumulative counts for all species, stream temperature, stream depth, precipitation, and number of adipose fin clipped coho salmon captured in 2004.
Morts04_Jordan.xls	Length, GPS coordinates, sex, cinch tag numbers, and otolith numbers for carcasses collected in 2004.
ASL05_Jordan.xls	Age, sex, and length data for adult coho salmon captured in 2005.
CWT and Otoliths05_Jordan.xls	Tag Lab CWT recovery data and otolith thermal mark data from 2005.
Harvest estimates05_Jordan.xls	Tag Lab harvest expansion report and marine harvest calculations for fish caught in commercial and recreational fisheries in 2005.
Master Data05_Jordan.xls	Daily and cumulative counts for all species, stream temperature, stream depth, precipitation, and number of adipose fin clipped coho salmon captured in 2005.
AWL03_Duck.xls	Age, weight, and length of coho salmon smolts tagged in 2003.
Daily03_Duck.xls	Daily and cumulative counts of all species captured and number of coho salmon smolts tagged in 2003.
Dollies03_Duck.xls	Lengths of Dolly Varden captured in 2003.
AWL04_Duck.xls	Age, weight, and length of coho salmon smolts tagged in 2004.
Daily04_Duck.xls	Daily and cumulative counts of all species captured and number of coho salmon smolts tagged in 2004.
Dollies04_Duck.xls	Lengths of Dolly Varden captured in 2004.
Cutthroat04_Duck.xls	Length, sex, and PIT tag codes of cutthroat trout captured in 2004.