Fishery Data Series No. 91-53

Cutthroat Trout Studies: Turner/Florence Lakes, Alaska, During 1990

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J. Douglas Jones
and
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ABSTRACT

Mark-recapture experiments to estimate abundance of cutthroat trout *Oncorhynchus clarki* in Turner Lake southeast of Juneau, and in Florence Lake on the west side of Admiralty Island, were conducted in 1990. Cutthroat trout were captured using baited fyke nets, baited and unbaited gill nets, hook and line, and baited funnel traps. Three sampling trips were made to Turner Lake between June 19 and July 23, and three trips were made to Florence Lake between August 1 and September 6. The estimate of cutthroat trout abundance in Turner Lake is 1,242 trout (SE = 157) for fish between 161 and 280 mm in length. The estimate for cutthroat trout abundance in Florence Lake is 14,780 (SE = 4,788) for fish between 141 and 280 mm in length.

A postal survey of registered users of U.S. Forest Service cabins at each lake was conducted to estimate minimum angler effort, catch, and harvests in 1990. A minimum 1,010 hours (SE = 62) of angler effort, and a minimum catch of 779 cutthroat trout (SE = 61), 310 kokanee *Oncorhynchus nerka* (SE = 34), and 288 Dolly Varden *Salvelinus malma* (SE = 36) is estimated for Turner Lake. A minimum 1,035 hours (SE = 72) of angler effort, and a minimum catch of 2,332 cutthroat trout (SE = 161), 25 kokanee (SE = 4), and 258 Dolly Varden (SE = 37) is estimated at Florence Lake.

KEY WORDS: Cutthroat trout, *Oncorhynchus clarki*, Turner Lake, Florence Lake, Southeast Alaska, mark-recapture experiment, Dolly Varden char, *Salvelinus malma*, kokanee, *Oncorhynchus nerka*, creel survey, postal survey, catch-per-unit-effort, CPUE.

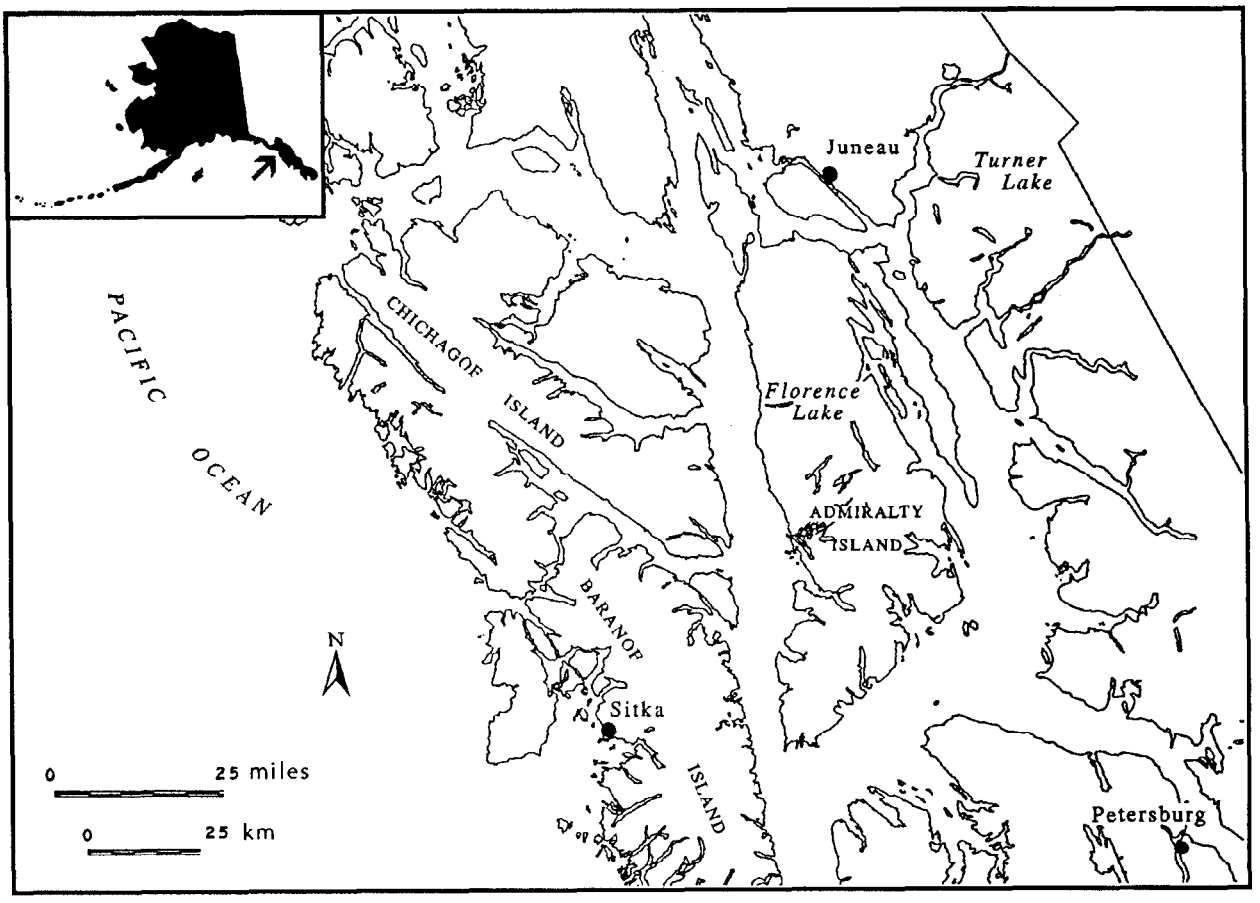

Figure 1. Juneau area and location of Turner Lake and Florence Lake, northern Southeast Alaska.

INTRODUCTION

Turner Lake and Florence Lake (Figure 1) are among the most popular lakes in Southeast Alaska for fly-in fishing for cutthroat trout *Oncorhynchus clarki*. Access to both lakes is predominately by small plane from either Juneau or Sitka.

Turner Lake is located in upper Taku Inlet 26 km east of Juneau (Figure 1). The lake is 14 km long and has a surface elevation of just over 22 m. Turner Lake is very steep-sided except near inlet streams, and is about 1,270 hectares in surface area. Maximum depth is 215 m (Figure 2), with a mean depth of 30 m (Schmidt 1979). The lake outlet flows about 1,700 m from the lake to Taku Inlet and is blocked to upstream fish passage by a barrier falls just below the lake. Turner Lake has produced more than 10% of the cutthroat trout in the Alaska Department of Fish and Game (ADFG) Trophy Fish Program. The largest cutthroat trout registered with the Trophy Fish Program from Turner Lake weighed 6 lb 7 oz (Robert Bentz, Alaska Department of Fish and Game, Juneau, personal communication) and was caught in 1980.

Turner Lake was selected as the site of a sockeye salmon *O. nerka* enhancement project to supplement the commercial gillnet harvest in the Taku Inlet area (McNair 1987). The ADFG Fisheries Rehabilitation Enhancement and Development (FRED) Division proposed to stock between 5 and 25 million juvenile sockeye salmon annually into Turner Lake. Sockeye salmon eggs were scheduled to be taken from Speel Lake in Port Snettisham in fall 1990. The eggs would have been incubated in a special facility at the Snettisham Hatchery and the resulting fry released as soon as Turner Lake was ice-free the following spring (McNair 1987).

The Turner Lake stocking project was canceled in May 1990 as a result of concerns relating to the potential for introduction of Infectious Hematopoietic Necrosis Virus (IHNV). There was concern, both for kokanee *O. nerka* and cutthroat trout in Turner Lake, as both species are IHNV susceptible. Sixty-four Turner Lake kokanee were sampled for IHNV in 1985 by the Northern Southeastern Aquaculture Association (NSRAA) (Joyce 1986). Kokanee were sampled again in 1988 (80 fish tested) and 1989 (167 fish tested) by ADFG. No virus was detected in any of the 311 fish sampled. All potential brood sources for sockeye eggs are known to have the IHNV. Fish populations that have had no contact with a disease can be more susceptible than those that have had long-term contact with it (Rohovec et al. 1988). ADFG has a disease policy prohibiting transplant of a stock of fish having a history of a particular disease agent into another system containing significant population of salmonid fish that does not have that disease.

Another concern was the potential for competition between age-0 cutthroat trout, planted sockeye salmon fry (age-0), and fry from existing kokanee stocks. Sockeye salmon fry and kokanee are very efficient open water planktivores (Leathe and Graham 1981). Sockeye salmon fry (and kokanee) can compete with young cutthroat trout for plankton (Marnell 1988), which can be an important food for juvenile cutthroat trout (Gresswell and Varley 1988; Gerstung 1988). Since cutthroat trout fry emerge in late summer, age-0 cutthroat trout would enter the lake up to two months after the sockeye fry were stocked. After feeding for the summer, sockeye salmon fry would be larger and more competitive for existing plankton resources, particularly during the subsequent winter months, when other food sources (like terrestrial insects) are limited.

According to Schmidt (1979), cutthroat trout rely heavily on kokanee as a food source once the cutthroat trout reach a fork length (FL) size of about 240 mm.

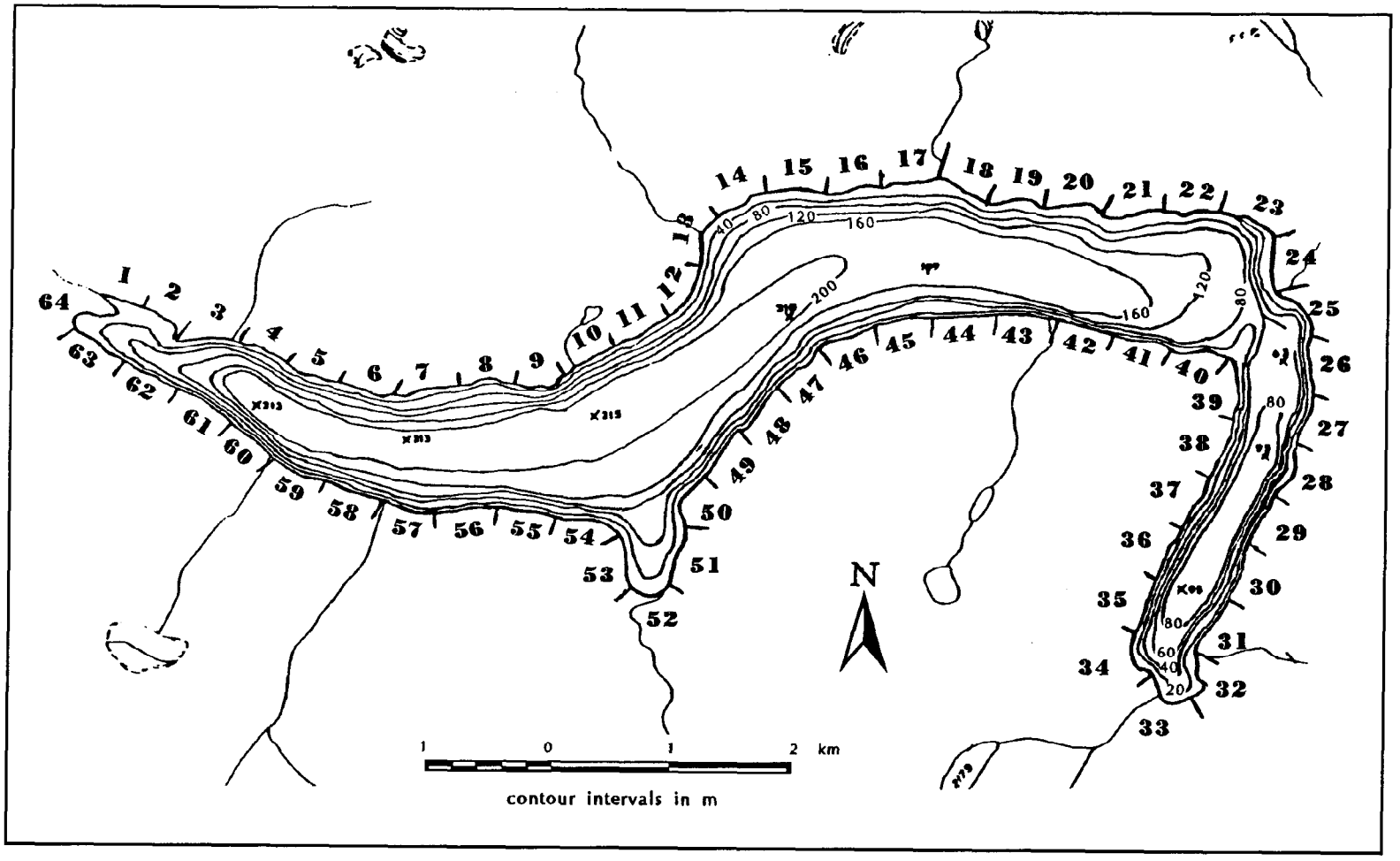

Figure 2. Bathymetric map of Turner Lake, northern Southeast Alaska, showing study area locations.

Other studies indicate that cutthroat trout switch to a piscivorous diet between 300 mm (Gerstung 1988) and 386 mm (Nielson and Lentsch 1988). Those larger cutthroat trout that have shifted to a piscivorous diet in Turner Lake might have benefited from increased food availability as a result of the introduction of large numbers of sockeye salmon fry.

Preliminary research in Turner Lake by Schmidt (1979) and Joyce (1986) provided no insights on the abundance, recruitment rates, or harvest rates of cutthroat trout. Anecdotal information for Turner Lake from anglers suggests that the catch rates have dropped since the mid-1970's. The size of the kokanee population in Turner Lake was assessed hydroacoustically by FRED Division in September 1986. Two sets of the nine transects were run, and the resulting population estimate was 29,650 kokanee (Dave Barto, Alaska Department of Fish and Game, Douglas, personal communication).

Florence Lake is located on the west side of Admiralty Island about 50 km southwest of Juneau (Figure 1). Florence Lake is a narrow lake ≈7.2 km long with a maximum depth of just over 27 m (Figure 3). The lake outlet flows about 1 km into Chatham Strait directly across from Tenakee Inlet. There is a barrier falls about 400 m upstream of Chatham Strait.

Florence Lake is one of the most popular fly-in lakes in Southeast Alaska, with >4,000 visitor days of use annually (U.S. Forest Service, Juneau, personal communication). The Florence Lake watershed is scheduled for extensive clear-cut logging in the next 2 to 4 years (James Senna, Shee Atika Corporation, Sitka, personal communication). The proposed logging is expected to strip the watershed around the lake of all marketable timber. The potential impacts of the logging and associated road building on the lake and its fishery resources are not known. Studies by Jones (1982) in Florence Lake included habitat mapping, but work on the cutthroat trout population was limited to lengths and ages for 30 fish. No estimate was obtained for the abundance of cutthroat trout.

In 1988, an in-season Jolly Seber experiment was used to estimate a population size of 1,753 (95% C.I. = 871, 2,635) cutthroat trout longer than about 120 mm FL in Turner Lake (Jones et al. 1989). In 1989, a two-occasion experiment across years was used to estimate a population size of 1,526 (SE = 154) cutthroat trout between about 100 mm FL and 400 mm FL in Turner Lake during 1988 (Jones et al. 1990). An attempt to estimate numbers of cutthroat trout in Florence Lake in 1989 failed due to the unexpectedly large number of cutthroat trout present.

Information on harvests of cutthroat trout at Turner and Florence Lakes is available from the Statewide Harvest Survey (SHS) and from the studies conducted in 1988 and 1989. Based on SHS, harvests for Turner Lake range from 42 cutthroat trout in 1983 (Mills 1984) to 882 in 1979 (Mills 1981). Similarly, harvests for Florence Lake range from 112 cutthroat in 1986 (Mike Mills, Alaska Department of Fish and Game, Anchorage, personal communication) to 1,727 in 1979 (Mills 1981). The 5-year average harvest for 1977-1981 in Turner Lake was 488 fish; the recent 5-year average (1984-1988) is 246 cutthroat trout, a 49.5% decrease. In Florence Lake, the decline between the same two periods was 60.6% (from 985 to 388). The number of reported visitor days at both Turner and Florence lakes have nearly doubled in the past 15 years (Laura Calhoon, U.S. Forest Service, Sitka, personal communication).

Turner and Florence lakes are designated as "High Quality" or "Important" watersheds by both ADFG and USFS (TLMP 1979), and in this report we continue to

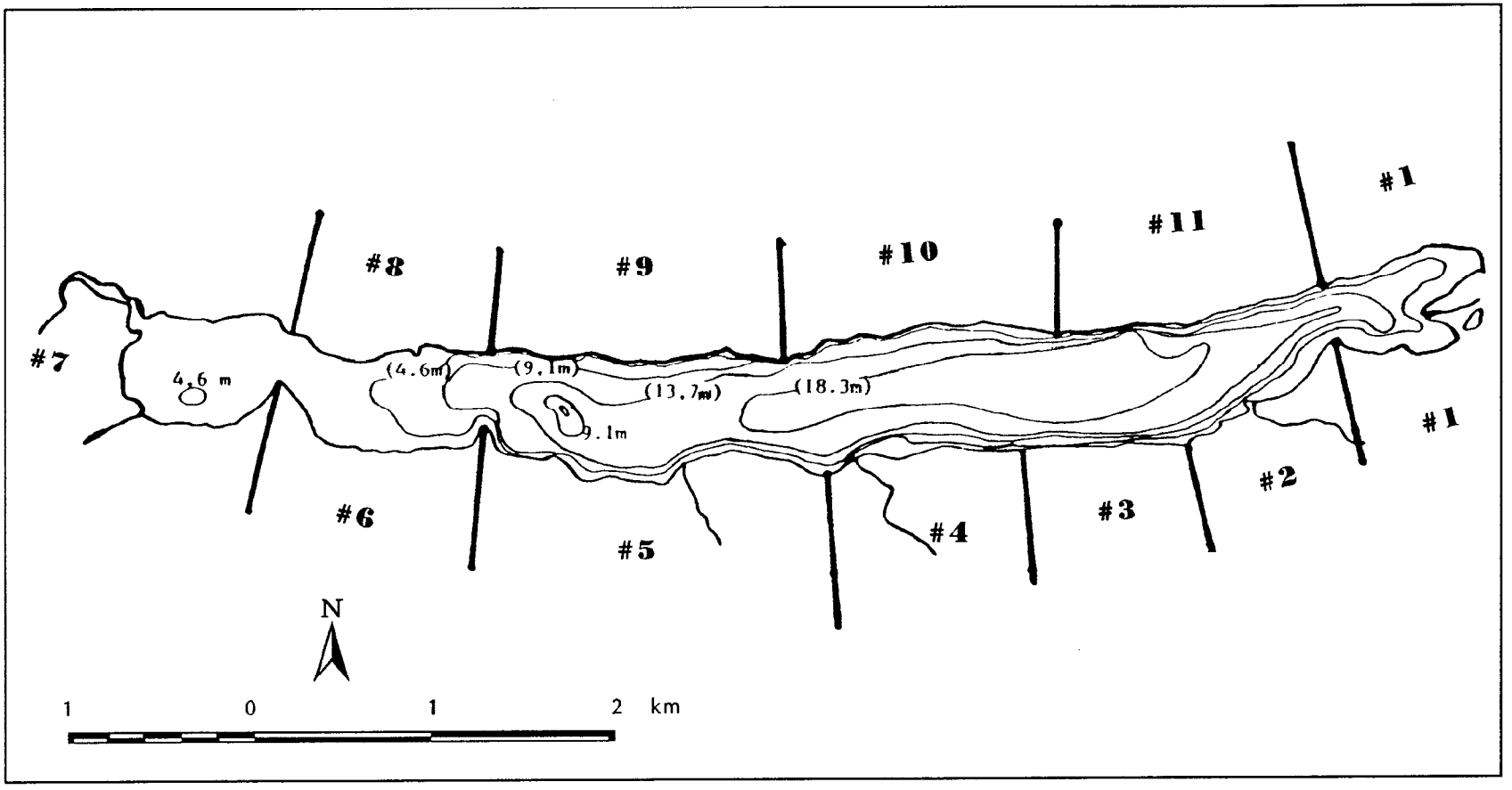

Figure 3. Bathymetric map of Florence Lake, Admiralty Island, Southeast Alaska, showing location of study areas.

develop methods and provide base line information needed to manage and conserve future cutthroat trout fisheries in these important recreational areas.

Our research objectives in 1990 were to:

1. estimate abundance of the cutthroat trout in Turner and Florence lakes using in-season, two-event mark-recapture experiments;

2. estimate the age composition of cutthroat trout in Turner and Florence lakes;

3. estimate mean length at age for cutthroat trout in Turner and Florence lakes; and

4. estimate minimum angler effort, catch, and harvests at Turner and Florence lakes.

METHODS

Abundance

The abundance of cutthroat trout in Turner and Florence lakes was estimated using two-event Peterson mark-recapture experiments. Three sampling trips were made to each lake in 1990; in both experiments, the first trip was considered the first sampling event while the second and third trips were combined as the second sampling event. The first trip to Turner Lake was June 19 to June 29, and the second event was July 5 to July 23. The first trip to Florence Lake was August 1 to August 9, and the second event was August 14 to September 6. The modified Chapman estimators (Seber 1982) were used to estimate abundance:

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

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

where $\hat{N}$ = abundance of cutthroat trout,
n_1 = number of fish marked and released in the 1st sampling event,
n_2 = number of fish inspected for marks in the 2nd sampling event, and
m_2 = number of marked fish recaptured in the 2nd sampling event.

Cutthroat trout over ≈140 mm FL captured in the various sampling events were anesthetized using either tricaine methanesulfonate (fish <180 mm) or an electroshocking basket (Gunstrom and Bethers 1985), tagged with a uniquely numbered T-bar (Floy-type) anchor tag, sampled for scales, measured for length to the nearest mm FL, and weighed (nearest gram).

Fish were captured using baited fyke nets, baited funnel traps, gill nets (both baited and unbaited), and sport fishing gear. Betadine-treated salmon eggs were used for bait (Jones et al. 1990). Fyke nets had 13 cm stretch mesh with a 0.9-m-by-1.8-m opening, two 6.1-m-by-1-m wings off each side, a 15.2-m-by-1-m center lead, and two funnel entrances leading to the cod end. The baited traps

were of two sizes. The large traps were 1.5 m long and 0.6 m in diameter, with a 9-cm opening in the funnels at each end of the trap and a mesh size of 1 cm. The small funnel traps were 44 cm long and 23 cm wide, with 4 cm openings and a mesh size of 0.6 cm. The gill nets were 38.1 m long, 1.8 m deep, and consisted of five 7.6-m panels of stretched mesh sizes 12.7 mm, 19.1 mm, 25.4 mm, 38.1 mm, and 50.8 mm. A small lure or spinner was used for bait with sport fishing gear.

An assumption that fish are marked with equal probability or that complete mixing (of marks) occurs between sampling events was evaluated by testing if, given *some* mixing between areas, marked fish are recovered with equal probability in each of three areas (ends and middle) of each lake. If this is not so, a Darroch estimator (Seber 1982, Chapter 11) is used to estimate abundance:

$$\underline{U} = \mathbf{D}_u \mathbf{M}^{-1} \underline{a} \tag{3}$$

where $\underline{U}$ = vector of the estimated number of *unmarked* fish in each area during the second sampling event,

$\mathbf{D}_u$ = diagonal matrix of the number of *unmarked* fish captured in each area during the second sampling event,

$\mathbf{M}$ = matrix (m_{ij}) of the number of tagged fish recovered in area (j) which were released in area i, and

$\underline{a}$ = vector of the number of tagged fish released in area i.

The estimate of abundance is then $\hat{\underline{N}} = \underline{U} + \underline{a}$ and the variance-covariance matrix is estimated:

$$E[(\hat{\underline{U}} - \underline{U})(\hat{\underline{U}} - \underline{U})^T] \approx \mathbf{D}_U \Theta^{-1} \mathbf{D}_\mu \mathbf{D}_\alpha^{-1} \Theta^{T^{-1}} \mathbf{D}_U + \mathbf{D}_U (\mathbf{D}_\rho - \mathbf{I}) \tag{4}$$

as described in Seber (1982, p.433) and Darroch (1961).

The probability that fish of different sizes (or in different size groups) were captured with equal probability in the 2nd sampling event was estimated with a Kolmogorov-Smirnov (K-S) and/or a chi-square goodness of fit test. If size selectivity is indicated the experiment was stratified by size groups.

Adipose fins were removed from fish to provide a secondary mark for estimating tag loss. However, previous experiments in both lakes removed adipose fins for the same reason, so tag loss in this experiment was not measured directly. Instead, tag loss was inferred from analyses of old data and the length frequency distributions of different groups of fish captured in 1990 (Appendix A1).

Dolly Varden *Salvelinus malma* and kokanee captured in Turner Lake were weighed (nearest gram), measured (nearest mm FL), scale sampled, and recorded by gear type and area. Because so many cutthroat trout were captured in Florence Lake, we kept only records of the numbers of Dolly Varden and kokanee captured by area and gear type; no length or weight records were kept.

Age, Weight, Length

Scales from an area just over the lateral line, forward of a line between the posterior insertion of the dorsal fin and the anterior insertion of the anal fin, were separated and placed on clear plastic sheeting for reading. Age was estimated on viewing the scales under a Micron 780 microfiche projector.

Age composition of the population was estimated by

$$\hat{p}_a = \frac{n_a}{n} \tag{5}$$

$$V[\hat{p}_a] = \frac{\hat{p}_a(1-\hat{p}_a)}{n-1} \tag{6}$$

where p_a = proportion of the population with estimated age a, n_a = number in the sample with estimated age a, and n = number in the sample.

Where sampling gear is found to be size selective, age composition was estimated:

$$\hat{p}_a = \frac{\sum_i \hat{p}_{a,i}\hat{N}_i}{\sum_i \hat{N}_i} \tag{7}$$

$$V[\hat{p}_a] = \sum_i V[\hat{p}_{a,i}]\left[\frac{\hat{N}_a}{\hat{N}}\right]^2 + \frac{\sum_i V[\hat{N}_i](\hat{p}_{a,i}-\hat{p}_a)^2}{\hat{N}^2} \tag{8}$$

where $p_{a,i}$ = fraction of estimated age a in length group i, N_i = abundance in length group i, N = sum of the abundances in all length groups. The variance formula (8) is an approximation derived with the delta method (Seber 1982).

Mean length at age was estimated using standard procedures for normally distributed data, and the data was graphically summarized with notched box plots.[1] Length-weight relationships for the cutthroat trout, Dolly Varden, and kokanee were estimated from length and weight data by assuming process error in a weight-length relationship is log-normally distributed. Thus, the formal regression model is

$$\log(W_i) = \alpha + \beta \log(L_i) + \epsilon_i \tag{9}$$

where α and β were parameters to be estimated, ϵ_i is an independent and normally distributed error term with mean 0 and variance σ^2, W is weight in grams, and
L is mm FL.

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[1] The median length at each age is represented by a horizontal line within the box, and the top and bottom of the box represent the upper and lower quartiles of the data for that age. Vertical lines from each box extend to the upper and lower adjacent values (upper and lower quartiles ± 1.5 x IQR, where IQR is the interquartile range); values outside the upper and lower adjacent values are plotted as asterisks. The tops and bottoms of the notches are at $M \pm 1.57(IQR/\sqrt{n})$, where M is the median and n is the number of observations, and estimate the 95% confidence intervals assuming a normal distribution of values about the median.

Creel Survey

Two cabins at Turner Lake and two cabins at Florence Lake are available for recreational use through the USFS for a $20 daily fee. We believe most angling at these lakes results from fisherman who fly in and stay at the USFS cabins. Thus, minimum estimates of angler effort, catch, and harvest were made, using a postal survey of all parties making reservations with the USFS for use of their cabins.

Two separate surveys were conducted to minimize the time between an angling trip and receipt of a survey questionnaire. The first survey covered reservations to August 30, and the second covered trips between September 1 and November 8, 1990.

The survey was sent to party leaders associated with specific cabin reservations. The questionnaire asked if the reservation was used, the party size, the number of individuals in the party who fished, the number of hours and days fished by party member, and the numbers of fish caught and kept and caught and released by species. We also asked about cutthroat trout harvested in trophy (≥18 in.) and non-trophy (<18 in.) size categories, and how party leaders rated the fishing.

Three separate mailings were conducted for each of the two mail-out surveys. The first mailing was sent to every party leader on a USFS reservation list. A second mailing was sent to each nonrespondent after 3 weeks. A third and final questionnaire was sent to remaining nonrespondents after another 3 weeks. The last mailing was sent by registered mail.

A one-way ANOVA was used to test the null hypotheses (H_o) of no significant differences in catch per party between respondents from the 3 mailings. Since H_o was accepted in both cases, total catch in each survey C was estimated:

$$C = \overline{C}\, N \tag{10}$$

$$\overline{C} = \frac{\sum_{i=1}^{n} C_i}{n} \tag{11}$$

where C_i = total catch by party i, N = total number of parties that kept the reservation and fished, and n = number of responding parties.

The variance of catch was estimated:

$$V[C] = N^2 \left(1 - \frac{n}{N}\right) V[\overline{C}] \tag{12}$$

$$V[\overline{C}] = \frac{\sum_{i=1}^{n} (C_i - \overline{C})^2}{n\,(n-1)} \tag{13}$$

Expansions for effort and harvest by species were calculated by substituting the appropriate variable for C.

RESULTS

Abundance

Turner Lake. Six hundred fifty-seven (657) cutthroat trout ≥130 mm FL, 178 Dolly Varden, and 114 kokanee were captured, mostly with large traps and spinning gear (Table 1, Figure 4). Tag loss was judged to be small (Appendix A1 and A2).

Two hundred twelve (212) cutthroat trout between 140 mm FL and 564 mm FL were marked and released alive in event 1. Forty two fish between 153 mm FL and 320 mm FL were recaptured in event 2, but only one was larger than 280 mm FL (it was 320 mm FL), and only 2 were smaller than 160 mm FL. Abundance was therefore estimated for fish between 161 mm FL and 280 mm FL. Parameters for sampling and estimation of cutthroat trout abundance in this size range are shown in Table 2.

We used sampling gear that was somewhat selective for fish of different sizes, at least with respect to the range of sizes captured (Figure 4 and 5). Comparing distributions of lengths of fish recaptured in event 2 (n = 39) to fish marked in event 1 (n = 162) suggests the second sampling event was not selective for fish of different sizes (Kolmogorov-Smirnov [K-S] test, d_{max} = 0.14, P = 0.56, Figure 6). Also, little growth occurred between sampling event 1 and sampling event 2 (average growth based on tag data was 4 mm FL, range -1 to 15 mm FL, n = 39). A contingency table analyses with the data divided at 230 mm FL also supports a hypothesis of equal probability of capture across 2 size classes (P = 0.07, Table 3). The 230-mm FL cut point is the approximate inflection point in a quantile-quantile plot of the lengths of fish marked in event 1 against lengths of fish recaptured in event 2.

Eighteen percent (7 of 39) of the cutthroat trout tagged and recovered in Turner Lake in 1990 were recovered in (1 of the 3) areas different from the area of tagging (Table 4), indicating some substantial mixing of fish occurred between events. Contingency table analyses fail to reject a hypothesis of equal probability of capture by lake area (P = 0.13, Table 5).

Estimated abundance of cutthroat trout for fish between 161 mm FL and 280 mm FL was 1,242, ($SE[\hat{N}]$ = 157, n_1 = 162, n_2 = 304, m_2 = 39) using Chapman's model.

Florence Lake. One thousand four hundred ninety-two (1,492) cutthroat trout ≥130 mm FL, 975 Dolly Varden, and 10 kokanee were captured (Table 6, Figure 5). Catch rates were generally higher than in Turner Lake, except for fishing with hook and line (Table 1 and 6).

Three hundred fifty-five (355) cutthroat trout between 137 mm FL and 460 mm FL were marked and released alive in event 1; 30 fish between 147 mm FL and 294 mm FL were recaptured in event 2. Abundance was therefore estimated for fish between 141 mm FL and 300 mm FL. Parameters for the sampling and estimation of cutthroat trout abundance in this range of sizes are shown in Table 7.

Comparing distributions of lengths of fish recaptured in event 2 (n = 30) to fish marked in event 1 (n = 346) using a K-S test does not suggest the second sampling event was selective for fish of different sizes (d_{max} = 0.17, P = 0.37). However, the cumulative distribution functions (Figure 7) do lead us to suspect the second sampling event was selective for fish of different sizes, especially since little growth (based on tag data) was observed between sampling events (avg = 1 mm FL, range -6 to 11 mm FL, n = 30). Contingency table analyses with the data divided

Table 1. Effort (hours), catch, and catch-per-unit-effort (CPUE, fish per hour) by sampling period, gear, and species for 1990 Turner Lake sampling.

			Cutthroat trout[d]		Dolly Varden		Kokanee	
Period	Gear	Effort	Catch	CPUE	Catch	CPUE	Catch	CPUE
1[a]	Fyke net	136	10	0.07	19	0.14	50	0.37
	Gill net	8	14	1.67	0	0.00	7	0.83
	Hook & line	30	90	3.03	0	0.00	1	0.03
	Large trap	1,120	149	0.13	66	0.06	12	0.01
	Total	1,294	263	0.20	85	0.07	70	0.05
2[b]	Gill net	14	19	1.39	0	0.00	28	2.04
	Hook & line	27	68	2.52	2	0.07	0	0.00
	Large trap	1362	189	0.14	68	0.05	8	0.01
	Total	1402	276	0.20	70	0.05	36	0.03
3[c]	Gill net	6	5	0.91	0	0.00	6	1.09
	Hook & line	21	41	1.95	0	0.00	0	0.00
	Large trap	904	72	0.08	23	0.03	2	0.00
	Total	931	118	0.13	23	0.02	8	0.01
Total	Fyke net	136	10	0.07	19	0.14	50	0.37
	Gill net	28	38	1.38	0	0.00	41	1.49
	Hook & line	78	199	2.56	2	0.03	1	0.01
	Large trap	3,386	410	0.12	157	0.05	22	0.01
	Total	3,627	657	0.18	178	0.05	114	0.03

[a] 19 June to 29 June.
[b] 5 July to 13 July.
[c] 19 July to 23 July.
[d] cutthroat ≥130 mm FL.

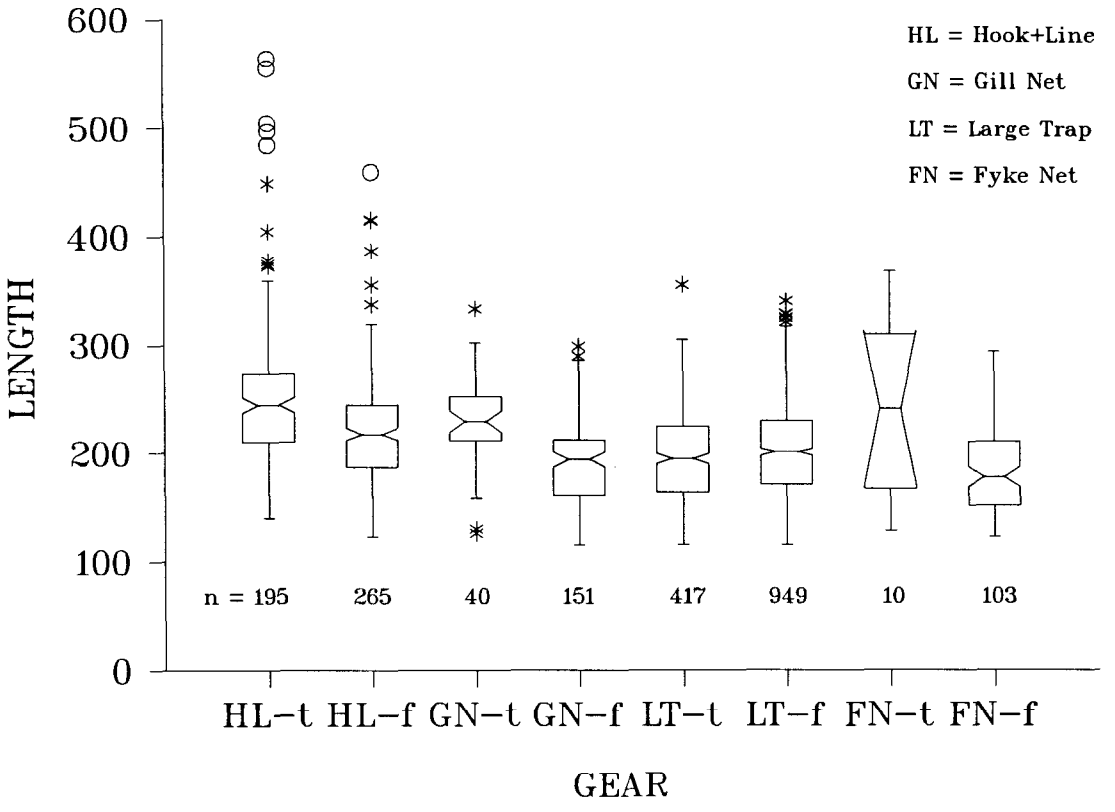

Figure 4. Box plots showing size distribution of total catch of cutthroat trout at Turner (-t) and Florence (-f) Lakes in 1990 by gear type.

Table 2. Summary of cutthroat trout tagging and recovery data for fish 161-280 mm FL, Turner Lake, 1990.

	1990 sampling period		
	Period 1 19 June- 29 June	Period 2 5 July- 13 July	Period 3 19 July- 23 July
Newly tagged fish Released alive	162[a]	161[b]	39[c]
Recaptured fish tagged in:			
1988	3	1	1
1989	24[f]	16[f,g]	10[h,i]
1990 Period 1	4	31[d]	8[e,h]
1990 Period 2		2	7
1990 Period 3			0
Captured, not tagged	8	11	6
Total catch	202[a]	226[b]	78[c]

[a] Fish 161-280 mm.
[b] Fish 161-277 mm.
[c] Fish 161-275 mm.
[d] Fish 164-275 mm.
[e] Fish 163-245 mm.
[f] Not including 1 fish recaptured twice in period.
[g] Not including 3 fish previously recaptured in Period 1.
[h] Not including 1 fish previously recaptured in Period 2.
[i] Not including 5 fish previously recaptured in Period 1.

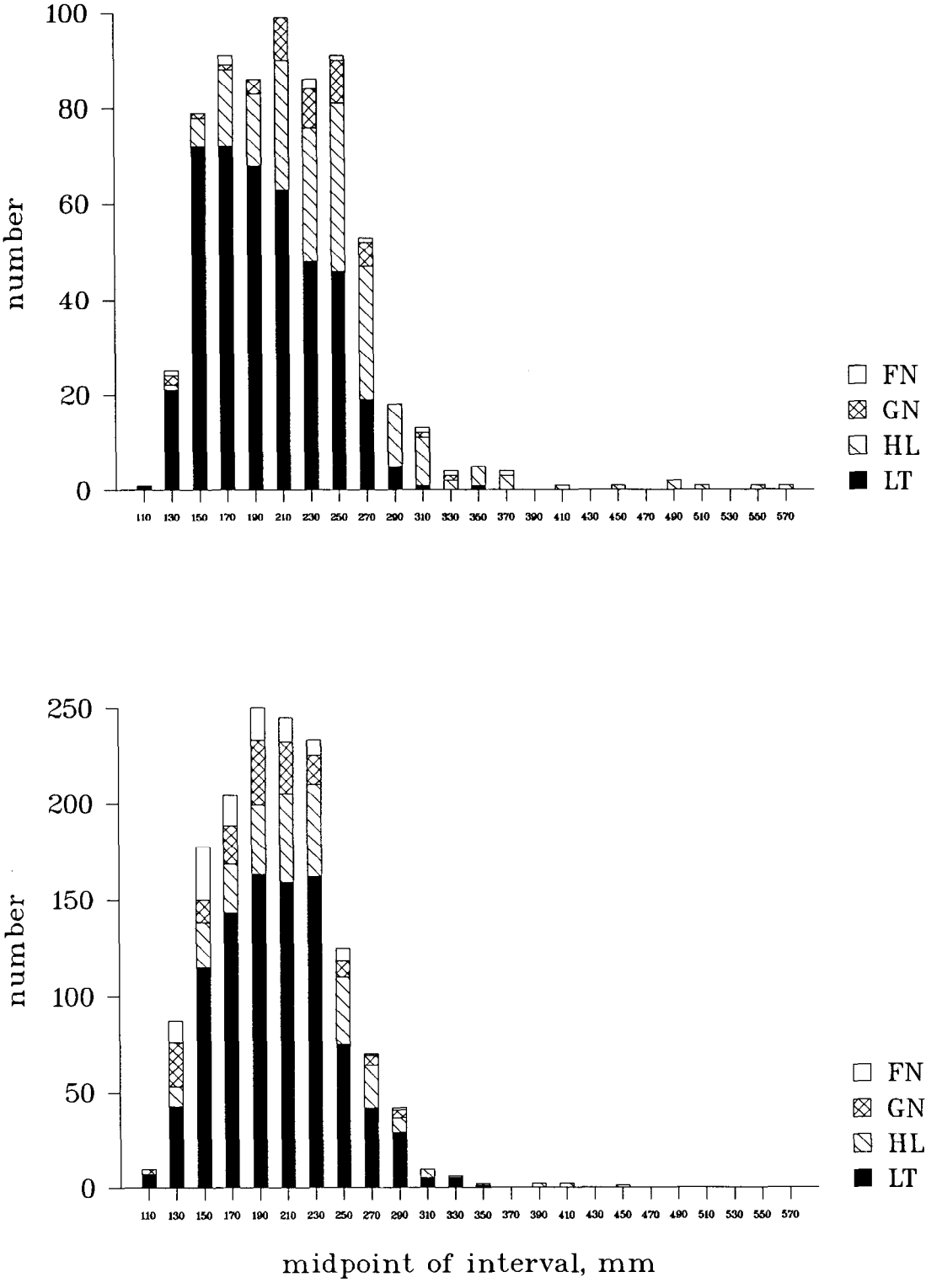

Figure 5. Length frequency of total cutthroat trout catch at Turner Lake (above) and Florence Lake (below) in 1990, by gear type (FN=fyke net, GN=gill net, HL=hook and line, LT=large trap).

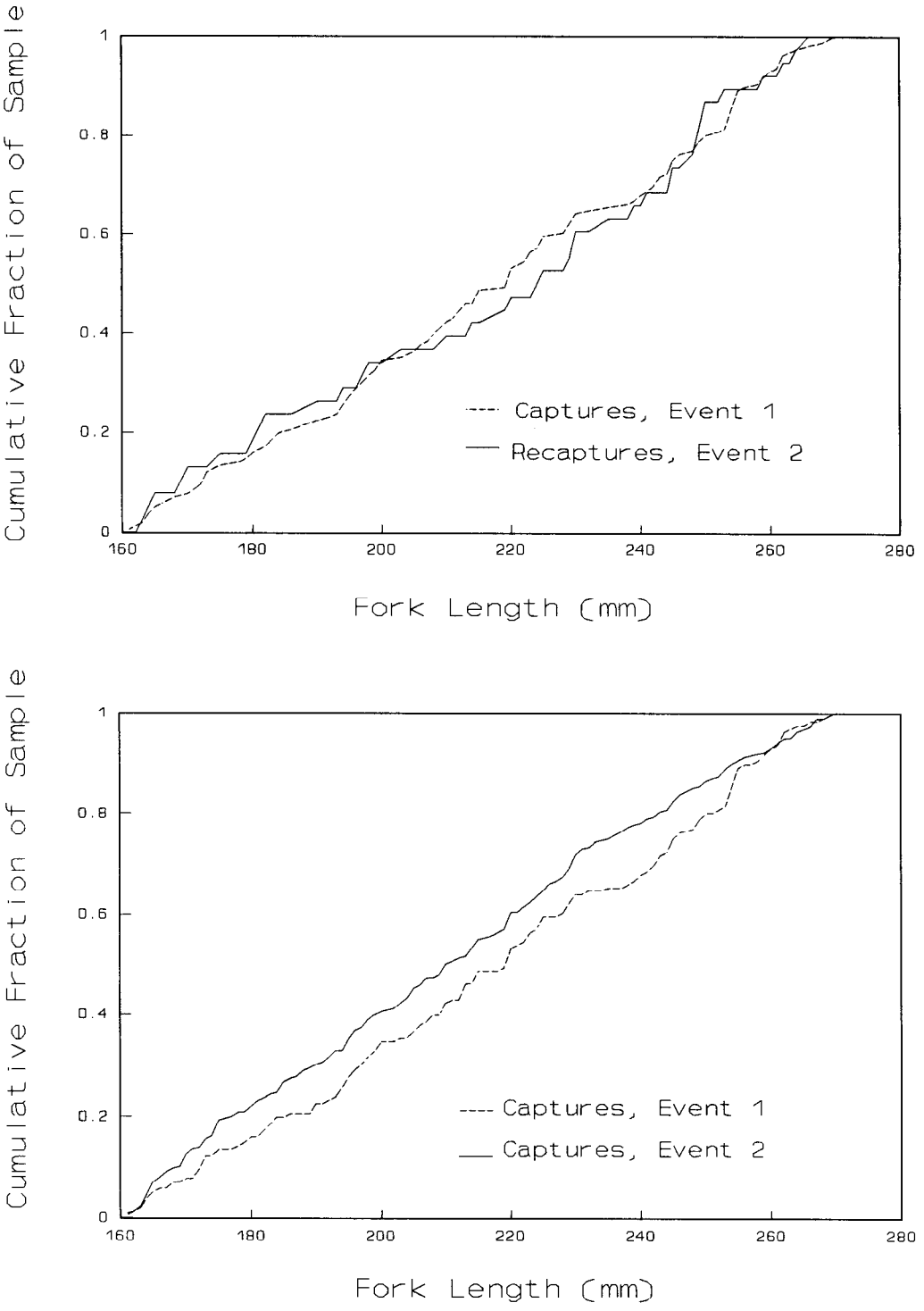

Figure 6. Cumulative histogram of lengths of cutthroat trout marked versus lengths of cutthroat trout recaptured (above) and versus lengths of cutthroat trout examined for marks (below), Turner Lake, 1990.

Table 3. Contingency table comparing the number of marked cutthroat trout 161-280 mm FL recaptured in event 2 to the number not recaptured, by length category, Turner Lake, 1990.

	Length category		
	161-230 mm FL	231-280 mm FL	
Recaptured fish	18	21	39
Not recaptured fish	77	46	123
	95	67	162

$\chi^2 = 3.03$, df = 1, P = 0.07.

Table 4. Numbers of cutthroat trout 161-280 mm FL recovered, by tagging and recovery area (m_{ij}), marked by area (a_i), and unmarked captures by area (u_j), sampling event 2, Turner Lake, 1990.

	Recovery area			
Tagging area	A[a]	B[b]	C[c]	a_i
A	9	3	0	38
B	0	11	4	67
C	0	0	12	57
u_j	106	76	83	

[a] study areas 1-12, 52-64.
[b] study areas 13-24, 40-51.
[c] study areas 25-39.

Table 5. Contingency table comparing the number of marked and unmarked cutthroat trout 161-280 mm FL captured in sampling event 2, by recovery area, Turner Lake, 1990.

	Recovery area			
	A[a]	B[b]	C[c]	
Marked fish	9	14	16	39
Unmarked fish	106	76	83	265
	115	90	99	304

$\chi^2 = 4.16$, df=2, P=0.13

[a] study areas 1-12, 52-64.
[b] study areas 13-24, 40-51.
[c] study areas 25-39.

Table 6. Effort (hours), catch, and catch-per-unit-effort (CPUE, fish per hour) by period, gear, and species for 1990 Florence Lake sampling.

			Cutthroat trout		Dolly Varden		Kokanee	
Period	Gear	Effort	Catch	CPUE	Catch	CPUE	Catch	CPUE
1[a]	Fyke net	163	20	0.12	2	0.01		
	Gill net	4	30	7.69	1	0.26		
	Hook & line	19	89	4.73			1	0.05
	Large trap	414	289	0.70	248	0.60		
	Total	599	428	0.71	251	0.42	1	0.00
2[b]	Fyke net	94	48	0.51				
	Gill net	4	43	10.0	4	0.93	4	0.93
	Hook & line	33	65	1.96			4	0.12
	Large trap	735	361	0.49	360	0.49		
	Total	866	517	0.60	364	0.42	8	0.01
3[c]	Fyke net	34	23	0.67				
	Gill net	4	80	18.2				
	Hook & line	40	106	2.68				
	Large trap	849	336	0.40	339	0.40	1	0.00
	Small trap	42	2	0.05	21	0.50		
	Total	970	547	0.56	360	0.37	1	0.00
Total	Fyke net	290	91	0.31	2	0.01		
	Gill net	13	153	12.1	5	0.40	4	0.32
	Hook & line	92	260	2.84			5	0.05
	Large trap	1,999	986	0.49	947	0.47	1	0.00
	Small trap	42	2	0.05	21	0.50		
	Total	2,436	1,492	0.61	975	0.40	10	0.00

[a] 1 August to 9 August.
[b] 14 August to 23 August.
[c] 28 August to 6 September.

Table 7. Summary of cutthroat trout tagging and recovery data for fish 141-300 mm FL, Florence Lake, 1990.

	1990 sampling period		
	Period 1 1 Aug- 9 Aug	Period 2 14 Aug- 23 Aug	Period 3 28 Aug- 6 Sept
Newly tagged fish Released alive	346[a]	418[b]	439[a]
Recaptured fish tagged in:			
1988	0	0	0
1989	12	16	6[e]
1990 Period 1	1	18[c]	12[d,e,f]
1990 Period 2		5	19
1990 Period 3			4
Captured, not tagged	16	11	22
Total catch	375[a]	468[b]	505[a]

[a] Fish 141-295 mm.
[b] Fish 141-299 mm.
[c] Fish 147-294 mm.
[d] Fish 149-277 mm.
[e] Not including 1 fish recaptured twice in period.
[f] Not including 1 fish previously recaptured in Period 2.

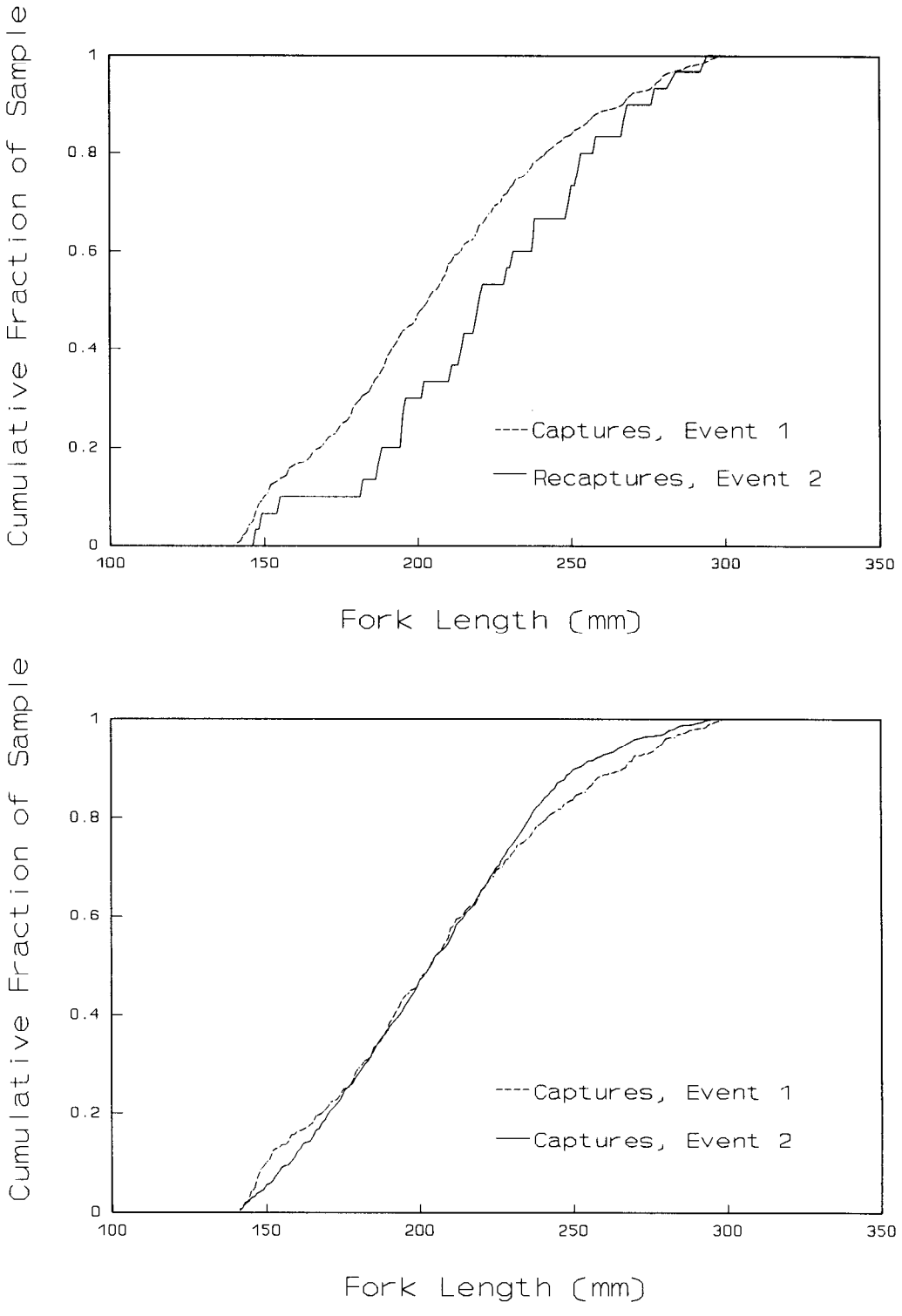

Figure 7. Cumulative histogram of lengths of cutthroat trout marked versus lengths of cutthroat trout recaptured (above) and versus lengths of cutthroat trout examined for marks (below), Florence Lake, 1990.

at 240 mm FL do not support the suspicion (P = 0.12, Table 8); therefore, the data were not stratified by length class. The 240 mm FL cut point was selected by viewing a quantile-quantile plot of lengths of fish marked in event 1 versus lengths of fish recaptured in event 2; other cut points yielded similar results.

Only 7% (2 of 30) of the cutthroat trout tagged and recovered in Florence Lake in 1990 were recovered in (1 of the 3) areas different from the area of tagging (Table 9), indicating little mixing of fish between events. Also, contingency table analyses fail to reject the hypothesis of equal probability of capture by lake area (P = 0.067, Table 10), suggesting the Darroch estimators were appropriate for the data.

We estimated abundance of cutthroat trout for fish between 141 mm FL and 300 mm FL as $\hat{N}$ = 14,780, SE[$\hat{N}$] = 4,788, using Darroch's model (equations 3 and 4, Table 9).

Age, Length, and Weight

Turner Lake. Age was estimated for 651 cutthroat trout sampled in 1990. The predominant age class sampled was 3 years (Table 11). The oldest fish sampled appeared to be 9 years old and averaged 523 mm FL. The cutthroat trout aged showed a linear or even increasing amount of growth with age (Figure 8).

The length frequency distribution of cutthroat trout captured in both sampling events (Figure 6) was not significantly different (K-S test, d_{max} = 0.10, P = 0.28) so data from all trips were combined to estimate age compositions. Based on catch (Figure 5) and catch at age (Table 11), we assume fish aged 4 and above are fully recruited to our gear. About 2/3 of the population aged 4 and above are fish aged at 4 years, ≈0.25 are aged 5, ≈0.067 are aged 6 (Table 12).

Estimated length-weight parameters for 659 cutthroat trout sampled in 1990 in Turner Lake are: a = -11.7324 (SE = 0.08338); b = 3.0345 (SE = 0.01341); correlation (a,b) = 0.9873.

The estimated parameters for the length-weight relationship for 174 Dolly Varden sampled in Turner Lake are: a = -10.5352 (SE = 0.08542); b = 2.7979 SE = 0.03784); correlation (a,b) = 0.9695.

The estimated parameters for the length-weight relationship for 31 kokanee sampled in Turner Lake in 1990 are: a = -12.1779 (SE = 0.08368); b = 3.1250 (SE = 0.35237); correlation (a,b) = 0.7306.

Florence Lake. Age was estimated for 925 cutthroat trout sampled in 1990. The oldest fish was 8 years of age and 460 mm FL (Table 13). Fish aged 2 and 3 years dominate the sample. Cutthroat trout aged again showed a linear or even increasing amount of growth with age (Figure 8).

The length frequency distributions of cutthroat trout captured in both sampling events (Figure 7) were significantly different (K-S test, d_{max} = 0.14, P=<0.001). However, the difference results from large sample sizes, enabling detection of small differences, rather than functional differences between the distributions. Data from all 3 trips were thus combined to estimate age composition. Based on catch (Figure 5) and catch at age (Table 13), we assume fish aged 4 and above are fully recruited to our gear. The age structure of the population aged 4, 5, and 6 appears quite similar to that observed in Turner Lake (Table 12).

Table 8. Contingency table comparing the number of marked cutthroat trout 141-300 mm FL recaptured in event 2 to the number not recaptured, by length category, Florence Lake, 1990.

	Length category		
	141-240 mm FL	241-300 mm FL	
Recaptured fish	20	10	30
Not recaptured fish	250	66	316
	270	76	346

$\chi^2 = 2.48$, df=1, P=0.12

Table 9. Numbers of cutthroat trout 141-300 mm FL recovered, by tagging and recovery area (m_{ij}), marked by area (a_i), and unmarked captures by area (u_j), sampling event 2, Florence Lake, 1990.

	Recovery area			
Tagging area	A[a]	B[b]	C[c]	a_i
A	3	0	0	83
B	0	12	0	126
C	1	1	13	137
u_j	317	312	314	

[a] study areas 6-8.
[b] study areas 4-5, 9-10.
[c] study areas 1-3, 11.

Table 10. Contingency table comparing the number of marked and unmarked cutthroat trout 141-300 mm FL captured in sampling event 2, by recovery area, Florence Lake, 1990.

	Recovery area			
	A[a]	B[b]	C[c]	
Marked fish	4	13	13	30
Unmarked fish	317	312	314	943
	321	325	327	304

$\chi^2 = 5.41$, df=2, P=0.067

[a] study areas 6-8.
[b] study areas 4-5, 9-10.
[c] study areas 1-3, 11.

Table 11. Length at age for cutthroat trout sampled in Turner Lake in 1988, 1989, 1990, and in all three years combined.

	Age	Number sampled	Minimum length	Maximum length	Mean length	Standard error
1988	1	6	93	127	111.8	13.26
	2	49	115	225	152.6	20.87
	3	69	124	264	196.6	23.87
	4	71	194	302	245.1	20.80
	5	40	222	345	272.2	26.68
	6	15	241	335	298.9	26.10
	7	6	310	510	383.7	69.46
	9	1	541	541	541.0	
	15	1	605	605	605.0	
1989	1	9	64	125	107.0	19.14
	2	105	108	196	146.8	16.93
	3	107	133	257	186.9	21.32
	4	67	166	281	232.0	20.12
	5	39	241	360	277.1	21.87
	6	17	277	375	314.3	27.46
	7	7	313	414	371.9	31.42
	8	3	436	577	492.7	74.46
	10	1	545	545	545.0	
1990	1	2	115	126	120.5	7.78
	2	109	124	193	153.1	14.37
	3	224	131	252	190.8	23.67
	4	206	168	295	236.1	22.25
	5	69	235	334	270.5	19.37
	6	21	269	373	319.7	25.84
	7	9	314	555	389.6	66.96
	8	8	431	564	480.3	40.83
	9	3	498	567	523.3	37.98
Combined	1	17	64	127	110.3	16.19
	2	263	108	225	150.5	16.96
	3	400	124	264	190.7	23.26
	4	344	166	302	237.2	21.93
	5	148	222	360	272.7	22.22
	6	53	241	375	312.1	27.33
	7	22	310	555	382.3	56.55
	8	11	431	577	483.6	48.06
	9	4	498	567	527.8	32.24
	10	1	545	545	545.0	
	15	1	605	605	605.0	

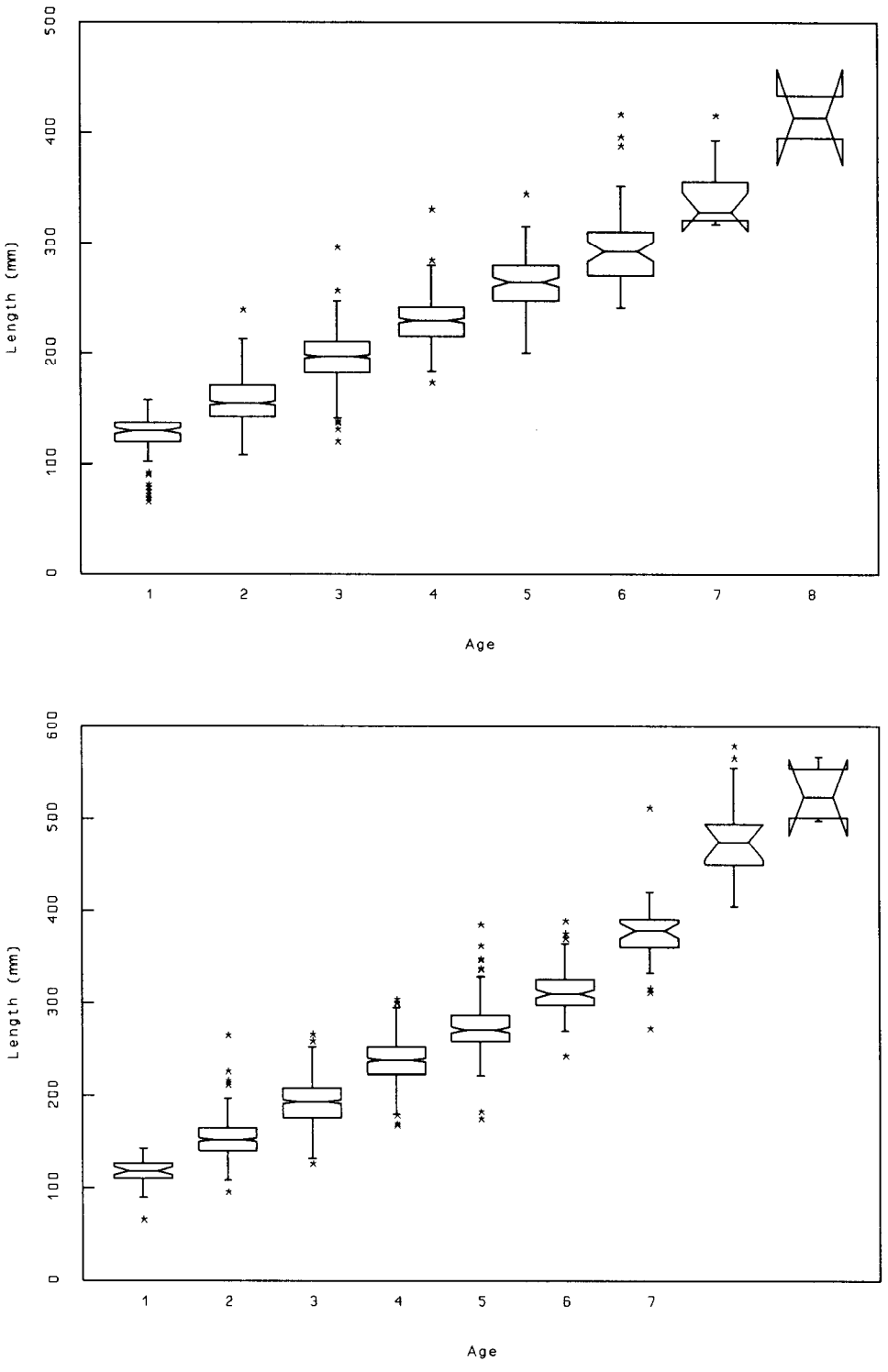

Figure 8. Notched box plot of length at age (estimated from scales) for cutthroat trout at Turner (upper panel) and Florence (lower panel) lakes, 1988 to 1990 data.

Table 12. Estimated age composition of cutthroat trout fully recruited to fishing gear (aged 4 and above) in Turner and Florence Lake, 1990.

	Turner Lake		Florence Lake	
Age	p_a	$SE(p_a)$	p_a	$SE(p_a)$
4	0.652	0.027	0.663	0.024
5	0.218	0.023	0.251	0.022
6	0.066	0.014	0.065	0.013
7	0.028	0.009	0.018	0.007
8	0.025	0.009	0.003	0.003
9	0.009	0.005		

Table 13. Length at age for cutthroat trout sampled in Florence Lake in 1988, 1989, 1990, and in all three years combined.

	Age	Number sampled	Minimum length	Maximum length	Mean length	Standard error
1988	1	6	64	89	73.7	8.78
	2	15	120	178	156.7	16.75
	3	20	153	228	191.2	20.68
	4	15	199	263	235.0	17.84
	5	10	215	343	251.4	35.70
	6	5	252	320	278.0	31.34
1989	1	70	80	158	130.5	13.25
	2	379	108	213	157.1	20.78
	3	303	119	295	195.7	24.16
	4	129	172	283	229.4	21.71
	5	40	200	315	263.4	24.51
	6	15	259	395	305.9	35.96
	7	3	321	393	355.0	36.17
	8	2	395	434	414.5	27.58
1990	1	26	91	147	127.6	12.23
	2	207	115	238	155.6	18.95
	3	306	143	247	196.1	19.01
	4	256	182	329	228.2	19.57
	5	97	207	304	265.9	19.09
	6	25	241	416	297.5	39.22
	7	7	317	415	340.3	35.58
	8	1	460	460	460.0	
Combined	1	102	64	158	126.4	18.38
	2	601	108	238	156.6	20.06
	3	629	119	295	195.8	21.68
	4	400	172	329	228.8	20.22
	5	147	200	343	264.2	22.18
	6	45	241	416	298.2	37.50
	7	10	317	415	344.7	34.43
	8	3	395	460	429.7	32.72

The estimated length-weight parameters from the 1,486 cutthroat trout sampled in Florence Lake in 1990 were: a = -10.8879 (SE = 0.09251); b = 2.8717 (SE = 0.01111); correlation (a,b) = 0.9783.

Creel Survey

Turner Lake. Seventy of 78 parties (89.7%) with registrations for use of USFS cabins at Turner Lake in 1990 responded to our survey. Of the parties who responded, 49 (70%) used their cabin reservation (Appendix A3), and 46 (93.9%) of them fished during their visit. Only 17 (37.8%) of the respondents from Turner Lake considered the fishing quality to be "good to excellent." The average party size in Turner Lake was 3.3 people (SE = 0.03).

We detected no change in the catch rate (catch/party) by parties responding to the three mailings in our survey (ANOVA, F = 1.01, P = 0.372). As a result, we were able to use a simple expansion with mean catch per party to estimate total catch and harvest.

Anglers spent an estimated total of 1,010 hours fishing at Turner Lake and caught an estimated 779 cutthroat trout (SE = 61), 310 kokanee (SE = 34), and 288 Dolly Varden (SE = 36) (Table 14). The total estimated number of cutthroat trout released was 465 for an overall release rate of 60%.

Florence Lake. Forty-three of 48 parties (89.6%) with registrations for use of USFS cabins at Florence Lake in 1990 responded to our survey. Of the parties who responded, 36 (83.7%) used their cabin reservation (Appendix A3) and 32 (88.9%) of them fished during their visit. Twenty-three (71.9%) of the respondents considered the fishing quality to be "good to excellent." The average party size was 2.9 people (SE = 0.03).

We detected no change in the catch rate (catch/party) by parties responding to the three mailings in our survey (ANOVA, F = 1.12, P = 0.340). As a result, we were able to use a simple expansion with mean catch per party to estimate total catch and harvest.

Anglers at Florence Lake spent an estimated total of 1,035 hours (SE = 72.2) to catch 2,332 cutthroat trout (SE = 161.3), 25 kokanee (SE = 4.0), and 258 Dolly Varden (SE = 36.7) (Table 14). Small cutthroat trout accounted for 2,286 (98%) of the 2,332 total. An estimated 1,725 cutthroat trout were released in Florence Lake for an overall release rate of 74.0%.

DISCUSSION

The accurate use of Peterson estimators requires several assumptions, including that there is no immigration, growth recruitment, or deaths in the size ranges of interest during the experiment. Since the time between our sampling events was short (1-2 weeks), we assume this assumption was valid in these experiments. Another assumption is that all fish have the same probability of capture during the first sample or in the second sample or that marked and unmarked fish mix completely between the two sampling events. During our sampling events, fishing gear was deployed across all geographic areas in an attempt to equalize probabilities of capture for fish in different areas of the lake. Since there was little movement of fish between sampling events, this strategy probably averted the need to stratify the experiments by area and thus resulted in minimum estimates for each lake.

Table 14. Observed and estimated total effort and harvest for Turner and Florence Lakes from mail-out creel survey in 1990.

		Observed		Expanded	
		Sum	SE	Total	SE
Florence	Days fished	282	6.1	314	15.8
	Hours fished	928	32.5	1,035	72.2
	Small[a] CT harvested	37	17.9	599	40.3
	Small CT released	1,511	65.7	1,687	140.4
	Big[b] CT harvested	7	0.8	8	1.5
	Big CT released	34	4.2	38	8.3
	Total CT caught	2,089	72.4	2,332	161.3
	Kokanee harvested	1	0.2	1	0.4
	Kokanee released	21	2.0	23	4.0
	Total kokanee caught	22	2.0	25	4.0
	Dolly Varden harvested	70	7.5	78	15.0
	Dolly Varden released	161	12.6	180	25.5
	Total Dolly Varden caught	231	18.2	258	36.7
Turner	Days fished	288	6.4	320	17.9
	Hours fished	907	23.2	1,010	62.2
	Small CT harvested	242	9.5	270	23.5
	Small CT released	388	14.5	432	36.1
	Big CT harvested	39	2.1	44	5.1
	Big CT released	30	2.5	33	5.8
	Total CT caught	699	24.0	779	60.8
	Kokanee harvested	139	7.7	155	18.6
	Kokanee released	139	7.8	155	18.8
	Total kokanee caught	278	14.0	310	33.9
	Dolly Varden harvested	52	2.9	58	7.1
	Dolly Varden released	206	13.6	230	32.3
	Total Dolly Varden caught	258	14.9	288	35.8

[a] Small cutthroat are those fish <450 mm (18 in.).
[b] Big cutthroat are those fish >450 mm (18 in.).

Cutthroat trout sampled showed a steady increase in length with increasing age (Figure 8), suggesting the oldest age classes in the lake were not sampled, or the estimated ages tend to underestimate age in the older fish sampled. It is unlikely that we did not sample the oldest age classes in the lake. In contrast, many authors note that ages estimated by reading scales may underestimate true fish age (Beamish and McFarlane 1987). Patterns related to fish age may not be discernible on scales from older fish, patterns near scale edges may be lost or regenerated, initial annulus formation may be absent, or scales may not be taken from the best location. We believe our estimates of age, especially for older fish, tend to be biased low due to one or more problems related to estimating fish age. Thus, estimates in this report which depend on estimated ages, especially those involving fish of older apparent age, are also biased and should be used with caution.

The abundance estimate for cutthroat trout in Florence Lake is higher than in any cutthroat trout system we have studied to date (Table 15). Overall CPUE for large traps in Florence Lake was 2.7 times higher than in Turner Lake, for example, while CPUE for lake fyke nets was 4.4 times higher. This difference may exist partly because Florence Lake has a relatively large amount of high quality, near-shore fish habitat. Whereas Turner Lake is 14 km in length, very steep-sided, and reaches >200 m deep, Florence Lake is 7.2 km long, has a maximum depth of 27 m, and is relatively shallow. The western 1.5 km of the lake is <4.5 m deep and contains heavy aquatic vegetation, which provides cover and feeding habitat for several sizes of cutthroat trout.

Anglers reported to us that 82% of the cutthroat they caught in Florence Lake were released, compared to only 42.8% in Turner Lake. Since the catch rate for cutthroat trout in Florence Lake (2.3 fish/hour) is about three times higher than in Turner Lake (0.8 fish/hour), anglers may be more inclined to release the fish they catch in Florence Lake.

Cutthroat trout exploitation rates in Turner Lake were obviously much higher (25.3% of the total abundance) than in Florence Lake (4.1% of the estimated abundance). Total cutthroat trout catches of 779 and 2,332 represent 63% and 16%, respectively, of the total estimated abundance in Turner and Florence lakes. Catch percentages do not consider the probability of multiple catch and release.

Our sampling trips and creel survey indicate a higher percentage of large cutthroat trout exist in Turner Lake compared to Florence Lake. It is not obvious to us why this may be so, since cutthroat trout exploitation rates in Turner Lake appear to be significantly greater than in Florence Lake.

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We appreciate the efforts of Kurt Kondzela and Brad Gruening for their outstanding work in the field and for their insights into the information we collected. Kurt also was invaluable in getting the scales from both lake systems aged. We thank the Shee Atika Corporation for allowing us to maintain a field camp on their property while we conducted our field studies on Florence Lake.

Table 15. Estimated population size of resident cutthroat trout in six lakes in Southeast Alaska.

Lake	Area (ha)	Year	Population estimate	Standard error
Turner Lake[a]	1,270	1988	1,753	450.0
		1989	1,586	154.1
		1990	1,242	252.3
Jims Lake[b]	112	1980	2,816	463.3
Mirror Lake[c]	474	1986	5,633	262.8
Harvey Lake[d]	160	1979	669	NA
Virginia Lake[d]	258	1979	5,631	469.9
Florence Lake		1990	14,780	1,549.5

[a] Turner Lake-1988, Jones et al. (1989);
Turner Lake-1989, Jones et al. (1990).
[b] Jones (1981).
[c] Jones(*unpublished*).
[d] Jones (1980).

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APPENDIX A

Appendix A1. Evaluation of floy-type tag loss at Turner Lake.

Individually numbered floy-type tags were placed on cutthroat trout captured at Turner Lake in 1988 (Jones et al. 1989), 1989 (Jones et al. 1990), and in 1990 (this study). In each study, all tagged fish were also marked by removing their adipose fins, to allow for estimation of tag loss. In addition, in 1989, fish were tagged with VI (Visual Implant) tags.

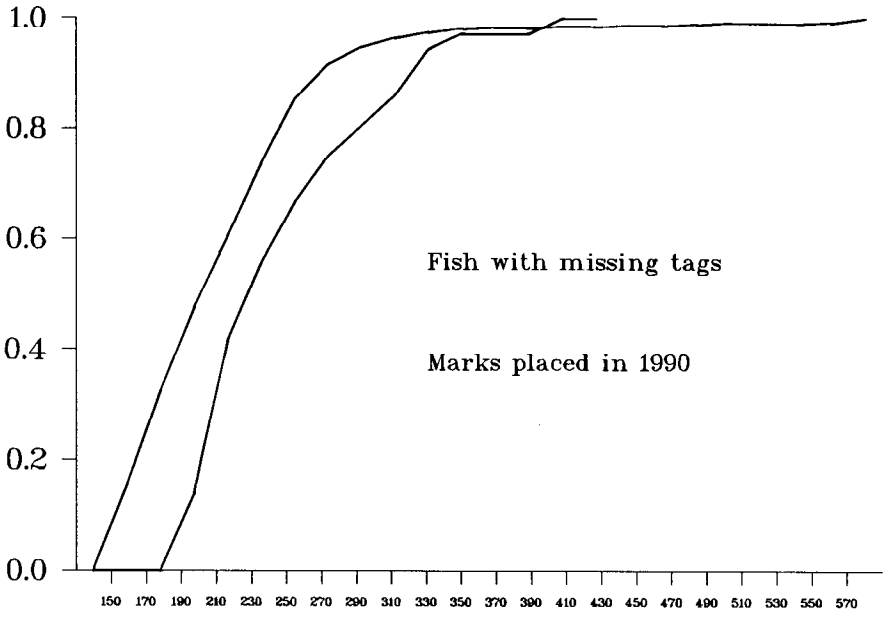
In 1988, 641 cutthroat trout were tagged in Turner Lake. During that sampling no cutthroat trout with naturally missing adipose fins, 1 fish with a lost tag, and 2 fish with insecure tags were observed in the catch.

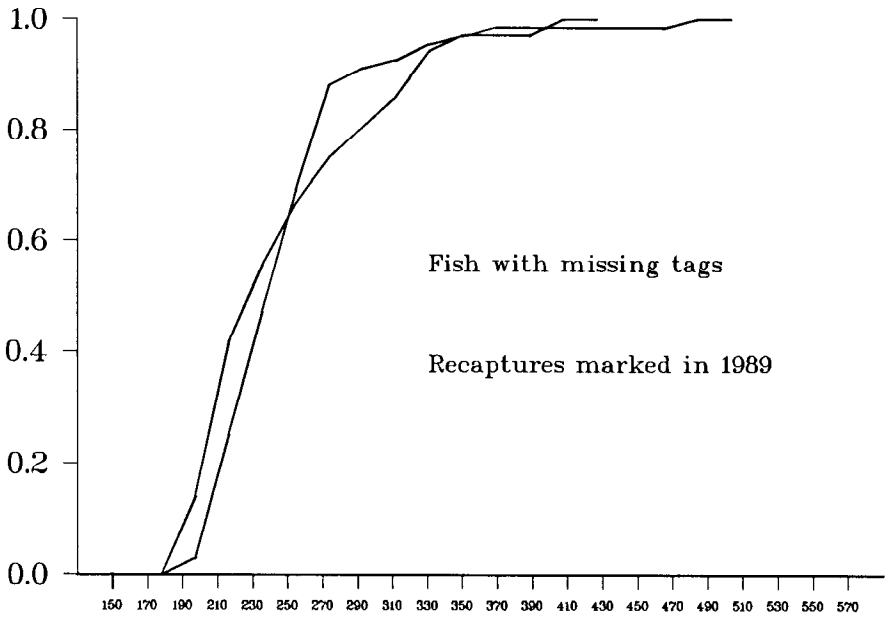
In 1989, 412 cutthroat trout were tagged in Turner Lake. During that sampling 31 sampled fish had potentially lost their floy-type tags: i.e., they were either missing an adipose fin and obviously scarred in the dorsal area (12 fish), missing an adipose fin but not obviously scarred from tagging (7 fish), "scarred" (no mention of adipose fin status, 9 fish), or lost their tag during the recapture (3 fish). These data suggest a substantial tag loss given that only 61 other fish tagged in 1988 and 30 fish tagged in 1990 were recaptured.

During sampling at Turner Lake in 1990, every captured fish was again inspected for a missing adipose fin, and a VI tag. Forty-four fish captured in 1990 were judged to have lost a tag, while 3 more may have had their adipose fin removed. The majority (33) of these 44 fish were missing adipose fins and showed scars in the dorsal area, presumably from prior tagging. Also, 8 of these 44 fish were identified as having been tagged in 1989 from VI tags observed still in place, so the 36 other fish (44 - 8) lost tags placed in either 1988, 1989, or 1990. If these fish were tagged in 1990 it would be necessary to consider tag loss in the analysis of abundance. However, comparing length frequency distributions of the 36 fish with unknown tagging dates to, a) the 480 fish captured and marked in 1990, and b) 68 recaptures in 1990 of fish tagged in 1989, strongly suggests that the 36 fish were not (predominately) tagged in 1990 (Appendix A2).

A hypothesis of similar length distributions between fish tagged in 1990 and the 36 fish with missing adipose fins is strongly rejected (K-S test, $p \leq 0.0001$). In contrast, a hypothesis of similar length distributions between fish tagged in 1989 and the 36 fish with missing adipose fins was not rejected ($p = 0.15$). Also, the length frequency distribution of 11 fish tagged in 1988 and recaptured in 1990 (median length = 275 mm FL, range 255 mm FL to 375 mm FL) is much different from that of the 36 unknown fish.

We conclude that the loss of floy-type anchor tags placed on cutthroat trout in these studies has been substantial, but there is little evidence to suggest that the loss is occurring within the summer sampling periods.





Appendix A2. Cumulative histogram of the lengths of cutthroat trout with missing adipose fins and unknown tagging year versus lengths of cutthroat trout tagged in 1990 (top) versus lengths of cutthroat trout marked in 1989 and recaptured in 1990 (bottom).

Appendix A3. Survey responses to the first page of the mail-out survey.

1. Did you or a member of your party use your U.S. Forest Service cabin reservation?

Turner Lake	Florence Lake
Yes - 49 (70%)	Yes - 36 (83.7%)
No - 21 (30%)	No - 7 (16.3%)

2. If you or a member of your party did use the cabin, did you fish while you were there?

Turner Lake	Florence Lake
Yes - 46 (93.9%)	Yes - 32 (88.9%)
No - 3 (6.1%)	No - 4 (11.1%)

3. How many people were in your group?

Turner Lake	Florence Lake
3.3 (Average, SE= 0.03)	2.9 (Average, SE=0.03)

4. Did you see any other anglers fishing from float planes while you were at the cabin?

Turner Lake	Florence Lake
Yes - 14 (28.6%)	Yes 5 (13.9%)
No - 35 (71.4%)	No 28 (77.8%)
	No Response 3 (8.3%)

5. Would you like to see a copy of our summary report when it is available?

Turner Lake	Florence Lake
Yes 37 (52.9%)	Yes 23 (53.5%)
No 18 (25.7%)	No 10 (23.3%)
No Response 15 (21.4%)	No Response 10 (23.3%)

6. Overall, how would you rate the fishing here?

Turner Lake	Florence Lake
Poor 14 (30.4%)	Poor 2 (6.2%)
Fair 14 (30.4%)	Fair 7 (21.9%)
Good 10 (21.7%)	Good 12 (37.5%)
Excellent 7 (15.2%)	Excellent 11 (34.4%)
No response 1 (2.1%)	