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ESTIMATES OF SPORT EFFORT AND HARVEST OF CHINOOK SALMON FROM THE KLUTINA AND GULKANA RIVERS, 1989[1]

By

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ABSTRACT

Stratified random creel surveys were conducted to estimate effort, harvest, and catch of (1) chinook salmon *Oncorhynchus tshawytscha*, sockeye salmon *Oncorhynchus nerka*, and Arctic grayling *Thymallus arcticus* by shore anglers and power boat operators in the Gulkana River downstream of the West Fork during 16 June through 31 July 1989, and (2) chinook salmon and sockeye salmon by shore anglers and power boat operators in the Klutina River during 24 June through 10 August 1989.

In the Gulkana River downstream of the West Fork these surveys estimated that anglers expended 29,103 (standard error = 5,834) angler-hours with 55 percent of the effort occurring on weekends during this period. Catch (fish kept plus fish released) totaled 2,398 (standard error = 888) chinook salmon, 2,415 (standard error = 1,266) Arctic grayling, and 446 (standard error = 300) sockeye salmon. The harvest (number of fish kept) of chinook salmon, Arctic grayling, and sockeye salmon was 61 percent, 20 percent, and 73 percent of the catch, respectively. Age 1.3 and 1.4 chinook salmon accounted for 94 percent (standard error = 8.22) and 97 percent (standard error = 5.97) of the harvest and escapement, respectively.

Findings from the survey conducted of the Klutina River estimated that boat anglers conducted 416 boat trips (standard error = 33) and shore anglers expended 3,764 angler-hours (standard error = 458) of effort during this period. Catch totaled 1,587 (standard error = 681) chinook salmon and 361 (standard error = 591) sockeye salmon. The harvest of chinook and sockeye salmon was 65 percent and 66 percent of the catch, respectively. Boat anglers accounted for 88 percent of the chinook salmon catch and 41 percent of the sockeye salmon catch. Age 1.3 and 1.4 chinook salmon accounted for 96 (standard error = 4.81) percent of the harvest.

KEY WORDS: Arctic grayling, *Thymallus arcticus*, chinook salmon, *Oncorhynchus tshawytscha*, sockeye salmon, *Oncorhynchus nerka*, creel survey, harvest, catch, effort, Gulkana River, Klutina River, sport fishing, age, length.

INTRODUCTION

The sport fisheries on the Gulkana and Klutina Rivers (Figures 1 and 2) are two of the most important recreational fisheries in Upper Copper River-Upper Susitna River (UCUS) management area. These fisheries are the two major sport fisheries on chinook salmon *Oncorhynchus tshawytscha* in the Upper Copper River (UCR) drainage. These chinook salmon stocks also sustain harvest by commercial, personal use, and subsistence users (Figure 3). Total harvest of Copper River chinook salmon (Brady et al. 1990; Delaney et al. 1988; Mills 1984-1988) has ranged from 71% to 91% of the total return during 1982-1989. This harvest rate may be in excess of that which is sustainable.

Angling effort in the Gulkana River has ranged from approximately 11,300-17,400 angler days during the previous 6 years (Figure 4), while angling effort in the Klutina River fishery has increased from approximately 1,100 angler days in 1983 to over 6,300 angler days in 1987 (Figure 5) (Mills 1984-1989; Roth and Delaney 1989). The harvest of chinook salmon has ranged from 1,033 to 2,833 fish in the Gulkana River and from 147 to 1,033 fish in the Klutina River during 1983-1989 (Delaney et al. 1988; Mills 1984-1989; Roth and Delaney 1989) (Figures 6 and 7). In addition to chinook salmon, anglers catch and harvest sockeye salmon *Oncorhynchus nerka*, Arctic grayling *Thymallus arcticus*, and rainbow and steelhead trout *Oncorhynchus mykiss* from the Gulkana River, and sockeye salmon and Dolly Varden *Salvelinus malma* from the Klutina River.

In January of 1989, the Alaska Board of Fisheries established regulations to reduce and/or stabilize the harvest of Copper River chinook salmon in the recreational and personal use fisheries. An area wide spawning season closure on all UCR streams and a reduced daily bag limit were established, restricting sport fishing opportunities. A seasonal bag limit of five chinook salmon was implemented on the personal use fishery.

The objectives of this report are to present: (1) estimates of angler-effort, catch, and harvest of chinook salmon, Arctic grayling, and sockeye salmon taken from the Gulkana River downstream of the West Fork during 16 June-31 July; (2) estimates of angler-effort, catch, and harvest of chinook and sockeye salmon taken from the Klutina River during 24 June-10 August; (3) estimates of the sex, age, and length composition of sport harvested chinook salmon from the Gulkana and Klutina Rivers; and (4) estimates of the sex, age, and length composition from the Gulkana River chinook salmon spawning escapement.

METHODS

Gulkana River Creel Survey

A stratified random creel survey was conducted to estimate effort, harvest, and catch of chinook salmon, Arctic grayling, and sockeye salmon by shore anglers and power boat operators downstream of the West Fork of the Gulkana River (Figure 1). The Gulkana River creel survey area was divided into three sections: (1) the West Fork downstream to Sourdough; (2) Sourdough downstream

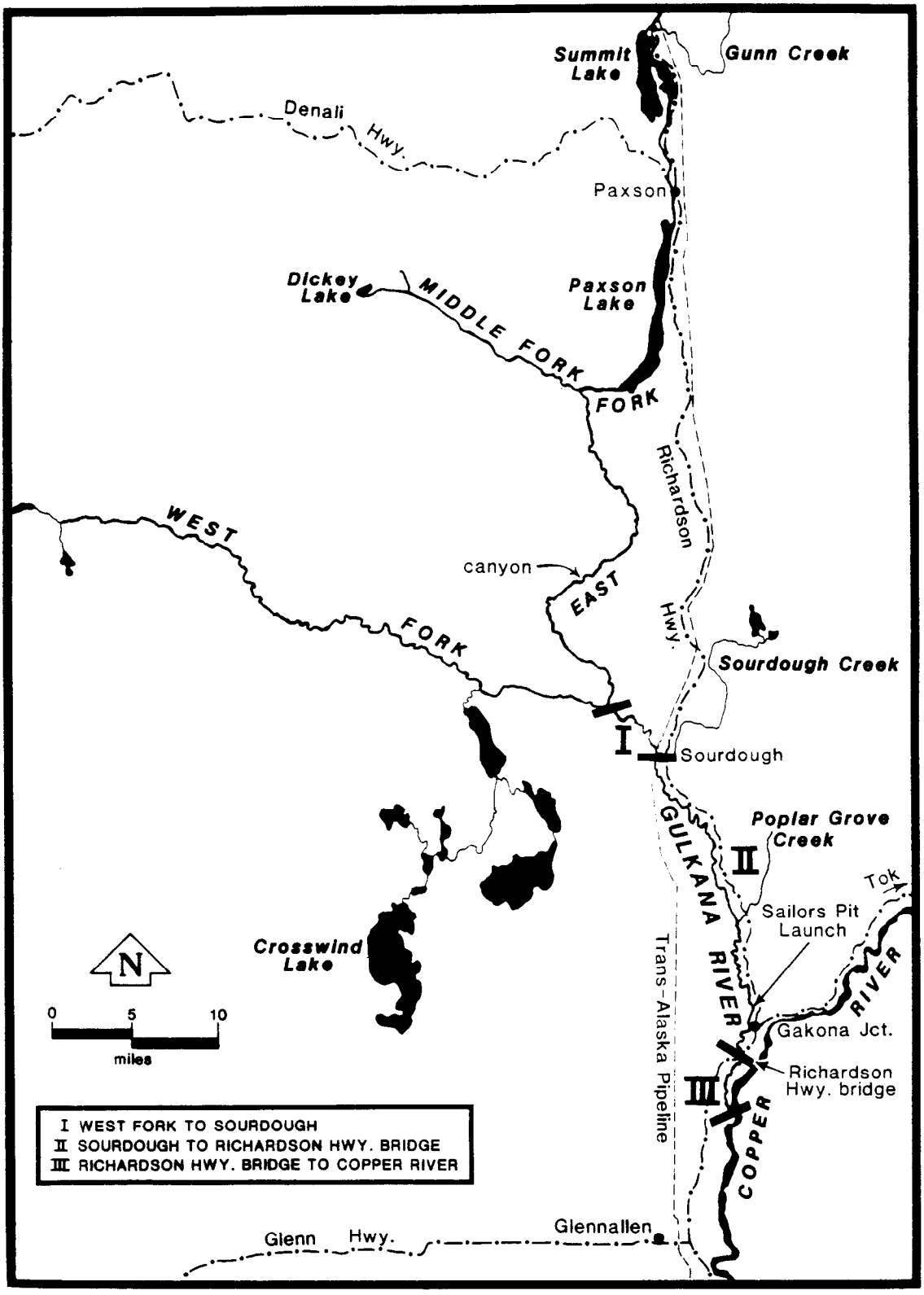

Figure 1. Map of the Gulkana River drainage.

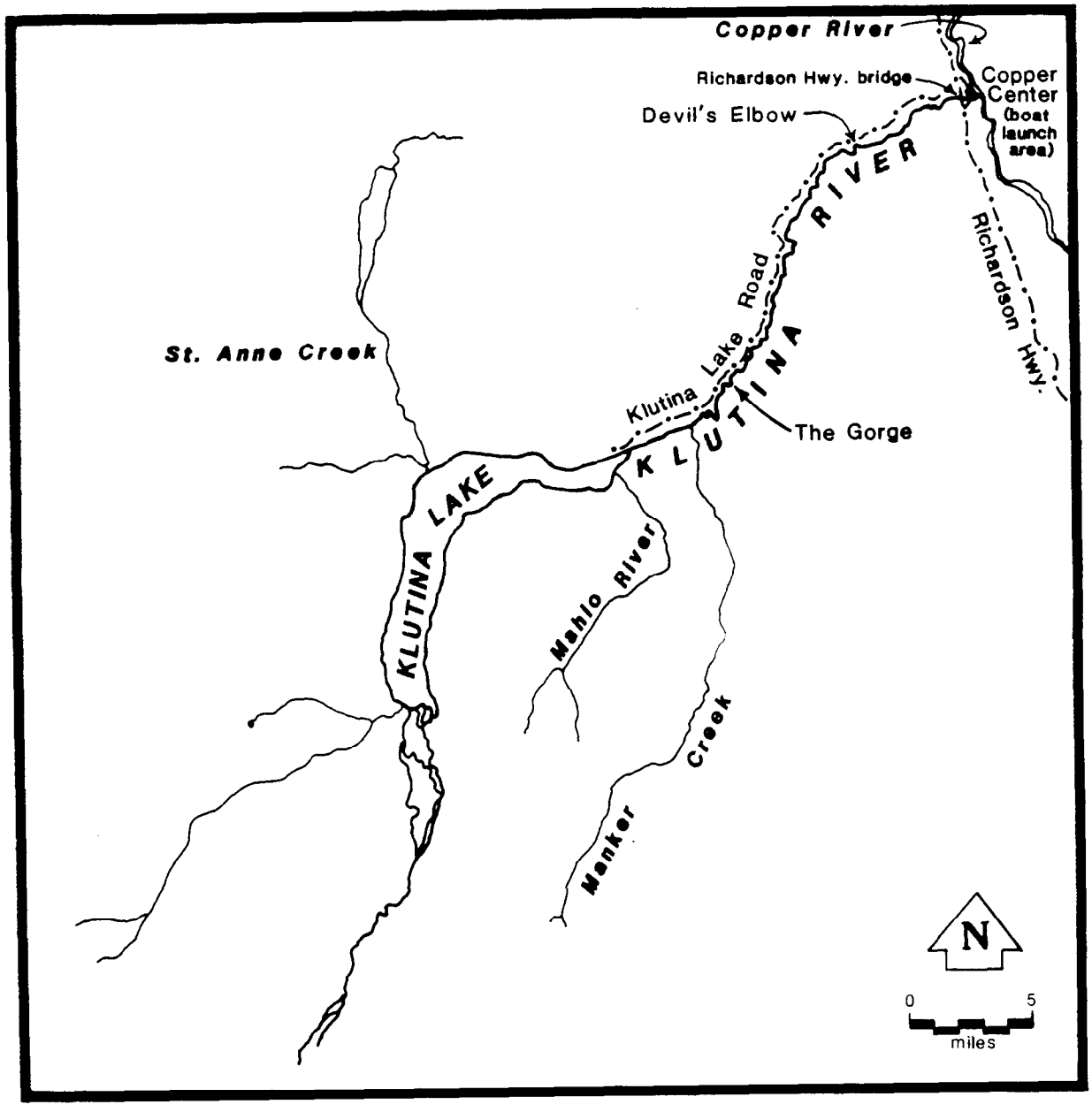

Figure 2. Map of the Klutina River drainage.

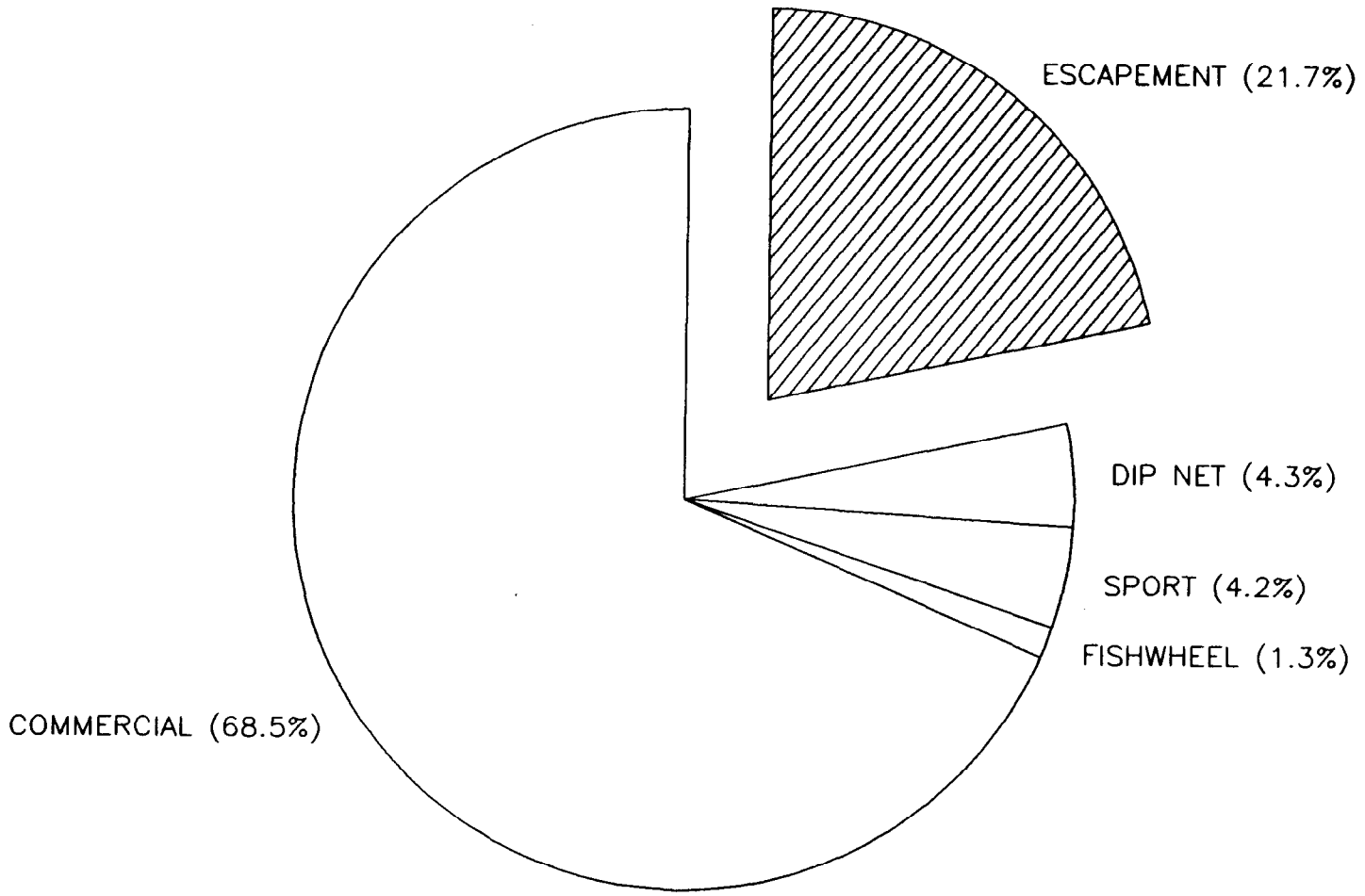

Figure 3. Average estimated exploitation by user group of Copper River chinook salmon, 1982-1989.

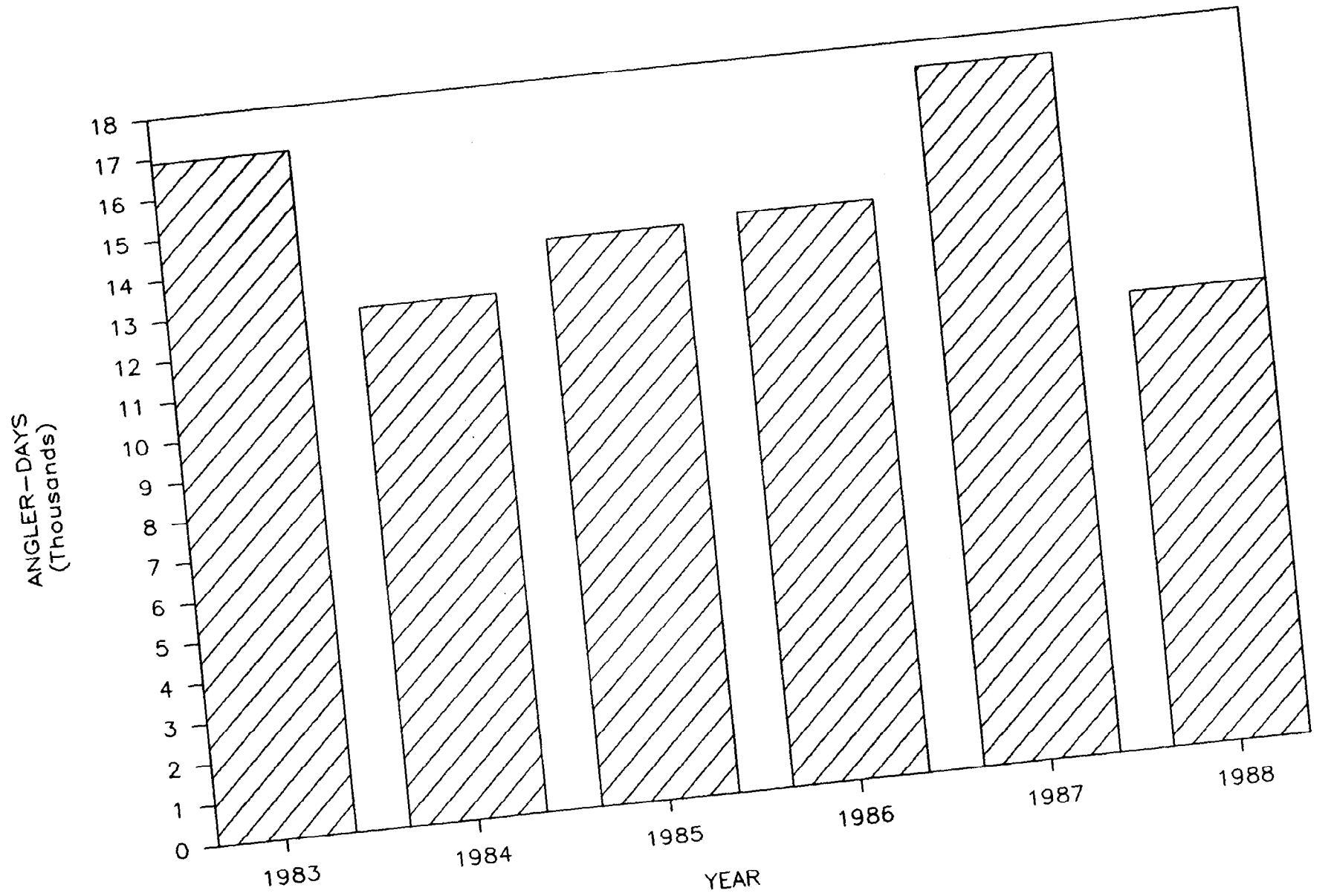

Figure 4. Sport fishing effort in the Gulkana River, 1983-1988.

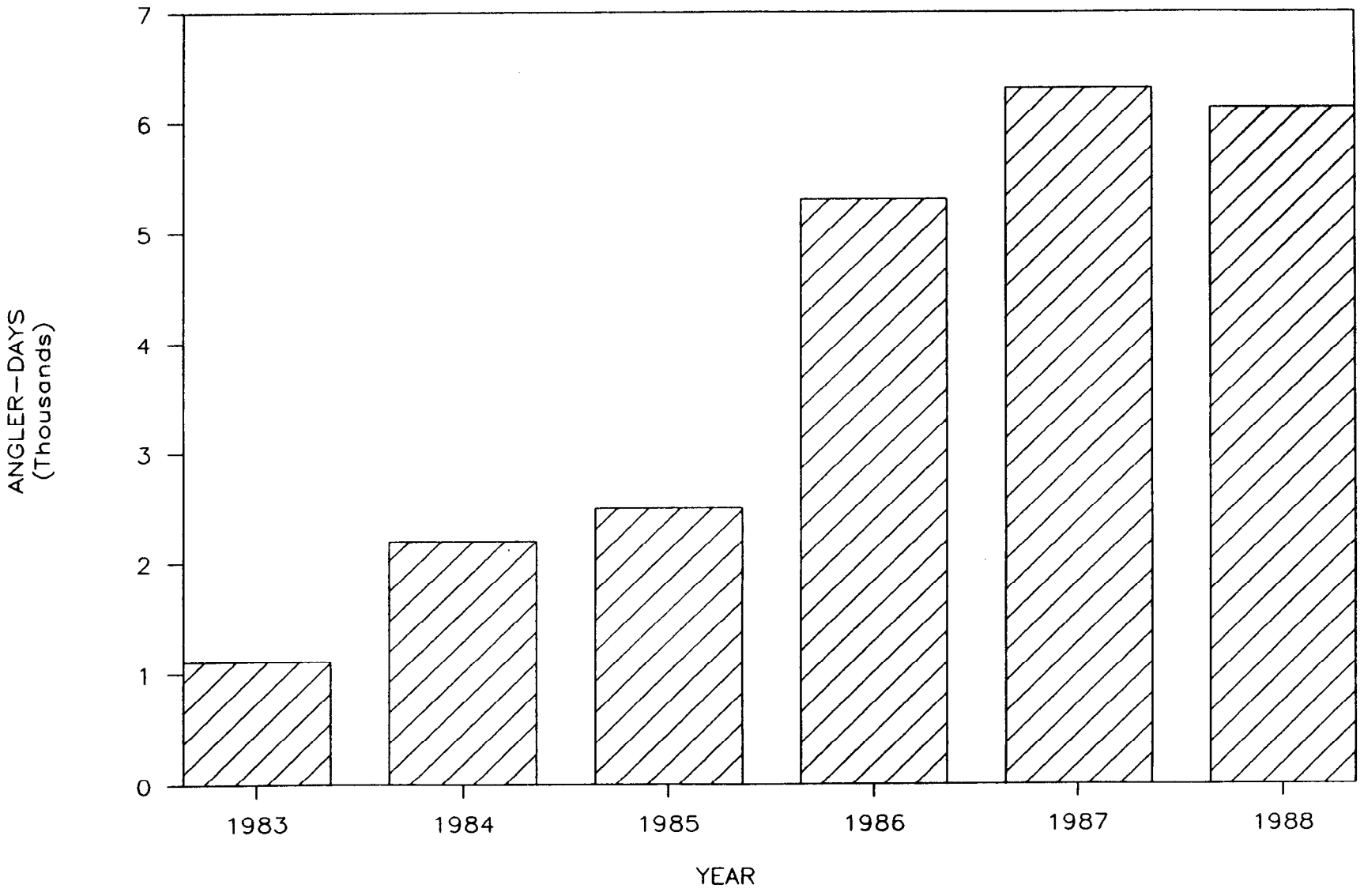

Figure 5. Sport fishing effort in the Klutina River, 1983-1988.

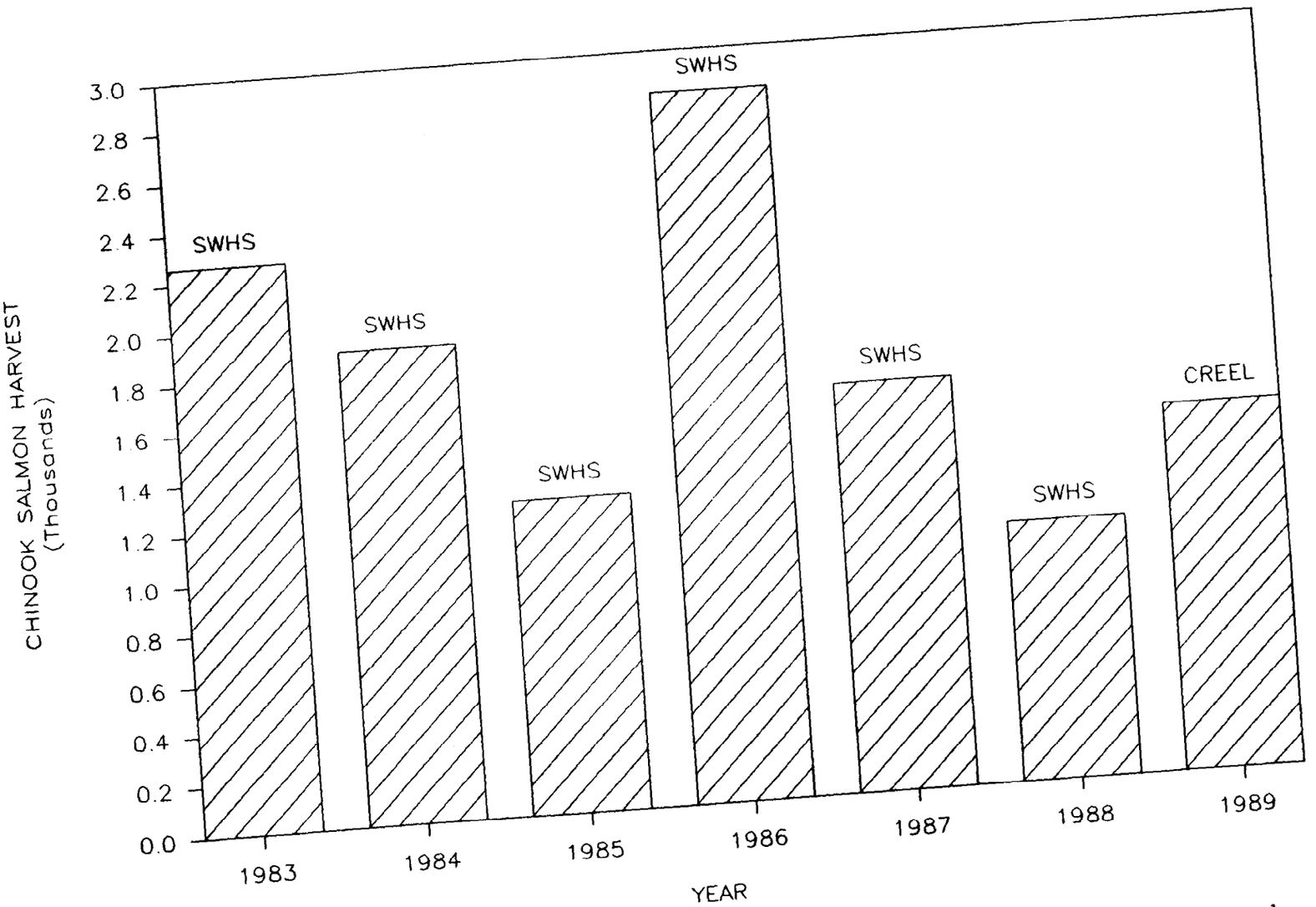

Figure 6. Sport harvest of chinook salmon, Gulkana River, 1983-1989. Estimate of harvest generated from 1989 creel survey compared to statewide harvest survey estimates from 1983-1988 (Mills 1984-1989).

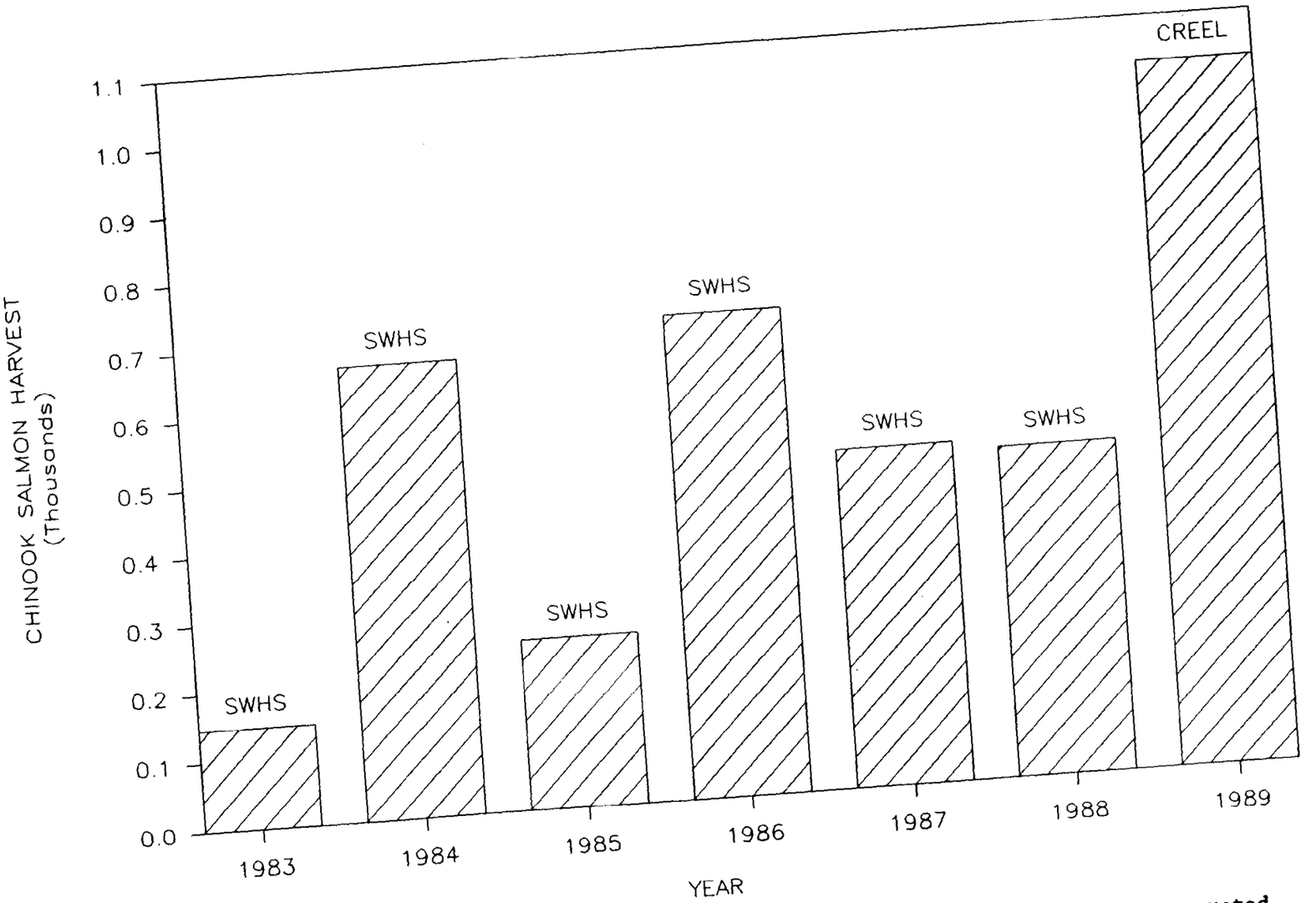

Figure 7. Sport harvest of chinook salmon, Klutina River, 1983-1989. Estimate of harvest generated from 1989 creel survey compared to statewide harvest survey estimates from 1983-1988 (Mills 1984-1989).

to the Richardson Highway bridge; and (3) the Richardson Highway bridge downstream to the Copper River. Angler interviews were conducted primarily at Sourdough and the area from the Richardson Highway bridge to Mile 129 of the Richardson Highway. Sourdough is a major access point for anglers using power boats to fish the river upstream and downstream from Sourdough. The area near the bridge is a major access point for bank anglers fishing the lower section of the river and a haul out point for float anglers.

A multi-stage stratified random sample design was used to estimate effort, catch, and harvest of chinook salmon, Arctic grayling, and sockeye salmon in the Gulkana River. The creel survey was conducted from 16 June through 31 July. Each week, all weekend/holiday days and 3 of the 5 weekday days were sampled. The weekdays not sampled were selected by randomly choosing 1 weekday and then randomly choosing the day before or after to allow 2 consecutive days off for the creel technician. Within selected days, allocation of sampling effort was based on historical use patterns. The angler day was stratified into two 7-hour periods (A: 0800-1459 hours, B: 1500-2200 hours). Two-thirds of the sampling effort was allocated to period B and one-third to period A.

Aerial counts of anglers were conducted on all weekend/holiday days and 2 of the 5 weekday days each week. The randomly surveyed weekdays were used to estimate catch and harvest rates in units of fish per angler-hour. These counts were considered instantaneous (Neuhold and Lu 1957).

Each angler contacted during the creel survey was interviewed for:

1. the number of hours fished;
2. the number of fish kept and released, by species; and,
3. the residence of the angler.

If the returning angler used a power boat, the following information was obtained and recorded:

4. whether the boat was an inboard or outboard;
5. the number of anglers in the boat;
6. whether or not the boat was guided; and,
7. whether fishing was their primary purpose.

Effort was estimated separately for boat versus shore anglers in each section of the surveyed river (Sections 1, 2, and 3) of the fishery using a stratified random sampling approach by period. Within each unique combination of section of river and type of fishing day (i.e., weekdays versus weekend-holidays) effort (E_j) was estimated as follows:

$$\hat{E}_j = \sum_{i=1}^{p} H_i \bar{x}_i; \qquad [1]$$

where:

j = subscript denoting stratum as defined by unique combinations of type of angler (boat versus shore), type of fishing day, and section of the river,

i = subscript denoting the period of the day,

p = total number of periods in stratum j,

H_i = the total number of hours of possible fishing time in period i and stratum j, and

$\bar{x}_i$ = the mean angler count for period i and stratum j.

The variance of the estimate of E_j was estimated as follows:

$$\hat{V}(\hat{E}_j) = \sum_{i=1}^{p} H_i^2 \, (s_i^2/m_i); \qquad [2]$$

where:

$$s_i^2 = [\sum_{k=1}^{m_i} (x_{ik} - \bar{x}_i)^2]/(m_i - 1) \qquad [3]$$

and:

x_{ik} = a count of anglers made during day k, period i, and stratum j, and

m_i = the number of counts of anglers conducted during period i and stratum j.

The total number of angler-hours of effort for the season was estimated by summing the estimates of effort for each of the strata. Because these are independent estimates, the variance for the total number of angler-hours of effort is the sum of the individual variances for each stratum estimate.

Mean catch per unit effort (catch per angler-hour) was estimated for each stratum (note that we are ignoring the period of the day) as:

$$\overline{CPUE}_j = \sum_{h=1}^{d_j} \sum_{o=1}^{m_h} c_{jho} \; / \; \sum_{h=1}^{d_j} \sum_{o=1}^{m_h} e_{jho}; \qquad [4]$$

where:

d_j = the number of days sampled for angler interviews during stratum j,

m_h = the number of anglers interviewed during sample h and stratum j,

c_{jho} = the catch by angler o interviewed during sample h and stratum j, and

e_{jho} = the effort (number of hours) expended by angler o interviewed during sample h and stratum j.

The variance of mean $CPUE_j$ was approximated as (Jessen 1978):

$$\hat{V}(\overline{CPUE_j}) = (\bar{C}_j/\bar{E}_j)^2 [s_c^2/\bar{C}_j + s_e^2/\bar{E}_j - (2r_j s_c s_e/\bar{C}_j\bar{E}_j)]; \quad [5]$$

where:

$$\bar{C}_j = (\sum_{h=1}^{d_j} \sum_{o=1}^{m_h} c_{jho}) / \sum_{h=1}^{d_j} m_h \quad [6]$$

$$\bar{E}_j = (\sum_{h=1}^{d_j} \sum_{o=1}^{m_h} e_{jho}) / \sum_{h=1}^{d_j} m_h \quad [7]$$

$$s_c^2 = (1/d_j)[\sum_{h=1}^{d_j} (\bar{c}_{jh}-\bar{C}_j)^2/(d_j-1) + \sum_{h=1}^{d_j} (1/m_h) \sum_{o=1}^{m_h} (c_{jho}-\bar{c}_{jh})^2/(m_h-1)] \quad [8]$$

$$\bar{c}_{jh} = \sum_{o=1}^{m_j} c_{jho} / m_h \quad [9]$$

$$s_e^2 = (1/d_j)[\sum_{h=1}^{d_j} (\bar{e}_{jh}-\bar{E}_j)^2/(d_j-1) + \sum_{h=1}^{d_j} (1/m_h) \sum_{o=1}^{m_h} (e_{jho}-\bar{e}_{jh})^2/(m_h-1)] \quad [10]$$

$$\bar{e}_{jh} = \sum_{o=1}^{m_j} e_{jho} / m_h \quad [11]$$

$$r_j = \frac{\sum_{h=1}^{d_j} \sum_{o=1}^{m_h} (c_{jho}-\bar{C}_j)(e_{jho}-\bar{E}_j)}{[\sum_{h=1}^{d_j} \sum_{o=1}^{m_h} (c_{jho}-\bar{C}_j)^2][\sum_{h=1}^{d_j} \sum_{o=1}^{m_h} (e_{jho}-\bar{E}_j)^2]} . \quad [12]$$

The catch of each species during stratum j was estimated by:

$$\hat{C}_j = \hat{E}_j(\overline{CPUE_j}) . \quad [13]$$

The variance of the estimated catch of each species was estimated using the product of two independent random variables as described by Goodman (1960):

$$\hat{V}(\hat{C}_j) = \hat{E}_j^2 \hat{V}(\overline{CPUE}_j) + \overline{CPUE}_j^2 \hat{V}(\hat{E}_j) - \hat{V}(\hat{E}_j)\hat{V}(\overline{CPUE}_j) \quad . \qquad [14]$$

Harvest rates and total harvest of each species were estimated for each stratum by substituting appropriate harvests for catches in equations 4-14.

The total catch and harvest for each species for the season over all strata were estimated by summing the corresponding estimates for each of the strata. Because these are independent estimates, the variances for the total catch and harvest are the sum of the individual variances for each stratum estimate.

Three important assumptions necessary for this analysis are:

1. The anglers interviewed are representative of the angling population.
2. Effort, harvest, and catch are normally distributed random variables.
3. No significant fishing effort occurred between 2200 and 0800 hours.

Klutina River Creel Survey

A stratified random creel survey was conducted to estimate effort, harvest, and catch of chinook and sockeye salmon from the Klutina River between 24 June and 10 August 1989. The survey consisted of two components: (1) a survey of the boat fishery conducted at the Copper Center boat launching area, and (2) a survey of the shore fishery downstream of the Richardson Highway bridge (Figure 2).

Boat Fishery:

A stratified random sample design was used to estimate effort, catch, and harvest of chinook salmon in the Klutina River boat fishery. Days were stratified into two 7-hour periods (A: 0800-1459 hours, B: 1500-2200 hours). All weekend/holiday days and 3 of the 5 weekday days were sampled each week. The weekdays not sampled were selected by randomly choosing 1 weekday and then randomly choosing the day before or after the selected day. One 7-hour sample unit was randomly selected each day. Allocation of sampling effort was evenly distributed among the two periods.

Counts of all boats returning to the survey area during the sampling period were used to estimate fishing effort in units of boat-trips. Interviews of returning boat anglers were used to estimate chinook salmon catch and harvest rates (number of fish per boat-trip). For each returning boat, the following information was collected:

1. the number of hours fished;
2. the number of anglers in the boat;
3. the number of fish kept and released, by species;
4. whether or not the boat was guided; and
5. whether the boat was an inboard, outboard, raft, or canoe/kayak.

All boat angler interviews were completed-trip interviews. Interviews for effort and harvest information were party interviews for all anglers in a returning boat.

Angler effort and its variance for boat anglers were estimated separately for weekdays and weekend/holidays for guided and unguided anglers. The number of boat-trips of effort in each fishery stratum i was estimated by:

$$\hat{B}_i = \sum_{j=1}^{p} N_{ij}\bar{b}_{ij} \ , \qquad [15]$$

where:

$\bar{b}_{ij}$ = the mean number of boats returning during period j in stratum i,

$$= \sum_{o=1}^{n_{ij}} b_{ijo} / n_{ij} \qquad [16]$$

o = subscript denoting the sample within stratum i and period j,

n_{ij} = the total number of sample units surveyed during period j in fishery stratum i,

b_{ijo} = number of boats counted during sample o within period j and stratum i, and

N_{ij} = the total number of sample units (7-hour time periods) possible during period j in stratum i.

The variance of $\hat{B}_i$ was estimated in the following manner (Scheaffer et al. 1979):

$$\hat{V}(B_i) = \sum_{j=1}^{p} N_{ij}^2 \, [s_{ij}^2/n_{ij}][1-(n_{ij}/N_{ij})] \ , \qquad [17]$$

where:

s_{ij}^2 = the sample variance for the mean number of boats returning during period j in fishery stratum i,

$$= \sum_{o=1}^{n_{ij}} (b_{ijo} - \bar{b}_{ij})^2 / (n_{ij} - 1) \ . \qquad [18]$$

The total number of boat trips for the Klutina River fishery was estimated by summing the estimates for each stratum of the fishery. These are considered independent estimates and the estimated variance of the total is the sum of the variances.

Catch per unit effort (CPUE) was estimated as mean catch per boat-trip for each stratum. Mean CPUE for stratum i was calculated by:

$$CPB_i = \left(\sum_{k=1}^{t_i} c_{ik}\right)/t_i \ , \qquad [19]$$

where:

t_i = the total number of boats interviewed during stratum i, and

c_{ik} = the catch of chinook salmon by boat k interviewed during stratum i.

$\overline{CPB}_i$ was estimated by a two-stage sampling design with days being the first stage sample unit (of which there are a finite number available to be sampled) and boats being the second stage sample unit (of which there are an unknown number available to be sampled on any given day).

The variance of $\overline{CPB}_i$ was estimated in the following manner (Von Geldern and Tomlinson 1973):

$$\hat{V}(\overline{CPB}_i) = [1 - (d_i/D_i)]\ [s^2_{Bi}/d_i] + [1/d_iD_i]\ \left[\sum_{q=1}^{d_i} s^2_{Wiq}/m_{iq}\right] \qquad [20]$$

where:

d_i = the number of days in stratum i during which interview samples were conducted,

D_i = the total number of days in stratum i,

s^2_{Bi} = the between-day variance of the mean of CPB_i in stratum i,

$$= \sum_{q=1}^{d_i} (\overline{CPB}_{iq} - \overline{CPB}_i)^2 \ / \ (d_i - 1) \qquad [21]$$

q = subscript denoting day sampled in stratum i,

$\overline{CPB}_{iq}$ = mean CPUE for boats interviewed on day q in stratum i,

$$= \sum_{r=1}^{m_{iq}} CPB_{iqr} \ / \ m_{iq} \qquad [22]$$

r = subscript denoting boat interviewed on day q in stratum i,

m_{iq} = total number of boats interviewed on day q in stratum i,

CPB_{iqr} = catch of boat r interviewed on day q in stratum i,

s^2_{Wiq} = the within-day variance of mean CPB_i in stratum i,

$$= \sum_{r=1}^{m_{iq}} (CPB_{iqr} - \overline{CPB}_{iq})^2 / (m_{iq} - 1) \quad . \qquad [23]$$

The number of chinook salmon harvested during the weekday or weekend/holiday stratum (C_i) of each fishery segment was calculated as follows:

$$\hat{C}_i = \hat{B}_i \overline{\overline{CPB}}_i \quad . \qquad [24]$$

The variance of $\hat{C}_i$ was estimated using the formula for the product of two independent random variables (Goodman 1960):

$$\hat{V}(C_i) = [\hat{B}_i^2 \hat{V}(\overline{\overline{CPB}}_i)] + [\overline{\overline{CPB}}_i^2 \hat{V}(B_i)] - [\hat{V}(B_i) \hat{V}(\overline{\overline{CPB}}_i)] \quad . \qquad [25]$$

The total chinook salmon catch by the boat fishery (C_T) was estimated as follows:

$$\hat{C}_T = \sum_{i=1}^{S} \hat{C}_i \qquad [26]$$

where i is one of two fishery strata. Because these are independent estimates, the estimated variance of the total is the sum of the variances.

Harvest rate and harvest were estimated as described above with the exception that the number of chinook salmon kept by anglers was substituted for the catch terms in equations 19 through 26.

Assumptions necessary for the creel survey analyses of the boat fishery include:

1. Interviewed boats are representative of the total population.
2. No significant fishing effort occurred between 2200 and 0800 hours.
3. Boat counts and catch per boat are normally distributed random variables.

Shore Fishery:

A roving creel survey (Neuhold and Lu 1957) was used to count anglers and conduct angler interviews of shore anglers fishing the lower 1 mile of the

Klutina River. The creel survey followed a stratified random sample design. The sampling schedule and allocation of sampling effort were the same as outlined for the boat fishery.

Angler counts were used to estimate fishing effort in units of angler-hours and angler interviews were used to estimate catch and harvest rates (number of fish per hour) of chinook and sockeye salmon. Counts of all anglers actively fishing were conducted during a randomly selected 15 minute interval during randomly selected sampling periods and were considered instantaneous. Interviews of shore anglers were conducted concurrently with the interviews of returning boat anglers during the time remaining in each randomly selected sampling period. For each shore angler interviewed, the following information was obtained:

1. the number of hours fished;
2. the number of fish kept and released, by species;
3. whether the interview was a completed-trip or incompleted-trip interview; and,
4. the residence of the angler.

Effort was estimated for this fishery using a stratified random sampling approach by type of fishing day (i.e., weekday versus weekend-holiday). Within each type of fishing day effort (E_i) was estimated as follows:

$$\hat{E}_i = H_i \bar{x}_i; \qquad [27]$$

where:

i = subscript denoting stratum as defined type of fishing day,

H_i = the total number of hours of possible fishing time in stratum i, and

$\bar{x}_i$ = the mean angler count for stratum i.

The variance of the estimate of E_i was estimated as follows:

$$\hat{V}(\hat{E}_i) = H_i^2 (s_i^2/m_i); \qquad [28]$$

where:

$$s_i^2 = [\sum_{k=1}^{m_i} (x_{ik} - \bar{x}_i)^2]/(m_i - 1) \qquad [29]$$

and:

k = subscript denoting the sample during stratum i,

x_{ik} = a count of anglers made during sample k and stratum i, and

m_i = the number of counts (i.e., samples) of anglers conducted during stratum i.

The total number of angler-hours of effort for the season was estimated by summing the estimates of effort for each of the strata. Because these are independent estimates, the variance for the total number of angler-hours of effort is the sum of the individual variances for each stratum estimate.

Mean catch per unit effort (catch per angler-hour) was estimated for each stratum as:

$$\overline{CPUE_i} = \sum_{h=1}^{d_i} \sum_{o=1}^{m_h} c_{iho} \Big/ \sum_{h=1}^{d_i} \sum_{o=1}^{m_h} e_{iho}; \quad [30]$$

where:

d_i = the number of days sampled for angler interviews during stratum i,

m_h = the number of anglers interviewed during sample h and stratum i,

c_{iho} = the catch by angler o interviewed during sample h and stratum i, and

e_{iho} = the effort (number of hours) expended by angler o interviewed during sample h and stratum i.

The variance of mean $CPUE_i$ was approximated as (Jessen 1978):

$$\hat{V}(\overline{CPUE_i}) = (\bar{C}_i/\bar{E}_i)^2 [s_c^2/\bar{C}_i + s_e^2/\bar{E}_i - (2r_i s_c s_e/\bar{C}_i\bar{E}_i)]; \quad [31]$$

where:

$$\bar{C}_i = \left(\sum_{h=1}^{d_i} \sum_{o=1}^{m_h} c_{iho}\right) \Big/ \sum_{h=1}^{d_i} m_h \quad [32]$$

$$\bar{E}_i = \left(\sum_{h=1}^{d_i} \sum_{o=1}^{m_h} e_{iho}\right) \Big/ \sum_{h=1}^{d_i} m_h \quad [33]$$

$$s_c^2 = (1/d_i)\left[\sum_{h=1}^{d_i} (\bar{c}_{ih}-\bar{C}_i)^2/(d_i-1) + \sum_{h=1}^{d_i} (1/m_h) \sum_{o=1}^{m_h} (c_{iho}-\bar{c}_{ih})^2/(m_h-1)\right] \quad [34]$$

$$\bar{c}_{ih} = \sum_{o=1}^{m_i} c_{iho} / m_h \quad [35]$$

$$s_e^2 = (1/d_i)[\sum_{h=1}^{d_i}(\bar{e}_{ih}-\bar{E}_i)^2/(d_i-1)+\sum_{h=1}^{d_i}(1/m_h)\sum_{o=1}^{m_h}(e_{iho}-\bar{e}_{ih})^2/(m_h-1)] \quad [36]$$

$$\bar{e}_{ih} = \sum_{o=1}^{m_i} e_{iho} / m_h \quad [37]$$

$$r_i = \frac{\sum_{h=1}^{d_i}\sum_{o=1}^{m_h}(c_{iho}-\bar{C}_i)(e_{iho}-\bar{E}_i)}{[\sum_{h=1}^{d_i}\sum_{o=1}^{m_h}(c_{iho}-\bar{C}_i)^2][\sum_{h=1}^{d_i}\sum_{o=1}^{m_h}(e_{iho}-\bar{E}_i)^2]} . \quad [38]$$

The catch of each species during stratum i was estimated by:

$$\hat{C}_i = \hat{E}_i(\overline{CPUE}_i) . \quad [39]$$

The variance of the estimated catch of each species was estimated using the product of two independent random variables as described by Goodman (1960):

$$\hat{V}(\hat{C}_i) = \hat{E}_i^2\hat{V}(\overline{CPUE}_i) + \overline{CPUE}_i^2\hat{V}(\hat{E}_i) - \hat{V}(\hat{E}_i)\hat{V}(\overline{CPUE}_i) . \quad [40]$$

Harvest rates and total harvest of each species was estimated for each stratum by substituting appropriate harvests for catches in equations 30-40.

The total catch and harvest for each species for the season over all strata were estimated by summing the corresponding estimates for each of the strata. Because these are independent estimates, the variances for the total catch and harvest are the sum of the individual variances for each stratum estimate.

The major assumptions for the shore creel survey analyses include:

1. Incomplete trip angler interviews provided an unbiased estimate of completed-trip CPUE.
2. Catch rate and length of fishing trip were independent.
3. Interviewed anglers were representative of the total angler population and anglers were interviewed in proportion to their abundance.
4. No significant fishing effort occurred between 2200 and 0800 hours.
5. For the angler interview data, effort and catch were normally distributed random variables.

Biological Data

A portion of the chinook salmon harvested by the sport fishery on the Gulkana and Klutina rivers were sampled for age, sex, and length information. Three scales were collected from the left side of each fish approximately two rows above the lateral line and on the diagonal row downward from the posterior

insertion of the dorsal fin as described in Clutter and Whitesel (1956). Scales were mounted on adhesive-coated cards and impressions were made in cellulose acetate. Age determinations were made by examination of scales using a microfiche reader. Ages were designated using the European method (Koo 1962) where the first number refers to the number of years of freshwater residence after emergence, and the second number refers to the number of years of marine residence. Fish lengths were measured from the middle of the eye to the fork of the tail to the nearest millimeter.

The proportional age composition of the sampled portion of the sport harvest was estimated for the fishery. Letting P_h equal the estimated proportion of age group h in the sample, the variance of P_h was estimated using the normal approximation to the binomial (Scheaffer et al. 1979):

$$V(\hat{P}_h) = \hat{P}_h(1-\hat{P}_h)/(n_t-1), \quad [41]$$

where n_t is the total number of legible scales collected from chinook salmon during the fishery, or during spawning ground surveys.

Mean length at age and its variance were estimated using standard normal procedures.

RESULTS

Gulkana River Creel Survey

Effort:

In total, 29,103 (SE = 5,834) angler-hours were expended by sport anglers during 16 June through 31 July downstream of the West Fork of the Gulkana River (Table 1). Approximately 55% (SE = 5,023) of the angler-hours were during weekends. A total of 18 anglers were observed fishing on the first day of the survey and no anglers were observed fishing following the 23 July angler count (Appendix A1).

Catch and harvest rate statistics for weekend and weekday anglers during the sport fishery for chinook salmon in the Gulkana River during 1989 are presented in Appendices A2 through A5.

Chinook Salmon:

A total of 2,398 (SE = 888) chinook salmon were caught from the Gulkana River during the period 16 June through 31 July 1989 (Table 2). Approximately 39% of the chinook salmon captured were released. Approximately 53% of the catch (SE = 630) and harvest (SE = 377) occurred on weekends. The catch per angler-hour was estimated to be 0.09 (SE = 0.045) fish for weekdays and 0.08 (SE = 0.033) fish for weekends (Table 3). The harvest rate of 0.05 (SE = 0.018 WD and 0.019 WE) fish per angler-hour was documented for both weekend and weekday.

Table 1. Number of angler-hours expended by sport anglers during the sport fishery in the Gulkana River downstream of the West Fork during 16 June-31 July 1989.

Strata	Angler-hours	SE	90% Confidence Interval	Relative precision[a]
Weekday	13,073	2,967	8,192 - 17,954	37.2%
Weekend	16,030	5,023	7,767 - 24,293	51.4%
All	29,103	5,834	19,506 - 38,700	32.9%

[a] Relative precision = (SE * 1.645)/Angler-hours, where 1.645 is the z-value at $\alpha = 0.10$.

Table 2. Catch and harvest of chinook salmon, Arctic grayling, and sockeye salmon during the sport fishery in the Gulkana River downstream of the West Fork during 16 June-31 July 1989.

Species/ Strata	Catch	SE	RP[a]	Harvest	SE	RP[a]	Percent of Catch Harvested
CHINOOK SALMON							
Weekday	1,162	627	88.7%	685	280	67.3%	59%
Weekend	1,236	630	87.8%	776	377	80.0%	63%
All	2,398	888	60.9%	1,461	470	57.9%	61%
ARCTIC GRAYLING							
Weekday	427	1,047	407.0%	159	471	485.5%	37%
Weekend	1,988	711	58.8%	316	488	254.0%	16%
All	2,415	1,266	86.2%	475	678	234.6%	20%
SOCKEYE SALMON							
Weekday	337	258	125.7%	218	167	126.1%	65%
Weekend	109	154	232.9%	109	154	232.9%	100%
All	446	300	110.7%	327	228	114.4%	73%

[a] Relative precision = (SE * 1.645)/Catch (or Harvest), where 1.645 is the z-value at $\alpha = 0.10$

Table 3. Catch and harvest rates for chinook salmon, Arctic grayling, and sockeye salmon during the sport fishery in the Gulkana River downstream of the West Fork during 16 June-31 July 1989.

Species	WD/WE[a]	Catch		Harvest	
		Rate[b]	SE	Rate[b]	SE
Chinook salmon	WD	0.09	0.045	0.05	0.018
	WE	0.08	0.033	0.05	0.019
Arctic grayling	WD	0.03	0.082	0.01	0.037
	WE	0.12	0.023	0.02	0.031
Sockeye salmon	WD	0.03	0.019	0.02	0.013
	WE	0.01	0.010	0.01	0.010

[a] WD = weekday; WE = weekend/holiday.

[b] Number of fish per angler-hour.

A total of 63 chinook salmon harvested in the Gulkana River sport fishery were sampled for age, sex, and size information (Table 4 and 5). The sample was comprised of 27% (SE = 5.64), 66.7% (SE = 5.99), and 4.8% (SE = 2.7) age 1.3, 1.4, and 1.5 fish, respectively. The ratio of males to females was 1:1.3. A total of 138 chinook salmon carcasses were sampled from Gulkana River spawning grounds for age, sex, and size information (Table 6 and 7). The sample was comprised of 41.3% (SE = 4.21) age 1.3 fish and 55.8% (SE = 4.24) age 1.4 fish. Males comprised 44.9% of the sample. The age composition of the sport harvest and the spawning escapement was arranged in a two-way table (r x c contingency table) and their independence was tested using the Chi-Square test. Age classes 1.2, 2.3, and 1.5 (representing 8 fish) were excluded from the analysis as their expected cell counts were less then 5. The estimated age composition of the sport harvest was not significantly different from that of the spawning escapement (p=0.071, χ^2=3.26, df=1).

Arctic Grayling:

A total of 2,415 (SE = 1,266) Arctic grayling were caught from the Gulkana River during the period 16 June through 31 July 1989 (Table 2). Approximately 80% of the catch was released with 82.3% of the catch being made on weekends. The catch per angler-hour was estimated to be 0.03 (SE = 0.082) fish for weekdays and 0.12 (SE = 0.023) fish for weekends (Table 3). The Arctic grayling fishery occurs throughout the drainage and open-water period. This estimate should not be confused with those generated by Mills (1984-1989) which pertain to the entire fishery.

Sockeye Salmon:

A total of 446 (SE = 300) sockeye salmon were estimated to have been caught from the Gulkana River (Table 2). Approximately 65% of the 337 (SE = 258) sockeye salmon captured during weekdays were harvested, while 100% of the 109 (SE = 154) sockeye captured on weekends were harvested. Approximately 24% of the catch and 33% of the harvest occurred on weekends. The catch per angler-hour was estimated to be 0.03 (SE = 0.019) fish for weekdays and 0.01 (SE = 0.010) fish for weekends (Table 3).

Klutina River Creel Survey

Effort:

In total, 3,764 (SE = 458) angler hours were expended downstream of the Richardson Highway bridge and 416 (SE = 33) boat trips were taken by sport anglers launching from Copper Center during 24 June through 10 August 1989 (Table 8). Approximately 65% (SE = 31) of the boat trips and 63% (SE = 428) of the shore angler-hours were conducted during weekdays. Boat and shore anglers were observed during each day the survey was conducted (Appendix A6).

Catch and harvest rate statistics for boat and shore anglers participating in the Klutina River chinook salmon sport fishery during 1989 are presented in Appendices A7 through A14.

Table 4. Age composition statistics for sport harvested chinook salmon taken from the Gulkana River downstream of the West Fork during 16 June-31 July 1989.

	Age Class				
Sex/Statistic:	1.2	1.3	1.4	1.5	Total
Females					
Sample Size		11	22	2	35
% of Sample		17.5	34.9	3.2	55.6
SE		4.82	6.05	2.23	6.31
Males					
Sample Size	1	6	20	1	28
% of Sample	1.6	9.5	31.7	1.6	44.4
SE	1.59	3.73	5.91	1.59	6.31
All					
Sample Size	1	17	42	3	63
% of Sample	1.6	27.0	66.7	4.8	100.0
SE	1.59	5.64	5.99	2.70	

Table 5. Length-at-age statistics for sport harvested chinook salmon taken from the Gulkana River downstream of the West Fork during 16 June-31 July 1989.

	Age Class				
Sex/Statistic:	1.2	1.3	1.4	1.5	Total
Females					
Average[a]		813	912	912	881
SE		16	11	9	11
Sample Size		11	22	2	35
Minimum[a]		685	810	903	685
Maximum[a]		890	987	920	987
Males					
Average[a]	924	923	958	990	952
SE		51	12		12
Sample Size	1	4	20	1	25
Minimum[a]	924	832	868	990	832
Maximum[a]	924	1030	1150	990	1150
All					
Average[a]	924	843	934	938	911
SE		21	9	27	9
Sample Size	1	15	42	3	60
Minimum[a]	924	685	810	903	685
Maximum[a]	924	1030	1150	990	1150

[a] Lengths were measured from mid-eye to fork-of-tail, in millimeters.

Table 6. Age composition statistics for chinook salmon sampled from the Gulkana River spawning escapement during 1989.

	Age Class				
Sex/Statistic:	1.2	1.3	1.4	2.3	Total
Females					
Sample Size	1	34	40	1	76
% of Sample	0.7	24.6	29.0	0.7	55.1
SE	0.72	3.68	3.88	0.72	4.25
Males					
Sample Size	1	23	37	1	62
% of Sample	0.7	16.7	26.8	0.7	44.9
SE	0.72	3.18	3.78	0.72	4.25
All					
Sample Size	2	57	77	2	138
% of Sample	1.4	41.3	55.8	1.4	100.0
SE	1.02	4.21	4.24	1.02	

Table 7. Length-at-age statistics for chinook salmon sampled from the Gulkana River spawning escapement during 1989.

	Age Class				
Sex/Statistic:	1.2	1.3	1.4	2.3	Total
Females					
Average[a]	780	889	894	855	890
SE		9	7		6
Sample Size	1	34	40	1	76
Minimum[a]	780	770	805	855	770
Maximum[a]	780	985	970	855	985
Males					
Average[a]	745	935	975	865	954
SE		15	7		8
Sample Size	1	23	37	1	62
Minimum[a]	745	800	895	865	745
Maximum[a]	745	1,040	1,045	865	1,045
All					
Average[a]	763	908	933	860	919
SE	18	8	7	5	5
Sample Size	2	57	77	2	138
Minimum[a]	745	770	805	855	745
Maximum[a]	780	1,040	1,045	865	1,080

[a] Lengths were measured from mid-eye to fork-of-tail, in millimeters.

Table 8. Number of boat trips taken by boat anglers and the number of angler-hours expended by shore anglers during the sport fishery in the Klutina River during 24 June-10 August 1989.

Angler Type	WE/WD[a]	Effort	Standard Error	Relative Precision[b]
Boat	WE	146 boat trips	11	12.5%
	WD	270 boat trips	31	18.9%
	All	416 boat trips	33	13.1%
Shore	WE	1,400 angler-hours	163	19.2%
	WD	2,364 angler-hours	428	29.8%
	All	3,764 angler-hours	458	20.0%

[a] WE = weekend/holiday; WD = weekday.

[b] Relative precision = (SE * 1.645)/Effort, where 1.645 is the z-value at $\alpha = 0.10$

Chinook Salmon:

A total of 1,587 (SE = 651) chinook salmon were estimated to have been captured from the Klutina River as reported by interviewed sport anglers (Table 9). Approximately 35% of the chinook salmon captured were released. Anglers that accessed the river by boat accounted for approximately 88% (SE = 635) of the catch and 86% (SE = 302) of the harvest.

The catch rate for boat anglers was 3.24 (SE = 1.605) fish per boat during weekends and 3.45 (SE = 2.161) fish per boat on weekdays with a weekend and weekday harvest rate per boat of 2.17 (SE = 0.830) fish and 2.11 (SE = 1.014) fish, respectively (Table 10). Unguided boat anglers averaged a catch rate of 3.00 (SE = 1.732) fish per boat on weekends and 0.00 (SE = 0.00) fish per boat on weekdays. Harvest rates per unguided boat were 1.33 (SE = 0.882) and 0.00 (SE = 0.00) fish per boat during weekends and weekdays, respectively. Guided boat anglers averaged a catch rate of 3.20 (SE = 1.570) fish per boat on weekends and 3.67 (SE = 2.255) fish per boat on weekdays. Harvest rates per guided boat were similar at 2.28 (SE = 0.889) and 2.26 (SE = 1.010) fish per boat during weekends and weekdays, respectively.

Shore anglers averaged a catch rate of 0.05 (weekend SE = 0.040, weekday SE = 0.057) fish per angler hour and a harvest rate of 0.04 (weekend SE = 0.035, weekday SE = 0.049) fish per angler hour during weekends and weekdays.

A total of 176 chinook salmon harvested in the Klutina River sport fishery were sampled for age, sex, and size information (Tables 11 and 12). The sample was comprised of 26.6% (SE = 3.33), 69.5% (SE = 3.47), and 2.3% (SE = 1.12) age 1.3, 1.4, and 1.5 fish, respectively. The ratio of males to females was approximately 1.1:1.0.

Sockeye Salmon:

A total of 361 (SE = 591) sockeye salmon were estimated to have been captured from the Klutina River as reported by interviewed sport anglers (Table 9). Approximately 34% of the sockeye salmon captured were released. Shore anglers accounted for approximately 59% (SE = 166) of the catch and 64% (SE = 133) of the harvest. Approximately 36% (SE = 114) of the catch by anglers that accessed the river by boat was made on weekends and 33% (SE = 87) of the shore angler catch was made on weekends. Weekday anglers that accessed the river by boat accounted for 37% (SE = 109) of the weekday boat harvest while weekday shore anglers accounted for 63% (SE = 108) of the weekday shore harvest.

The catch rate for sockeye salmon for all boat anglers was 0.37 (SE = 0.785) fish per boat during weekends and 0.35 (SE = 2.072) fish per boat on weekdays with a weekend and weekday harvest rate per boat of 0.37 (SE = 0.785) fish and 0.12 (SE = 0.408) fish, respectively (Table 13). Unguided boat anglers reported no catch or harvest for the entire season. Guided boat anglers averaged a catch rate of 0.44 (SE = 0.886) fish per boat on weekends and 0.12 (SE = 0.225) fish per boat on weekdays. Harvest rates per guided boat were 0.44 (SE = 0.886) on weekends and 0.09 (SE = 0.141) on weekdays.

Table 9. Number of chinook salmon and sockeye salmon caught and harvested by boat and shore anglers during the sport fishery in the Klutina River during 24 June-10 August 1989.

Angler type	WE/WD[a]	Catch	SE	RP[b]	Harvest	SE	RP[b]	Percent of Catch Harvested
Chinook salmon								
Boat	WE	473	236	82.2%	316	103	53.6%	67%
	WD	930	589	104.2%	569	283	81.9%	62%
	All	1,403	635	74.4%	885	302	56.0%	63%
Shore	WE	65	57	146.0%	52	6	19.9%	80%
	WD	119	134	185.1%	96	18	31.3%	81%
	All	184	145	130.5%	148	19	21.4%	80%
Total		1,587	651	67.4%	1,033	302	48.1%	65%
Sockeye salmon								
Boat	WE	54	114	348.2	54	114	348.2	100%
	WD	95	556	967.5	32	109	555.9	34%
	All	149	567	628.5	86	158	301.4	58%
Shore	WE	70	87	203.5	56	77	225.5	80%
	WD	142	142	164.5	95	108	188.4	67%
	All	212	166	129.0	151	133	145.0	72%
Total		361	591	641.6	237	206	143.0	66%

[a] WE = weekend/holiday; WD = weekday.

[b] Relative precision = (SE * 1.645)/Catch (or Harvest), where 1.645 is the z-value at a = 0.10

Table 10. Catch and harvest rates of chinook salmon by boat and shore anglers during the sport fishery in the Klutina River during 24 June-10 August 1989.

Angler Type	WE/WD[a]	Catch		Harvest	
		Rate[b]	SE	Rate[b]	SE
Unguided Boat	WE	3.00	1.732	1.33	0.882
	WD	0.00	0.000	0.00	0.000
Guided Boat	WE	3.20	1.570	2.28	0.889
	WD	3.67	2.255	2.26	1.010
All Boat	WE	3.24	1.605	2.17	0.830
	WD	3.45	2.161	2.11	1.014
All Shore	WE	0.05	0.040	0.04	0.035
	WD	0.05	0.057	0.04	0.049

[a] WE = weekend/holiday; WD = weekday.

[b] Rate for boat anglers is in units of fish per boat; rate for shore anglers is in units of fish per angler hour.

Table 11. Age composition statistics for chinook salmon harvested in the Klutina River sport fishery during 24 June-10 August 1989.

	Age Class				
Sex/Statistic:	1.2	1.3	1.4	1.5	Total
Females					
Sample Size		18	65	3	86
% of Sample		10.2	36.7	1.7	48.6
SE		2.28	3.63	0.97	3.77
Males					
Sample Size	3	29	57	1	90
% of Sample	1.7	16.4	32.2	0.6	50.8
SE	0.97	2.79	3.52	0.56	3.77
All					
Sample Size	3	47	122	4	176
% of Sample	1.7	26.6	69.5	2.3	100.0
SE	0.97	3.33	3.47	1.12	

Table 12. Length-at-age statistics for chinook salmon harvested in the Klutina River sport fishery during 24 June-10 August 1989.

	Age Class				
Sex/Statistic:	1.2	1.3	1.4	1.5	Total
Females					
Average[a]		862	946	932	928
SE		8	5	9	6
Sample Size		18	65	3	86
Minimum[a]		810	871	915	810
Maximum[a]		935	1055	946	1055
Males					
Average[a]	627	845	976	1025	923
SE	15	18	7		11
Sample Size	3	29	57	1	90
Minimum[a]	605	645	848	1025	605
Maximum[a]	657	1030	1080	1025	1080
All					
Average[a]	627	852	960	955	925
SE	15	11	5	24	6
Sample Size	3	47	122	4	176
Minimum[a]	605	645	848	915	605
Maximum[a]	657	1030	1080	1025	1080

[a] Lengths were measured from mid-eye to fork-of-tail, in millimeters.

Table 13. Catch and harvest rates of sockeye salmon by boat and shore anglers during the sport fishery in the Klutina River during 24 June-10 August 1989.

Angler Type	WE/WD[a]	Catch		Harvest	
		Rate[b]	SE	Rate[b]	SE
Unguided Boat	WE	0.00	0.000	0.00	0.000
	WD	0.00	0.000	0.00	0.000
Guided Boat	WE	0.44	0.886	0.44	0.886
	WD	0.12	0.225	0.09	0.141
All Boat	WE	0.37	0.785	0.37	0.785
	WD	0.35	2.072	0.12	0.408
All Shore	WE	0.05	0.062	0.04	0.055
	WD	0.06	0.060	0.04	0.046

[a] WE = weekend/holiday; WD = weekday.

[b] Rate for boat anglers is in units of fish per boat; rate for shore anglers is in units of fish per angler-hours.

Shore anglers averaged a catch rate of 0.05 (SE = 0.062) fish and 0.06 (SE = 0.060) fish per angler hour on weekends and weekdays, respectively. The shore angler harvest rate was 0.04 on weekends (SE = 0.055) and weekdays (SE = 0.046).

DISCUSSION

Gulkana River Creel Survey

The estimated harvest of 1,461 chinook salmon in 1989 falls at the low end of the 1983 to 1988 harvest range and is 18% below the average harvest for these years (Figure 6). This slightly reduced harvest is attributed to: (1) implementation of a spawning season closure, (2) omission of catch and harvest of chinook salmon above the West Fork, (3) the release of an estimated 931 fish, and (4) omission of catch and harvest by anglers taken prior (0800 hours) to and following (2200 hours) the daily interview periods (i.e., interview data indicate that both shore and boat anglers may have started fishing prior to and following daily interview periods).

The Arctic grayling harvest during the creel survey is only a fraction of that reported for the entire drainage (Mills 1984-1989). The time and area addressed by this survey clearly has little to do with the directed Arctic grayling fishery in the Gulkana River. The high incidence of release indicates that Arctic grayling are not targeted for harvest in this fishery.

The estimated harvest of 327 sockeye salmon was only 14% of the 1983-1988 average harvest of approximately 2,400 fish for the entire drainage for the entire season. Sockeye salmon continued to enter and pass through the survey area through August, after the termination of the survey. Sockeye salmon were also taken by recreational fishermen upstream of the West Fork during and following the survey period. A targeted sockeye salmon fishery has been slow to develop in the Gulkana River. Sockeye salmon are available in great enough numbers to allow for a substantially increased harvest. Factors that appear to be limiting the development of the sockeye salmon fishery are: (1) angler unfamiliarity with the availability of the resource, (2) angler difficulty associated in enticing sockeye salmon to strike, (3) perception by anglers of low quality fish due to the distance from marine waters, and (4) availability of sockeye salmon in other fisheries including the Copper River personal use fishery and the Copper River subsistence fishery.

Fishing effort was distributed throughout the survey area, however, the majority of the anglers fished in the upper and middle sections of the river. Approximately 42% of the interviews were received from anglers that fished downstream of the West Fork and above Sourdough Landing, 56% of the interviews were received from anglers that fished between Sourdough and the Richardson Highway bridge, and only 2.5% of the interviews were received from anglers that fished downstream of the Richardson Highway bridge in the fly-fishing-area. Additionally, the upper and middle section of the river are fished primarily, though not exclusively, by anglers that access the river by boat. Aerial counts of anglers showed a similar distribution of angling effort.

It was not possible to estimate the guided catch and harvest component of the total catch and harvest since no distinction was visible to the aerial surveyor to identify guided anglers during angler counts. Guided boat anglers accounted for 12% of the completed trip interviews. Five guides provided services to anglers on the Gulkana River during 1989.

Klutina River Creel Survey

The estimated harvest of 1,033 chinook salmon during 1989 was 2.3 times greater than the 1983-1988 average harvest and the highest harvest on record (Figure 7). This increased harvest is attributed to: (1) increased guided power boat operators participating in the fishery, (2) continued good river water conditions throughout the fishery, and (3) increased knowledge of participants in the fishery during recent prior years on how to catch Klutina River chinook salmon. Interview data indicated that anglers participated in the fishery prior to (0800 hours) and following (2200 hours) the daily interview periods, suggesting that harvest may have been greater than the estimate.

The estimated harvest of 237 sockeye salmon was only 30% of the 1983-1988 average harvest of approximately 785 fish for the entire drainage for the entire season. Sockeye salmon continued to enter and pass through the survey area through August, after the survey period. Shore anglers accounted for 64% of the harvest, indicating that boat fishermen were primarily targeting chinook salmon. Development of the Klutina River sockeye salmon fishery has not developed to its potential for reasons similar to the Gulkana River sockeye salmon fishery.

The Klutina River fishery occurred downstream of the Richardson Highway bridge by shore anglers and upstream of the bridge by boat anglers. The velocity and gradient of the Klutina River limits angler participation to specific sites, generally of a size that only one or two anglers can fish effectively. Access to upriver fishing sites requires a high powered durable boat with an experienced operator.

Anglers that accessed the river by boat had significantly higher catch and harvest rates than shore anglers; however, individual shore angler as well as boat party catch and harvest rates tended to decrease with increasing angler effort. The restrictive bag limit, combined with limited shore access to fishing sites, resulted in shore anglers catching primarily no fish or only one fish. It was not uncommon for parties of boat anglers to catch 15-20 chinook salmon, indicating that boat anglers had better access to good uncrowded fishing. The fishing sites in the upriver area accessed by boat anglers are also limited, therefore, there was competition between guides to arrive at the good sites with their clients prior to the arrival of other guides.

Approximately 12 guides operated on the Klutina River during 1989, all conducting boat trips. A total of 123 boat angler parties were interviewed over the course of the survey and 109 of the interviews (89%) were of guide operated boats. Unguided boat operators were generally local residents with vast river boat experience that were familiar with the river.

General observation indicated shore anglers participated in the fishery in the morning and evening with very little activity between noon and 4:00 p.m. Approximately 88% of the shore anglers that participated in the fishery conducted their activity between the new and old Richardson Highway bridges. A few shore anglers accessed the upper river by the Brenwick-Craig Road which parallels the river to within a few hundred yards of Klutina Lake. This activity was documented for the first time in 1989 and may prove to become a trend of the fishery.

RECOMMENDATIONS

It is anticipated that the Gulkana and Klutina rivers chinook salmon fishery during the next few years will maintain harvest levels similar to those of recent years. Regulatory restrictions implemented during 1989, including the spawning season closure and bag limit restrictions, have reduced the concerns of the Department regarding conservation problems associated with the recreational chinook salmon fishery. However, it is recommended that a fishery monitoring program be continued on the Gulkana and Klutina rivers to evaluate chinook salmon run timing, fishery timing, and angler characteristics. It is additionally recommended that harvest and escapement biological sampling be maintained for development of brood tables and that spawning escapement enumeration surveys continue to be conducted.

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APPENDIX A

Appendix A1. Counts of anglers during the sport fishery in the Gulkana River downstream of the West Fork during 16 June-31 July 1989.

Date	Counts by Period	
	A[a]	B[b]
16 June		18
17		57
18		50
19		26
20		
21	73	
22		
23		
24		127
25	110	
26	36	
27		
28		
29		
30		64
1 July	228	
2	207	
3		
4		92
5		
6	35	
7		
8	91	
9	87	
10		
11		
12	29	
13		
14		
15		22
16		12
17		
18		
19		
20		6
21		
22		7
23		4
24		
25		0

-Continued-

Appendix A1. (Page 2 of 2).

Date	Counts by Period	
	A[a]	B[b]
26		
27		
28		0
29		0
30		0
31		

[a] Period A: 0800-1459 hrs.
[b] Period B: 1500-2200 hrs.

Appendix A2. Catch rate statistics for weekend anglers during the sport fishery in the Gulkana River downstream of the West Fork during 16 June-31 July 1989.

Date	n[a]	Effort (Angler-hours) Mean	Effort (Angler-hours) SE	Chinook Salmon Mean Catch	Chinook Salmon SE	Chinook Salmon CPUE	Arctic Grayling Mean Catch	Arctic Grayling SE	Arctic Grayling CPUE	Sockeye Salmon Mean Catch	Sockeye Salmon SE	Sockeye Salmon CPUE
6/17	25	2.9	0.39	0.24	0.087	0.083	0.16	0.160	0.055	0.00	0.000	0.000
6/18	23	4.1	0.29	0.65	0.195	0.157	0.00	0.000	0.000	0.04	0.043	0.010
6/24	41	5.5	0.36	0.85	0.173	0.155	0.00	0.000	0.000	0.02	0.024	0.004
6/25	18	5.0	0.55	0.00	0.000	0.000	0.00	0.000	0.000	0.17	0.121	0.033
7/01	33	5.1	0.27	0.09	0.051	0.018	0.00	0.000	0.000	0.00	0.000	0.000
7/02	26	5.7	0.25	0.38	0.137	0.068	0.00	0.000	0.000	0.00	0.000	0.000
7/04	40	5.0	0.24	0.55	0.179	0.109	1.40	0.702	0.278	0.00	0.000	0.000
7/08	25	5.1	0.39	0.12	0.066	0.024	0.04	0.040	0.008	0.16	0.095	0.031
7/09	17	3.4	0.51	0.06	0.059	0.017	0.00	0.000	0.000	0.00	0.000	0.000
7/15	9	4.1	0.26	0.00	0.000	0.000	0.33	0.236	0.082	0.00	0.000	0.000
7/16	18	3.2	0.25	0.39	0.335	0.123	5.00	3.499	1.579	0.00	0.000	0.000
7/22	6	3.0	0.63	0.00	0.000	0.000	0.50	0.500	0.167	0.00	0.000	0.000
7/23	2	1.8	0.25	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000
7/29	7	1.3	0.15	0.00	0.000	0.000	0.29	0.184	0.222	0.00	0.000	0.000
7/30	7	2.2	0.45	0.00	0.000	0.000	0.71	0.474	0.323	0.00	0.000	0.000

[a] n = sample size.

Appendix A3. Harvest rate statistics for weekend anglers during the sport fishery in the Gulkana River downstream of the West Fork during 16 June-31 July 1989.

Date	n[a]	Effort (Angler-hours) Mean	SE	Chinook Salmon Mean Catch	SE	HPUE	Arctic Grayling Mean Catch	SE	HPUE	Sockeye Salmon Mean Catch	SE	HPUE
6/17	25	2.9	0.39	0.16	0.075	0.055	0.00	0.000	0.000	0.00	0.000	0.000
6/18	23	4.1	0.29	0.35	0.102	0.084	0.00	0.000	0.000	0.04	0.043	0.010
6/24	41	5.5	0.36	0.49	0.079	0.089	0.00	0.000	0.000	0.02	0.024	0.004
6/25	18	5.0	0.55	0.00	0.000	0.000	0.00	0.000	0.000	0.17	0.121	0.033
7/01	33	5.1	0.27	0.09	0.051	0.018	0.00	0.000	0.000	0.00	0.000	0.000
7/02	26	5.7	0.25	0.27	0.089	0.048	0.00	0.000	0.000	0.00	0.000	0.000
7/04	40	5.0	0.24	0.35	0.111	0.069	0.30	0.275	0.060	0.00	0.000	0.000
7/08	25	5.1	0.39	0.12	0.066	0.024	0.00	0.000	0.000	0.16	0.095	0.031
7/09	17	3.4	0.51	0.06	0.059	0.017	0.00	0.000	0.000	0.00	0.000	0.000
7/15	9	4.1	0.26	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000
7/16	18	3.2	0.25	0.22	0.173	0.070	0.78	0.409	0.246	0.00	0.000	0.000
7/22	6	3.0	0.63	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000
7/23	2	1.8	0.25	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000
7/29	7	1.3	0.15	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000
7/30	7	2.2	0.45	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000

[a] n = sample size.

Appendix A4. Catch rate statistics for weekday anglers during the sport fishery in the Gulkana River downstream of the West Fork during 16 June-31 July 1989.

Date	n[a]	Effort (Angler-hours) Mean	SE	Chinook Salmon Mean Catch	SE	CPUE	Arctic Grayling Mean Catch	SE	CPUE	Sockeye Salmon Mean Catch	SE	CPUE
6/16	15	4.0	0.82	1.33	0.591	0.333	0.00	0.000	0.000	0.00	0.000	0.000
6/19	24	2.8	0.21	0.17	0.078	0.060	0.21	0.147	0.075	0.71	0.229	0.254
6/20	32	4.4	0.32	1.00	0.301	0.227	0.00	0.000	0.000	0.00	0.000	0.000
6/21	16	2.5	0.17	1.00	0.158	0.405	0.00	0.000	0.000	0.00	0.000	0.000
6/26	13	3.4	0.13	0.00	0.000	0.000	0.00	0.000	0.000	0.08	0.077	0.023
6/27	20	3.8	0.24	0.05	0.050	0.013	0.00	0.000	0.000	0.00	0.000	0.000
6/28	44	5.2	0.47	0.48	0.095	0.091	0.00	0.000	0.000	0.27	0.119	0.052
7/03	44	5.9	0.27	0.41	0.082	0.070	0.00	0.000	0.000	0.07	0.068	0.012
7/07	34	5.8	0.38	0.12	0.056	0.020	0.03	0.029	0.005	0.00	0.000	0.000
7/12	10	4.7	0.85	0.10	0.100	0.022	0.00	0.000	0.000	0.00	0.000	0.000
7/13	10	5.0	0.49	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000
7/14	9	3.7	0.86	0.00	0.000	0.000	0.22	0.222	0.061	0.11	0.111	0.030
7/17	8	2.1	0.06	0.00	0.000	0.000	0.75	0.412	0.364	0.00	0.000	0.000
7/18	10	2.5	0.38	0.00	0.000	0.000	1.40	0.600	0.560	0.00	0.000	0.000
7/21	7	1.6	0.14	0.00	0.000	0.000	0.57	0.429	0.348	0.00	0.000	0.000
7/24	3	1.6	0.42	0.00	0.000	0.000	1.33	0.882	0.842	0.00	0.000	0.000
7/25	2	1.0	0.00	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000
7/26	7	1.8	0.18	0.00	0.000	0.000	1.00	0.577	0.560	0.00	0.000	0.000

[a] n = sample size.

Appendix A5. Harvest rate statistics for weekday anglers during the sport fishery in the Gulkana River downstream of the West Fork during 16 June-31 July 1989.

Date	n[a]	Effort (Angler-hours) Mean	SE	Chinook Salmon Mean Catch	SE	HPUE	Arctic Grayling Mean Catch	SE	HPUE	Sockeye Salmon Mean Catch	SE	HPUE
6/16	15	4.0	0.82	0.27	0.118	0.067	0.00	0.000	0.000	0.00	0.000	0.000
6/19	24	2.8	0.21	0.17	0.078	0.060	0.21	0.147	0.075	0.33	0.098	0.119
6/20	32	4.4	0.32	0.41	0.088	0.092	0.00	0.000	0.000	0.00	0.000	0.000
6/21	16	2.5	0.17	0.69	0.120	0.278	0.00	0.000	0.000	0.00	0.000	0.000
6/26	13	3.4	0.13	0.00	0.000	0.000	0.00	0.000	0.000	0.08	0.077	0.023
6/27	20	3.8	0.24	0.05	0.050	0.013	0.00	0.000	0.000	0.00	0.000	0.000
6/28	44	5.2	0.47	0.34	0.072	0.065	0.00	0.000	0.000	0.20	0.101	0.039
7/03	44	5.9	0.27	0.39	0.074	0.066	0.00	0.000	0.000	0.07	0.068	0.012
7/07	34	5.8	0.38	0.09	0.049	0.015	0.00	0.000	0.000	0.00	0.000	0.000
7/12	10	4.7	0.85	0.10	0.100	0.022	0.00	0.000	0.000	0.00	0.000	0.000
7/13	10	5.0	0.49	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000
7/14	9	3.7	0.86	0.00	0.000	0.000	0.22	0.222	0.061	0.11	0.111	0.030
7/17	8	2.1	0.06	0.00	0.000	0.000	0.25	0.250	0.121	0.00	0.000	0.000
7/18	10	2.5	0.38	0.00	0.000	0.000	0.40	0.306	0.160	0.00	0.000	0.000
7/21	7	1.6	0.14	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000
7/24	3	1.6	0.42	0.00	0.000	0.000	0.33	0.333	0.211	0.00	0.000	0.000
7/25	2	1.0	0.00	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000
7/26	7	1.8	0.18	0.00	0.000	0.000	0.29	0.286	0.160	0.00	0.000	0.000

[a] n = sample size.

Appendix A6. Counts of boats and shore anglers, by period, during the sport fishery in the Klutina River during 24 June-10 August 1989.

Date	Boat Counts by Period		Shore Angler Counts by Period	
	A[a]	B[b]	A[a]	B[b]
24 June		3		13
25		2		7
26		2		5
27		4		7
28				
29				
30		4		6
1 July		3		8
2	7		4	
3		6		11
4	6		8	
5				
6				
7		1		4
8		4		9
9	9		9	
10		2		5
11	9		5	
12	7		4	
13				
14				
15		7		4
16		4	5	
17		3		1
18		6		1
19	6		7	
20				
21				
22		2		2
23	4		4	
24	3		6	
25	3		20	
26				
27				
28	2		4	
29	3			2
30	3		6	
31				

-Continued-

Appendix A6. (Page 2 of 2).

Date	Boat Counts by Period		Shore Angler Counts by Period	
	A[a]	B[b]	A[a]	B[b]
1 August				
2		4		2
3		4		5
4	3		3	
5	6		4	
6	4		4	
7				
8				
9		4		3
10		4		2

[a] Period A: 0800-1459 hrs.
[b] Period B: 1500-2200 hrs.

Appendix A7. Catch rate statistics for weekend boat anglers during the sport fishery in the Klutina River during 24 June-10 August 1989.

Date	n[a]	Effort (Boat Trips) Mean	SE	Chinook Salmon Mean Catch	SE	CPUE	Sockeye Salmon Mean Catch	SE	CPUE
6/24	3	3.3	0.67	2.00	1.155	0.600	0.67	0.667	0.200
7/01	3	5.0	2.65	1.33	0.667	0.267	0.33	0.333	0.067
7/02	7	4.4	0.41	1.00	0.535	0.226	0.43	0.202	0.097
7/04	5	5.1	0.68	0.60	0.400	0.118	0.00	0.000	0.000
7/08	4	2.8	0.60	4.75	0.750	1.727	1.50	1.500	0.545
7/09	9	5.4	0.83	4.44	1.709	0.825	0.00	0.000	0.000
7/15	7	4.9	0.77	2.14	0.884	0.435	0.00	0.000	0.000
7/16	3	4.3	0.44	1.67	0.882	0.385	2.00	2.000	0.462
7/23	2	2.0	0.00	5.00	2.000	2.500	0.00	0.000	0.000
7/29	3	7.5	0.76	10.33	2.728	1.378	0.00	0.000	0.000
8/05	4	4.9	0.38	3.25	0.479	0.667	0.25	0.250	0.051
8/06	4	4.1	0.77	5.50	2.102	1.333	0.25	0.250	0.061

[a] n = sample size.

Appendix A8. Harvest rate statistics for weekend boat anglers during the sport fishery in the Klutina River during 24 June-10 August 1989.

Date	n[a]	Effort (Boat Trips) Mean	SE	Chinook Salmon Mean Catch	SE	HPUE	Sockeye Salmon Mean Catch	SE	HPUE
6/24	3	3.3	0.67	2.00	1.155	0.600	0.67	0.667	0.200
7/01	3	5.0	2.65	1.33	0.667	0.267	0.33	0.333	0.067
7/02	7	4.4	0.41	1.00	0.535	0.226	0.43	0.202	0.097
7/04	5	5.1	0.68	0.60	0.400	0.118	0.00	0.000	0.000
7/08	4	2.8	0.60	4.25	1.031	1.545	1.50	1.500	0.545
7/09	9	5.4	0.83	2.33	0.687	0.433	0.00	0.000	0.000
7/15	7	4.9	0.77	1.43	0.612	0.290	0.00	0.000	0.000
7/16	3	4.3	0.44	1.67	0.882	0.385	2.00	2.000	0.462
7/23	2	2.0	0.00	2.50	0.500	1.250	0.00	0.000	0.000
7/29	3	7.5	0.76	4.33	0.333	0.578	0.00	0.000	0.000
8/05	4	4.9	0.38	3.25	0.479	0.667	0.25	0.250	0.051
8/06	4	4.1	0.77	3.25	1.109	0.788	0.25	0.250	0.061

[a] n = sample size.

Appendix A9. Catch rate statistics for weekday boat anglers during the sport fishery in the Klutina River during 24 June-10 August 1989.

Date	n[a]	Effort (Boat Trips) Mean	SE	Chinook Salmon Mean Catch	SE	CPUE	Sockeye Salmon Mean Catch	SE	CPUE
6/26	2	6.5	1.50	1.50	1.500	0.231	8.00	8.000	1.231
6/27	4	5.0	1.29	1.00	0.707	0.200	0.00	0.000	0.000
6/30	4	4.3	0.78	1.25	0.479	0.294	1.00	0.707	0.235
7/03	5	4.8	1.36	0.40	0.245	0.083	0.20	0.200	0.042
7/10	2	7.0	1.00	3.50	2.500	0.500	0.00	0.000	0.000
7/11	7	4.4	0.48	2.43	0.948	0.557	0.00	0.000	0.000
7/12	6	5.2	0.65	5.00	2.422	0.968	0.17	0.167	0.032
7/17	3	4.5	0.87	14.67	5.457	3.259	0.00	0.000	0.000
7/18	6	5.0	0.68	6.17	2.315	1.233	0.00	0.000	0.000
7/19	4	5.1	0.59	6.00	2.944	1.171	0.00	0.000	0.000
7/25	4	5.1	0.52	1.50	0.645	0.293	0.00	0.000	0.000
8/02	3	4.7	0.44	3.33	1.202	0.714	0.00	0.000	0.000
8/03	4	3.1	0.52	2.50	0.500	0.800	0.00	0.000	0.000
8/04	3	3.3	0.88	2.33	0.333	0.700	0.33	0.333	0.100
8/09	4	4.5	0.29	2.50	0.500	0.556	0.00	0.000	0.000
8/10	4	4.5	0.29	2.00	0.816	0.444	0.00	0.000	0.000

[a] n = sample size.

Appendix A10. Harvest rate statistics for weekday boat anglers during the sport fishery in the Klutina River during 24 June-10 August 1989.

Date	n[a]	EFFORT (Boat Trips) Mean	SE	Chinook Salmon Mean Catch	SE	HPUE	Sockeye Salmon Mean Catch	SE	HPUE
6/26	2	6.5	1.50	1.50	1.500	0.231	1.50	1.500	0.231
6/27	4	5.0	1.29	1.00	0.707	0.200	0.00	0.000	0.000
6/30	4	4.3	0.78	1.00	0.577	0.235	0.50	0.289	0.118
7/03	5	4.8	1.36	0.40	0.245	0.083	0.20	0.200	0.042
7/10	2	7.0	1.00	3.50	2.500	0.500	0.00	0.000	0.000
7/11	7	4.4	0.48	1.86	0.595	0.426	0.00	0.000	0.000
7/12	6	5.2	0.65	2.50	0.619	0.484	0.17	0.167	0.032
7/17	3	4.5	0.87	5.33	1.202	1.185	0.00	0.000	0.000
7/18	6	5.0	0.68	3.50	0.719	0.700	0.00	0.000	0.000
7/19	4	5.1	0.59	2.25	0.854	0.439	0.00	0.000	0.000
7/25	4	5.1	0.52	1.50	0.645	0.293	0.00	0.000	0.000
8/02	3	4.7	0.44	2.33	0.667	0.500	0.00	0.000	0.000
8/03	4	3.1	0.52	1.50	0.500	0.480	0.00	0.000	0.000
8/04	3	3.3	0.88	2.33	0.333	0.700	0.33	0.333	0.100
8/09	4	4.5	0.29	2.50	0.500	0.556	0.00	0.000	0.000
8/10	4	4.5	0.29	1.75	0.854	0.389	0.00	0.000	0.000

[a] n = sample size.

Appendix A11. Catch rate statistics for weekend shore anglers during the sport fishery in the Klutina River during 24 June-10 August 1989.

Date	n[a]	Effort (Angler-hours) Mean	SE	Chinook Salmon Mean Catch	SE	CPUE	Sockeye Salmon Mean Catch	SE	CPUE
6/24	15	3.9	0.60	0.00	0.000	0.000	0.07	0.067	0.017
6/25	19	3.4	0.67	0.00	0.000	0.000	0.58	0.345	0.173
7/01	7	3.3	0.76	0.14	0.143	0.043	0.14	0.143	0.043
7/02	11	2.2	0.36	0.18	0.122	0.083	0.00	0.000	0.000
7/04	8	2.6	0.42	0.25	0.164	0.096	0.13	0.125	0.048
7/08	16	3.5	0.65	0.00	0.000	0.000	0.00	0.000	0.000
7/09	13	2.7	0.41	0.15	0.104	0.058	0.00	0.000	0.000
7/15	11	1.9	0.48	0.00	0.000	0.000	0.00	0.000	0.000
7/16	11	1.6	0.43	0.00	0.000	0.000	0.00	0.000	0.000
7/22	2	1.0	0.00	0.00	0.000	0.000	0.00	0.000	0.000
7/23	6	2.0	0.32	0.00	0.000	0.000	0.83	0.477	0.417
7/29	11	3.1	0.73	0.27	0.141	0.088	0.09	0.091	0.029
7/30	14	2.3	0.29	0.64	0.225	0.275	0.07	0.071	0.031
8/05	10	3.0	0.56	0.10	0.100	0.033	0.00	0.000	0.000
8/06	10	2.6	0.44	0.10	0.100	0.038	0.00	0.000	0.000

[a] n = sample size.

Appendix A12. Harvest rate statistics for weekend shore anglers during the sport fishery in the Klutina River during 24 June-10 August 1989.

Date	n[a]	Effort (Angler-hours) Mean	Effort (Angler-hours) SE	Chinook Salmon Mean Catch	Chinook Salmon SE	Chinook Salmon HPUE	Sockeye Salmon Mean Catch	Sockeye Salmon SE	Sockeye Salmon HPUE
6/24	15	3.9	0.60	0.00	0.000	0.000	0.07	0.067	0.017
6/25	19	3.4	0.67	0.00	0.000	0.000	0.32	0.172	0.094
7/01	7	3.3	0.76	0.14	0.143	0.043	0.14	0.143	0.043
7/02	11	2.2	0.36	0.18	0.122	0.083	0.00	0.000	0.000
7/04	8	2.6	0.42	0.25	0.164	0.096	0.13	0.125	0.048
7/08	16	3.5	0.65	0.00	0.000	0.000	0.00	0.000	0.000
7/09	13	2.7	0.41	0.15	0.104	0.058	0.00	0.000	0.000
7/15	11	1.9	0.48	0.00	0.000	0.000	0.00	0.000	0.000
7/16	11	1.6	0.43	0.00	0.000	0.000	0.00	0.000	0.000
7/22	2	1.0	0.00	0.00	0.000	0.000	0.00	0.000	0.000
7/23	6	2.0	0.32	0.00	0.000	0.000	0.83	0.477	0.417
7/29	11	3.1	0.73	0.18	0.122	0.058	0.09	0.091	0.029
7/30	14	2.3	0.29	0.43	0.137	0.183	0.07	0.071	0.031
8/05	10	3.0	0.56	0.10	0.100	0.033	0.00	0.000	0.000
8/06	10	2.6	0.44	0.10	0.100	0.038	0.00	0.000	0.000

[a] n = sample size.

Appendix A13. Catch rate statistics for weekday shore anglers during the sport fishery in the Klutina River during 24 June-10 August 1989.

Date	n[a]	Effort (Angler-hours) Mean	SE	Chinook Salmon Mean Catch	SE	CPUE	Sockeye Salmon Mean Catch	SE	CPUE
6/26	19	2.4	0.41	0.00	0.000	0.000	0.00	0.000	0.000
6/27	18	1.7	0.20	0.00	0.000	0.000	0.00	0.000	0.000
6/30	19	1.8	0.27	0.00	0.000	0.000	0.16	0.158	0.089
7/03	29	2.6	0.25	0.00	0.000	0.000	0.10	0.058	0.039
7/07	12	3.3	0.95	0.00	0.000	0.000	0.17	0.167	0.051
7/10	7	1.6	0.27	0.00	0.000	0.000	0.00	0.000	0.000
7/11	7	1.1	0.30	0.14	0.143	0.133	0.00	0.000	0.000
7/12	12	2.4	0.46	0.08	0.083	0.035	0.00	0.000	0.000
7/17	4	1.6	1.13	0.00	0.000	0.000	0.00	0.000	0.000
7/18	5	1.6	0.22	0.20	0.200	0.121	0.00	0.000	0.000
7/19	14	1.9	0.29	0.00	0.000	0.000	0.00	0.000	0.000
7/24	8	2.1	0.47	0.13	0.125	0.060	0.25	0.250	0.119
7/25	24	2.3	0.21	0.04	0.042	0.018	0.58	0.240	0.253
7/28	11	1.8	0.32	0.27	0.141	0.152	0.09	0.091	0.051
8/02	23	2.0	0.40	0.26	0.094	0.132	0.09	0.060	0.044
8/03	10	1.5	0.24	0.50	0.167	0.328	0.10	0.100	0.066
8/04	8	1.7	0.36	0.00	0.000	0.000	0.00	0.000	0.000
8/09	6	2.8	0.40	0.50	0.224	0.182	0.00	0.000	0.000
8/10	10	2.2	0.54	0.40	0.221	0.180	0.30	0.300	0.135

[a] n = sample size.

Appendix A14. Harvest rate statistics for weekday shore anglers during the sport fishery in the Klutina River during 24 June-10 August 1989.

Date	n[a]	Effort (Angler-hours) Mean	SE	Chinook Salmon Mean Catch	SE	HPUE	Sockeye Salmon Mean Catch	SE	HPUE
6/26	19	2.4	0.41	0.00	0.000	0.000	0.00	0.000	0.000
6/27	18	1.7	0.20	0.00	0.000	0.000	0.00	0.000	0.000
6/30	19	1.8	0.27	0.00	0.000	0.000	0.16	0.158	0.089
7/03	29	2.6	0.25	0.00	0.000	0.000	0.10	0.058	0.039
7/07	12	3.3	0.95	0.00	0.000	0.000	0.17	0.167	0.051
7/10	7	1.6	0.27	0.00	0.000	0.000	0.00	0.000	0.000
7/11	7	1.1	0.30	0.14	0.143	0.133	0.00	0.000	0.000
7/12	12	2.4	0.46	0.08	0.083	0.035	0.00	0.000	0.000
7/17	4	1.6	1.13	0.00	0.000	0.000	0.00	0.000	0.000
7/18	5	1.6	0.22	0.00	0.000	0.000	0.00	0.000	0.000
7/19	14	1.9	0.29	0.00	0.000	0.000	0.00	0.000	0.000
7/24	8	2.1	0.47	0.13	0.125	0.060	0.25	0.250	0.119
7/25	24	2.3	0.21	0.04	0.042	0.018	0.33	0.155	0.145
7/28	11	1.8	0.32	0.27	0.141	0.152	0.09	0.091	0.051
8/02	23	2.0	0.40	0.17	0.081	0.088	0.04	0.043	0.022
8/03	10	1.5	0.24	0.40	0.163	0.262	0.10	0.100	0.066
8/04	8	1.7	0.36	0.00	0.000	0.000	0.00	0.000	0.000
8/09	6	2.8	0.40	0.50	0.224	0.182	0.00	0.000	0.000
8/10	10	2.2	0.54	0.30	0.153	0.135	0.10	0.100	0.045

[a] n = sample size.