

**Fishery Data Series No. 98-44**

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**Juneau Roadside Cutthroat Trout Studies: Windfall  
Creek Weir and Windfall Lake, 1997**

by

**J. Douglas Jones**

and

**Roger D. Harding**

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December 1998

Alaska Department of Fish and Game

Division of Sport Fish



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<b>Weights and measures (metric)</b>		<b>General</b>		<b>Mathematics, statistics, fisheries</b>	
centimeter	cm	All commonly accepted abbreviations.	e.g., Mr., Mrs., a.m., p.m., etc.	alternate hypothesis	$H_A$
deciliter	dL			base of natural logarithm	e
gram	g	All commonly accepted professional titles.	e.g., Dr., Ph.D., R.N., etc.	catch per unit effort	CPUE
hectare	ha	and	&	coefficient of variation	CV
kilogram	kg	at	@	common test statistics	F, t, $\chi^2$ , etc.
kilometer	km	Compass directions:		confidence interval	C.I.
liter	L			correlation coefficient	R (multiple)
meter	m	east	E	correlation coefficient	r (simple)
metric ton	mt	north	N	covariance	cov
milliliter	ml	south	S	degree (angular or temperature)	°
millimeter	mm	west	W	degrees of freedom	df
		Copyright	©	divided by	÷ or / (in equations)
		Corporate suffixes:		equals	=
		Company	Co.	expected value	E
		Corporation	Corp.	fork length	FL
		Incorporated	Inc.	greater than	>
		Limited	Ltd.	greater than or equal to	≥
		et alii (and other people)	et al.	harvest per unit effort	HPUE
		et cetera (and so forth)	etc.	less than	<
		exempli gratia (for example)	e.g.,	less than or equal to	≤
		id est (that is)	i.e.,	logarithm (natural)	ln
		latitude or longitude	lat. or long.	logarithm (base 10)	log
		monetary symbols (U.S.)	\$, ¢	logarithm (specify base)	log <sub>2</sub> , etc.
		months (tables and figures): first three letters	Jan,...,Dec	mideye-to-fork	MEF
		number (before a number)	# (e.g., #10)	minute (angular)	'
		pounds (after a number)	# (e.g., 10#)	multiplied by	x
		registered trademark	®	not significant	NS
		trademark	™	null hypothesis	$H_0$
		United States (adjective)	U.S.	percent	%
		United States of America (noun)	USA	probability	P
		U.S. state and District of Columbia abbreviations	use two-letter abbreviations (e.g., AK, DC)	probability of a type I error (rejection of the null hypothesis when true)	$\alpha$
				probability of a type II error (acceptance of the null hypothesis when false)	$\beta$
				second (angular)	"
				standard deviation	SD
				standard error	SE
				standard length	SL
				total length	TL
				variance	Var
<b>Weights and measures (English)</b>					
cubic feet per second	ft <sup>3</sup> /s				
foot	ft				
gallon	gal				
inch	in				
mile	mi				
ounce	oz				
pound	lb				
quart	qt				
yard	yd				
Spell out acre and ton.					
<b>Time and temperature</b>					
day	d				
degrees Celsius	°C				
degrees Fahrenheit	°F				
hour (spell out for 24-hour clock)	h				
minute	min				
second	s				
Spell out year, month, and week.					
<b>Physics and chemistry</b>					
all atomic symbols					
alternating current	AC				
ampere	A				
calorie	cal				
direct current	DC				
hertz	Hz				
horsepower	hp				
hydrogen ion activity	pH				
parts per million	ppm				
parts per thousand	ppt, ‰				
volts	V				
watts	W				

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CREEK WEIR AND WINDFALL LAKE 1997**

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December 1998

Development and publication of this manuscript were partially financed by the Federal Aid in Sport Fish Restoration Act (16 U.S.C. 777-777K ) under Project F-10-12 and F-10-13, Job No. R-1-7.

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*This document should be cited as:*

*Jones, J. Douglas and Roger D. Harding. 1998. Juneau Roadside Cutthroat Trout Studies: Windfall Creek Weir and Windfall Lake, 1997. Alaska Department of Fish and Game, Fishery Data Series No. 98-44, Anchorage.*

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## ABSTRACT

Sport Fish Division staff from the Alaska Department of Fish and Game operated a weir to count outmigrating cutthroat trout *Oncorhynchus clarki* and Dolly Varden *Salvelinus malma* from Windfall Creek in spring 1997, and counted a total of 616 cutthroat trout, 34,074 Dolly Varden, and nine steelhead *Oncorhynchus mykiss* during 10 April through 31 May 1997. Fifty-eight sexually mature cutthroat trout outmigrating from Windfall Lake were radio-tagged. Estimates based on radiotelemetry data indicated that approximately 27% (SE 1.3%) of the cutthroat trout leaving Windfall Lake were sea-run fish and the remainder were resident trout. Of the 58 cutthroat trout fitted with radio transmitters; 25 were tagged with external tags and another 25 were fitted with esophageal, stomach-implant tags in order to compare retention rates between tag types. Results from the differently tagged groups indicated that 28% of the internally equipped fish regurgitated the tags, whereas only one fish in the externally tagged group was lost to mortality. A mark-recapture experiment conducted in-season to estimate the abundance of resident trout in Windfall Lake was attempted after emigrating fish had departed, but catches were not sufficient to provide an accurate estimate.

Key words: Alaska, Windfall Creek, cutthroat trout, radiotelemetry, sea-run, weir, Dolly Varden, steelhead, tracking, migration, life history, surgical, saddleback, attachment.

## INTRODUCTION

Concern about declining cutthroat trout *Oncorhynchus clarki* harvests in Southeast Alaska and increasing effort prompted the Alaska Board of Fisheries to adopt more restrictive trout regulations in 1994. Cutthroat trout are sensitive to fishing pressure (Behnke 1992, Wright 1992) and the new regulations were designed to protect fish until the majority of females had an opportunity to spawn at least once. The Juneau roadside (including Windfall Lake) was designated in the new regulations as a "high use" lake with a minimum size limit of 14 inches for cutthroat trout.

Despite the ease of accessibility and relative popularity of fishing for cutthroat trout and Dolly Varden char *Salvelinus malma* populations along the Juneau roadside system, life history characteristics and baseline information on local populations remain sparse. Windfall Lake, a tributary to Herbert River, is accessible from the Juneau roadside by a 3-mile trail, and it is a popular local fishing spot. During the years 1990 through 1996, anglers' annual catches from the Windfall Lake system averaged 314 cutthroat trout and peaked in 1994 at 697 fish (Howe et al. 1996).

The purpose of this study was to investigate the stock status of sea-run cutthroat trout in the Windfall Lake system adjacent to the Juneau roadside area (Figure 1).

Study goals were: (1) estimate abundance and size distribution of cutthroat trout that use Windfall Lake as an overwintering area; (2) estimate the proportion of these adults that emigrate to sea; and (3) estimate the number and size distribution of cutthroat trout that do not emigrate from the lake (i.e., resident fish).

In previous cutthroat trout studies, surgical implantation of radio tags into the stomach had limited success because of high mortality and regurgitation of tags (Jones and Seifert 1997). Consequently, during this study we evaluated another method of attaching the tag externally to the back of the fish just below the dorsal fin. Results are also presented from the stomach insertion and external methods of attaching radio transmitters to cutthroat trout.

The information collected in this study will provide managers with further insight into crafting management strategies for Dolly Varden and cutthroat trout populations in Windfall Lake as recreational use increases. The U.S. Forest Service constructed a large (six-person-capacity) cabin on Windfall Lake in June of 1998.

## STUDY AREA

The Windfall Lake system drains an area of approximately 2.59 km<sup>2</sup> (Figure 1). Windfall Lake is 1.3 km long; its surface area covers about 42 ha and its maximum depth is 5 m. The lake

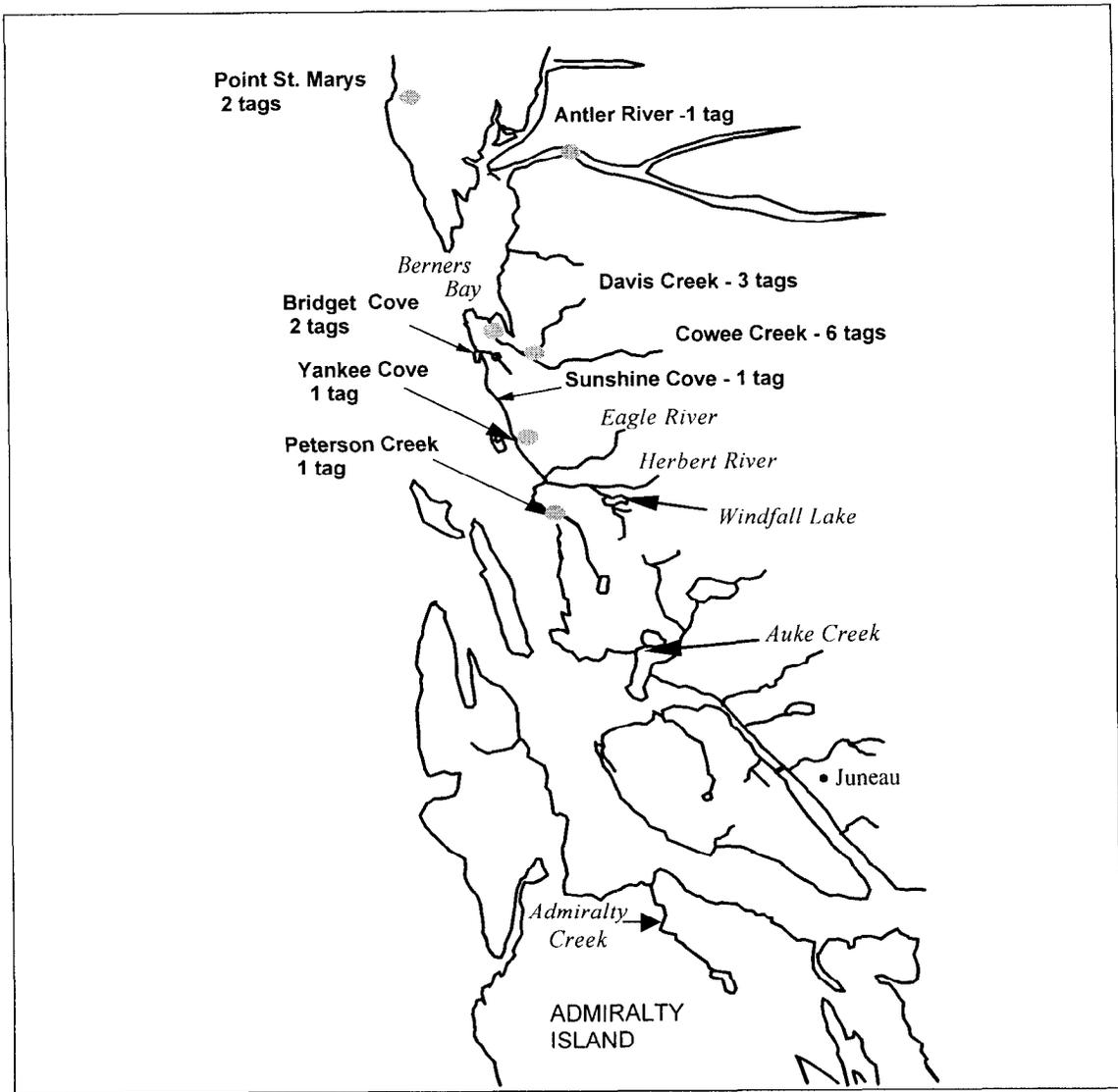


Figure 1.—Windfall Lake and location of area streams in the Juneau roadside system, Southeast Alaska, where sea-run cutthroat trout were tracked in 1997.

has two major inlets: Windfall-Slate Creek, which enters into the southwest corner of the lake, and an unnamed stream which enters the southeast corner of the lake. Windfall Lake empties into Herbert River through a low-gradient outlet stream 0.8 km in length with many riffles and pools ranging to 2 m deep.

## METHODS

The weir on Windfall Creek was operational from 10 April through 31 May to intercept all migrating

cutthroat trout and Dolly Varden char. On 1 June, the weir operation continued as a salmon project to count sockeye salmon into Windfall Lake, but counts also continued for cutthroat trout and Dolly Varden. The abundance of cutthroat trout  $\geq 180$  mm fork length (FL) in Windfall Lake was estimated by using a two-event, mark-recapture experiment.

## WEIR

An aluminum bipod weir overlaid with vexar netting (18.75-mm square openings) and with separate emigrant/immigrant traps (2.5-m square)

was constructed on Windfall Creek approximately halfway between the outlet of Windfall Lake and the confluence with Herbert River. The numbers of cutthroat trout and Dolly Varden outmigrating from 10 April through 31 May are detailed in this report. Each migrant Dolly Varden char and cutthroat trout captured between 10 April and 31 May was counted. Mortalities found in either trap or on the weir (including predation-caused and of apparent natural causes) were included in the daily total but noted separately.

All Dolly Varden char were counted and adipose finclipped so they could be detected in fisheries on the Juneau roadside and as they entered Auke Lake through Auke Creek weir. No other studies were being conducted on Dolly Varden in the Juneau area, so the adipose clip was unique to Windfall Lake emigrating fish. Length data were collected from a systematic sample (1 in 20) of the daily Dolly Varden char emigration, and every 20th Dolly Varden was tagged with a uniquely numbered Floy tag. Samples were taken by holding (placing in a pen) the 1st, 21st, 41st, 61st, 81st, etc., fish passed downstream. Length was measured to the nearest millimeter from the tip of the snout to the fork of the tail (fork length).

All cutthroat trout were measured to the nearest millimeter. Fish  $\geq 180$  mm were tagged with a uniquely numbered Floy tag, were given a secondary clip of the left axillary process above the left pelvic fin, placed in a holding tank filled with water, and sampled for scales. Uniquely numbered tags provided us a means to gather information on the distribution of these fish in local sport fisheries as well as to identify migrating fish during the cutthroat trout mark-recapture experiment. Cutthroat trout  $\leq 180$  mm were also given a secondary mark by clipping the left ventral fin.

Radiotelemetry was used to determine the proportion of sea-run cutthroat trout leaving Windfall Lake: 58 cutthroat trout ( $\geq 300$  mm FL) leaving the system were implanted with radio transmitters to evaluate the distribution and life history characteristics of fish leaving the system for salt water. The 300-mm cutoff point was selected to insure tags did not exceed the recommended maximum of 2% of the fish's body weight (Winter 1983). Fish were systematically

selected from all emigrants  $\geq 300$  mm FL. Fish selected were alternately given either an esophageal implant or an externally attached tag.

A data logger to detect radio signals was installed downstream of the confluence of the Eagle and Herbert rivers to record date and time of the movement of radio-tagged fish out of the Windfall system. Weekly aerial surveys were also conducted from north Douglas Island to Berners Bay to locate radio tags (in and out of the Windfall system), and foot surveys were used to investigate the status of located fish. Aerial receivers were used with wing-mounted antennae aboard a DeHavilland DHC-2 Beaver aircraft. Tracking flights were conducted until the expected life of the last external radio tag released below the weir had expired. During each aerial survey, an attempt was made to locate all tags whose location remained unknown. Search locations were noted during each flight. Foot surveys were conducted after tracking flights to streams where tags were located from the air. Personnel located fish/transmitters using hand-held receivers.

The proportion of sea-run emigrant fish was estimated using a stratified estimator in order to account for unequal tagging rates over time. Within each tagging stratum, the sea-run proportion was estimated as the number of fish having "sea-run" fates divided by the number of all marked fish with known fates.

The estimated proportion  $\hat{p}_a$  of sea-run cutthroat was computed (Cochran 1977):

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

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

$$\hat{p}_a = \frac{1}{N} \sum W_h^2 \hat{p}_{a,h}$$

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

where  $\hat{p}_{a,h}$  is the estimated proportion of the population of cutthroat trout in stratum  $h$  that were sea-run,  $n_{a,h}$  is the number of sea-run fish marked in stratum  $h$  and successfully tracked to a location through salt water,  $n_h$  is the number of fish marked in stratum  $h$  and successfully tracked to any location,  $N_h$  is the total number of fish counted at the weir in stratum  $h$ ,  $W_h = N_h/N$ , and  $N = \sum N_h$ .

Captured emigrants were alternately tagged: one tag as a stomach insertion and the next as an external attachment. Radio tags were supplied by Advanced Telemetry Systems (ATS) of Isanti, Minnesota. Twenty-five (25) radio tags were used for stomach insertions and 25 radio tags were externally attached; all selected cutthroat trout were  $\geq 300$  mm. All radio tags transmitted on a frequency in the 152 MHz range.

The external radio transmitters were ATS model LT-2-357 with silver oxide battery and a 30-day battery life. The tags were 5 g in weight, 13 mm wide, 6–7 mm thick, and 35 mm long. Externally attached radio tags were encased in molded plastic with two attachment holes. A surgical needle was used to pass a suture (a dissolvable cotton material) through the adipose tissue beneath the dorsal fin and between the pterygiophore bones. The transmitter was snubbed against the fish and the sutures were threaded through the holes in the plastic plate. With the plate positioned against the fish, knots were tied in the sutures to prevent them from pulling through the fish. A neoprene pad was placed between the radio tag and the fish to reduce abrasions. In addition, the attached tags were positioned so the whip antenna did not extend beyond the caudal fin.

Internal radio transmitters used for stomach insertion were ATS model 10-28, 9.5 mm in diameter and 25.4 mm in length. The tags broadcast on a radio frequency of 152 MHz. Each transmitter weighed 5.0 g, which constituted less than 2% of the body weight of a cutthroat trout 300 mm in length (Winter 1983). The 254-mm antenna for each transmitter protruded from the mouth of the fish. Internal tags also had a 30-day battery life. All radio-tagged fish were released below the weir after being held for a 24-h period.

## CUTTHROAT TROUT ABUNDANCE IN WINDFALL LAKE

The marking event to estimate abundance in Windfall Lake took place between 14 July and 19 July. The recapture event took place from 29 July through 2 August 1997. Large funnel traps and hoop traps baited with Betadine-treated salmon eggs, and hook and line, were used to capture cutthroat trout during each sampling event.

Funnel traps were 1.5 m long and 0.6 m in diameter, with a 9-cm opening in each end of the trap and a mesh size of 1 cm. Hoop nets were 1.4 m long and consisted of four 0.6-m-diameter hoops with 9-cm-diameter throats attached to the first and third hoops, and a mesh size of 1 cm. Catch, trap number, trap depth, and the number of gear units (trap-hours or rod-hours) for each gear type were recorded each sampling day. Hook and line gear was fished by casting from a boat, and effort was concentrated during the morning and evening hours. Effort was recorded as the number of rods and the time each rod was fished.

The abundance experiment was designed to take place after the mature, sea-run cutthroat trout had emigrated, using the weir counts to determine when this has occurred. The best available data for estimating the timing for the sampling periods were based on abundance experiments conducted at Sitkoh Lake and Lake Eva (Armstrong 1971, Yanusz and Schmidt 1996, Yanusz 1997). The smallest number of migrants moving in and out of Lake Eva occurred approximately 14 July (Yanusz and Schmidt 1996), when an average 94% of emigration and 4% of immigration were complete. Therefore, the first abundance sampling at Windfall Lake was scheduled for 14 July, to minimize the possibility of capturing outmigrating fish.

Windfall Lake was divided into 21 roughly equal areas (Appendix A2). One trap per sample day was systematically set in each area. A two-person crew conducted one 5-day marking event, followed by a 10-day hiatus (mixing), and then a second 5-day recapture event. During the marking event, cutthroat trout  $\geq 180$  mm FL in good physical condition were tagged with a uniquely numbered Floy tag, sampled for scales, and measured to the nearest mm FL, given a secondary mark (a punch in the anal fin) and

released back into the lake. During the recapture event, all captured cutthroat trout were examined for marks, measured to the nearest mm FL and given a secondary mark (clipped half of the right ventral fin) for identification as repeat captures. Unmarked fish  $\geq 180$  mm FL were sampled for scales but were not uniquely tagged. Cutthroat trout with tags or marks captured at the weir were recorded but were not included in the abundance experiment.

Daily trap placement was determined by randomly selecting from the grid of 21 established sample areas at Windfall Lake. The first point was randomly selected, and the remaining points were systematically and evenly spaced from the first point. Traps were set on the lake bottom and depths were determined with a fathometer. Capture data for each trap were recorded to ensure the grid points (x-y locations) and depths could be associated with the data recorded for each fish captured.

Abundance was estimated with Chapman's modified Petersen estimator (Seber 1982):

$$\hat{N} = \frac{(n_1 + 1)(n_2 + 1)}{(m_2 + 1)} - 1$$

$$V[\hat{N}] = \frac{(n_1 + 1)(n_2 + 1)(n_1 - m_2)(n_2 - m_2)}{(m_2 + 1)^2 (m_2 + 2)}$$

where

$\hat{N}$  = abundance of cutthroat trout  $\geq 180$  mm FL;

$n_1$  = number of cutthroat trout  $\geq 180$  mm FL marked in event 1;

$n_2$  = number of cutthroat trout  $\geq 180$  mm FL examined in event 2;

and

$m_2$  = the number of marked cutthroat trout recaptured in event 2.

## RESULTS

From 10 April, when the Windfall Creek weir was made fish-tight, through 31 May, 616 cutthroat trout passed downstream (Appendix A1). Due to a flood on 12 May and the possibility that fish

escaped the weir during the high water, these numbers are considered a minimum count. Of the fish outmigrating in the spring, 275 (44.6%) were  $\geq 300$  mm FL and assumed to be mature trout. The first trout was captured on 12 April and the daily counts peaked on 11 May. Water temperatures were 1°C at the start of the outmigration on 12 April, and peaked at 14°C late in May. There was no correlation between water temperature or gauge height and trout emigration during the outmigration (Figure 2). The midpoint of the run occurred on 13 May and the 5th and the 95th percentile of the emigration spanned 5 weeks.

The total number of outmigrating cutthroat trout that were  $\geq 356$  mm, or legal minimum length (14 inches) for retention under current regulations, was 123 fish (20%). Captured fish ranged in length from 159 mm to 466 mm ( $n = 616$ ). The greatest proportion of outmigrating cutthroat trout was in the 341–360 mm range (Figure 3). The mean weekly FL of sea-run cutthroat trout decreased over time, with a sharp decline starting the week of 11 May (Figure 4). The maturity of cutthroat trout also changed over time, with the larger mature fish outmigrating first (Figures 4 and 5) followed by smaller, immature fish (Figure 6).

Fifty-eight (58) cutthroat trout  $\geq 300$  mm FL were tagged with radio tags (25 were external tags); 7 regurgitated tags were reused in newly caught emigrants. One external tag was lost (fish died) and recovered below the weir, and reused on another fish. Seventeen (17) sea-run cutthroat trout were tracked out of the Eagle/Herbert/Windfall system and assumed to be sea-run fish. One fish was tracked out of the Herbert system into salt water but was never heard again. The tag was assumed to have been regurgitated into salt water where the signal is lost to our aerial tracking equipment, or the fish assumed to have died.

Radio tags were detected in seven streams outside of the Herbert/Eagle river system (Figure 1; Appendix A3). We estimate that 27% (SE = 3.1%) of the total outmigration from Windfall Lake were sea-run cutthroat (166 of the total 616 cutthroat trout through the weir). We stratified the data into three seasonal strata based on actual changes in the tagging fractions due to tagging rates and tag loss (Table 1). The proportion of

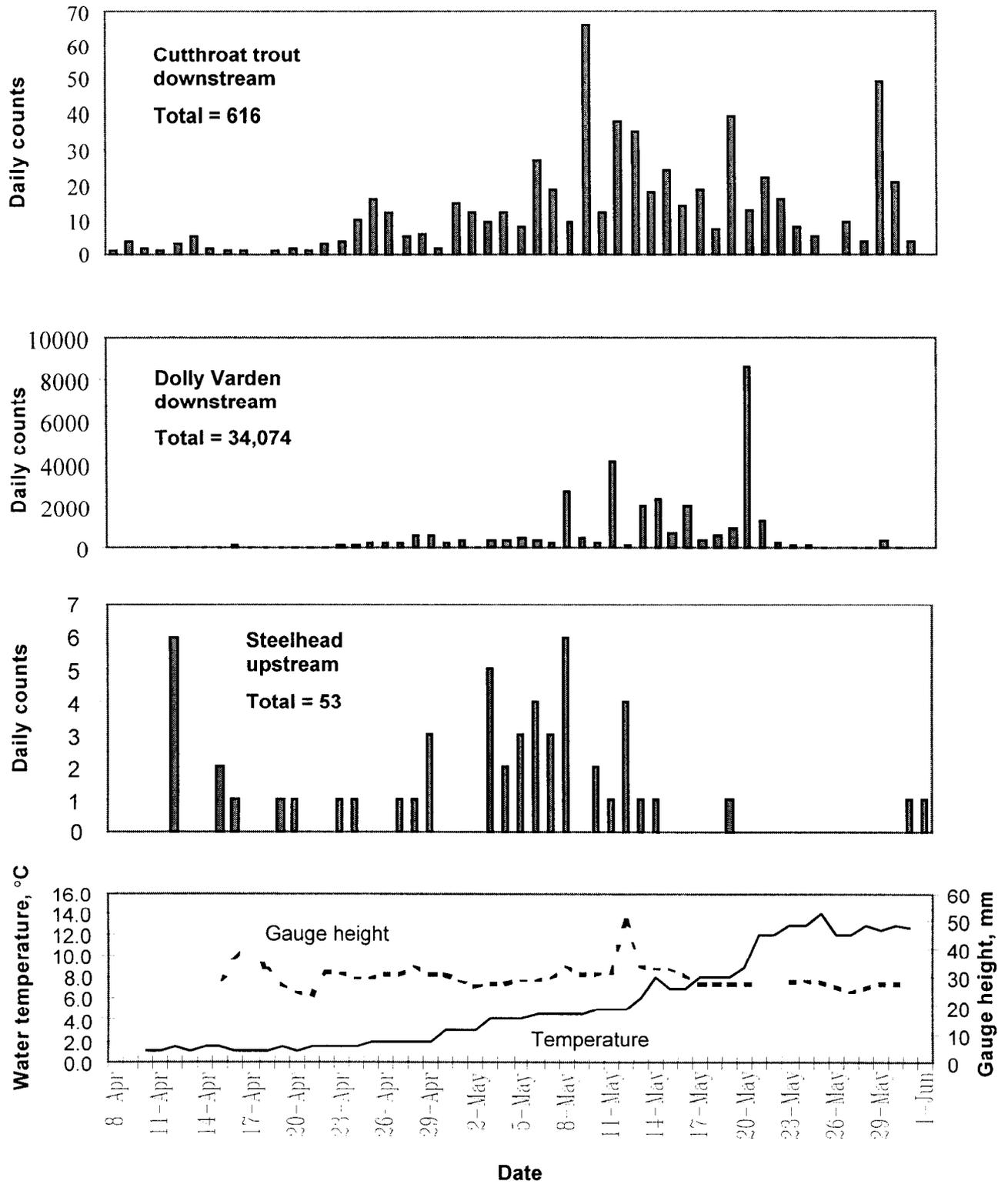


Figure 2.—Daily counts of cutthroat trout, Dolly Varden, and steelhead with daily water gauge height and water temperature at the Windfall Creek weir during 1997.

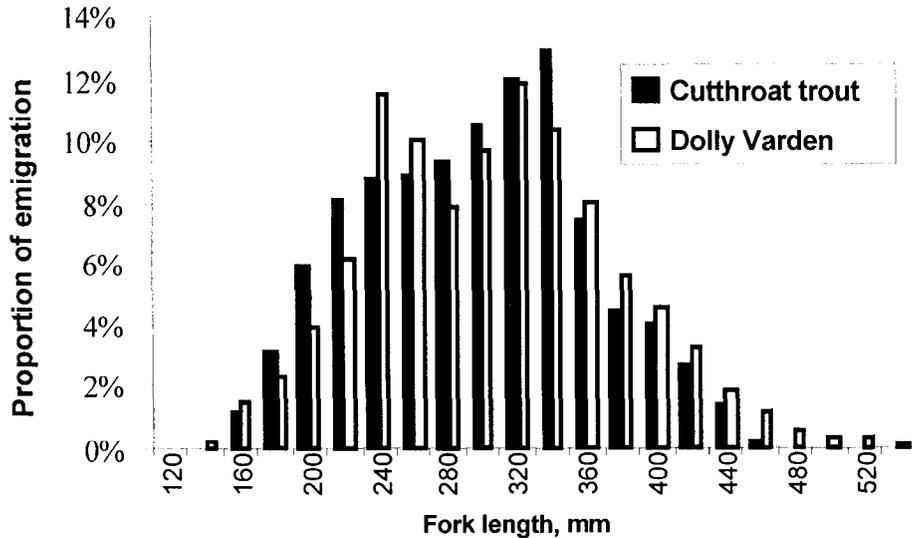


Figure 3.—Length-frequency distributions of cutthroat trout and Dolly Varden emigrating from Windfall Creek during 1997.

sea-run cutthroat trout dropped from 46% (6 of 13 tagged fish) in the first stratum (12–27 April) to 35% (9 of 26 tagged fish) in the second stratum (28 April–10 May), and to 22% (4 of 18) in the third and final stratum (11–31 May).

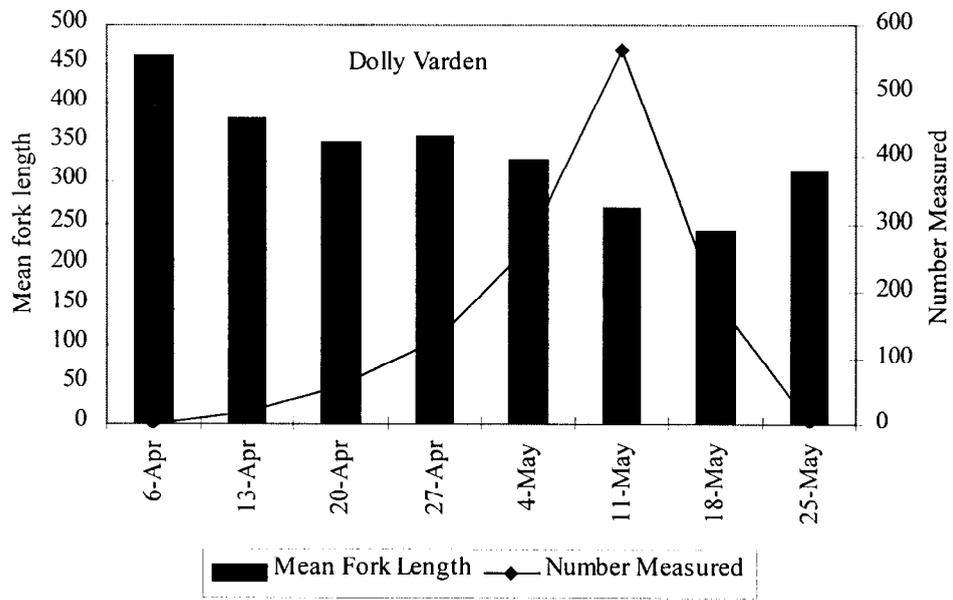
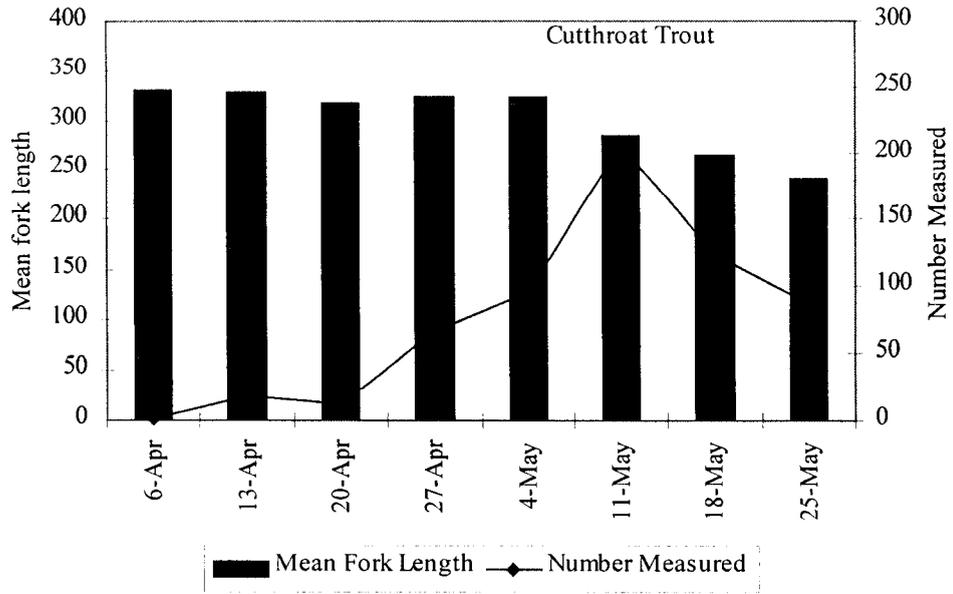
The total number of Dolly Varden passed downstream through the weir was 34,074 fish (Appendix A1, Figure 2). The first Dolly Varden was captured on 12 April, and the daily count peaked on 20 May when 8,591 passed downstream. Most of the emigration occurred when water temperatures were between 5°C and 13°C. Daily counts of emigrant Dolly Varden were not correlated to gauge heights (Figure 2). The midpoint of the emigration occurred on 14 May, with four weeks between the 5th and the 95th percentile of run. Fifty-two (52) Dolly Varden were passed upstream through the weir through the end of May. The upstream migration began on 12 April and was continuous until the weir was removed on 17 August.

The mean FL of all emigrant Dolly Varden char sampled during 1997 was 292 mm (SE = 8 mm) and the range was 136–560 mm. The length

distribution of emigrant Dolly Varden was somewhat bimodal, peaking in the 241–260 mm range and again in the 321–340 mm range (Figure 3). Mean weekly FL of Dolly Varden varied between weeks but generally decreased over time (Figure 4).

Forty-two (42) adipose finclipped or tagged Dolly Varden from the Windfall Creek weir study were recovered in fisheries in the Juneau area (Figure 7, Appendix A4). Most of those (19) were caught in the Echo Cove/Cowee Creek area, and six were caught off the mouth of the Eagle/Herbert rivers. Three fish were caught near Hawk Inlet in Greens Creek and Wheeler Creek. In addition, 63 Dolly Varden marked during this study were recorded migrating through Auke Creek weir in the late summer and fall of 1997, presumably to overwinter.

Fifty-three (53) steelhead were counted upstream during the period the weir was operated for trout. The first steelhead passed through the weir on 12 April and the daily count peaked on 8 May with six fish (Table 1). There were six fish passed upstream the two days after the weir was installed, but that



**Figure 4.—Number of fish (N) measured and mean fork length (FL) by week for cutthroat trout and Dolly Varden at Windfall Lake, 1997.**

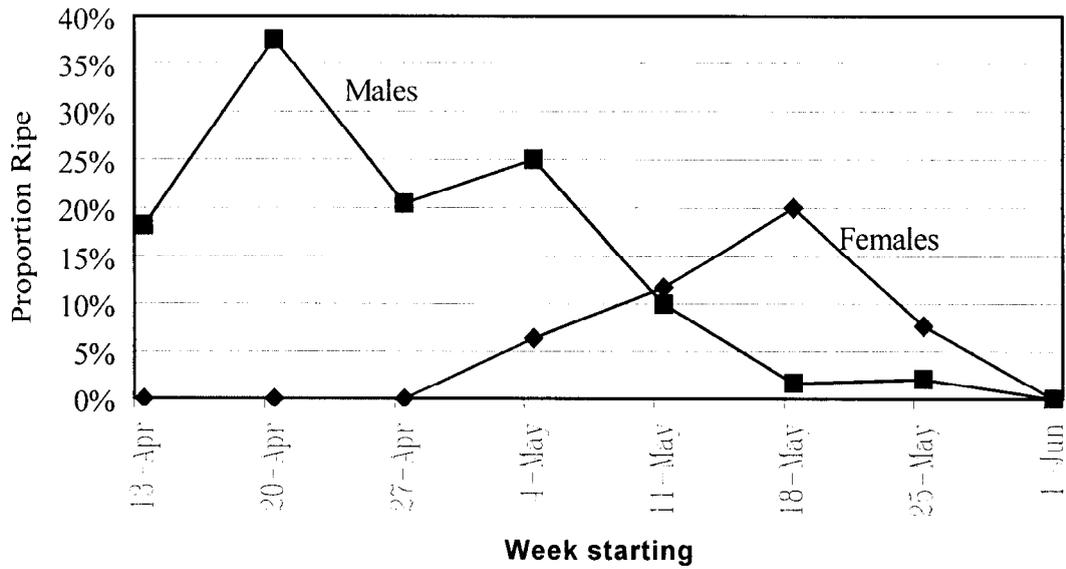


Figure 5.—Weekly proportion of cutthroat trout passing through the Windfall Lake weir in 1997 which exhibited characteristics of sexual maturity.

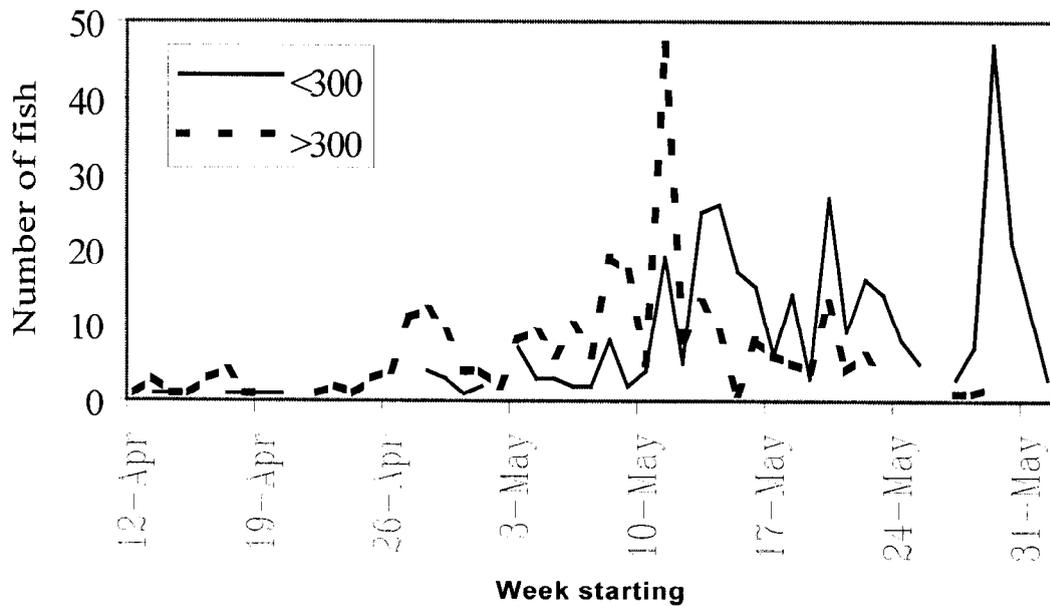


Figure 6.—Daily number of outmigrating cutthroat trout  $\geq 300$  mm and trout  $< 300$  mm in length at Windfall Creek, 1997.

**Table 1.—Daily cutthroat trout outmigration and tagging fraction by date for Windfall Creek, 1997.**

Date	Daily	Cum.	Percent	Successful		Percent tagged	Number sea-run
				Tags	Cum.		
12-Apr	1	1	0				
13-Apr	4	5	1				
14-Apr	2	7	1				
15-Apr	1	8	1				
16-Apr	3	11	2	1	1	9	
17-Apr	5	16	3	1	2	13	
18-Apr	2	18	3	1	3	17	
19-Apr	1	19	3	1	4	21	
20-Apr	1	20	3	1	5	25	
21-Apr	0	20	3	1	6	30	
22-Apr	1	21	3	2	8	38	1
23-Apr	2	23	4	2	10	43	2
24-Apr	1	24	4	2	12	50	2
25-Apr	3	27	4	1	13	48	1
26-Apr	4	31	5		13	42	
27-Apr	10	41	7		13	32	
28-Apr	16	57	9		13	23	
29-Apr	12	69	11	1	14	20	1
30-Apr	5	74	12	6	20	27	2
1-May	6	80	13	5	25	31	2
2-May	2	82	13	2	27	33	1
3-May	15	97	16	1	28	29	
4-May	12	109	18	2	30	28	1
5-May	9	118	19	1	31	26	
6-May	12	130	21	2	33	25	1
7-May	8	138	22	1	34	25	
8-May	27	165	27	2	36	22	
9-May	19	184	30	1	37	20	
10-May	9	193	31	2	39	20	1
11-May	66	259	42	2	41	16	
12-May	12	271	44	1	42	15	
13-May	38	309	50	4	46	15	
14-May	35	344	56	2	48	14	1
15-May	18	367	60	2	50	14	1
16-May	24	386	63	3	53	14	
17-May	14	400	65	2	55	14	1
18-May	19	419	68	2	57	14	1
19-May	7	426	69		57	13	
20-May	39	465	75		57	12	
21-May	13	478	78		57	12	
22-May	22	500	81		57	11	
23-May	16	516	84		57	11	
24-May	8	524	85		57	11	
25-May	5	529	86		57	11	
26-May	0	529	86		57	11	
27-May	9	538	87		57	11	
28-May	4	542	88		57	11	
29-May	49	591	96		57	10	
30-May	21	612	99		57	9	
31-May	4	616	100		57	9	

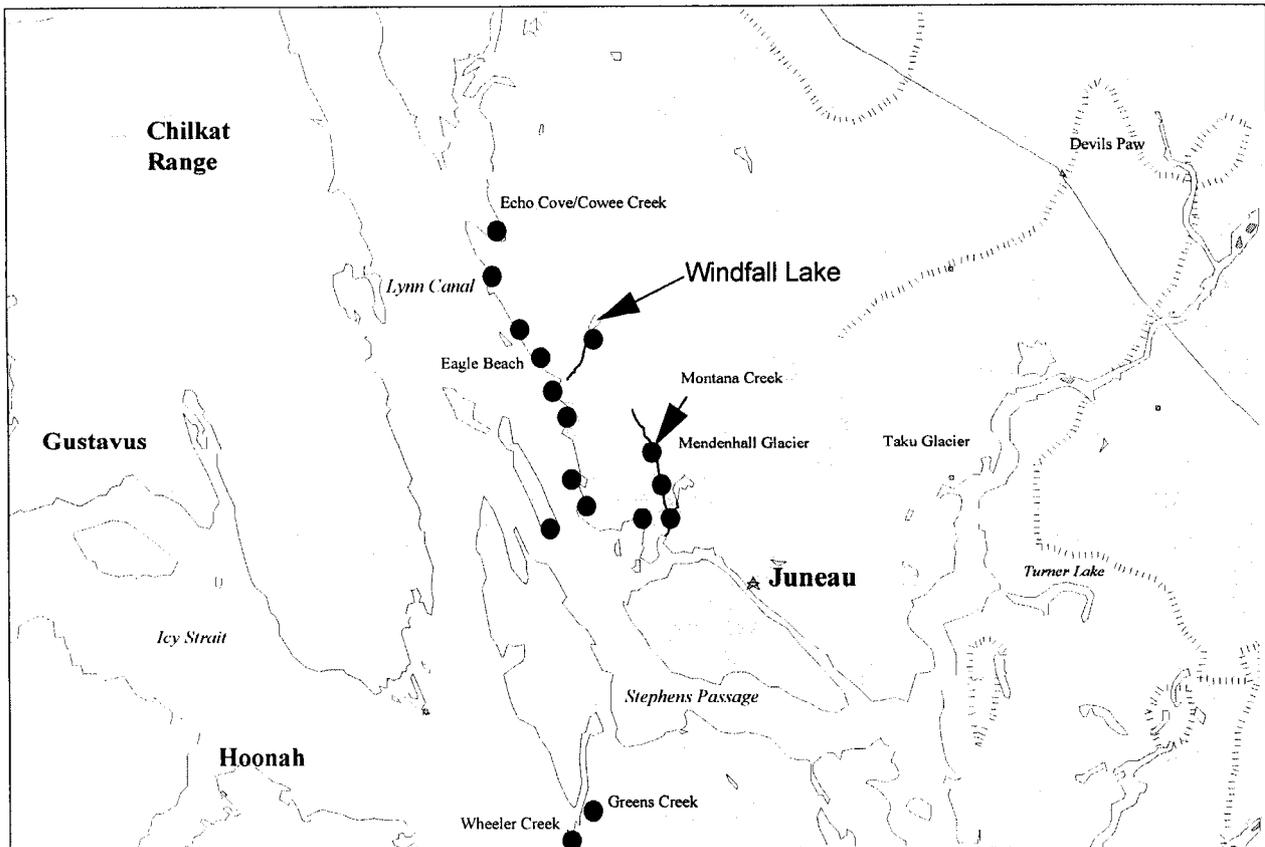


Figure 7.—Recovery locations of Dolly Varden tagged at the Windfall Creek weir that were subsequently caught in sport fisheries and reported to ADF&G in 1997.

probably represents fish which held downstream during all the activity of weir-building and thus does not represent a peak in run timing. The mean FL for all steelhead was 770 mm; 28 were female and 25 were males.

#### CUTTHROAT TROUT ABUNDANCE IN WINDFALL LAKE

We captured, marked, and released a total of 152 cutthroat trout between 180 mm and 399 mm FL during the marking event (Figure 8). An additional ten fish captured during the marking event had previously immigrated through the weir and were already marked. During the recapture event, 32 cutthroat trout (between 180 mm FL and 362 mm FL) were caught and inspected for marks. Of the fish inspected during the recapture event, five had been marked in the marking event and four others had been marked as they immigrated through the weir (Table 2).

Tests were not conducted to evaluate differences between the length distributions of fish captured during the marking or recapture events because of the small number of recaptured fish ( $n = 5$ ). Therefore, length data for both events were pooled to estimate length composition (Table 3).

The small sample size of fish recaptured also negated any hypothesis testing of equal probability of capture by area. The Chapman's modified Petersen estimator, with no stratification by length or area, was used to estimate the abundance of cutthroat trout in Windfall Lake at 841 (SE = 282)  $\geq 180$  mm FL. Relative precision for the estimate is  $\pm 65\%$ , for a 95% confidence interval. However, this abundance estimate is based on a small recapture sample size ( $n = 5$ ) and thus is imprecise and may be biased (Seber 1982, p. 60).

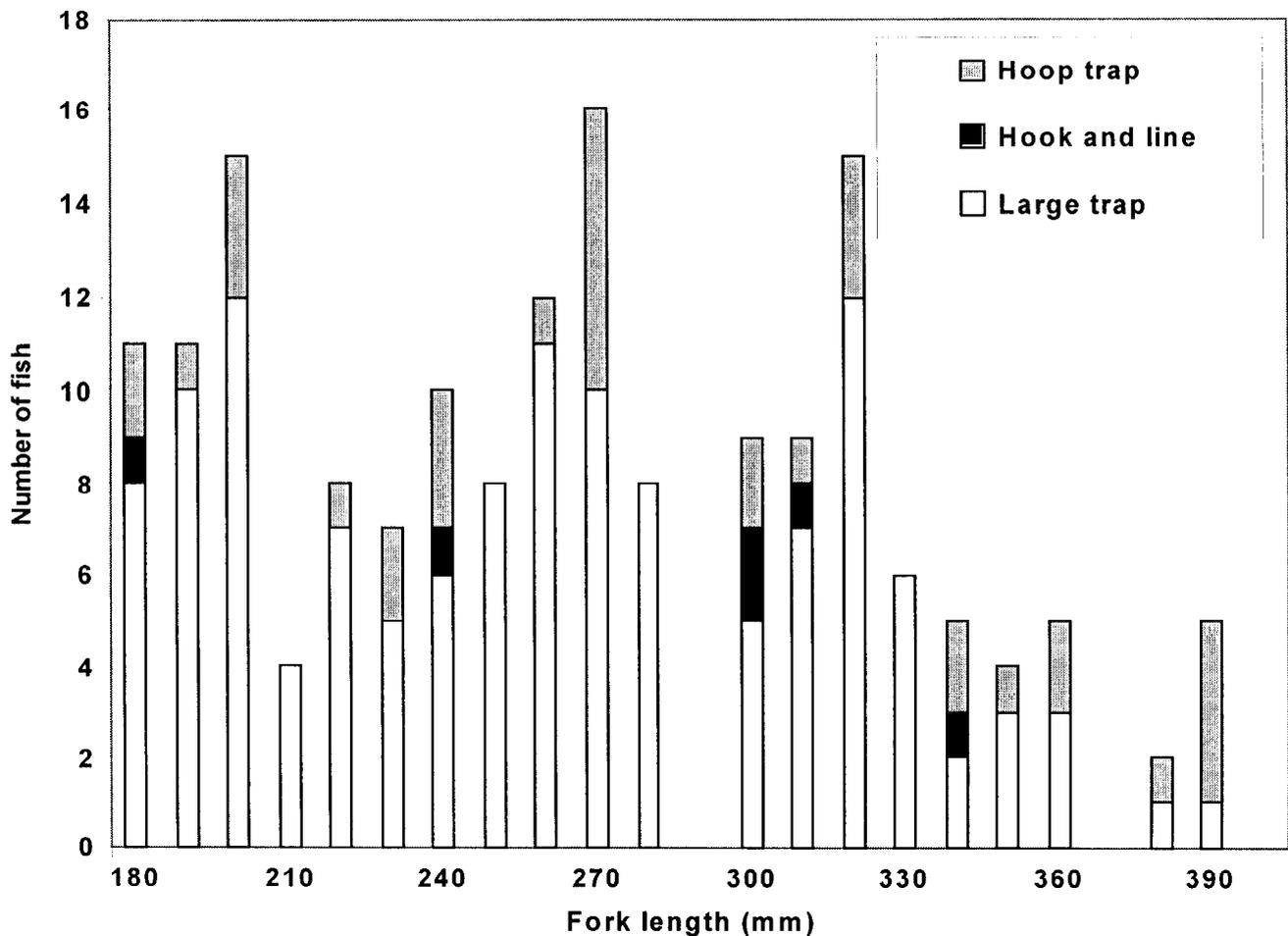


Figure 8.—Length frequencies of cutthroat trout captured at Windfall Lake by gear type, 1997.

## DISCUSSION

The number of cutthroat trout outmigrating from Windfall Creek in 1997 (616) was comparable with the outmigration of 500 at Auke Lake in 1997 (Taylor and Lum 1998). The abundance at both sites on the Juneau roadside (Windfall and Auke creeks) was well below recent estimates from other sites. At Sitkoh Creek, 3,955 cutthroat trout were counted downstream in 1996 (Yanusz 1997), at Eva Creek 1,233 to 2,562 fish (Armstrong 1971; Yanusz and Schmidt 1996). The counts were similar to counts at Kook Lake of 345 to 564 fish (David Barto, Alaska Department of Fish and Game, personal communication). The mean FL of cutthroat trout leaving Windfall Lake (287 mm) was comparable

to Sitkoh Creek at 284 mm in 1996 (Yanusz 1997); it also compares favorably with other systems such as Eva Creek at 303 mm (Yanusz and Schmidt 1996), and 233 to 330 mm at Auke Lake (Jerry Taylor, National Marine Fisheries Service, personal communication).

The estimated number of sea-run cutthroat trout using Windfall Lake as an overwintering site (166 fish) suggests that this is an important site for cutthroat trout on the Juneau roadside.

We encountered problems with fish regurgitating the stomach implanted tags early in the outmigration. Seven fish with stomach implant tags lost their tags (28% tag loss, Figure 9). After resolving the initial problems with regurgitation and reinsertion of those tags, no additional lost

**Table 2.—Number of cutthroat trout captured by day and by gear type in Windfall Lake, 1997.**

DATE	GEAR			Total captured
	Hoop net	Hook & line	Large trap	
<b>Marking event</b>				
7/15/97	13	0	70	83
7/16/97	0	1	23	24
7/17/97	5	0	18	23
7/18/97	5	0	9	14
7/19/97	13	0	10	23
Event totals	36	1	130	167
<b>Recapture event</b>				
7/28/97		1		1
7/29/97	3	1	8	12
7/30/97	0	1	3	4
7/31/97	5	0	2	7
8/01/97	3	0	4	7
8/02/97	0	0	5	5
Event totals	11	3	22	36
Combined totals	47	4	152	203

tags were recovered in any of our foot surveys. When we successfully tracked a tag on foot, we were able to make fish move and verify that the tags (both stomach and external tags) were still in live fish. Even then, we were unable to visually locate the fish.

Tracking on foot for tagged fish was difficult and we did not observe any spawning fish during this study. We tracked fish to specific pools or stream areas in Cowee Creek, Peterson Creek, and tributaries to Eagle River but were never able to see any of the fish. As a result, this study most accurately documents movements of trout after they left Windfall Creek; actual spawning location and/or spawning success was not documented.

The abundance estimate for Windfall Lake lacks precision and may be biased as a result of small sample sizes; only 36 fish were captured during the second or recapture event. The low catch rates during the second sampling event may result from sockeye entering the lake to spawn and attracting resident cutthroat trout into inlet streams, leaving fewer cutthroat in the lake to be captured.

**Table 3.—Length composition statistics for cutthroat trout  $\geq 180$  mm FL, Windfall Lake, 1997.** Number ( $n_k$ ), proportion ( $p_k$ ) abundance ( $N_k$ ), standard error (SE), and coefficient of variation (CV) for each 20-mm length class.

LENGTH k	$n_k$	$p_k$	$V[p_k]$	$SE[p_k]$	$CV[p_k]$	$N_k$	$V[N_k]$	$SE[N_k]$	$CV[N_k]$
180-199	22	0.1294	0.0007	0.0258	0.1995	112	1861	43	0.384
200-219	19	0.1118	0.0006	0.0242	0.2169	97	1449	38	0.392
220-239	15	0.0882	0.0005	0.0218	0.2473	77	977	31	0.408
240-259	18	0.1059	0.0006	0.0237	0.2235	92	1322	36	0.396
260-279	28	0.1647	0.0008	0.0285	0.1732	143	2837	53	0.372
280-299	8	0.0471	0.0003	0.0163	0.3462	41	365	19	0.467
300-319	18	0.1059	0.0006	0.0237	0.2235	92	1322	36	0.396
320-339	21	0.1235	0.0006	0.0253	0.2049	107	1718	41	0.386
340-359	9	0.0529	0.0003	0.0172	0.3253	46	435	21	0.454
360-379	5	0.0294	0.0002	0.0130	0.4419	26	186	14	0.534
380-400	7	0.0412	0.0002	0.0153	0.3712	36	300	17	0.484
<i>n</i>	170					868			

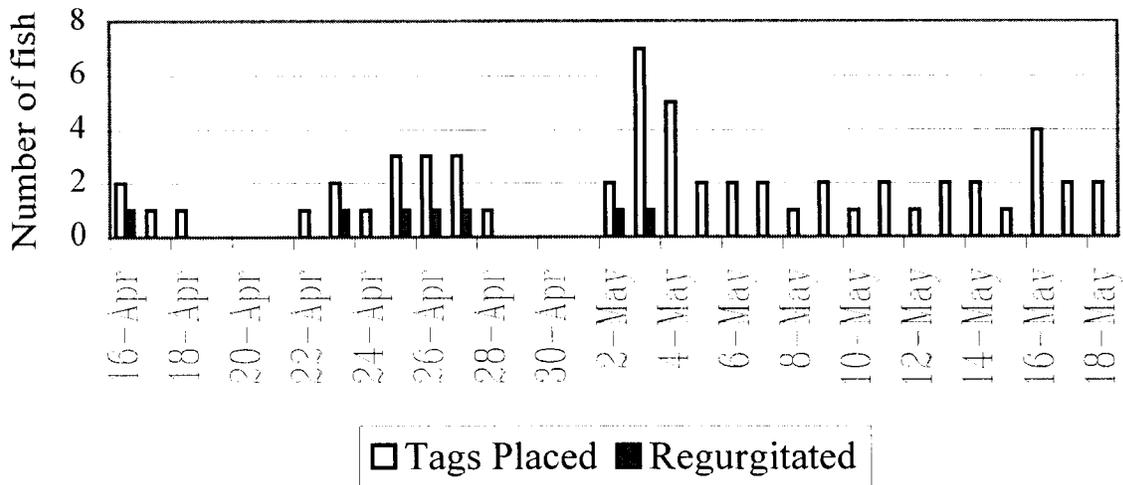


Figure 9.—Dates and number of cutthroat trout radio-tagged with esophageal tags and fish that regurgitated tags at Windfall Lake, 1997.

The abundance of overwintering Dolly Varden at Windfall Creek (34,074) compares favorably with other areas: Lake Eva—38,957 to 117,821 fish (Heiser 1966; Yanusz and Schmidt, 1996); Auke Lake—3,052 to 11,728 fish (Jerry Taylor, National Marine Fisheries Service, personal communication); Kook Lake—10,519 to 29,595 fish (David Barto, Alaska Department of Fish and Game, Douglas, personal communication); Buskin Lake—30,725 to 90,600 fish (Whalen 1993); and Sitkoh Creek—48,252 fish (Yanusz 1997).

Dolly Varden are thought to have a high fidelity to their overwintering site (Armstrong 1965, Bernard et al. 1995), but this study documented 63 fish moving into Auke Lake during fall 1997, presumably to overwinter. That represents a small percentage of the total number emigrating from Windfall Lake, but it is likely that if some fish overwintered in Auke Lake, other Dolly Varden may be using other lakes in the area as well.

The mean fork length of Dolly Varden emigrating from Windfall Creek of 296 mm compared favorably with a mean of 266 mm emigrating in 1996 from Sitkoh Creek (Yanusz 1997), 304 mm at Lake Eva in 1995 (Yanusz and Schmidt 1996) and 322 mm (Whalen 1992) and 284 mm (Whalen 1993) at Buskin Lake. Weir designs were identical

at Eva Creek, Sitkoh Creek, and Windfall Creek; all retained fish >150 mm FL, and systematic sampling was used at all three sites, so comparative bias should be minimal between mean fork lengths. The Buskin Lake weir had larger plastic mesh (25.4 mm square) that retained fewer small fish (>210 mm FL); consequently, mean fork lengths are not comparable. The mean fork length of Auke Creek Dolly Varden was 234 mm in 1992 (Jerry Taylor, National Marine Fisheries Service, personal communication)—much smaller than those in Windfall Creek, but the Auke Creek weir was constructed of metal screen with 1/8-inch circular openings and would therefore retain more small fish (>30 mm FL), making a comparison between the sampled fork lengths at the two locations invalid.

## CONCLUSIONS

This study demonstrated that Windfall Lake serves as an important overwintering site for mixed stocks of sea-run cutthroat trout and Dolly Varden as well as resident trout from the Herbert and Eagle river drainage. These fish, based on tag returns, contribute to fisheries throughout the Juneau roadside including most of the important local stream systems.

Externally attached radio tags appeared to be more reliable than the stomach implanted tags. Future studies should consider using external tags with a biodegradable attachment.

## ACKNOWLEDGMENTS

We would like to thank Rich Yanusz for his help and his field crew. Mike Dean provided the oversight for the field aspects of this project. Kurt Kondzela and Judy Lum assisted with the aerial tracking.

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## **APPENDIX A**



Appendix A1.—Daily fish counts, water temperature, and water level at the Windfall Creek weir during 1997.

Date	Water Level (cm)	Temp. (°C)	DOLLY VARDEN				CUTTHROAT				STEELHEAD				SH SMOLT/RAINBOW				Comments	
			Down		Up		Down		Up		Down		Up		Down		Up			
			Daily	Cum.	Daily	Cum.	Daily	Cum.	Daily	Cum.	Daily	Cum.	Daily	Cum.	Daily	Cum.	Daily	Cum.		
4/10/97		1.0		0		0		0		0		0		0		0		0		
4/11/97		1.0		0		0		0		0		0		0		0		0		
4/12/97		1.5		31		31		0		1		1		0		0		6		6
4/13/97		1.0		41		72		0		4		5		0		0		0		6
4/14/97		1.5		54		126		0		2		7		0		0		0		6
4/15/97	29.0	1.5		65		191		0		1		8		0		0		2		8
4/16/97	37.0	1.0		156		347		0		3		11		0		0		1		9
4/17/97	42.0	1.0		81		428		0		5		16		0		0		0		9
4/18/97	33.0	1.0		39		467		0		2		18		0		0		0		9
4/19/97	27.5	1.5		11		478		0		1		19		0		0		1		10
4/20/97	25.0	1.0		12		490		0		1		20		1		1		1		11
4/21/97	24.0	1.5		15		505		0		0		20		0		1		0		11
4/22/97	32.0	1.5		61		566		0		1		21		0		1		1		11
4/23/97	31.5	1.5		160		726		0		2		23		0		1		1		12
4/24/97	30.0	1.5		120		846		0		1		24		0		1		1		13
4/25/97	30.0	2.0		250		1,096		0		3		27		0		1		0		13
4/26/97	31.0	2.0		308		1,404		0		4		31		1		2		0		13
4/27/97	31.0	2.0		313		1,717		0		10		41		1		3		0		14
4/28/97	34.0	2.0		641		2,358		0		16		57		0		3		0		15
4/29/97	31.0	2.0		596		2,954		0		12		69		0		3		0		15
4/30/97	31.0	3.0		276		3,230		0		5		74		0		3		0		18
5/1/97	29.0	3.0		374		3,604		0		6		80		0		3		0		18
5/2/97	27.0	3.0		104		3,708		0		2		82		0		3		0		18
5/3/97	28.0	4.0		387		4,095		0		15		97		0		3		0		23
5/4/97	28.0	4.0		442		4,537		0		12		109		0		3		0		25
5/5/97	29.0	4.0		566		5,103		0		9		118		0		3		0		28
5/6/97	29.0	4.5		447		5,550		0		12		130		0		3		1		2
5/7/97	30.0	4.5		287		5,837		0		8		138		0		3		1		3
5/8/97	34.0	4.5		2,696		8,533		0		27		165		0		3		0		3
5/9/97	31.0	4.5		507		9,040		0		19		184		0		3		1		4
5/10/97	31.0	5.0		305		9,345		0		9		193		0		3		0		4
5/11/97	32.0	5.0		4,103		13,448		0		66		259		0		3		0		4
5/12/97	50.0 <sup>1</sup>	5.0		187		13,635		0		12		271		0		3		0		4
5/13/97	34.0	6.0		2,077		15,712		0		38		309		0		3		3		7
5/14/97	33.0	8.0		2,362		18,074		0		35		344		0		3		0		7
5/15/97	33.0	7.0		764		18,838		0		18		362		0		3		0		7
5/19/97	28.0	8.0		1,027		22,918		0		7		426		0		3		0		7
5/20/97	28.0	9.0		8,591		31,509		0		39		465		1		4		0		7

-continued

Appendix A1.– (Page 2 of 4).

Date	Water Level (cm)	Temp. (°C)	DOLLY VARDEN				CUTTHROAT				STEELHEAD				SH SMOLT/RAINBOW				Comments
			Down		Up		Down		Up		Down		Up		Down		Up		
			Daily	Cum.	Daily	Cum.	Daily	Cum.	Daily	Cum.	Daily	Cum.	Daily	Cum.	Daily	Cum.	Daily	Cum.	
5/21/97	28.0	12.0	1,313	32,822		0	13	478	0	4	0	7	0	51	8	215		0	
5/22/97	nr	12.0	264	33,086		0	22	500	0	4	0	7	0	51	13	228		0	
5/23/97	28.5	13.0	210	33,296		0	16	516	1	5	0	7	0	51	5	233		0	
5/24/97	29.0	13.0	128	33,424		0	8	524	0	5	0	7	0	51	4	237		0	
5/25/97	28.5	14.0	106	33,530		0	5	529	0	5	0	7	0	51	13	250		0	
5/26/97	27.0	12.0	1	33,531		0	0	529	0	5	0	7	0	51	0	250		0	
5/27/97	25.0	12.0	8	33,539		0	9	538	0	5	0	7	0	51	0	250		0	
5/28/97	26.0	13.0	39	33,578		0	4	542	0	5	0	7	0	51	3	253		0	
5/29/97	28.0	12.5	420	33,998		0	49	591	0	5	0	7	0	51	24	277		0	
5/30/97	28.0	13.0	75	34,073		0	21	612	0	5	1	8	0	51	12	289		0	
5/31/97	27.0	12.8	1	34,074		0	4	616	0	5	1	9	1	52	0	289		0	
6/1/97				34,074	0	0	5	621	0	5		9	1	53	1	290		0	
6/2/97				34,074	0	0	1	622	0	5		9	0	53	2	292		0	
6/3/97	66.0	13.0	1	34,075	0	0	1	623	0	5		9	0	53	0	292		0	
6/4/97	66.0	13.0	4	34,079	0	0	1	624	0	5	1	10	0	53	2	294		0	
6/5/97	63.5	12.0	3	34,082	0	0	0	624	1	6	1	11	0	53	3	297		0	
6/6/97	63.5	12.0	0	34,082	0	0	0	624	0	6	4	15	0	53	2	299		0	
6/7/97			1	34,083	0	0	0	624	3	9	2	17	0	53	0	299		0	
6/8/97			0	34,083	0	0	1	625	2	11	1	18	0	53	3	302		0	
6/9/97			5	34,088	0	0	5	630	0	11	3	21	0	53	1	303		0	
6/10/97	63.5	13.0	7	34,095	0	0	3	633	5	16	0	21	0	53	1	304		0	
6/11/97	63.5	14.0	0	34,095	0	0	0	633	0	16	2	23	0	53	0	304		0	
6/12/97	63.5	14.0	0	34,095	0	0	5	638	0	16	0	23	0	53	0	304		0	
6/13/97	35.0	12.0	3	34,098	0	0	5	643	0	16	0	23	0	53	5	309		0	
6/14/97	75.0	12.0	9	34,107	1	1	10	653	3	19	13	36	0	53	23	332	1	1	
6/15/97	72.5	12.0	0	34,107	0	1	0	653	0	19	4	40	0	53	0	332	0	1	
6/16/97	67.5	12.0	0	34,107	0	1	0	653	0	19	0	40	0	53	0	332	0	1	
6/17/97	63.5	12.5	0	34,107	0	1	0	653	0	19	0	40	0	53	0	332	1	2	
6/18/97	61.0	12.0	0	34,107	0	1	0	653	0	19	0	40	0	53	0	332	0	2	
6/19/97	66.0	12.5	0	34,107	1	2	0	653	4	23	0	40	0	53	0	332	0	2	
6/20/97	67.3	12.0	2	34,109	3	5	0	653	0	23	0	40	0	53	0	332	1	3	
6/21/97	63.5	14.0	0	34,109	0	5	3	656	0	23	0	40	0	53	2	334	0	3	
6/22/97	62.2	15.5	0	34,109	0	5	3	659	2	25	0	40	0	53	0	334	0	3	
6/23/97	61.5	17.0	0	34,109	1	6	0	659	0	25	0	40	0	53	0	334	0	3	
6/24/97	61.0	17.0	0	34,109	1	7	2	661	5	30	0	40	0	53	8	342	0	3	
6/25/97	59.5	17.0	0	34,109	0	7	0	661	2	32	0	40	0	53	1	343	1	4	
6/26/97	60.0	18.0	0	34,109	9	16	0	661	15	47	0	40	0	53	0	343	1	5	
6/27/97	59.0	17.0	0	34,109	2	18	0	661	5	52	0	40	0	53	0	343	1	6	

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Appendix A1.– (Page 3 of 4).

Date	Water Level (cm)	Temp. (°C)	DOLLY VARDEN				CUTTHROAT				STEELHEAD				SH SMOLT/RAINBOW				Comments
			Down		Up		Down		Up		Down		Up		Down		Up		
			Daily	Cum.	Daily	Cum.	Daily	Cum.	Daily	Cum.	Daily	Cum.	Daily	Cum.	Daily	Cum.	Daily	Cum.	
6/28/97	59.0	16.0	0	34,109	4	22	0	661	3	55	0	40	0	53	0	343	0	6	
6/29/97	58.5	16.5	0	34,109	8	30	0	661	2	57	0	40	0	53	0	343	0	6	
6/30/97	57.5	17.0	0	34,109	7	37	0	661	0	57	0	40	0	53	0	343	0	6	
7/1/97	56.0	16.0	0	34,109	2	39	0	661	0	57	0	40	0	53	0	343	0	6	
7/2/97	54.0	17.0	0	34,109	10	49	0	661	2	59	0	40	0	53	0	343	0	6	
7/3/97	54.0	17.0	0	34,109	13	62	0	661	1	60	0	40	0	53	0	343	0	6	
7/4/97	53.0	18.0	0	34,109	3	65	0	661	0	60	0	40	0	53	0	343	0	6	
7/5/97	53.0	17.0	0	34,109	19	84	0	661	0	60	0	40	0	53	0	343	0	6	
7/6/97	53.0	17.5	0	34,109	7	91	0	661	0	60	0	40	0	53	0	343	0	6	
7/7/97	67.0	17.0	0	34,109	94	185	0	661	1	61	0	40	0	53	0	343	0	6	
7/8/97	65.0	17.5	0	34,109	101	286	0	661	2	63	0	40	0	53	0	343	0	6	
7/9/97	61.0	16.0	0	34,109	2	288	0	661	0	63	0	40	0	53	0	343	0	6	
7/10/97	57.0	17.0	0	34,109	98	386	0	661	1	64	0	40	0	53	0	343	0	6	
7/11/97	54.0	16.0	0	34,109	109	495	0	661	0	64	0	40	0	53	0	343	0	6	
7/12/97	64.0	16.0	0	34,109	667	1162	0	661	0	64	0	40	0	53	0	343	1	7	
7/13/97	104.0	14.0	0	34,109	396	1558	0	661	1	65	0	40	0	53	0	343	0	7	
7/14/97	95.0	13.0	0	34,109	1	1559	0	661	0	65	0	40	0	53	0	343	0	7	
7/15/97	71.5	13.0	0	34,109	34	1593	0	661	0	65	0	40	0	53	0	343	0	7	
7/16/97	68.0	14.0	0	34,109	17	1610	0	661	0	65	0	40	0	53	0	343	0	7	
7/17/97	66.0	14.0	0	34,109	31	1641	0	661	0	65	0	40	0	53	0	343	0	7	
7/18/97	65.0	14.0	0	34,109	65	1706	0	661	1	66	0	40	0	53	0	343	0	7	
7/19/97	96.0	12.0	0	34,109	72	1778	0	661	0	66	0	40	0	53	0	343	0	7	
7/20/97	90.0	12.0	0	34,109	53	1831	0	661	0	66	0	40	0	53	0	343	0	7	
7/21/97	80.0	13.0	0	34,109	41	1872	0	661	2	68	0	40	0	53	0	343	1	8	
7/22/97	72.0	13.0	0	34,109	91	1963	0	661	0	68	0	40	0	53	0	343	0	8	
7/23/97	75.0	12.0	0	34,109	89	2052	0	661	0	68	0	40	0	53	0	343	0	8	
7/24/97	76.5	12.0	0	34,109	108	2160	0	661	0	68	0	40	0	53	0	343	0	8	
7/25/97	110.0	11.0	0	34,109	11	2171	0	661	0	68	0	40	0	53	0	343	0	8	
7/26/97	82.0	12.0	0	34,109	51	2222	0	661	0	68	0	40	0	53	0	343	0	8	
7/27/97	72.0	12.0	0	34,109	186	2408	0	661	1	69	0	40	0	53	0	343	0	8	
7/28/97	66.0	14.5	0	34,109	88	2496	0	661	1	70	0	40	0	53	0	343	1	9	
7/29/97	63.0	14.0	0	34,109	149	2645	0	661	1	71	0	40	0	53	0	343	0	9	
7/30/97	60.5	14.0	0	34,109	107	2752	0	661	1	72	0	40	0	53	0	343	0	9	
7/31/97	60.0	14.0	0	34,109	230	2982	0	661	0	72	0	40	0	53	0	343	0	9	
8/1/97	59.0	15.0	0	34,109	182	3164	0	661	0	72	0	40	0	53	0	343	0	9	1 daily, 1 cum. Coho
8/2/97	58.0	14.0	0	34,109	166	3330	0	661	1	73	0	40	0	53	0	343	0	9	
8/3/97	57.0	17.0	0	34,109	82	3412	0	661	0	73	0	40	0	53	0	343	0	9	

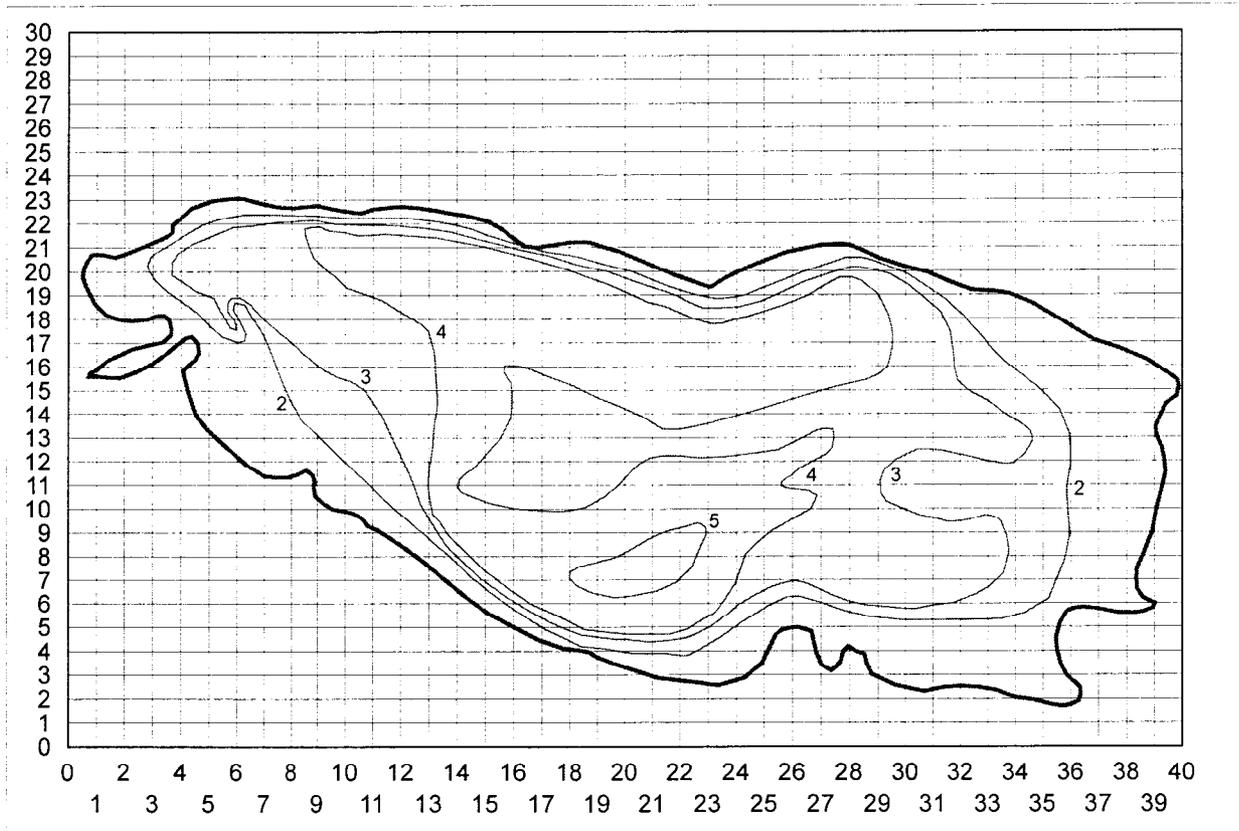
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Appendix A1.– (Page 4 of 4).

Date	Water Level (cm)	Temp. (°C)	DOLLY VARDEN				CUTTHROAT				STEELHEAD				SH SMOLT/RAINBOW				Comments
			Down		Up		Down		Up		Down		Up		Down		Up		
			Daily	Cum.	Daily	Cum.	Daily	Cum.	Daily	Cum.	Daily	Cum.	Daily	Cum.	Daily	Cum.	Daily	Cum.	
8/4/97	56.0	16.0	0	34,109	17	3429	0	661	0	73	0	40	0	53	0	343	0	9	
8/5/97	55.5	15.0	0	34,109	66	3495	0	661	0	73	0	40	0	53	0	343	0	9	
8/6/97	57.0	16.0	0	34,109	0	3495	0	661	0	73	0	40	0	53	0	343	0	9	
8/7/97	54.5	16.0	0	34,109	44	3539	0	661	0	73	0	40	0	53	0	343	0	9	
8/8/97	54.0	15.0	0	34,109	16	3555	0	661	0	73	0	40	0	53	0	343	0	9	
8/9/97	53.0	15.0	0	34,109	24	3579	0	661	0	73	0	40	0	53	0	343	0	9	
8/10/97	52.5	16.5	0	34,109	30	3609	0	661	0	73	0	40	0	53	0	343	0	9	
8/11/97	53.0	16.0	0	34,109	20	3629	0	661	0	73	0	40	0	53	0	343	0	9	
8/12/97	52.0	16.0	0	34,109	17	3646	0	661	0	73	0	40	0	53	0	343	0	9	
8/13/97	73.0	15.5	0	34,109	16	3662	0	661	0	73	0	40	0	53	0	343	49	58	no flow Herbert high
8/14/97	90.0	15.5	0	34,109	139	3801	0	661	0	73	0	40	0	53	0	343	0	58	
8/15/97	62.0	15.5	0	34,109	71	3872	0	661	0	73	0	40	0	53	0	343	0	58	
8/16/97	58.0	17.0	0	34,109	24	3896	0	661	0	73	0	40	0	53	0	343	0	58	
8/17/97	56.0	17.0	0	34,109	5	3901	0	661	0	73	0	40	0	53	0	343	0	58	
8/18/97				34,109		3901		661		73		40		53	0	343		58	weir pulled @ 11:00

<sup>1</sup> Flood event—vexar mesh removed so an unknown number of fish may have passed through the pickets. Counts are considered minimum.

Appendix A2.—Grid overlay of Windfall Lake capture area map, showing the three large areas and their 21 subareas.



Appendix A3.—Cutthroat trout radio-tagged and released at the Windfall Creek weir in 1997.

#	Freq.	Code	Date tagged	Tag type	Tag # out of 50	Floy	Length	Sex	Comments	Tracked to	Sea-run
1	152.044	145	16-Apr	ESP	1	1009	440		Regurgitated	-	
2	152.314	145	16-Apr	EXT	2	1012	310	M		Eagle/Herbert Conf	
3	152.434	145	17-Apr	ESP	3	1017	355	M		Eagle/Herbert Conf	
4	152.103	145	18-Apr	EXT	4	1020	320			Eagle River	
5	152.044	145	22-Apr	ESP	1	2001	355	M	Attempt 2 with this tag	Eagle Conf	
6	152.253	145	23-Apr	EXT	5	2002	375	M		Boulder Ck-Eagle	
7	152.013	145	23-Apr	ESP	6	2003	340	F	Regurgitated		
8	152.223	145	24-Apr	EXT	7	2004	340	F		Eagle River	
9	152.013	145	25-Apr	ESP	6	2005	385	F	Attempt 2	-	
10	152.404	145	25-Apr	ESP	8	2006	330	M	Regurgitated		
11	152.554	145	25-Apr	EXT	9	2008	350	F		Cowee/Davis 5/30	Yes
12	152.013	175	26-Apr	ESP	10	2009	325	M	Regurgitated		
13	152.193	145	26-Apr	EXT	11	2010	328	M		Cowee Creek	Yes
14	152.044	175	26-Apr	ESP	12	2011	368	F		Lower Cowee Ck	Yes
15	152.133	145	27-Apr	EXT	13	2016	385	M		Cowee Creek	Yes
16	152.404	145	27-Apr	ESP	8	2017	355	M	Attempt 2	Regurgitated again	
17	152.163	145	27-Apr	EXT	14	2018	335	M	Recovered below weir	Davis/Cowee	Yes
18	152.013	175	28-Apr	ESP	10	2028	370	M	Attempt 2	Davis/Cowee	Yes
19	152.133	175	2-May	ESP	15	2063	352	F		Yankee Cv. Ck	Yes
20	152.163	175	2-May	ESP	16	2064	312	M	Regurgitated		
21	152.163	175	3-May	ESP	16	2065	323	F	Attempt 2	Windfall Creek	
22	152.194	175	3-May	ESP	17	2066	380	F			
23	152.223	175	3-May	ESP	18	2067	336	M	Regurgitated		
24	152.404	145	3-May	ESP	8	2068	342	F	Attempt 3	Eagle River	
25	152.404	175	3-May	ESP	19	2070	342	F		Eagle River	
26	152.103	175	3-May	EXT	20	2071	401	F		Cowee Creek	Yes
27	152.253	175	3-May	EXT	21	2072	340	F		Antler River	Yes
28	152.283	175	4-May	EXT	22	2082	306	M		N. Pt. St. Mary's	Yes
29	152.223	175	4-May	ESP	18	2083	439	F	Attempt 2	Bridget Cove	Yes
30	152.434	175	4-May	ESP	23	2084	345	M		Eagle River	
31	152.554	175	4-May	ESP	24	2085	363	F			

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Appendix A3.–Page 2 of 2.

#	Freq.	Code	Date tagged	Tag type	Tag # out of 50	Floy	Length	Sex	Comments	Tracked to	Sea-run
32	152.314	175	4-May	EXT	25	2086	384	F		Eagle River	
33	152.013	185	5-May	ESP	26	2099	312	F		Sunshine Cove	Yes
34	152.344	175	5-May	EXT	27	2100	312	M	Rtnd to weir 6/5	Eagle River	
35	152.014	195	6-May	ESP	28	2102	390	F			
36	152.044	185	6-May	EXT	29	2103	311	F	Behind weir 5/8	Behind weir	
37	152.134	185	7-May	ESP	30	2114	365	M		Eagle River	
38	152.103	185	7-May	EXT	31	2115	335	F	Behind weir 5/8	Bridget Cove	Yes
39	152.163	185	8-May	EXT	32	2139	358	F		Eagle River	
40	152.223	185	9-May	ESP	33	2148	378	F		Cowee Creek	Yes
41	152.193	185	9-May	EXT	34	2149	420	F		Eagle R. tributary	
42	152.344	185	10-May	ESP	35	2169	407	F		Eagle River	
43	152.404	185	11-May	ESP	36	2178	346	F		Eagle R. tributary	
44	152.253	185	11-May	EXT	37	2179	382	F			
45	152.283	185	12-May	EXT	38	2243	356	F			
46	152.104	195	13-May	ESP	39	2256	321	F		Eagle River	
47	152.044	195	13-May	EXT	40	2257	327	F		Peterson Creek	Yes
48	152.314	195	14-May	ESP	41	2298	364	F			
49	152.253	195	14-May	EXT	42	2299	396	F		Eagle River	
50	152.163	195	15-May	EXT	43	2332	311	F		Herbert River	
51	152.044	185	16-May	EXT	29	2350	350	F		Eagle R. tributary	
52	152.223	195	16-May	ESP	44	2351	374	M		Eagle River	
53	152.314	185	16-May	EXT	45	2359	320	F		lower Herbert R	
54	152.314	145	16-May	ESP	46	2361	319	F		Eagle River	
55	152.554	185	17-May	EXT	47	2373	300	F		Cowee Creek	Yes
56	152.404	195	17-May	ESP	48	2377	365	F		Eagle River	
57	152.193	195	18-May	EXT	49	2384	315	F		Eagle R. tributary	
58	152.554	195	18-May	ESP	50	2386	320	M		N. Pt. St. Mary's	Yes

**Appendix A4.—Recovery locations of Dolly Varden and cutthroat trout tagged at Windfall Creek weir and later caught in sport fisheries and reported to ADF&G.**

#	Date caught	Species	Tag #	Tag color	Fish status	Location
1	5/10/97	Dolly Varden	0948		Kept	South Shelter from Anchor Pt. Lodge
2	5/16/97	Dolly Varden	Ad Clip			Caught from a boat in Tee Harbor
3	5/18/97	Dolly Varden	0320	Green		Echo Cove
4	5/25/97	Dolly Varden	0330			Eagle Beach Sand Spit
5	5/26/97	Dolly Varden	0181			Cowee Creek below bridge
6	5/26/97	Dolly Varden	0375			Sunshine Cove
7	6/01/97	Dolly Varden	0054			1/4 mile below Cowee Creek Bridge
8	6/07/97	Dolly Varden	0657			Wheeler Creek
9	6/08/97	Cutthroat	2138			Cowee Creek below bridge
10	6/08/97	Cutthroat	2122			Cowee Creek below bridge
11	6/08/97	Dolly Varden	0263			Cowee Creek below bridge
12	6/11/97	Dolly Varden	0229			Auke Bay by boat launch ramp
13	6/11/97	Dolly Varden	1194		Kept	Eagle Beach near Boy Scout Camp
14	6/13/97	Dolly Varden	0196		Kept	Eagle Beach near Boy Scout Camp
15	6/14/97	Dolly Varden	0165			200yards below Cowee Creek Bridge
16	6/14/97	Dolly Varden	0273			200yards below Cowee Creek Bridge
17	6/22/97	Dolly Varden	WF0789		Release	Mixing zone of Mend. R. Montana Ck.
18	6/24/97	Dolly Varden	1129	Yellow	Release	Green's Creek just above mouth
19	6/25/97	Dolly Varden	WF0964		Kept	Eagle Beach
20	6/26/97	Cutthroat	2064	Yellow	Release	Echo Cove
21	6/26/97	Cutthroat	2205			0.25-0.5 south of Sunshine Cove
22	6/27/97	Dolly Varden	1195		Release	Montana Creek above rifle range
23	6/28/97	Dolly Varden	0602	Green	Release	Eagle Beach near Boy Scout Camp
24	7/03/97	Cutthroat	2401	White		Near mouth of Echo Cove
25	7/03/97	Dolly Varden	WF0711	Green	Release	Cowee Creek below bridge 100 yards
26	7/04/97	Dolly Varden	WF0138	Green	Kept	Cowee Creek 200 yds below bridge
27	7/10/97	Dolly Varden	Ad Clip	No tag	Up	Auke Creek
28	7/10/97	Dolly Varden	Ad Clip	No tag	Up	Auke Creek
29	7/10/97	Dolly Varden	1228	Yellow	Kept	Cowee Ck. Bridge
30	7/13/97	Dolly Varden	WF 232		Kept	Amalga Harbor
31	7/14/97	Dolly Varden	0636	Green	Kept	Amalga Harbor in the Bay from processor
32	7/17/97	Dolly Varden	0372	Green	Kept	Cowee Creek below bridge 1 mile
33	7/18/97	Dolly Varden	WF0266	Green	Kept	Wheeler Creek/Admiralty 1 mile upstream
34	7/20/97	Dolly Varden	Ad Clip	No tag	Release	Montana Creek near rifle range
35	7/21/97	Dolly Varden	Ad Clip	No tag	Up	Auke Creek
36	7/27/97	Dolly Varden	WF0523	Green	Kept	Cowee Creek below bridge
37	7/28/97	Cutthroat	2336			Caught moving up at Auke Creek weir
38	7/28/97	Dolly Varden	WF0763	Green		Montana Creek above Loop Road bridge
39	8/14/97	Cutthroat	2198	Clear	Kept	Echo Cove
40	8/31/97	Dolly Varden	WF0403	Green	Release	Lower Cowee Creek
41	9/14/97	Dolly Varden	WF0732	Green	Kept	Cowee Creek
42	9/22/97	Dolly Varden	WF0250	Green		Windfall Lake
43	9/22/97	Dolly Varden	WF1153	Yellow		Windfall Lake
44	10/1/97	Cutthroat	2568	Clear	Release	Windfall Lake
45	10/1/97	Cutthroat	2631	Clear	Release	Windfall Lake
46	10/4/97	Cutthroat	2349		Release	Windfall Lake
47	5/05/98	Dolly Varden	0045	Green	Kept	South Shelter from shore
48	5/06/98	Dolly Varden	WF0606	Green	Kept	Amalga Harbor
49	5/08/98	Dolly Varden	WF0149	Green	Kept	Yankee Cove - Adlersheim
50	6/01/98	Dolly Varden	1131	Yellow	Release	Boy Scout Camp
51	6/07/98	Dolly Varden	1032	Yellow	Kept	Amalga Harbor
52	6/19/98	Dolly Varden	WF0457	Green	Kept	Cowee Creek

**Appendix A5.—Historical data and raw data files used to produce this report.**

<b>File Name</b>	<b>Software</b>	<b>Contents</b>
Wfcounts.xls	Excel	Daily weir counts, fish lengths, floy tag numbers, and radio tag numbers.
Radiotrk.xls	Excel	Weekly aerial radio tracking results including fish locations and areas surveyed.
Daily_ta.xls	Excel	Daily weir cutthroat numbers and numbers of radio tags successfully placed and released.
Dv_recov.xls	Excel	Tagged Dolly Varden recovered in sport fisheries in the Juneau area.
Wfefrt97.dbf	FoxPro	Trap catch and hook-and-line data for cutthroat trout abundance estimation in lake.
Wfaw197.dbf	FoxPro	Length, floy tag number, location, and depth data for both marking and recapture events for cutthroat trout abundance estimation in lake.
Wf97_pop.xls	Excel	Analysis and data summaries of cutthroat trout abundance estimation in lake.

