

FISHERY DATA SERIES NO. 90-60

COOK INLET RAINBOW TROUT STUDIES 1989¹

By

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ABSTRACT

A total of 567 rainbow trout *Oncorhynchus mykiss* were captured by hoop traps, fyke traps, minnow traps, and/or hook and line from Lake Creek, Deshka River, and the Talachulitna River in 1989. Rainbow trout were sampled for length and age. Age composition and mean length at age varied by stream. Few age 1 rainbow trout were captured. Length composition of the catch by hoop traps and hook and line was significantly different at Lake Creek. Gear evaluation at Deshka River and the Talachulitna River was inconclusive due to an insufficient number of samples.

Roving creel surveys were conducted at Lake Creek to estimate effort for and catch and harvest of coho salmon *Oncorhynchus kisutch* and rainbow trout in the sport fishery at Lake Creek from 5 August through 4 September 1989. An estimated 7,411 angler-hours of effort resulted in the catch (fish kept plus fish released) of 3,950 coho salmon and 663 rainbow trout. An estimated 2,905 coho salmon and 53 rainbow trout were harvested (fish kept only) during the survey.

KEY WORDS: age composition, mean length at age, length composition, gear evaluation, creel survey, Lake Creek, Deshka River, Talachulitna River, coho salmon, rainbow trout, catch, harvest, effort.

INTRODUCTION

Use of special regulations which set size and bag limits and restrict terminal tackle to artificial lures is increasing on trout waters in Alaska. This regulatory tendency reflects a growing concern among sport anglers that larger and older trout are or will be overexploited and that the quality of fishing is declining at many popular trout streams.

Implementation of special regulations has occurred in almost all waters without a thorough awareness of existing exploitation rates and with little knowledge of what constitutes an allowable rate of sustained harvest. Age and size composition, longevity, recruitment rates, and many other essential biological considerations are likewise poorly understood or completely lacking for many trout populations that have been targeted for special regulations.

A comprehensive evaluation of the effectiveness of special regulations requires assessment of both the fishery and fish population before and after application of special regulations. Such evaluations have seldom been performed on Alaskan trout. Continued application of special regulations without evaluation may hinder rather than enhance achievement of optimum sustained human benefits from Cook Inlet trout stocks.

Satisfying growing public demand for diversified recreational fishing opportunities while simultaneously maintaining and protecting fishery resources has become a complex responsibility of the Department of Fish and Game. Many accessible trout fisheries within the Cook Inlet basin have become congested. New fisheries have developed and the pressure of urban Anchorage and surrounding communities is spreading further afield each year. With escalating pressure on wild trout has come growing public concern regarding the conservation and welfare of this species. Unfortunately the Department cannot respond adequately to these concerns because of an insufficient wild trout data base. A comprehensive wild trout study has never been conducted by the Department within the Susitna River basin. Present management of wild trout depends almost solely on catch trends developed by the Alaska Sport Fish Harvest Survey. Essential information such as harvest rates, size and age structure of harvest, location and seasonal nature of harvest plus the biological characteristics of the various trout populations is currently lacking for almost all Susitna Basin trout.

The Department's poor understanding of wild trout biology and its limited awareness of what constitutes an allowable sustained harvest has catalyzed the angling public to request restrictive regulations that many hope will yield improved fishing or at the very least will protect the resource until definitive management information becomes available. Deluged with such requests, the Board of Fisheries has in recent years: (1) reduced the daily Cook Inlet trout limit from 10 to 5 fish; (2) reduced the daily limit in most Susitna Basin streams to two trout; (3) designated four Susitna Basin streams or portions of streams as hook and release waters for trout i.e. (no kill); (4) required only single hook lures or artificial lures in most flowing waters at specific times; and (5) closed certain streams or stream sections during specific seasonal times.

Nearly all of these special regulations were adopted with little documented data regarding the status of the affected trout. Both the Board of Fisheries and the Department recognized that many of these special provisions may not be "good" trout management in the classical sense but none of the special regulations are expected to have detrimental effects on the resource. The Board and Department further acknowledge that reducing the trout catch needlessly may not be a good practice as far as providing maximum fishing opportunities is concerned, but a conservative regulatory approach is warranted because of the scarcity of stock specific data.

It is clearly recognized by the Department that there is a serious need for new management approaches dealing with Alaska's wild trout fisheries. As the number of fishermen increases the quality of trout fishing can be expected to decrease. Protective fishing regulations will become increasingly necessary to reduce angler induced mortality; and recycling of the catch will likely become a dominant consideration for some fisheries. Successful uses of special regulations to improve or diversify angling opportunities and to protect the resource are becoming increasingly common in fishery literature. However, application of some of these "new" findings or procedures to situations such as an Alaska trout population is not prudent without knowledge of species composition, growth rates, natural mortality, and harvest by fishermen. The literature, in addition to identifying successful applications of special regulations, also contains numerous references to management procedures that have been counter productive. These failures, in nearly all situations, can be attributed to a poor understanding of the resource prior to implementation of special regulations.

If Alaska is to maintain quality wild trout fishing it is essential that the Department deploy regulations that are commensurate with the capabilities of the resource and that these regulations are compatible with the diversified desires of the angling public. The Department cannot presently meet this obligation because of a poor knowledge of Susitna Basin trout and their supporting environments. This investigation is viewed as a first phase effort to acquire needed data relative to the biology of Susitna Basin trout and the harvest of these stocks.

The objectives of this report are to present:

1. an evaluation of various capture methods and gear for rainbow trout in flowing waters;
2. estimation of fishing effort for and the catch and harvest of rainbow trout at Lake Creek during the fall; and
3. determination of distribution of rainbow trout spawning at Fish Creek, a tributary of the Talkeetna River drainage.

METHODS

Evaluation of Capture Methods and Gear for Rainbow Trout

The development of sampling methodology was conducted at Lake Creek, Talachulitna River, and Deshka River (Figure 1). Portions of all three streams are currently governed by special regulations that require the use of unbaited single hook artificial lures and the release of all rainbow trout. Examination of capture techniques began 22 August and continued until 13 October. Selected stream reaches of the three study waters were sampled with hook and line, seines, minnow traps, and/or fyke traps to measure the effectiveness of each capture device. Stationary gear, such as minnow and fyke traps, was serviced (i.e. fish removed) at least every 24 hours. All stationary gear was baited with salmon roe held in perforated plastic containers. Trap entrances were positioned parallel to the stream flow.

Seining was conducted using hand-held beach and bag seines. A standard set consisted of a haul that began and terminated along the shore. Sites sampled by seine were relatively homogeneous with regard to bottom substrate size and had a gradual, unobstructed slope to the shore.

Hook and line fishing was conducted with conventional spin and fly casting equipment. Terminal gear consisted of artificial lures and/or salmon roe as bait.

Differing stream morphologies were sampled in the respective rivers. A study reach was sampled in the following sequence: (1) hook and line, (2) stationary traps, and (3) seine. Sampling was performed by a crew of at least two people using a riverboat or raft for transportation.

All sample sites were grossly defined in terms of water velocity, water temperature, water clarity, water depth, bottom substrate composition, surrounding cover, and general physical morphology.

Hoop traps were 2 feet in diameter by 8 feet in length and held in position by two pieces of 1/2-inch pipe. The seven wire hoops were covered with 1 inch mesh. The double throats each had a 4 inch entrance opening. Minnow traps, consisting of 1/4-inch wire mesh, were 18 inches in length. All traps were of a two-piece double funnel entrance design. Fyke nets were 9 feet in length, 30 inches in diameter, and were supported by six steel or aluminum hoops. Internal throats, body, and short entrance wings were constructed of 3/16-inch square mesh knotless nylon dyed green. Beach seines, 50 feet by 6 feet with floats and lead lines and consisting of 1/4-inch nylon mesh, were employed as well as 50 feet by 5 feet bag seines of similar construction.

Sampled stream reaches were identified and numbered on USGS maps (scale 1:250,000). Stream reach identification numbers were entered on all data collection forms. The beginning and ending times for all hook and line sampling were recorded for each angler during periods of active fishing. The type of terminal gear was also recorded. The number of fish caught by species was recorded. Data from captured rainbow trout consisted of fork length measurements (to nearest millimeter) and three scales taken from the

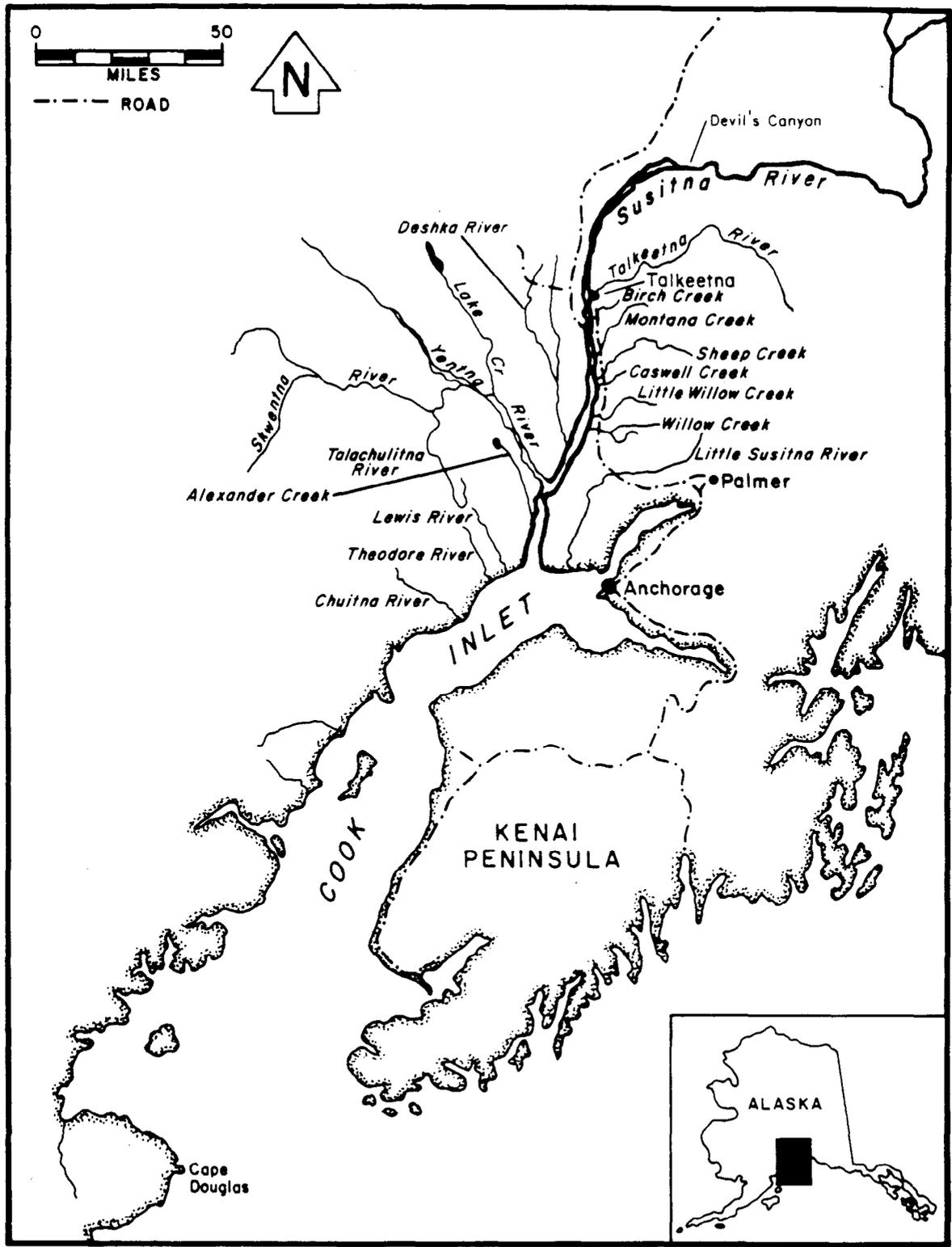


Figure 1. Map of the Cook Inlet rainbow trout study area.

left side of each fish about two rows above the lateral line and on a diagonal row downward from the posterior insertion of the dorsal fin (Clutter and Whitesel 1956). Scales were placed in coin envelopes that were labeled with appropriate identification information.

The beginning and ending times as well as trap number were recorded for each fyke and minnow trap set. The catch from all traps was emptied into a tub containing water where the fish were identified by species and returned to the stream. Catches were anesthetized with equal parts of MS-222 and Quinate. Length measurements and scales were collected as described above.

The beginning and ending times for all seine sampling were recorded. The approximate length and width (to nearest 0.1 meter) of a seine haul was recorded. The catch for each seine haul was recorded separately. Biological collections were identical to that described for trap catches.

Scale collection goals for each of the three study streams were 600 sets. These goals included 300 scales from trout less than 150 mm fork length from each stream.

Physical habitat variables were recorded for each sample site as follows:

1. Water Temperature: hand held mercury thermometer to nearest degree Celsius
2. Water Depth: to nearest centimeter
3. Water Clarity: clear, moderate, turbid
4. Water Velocity: swift, moderate, slow
5. Cover:
 - a. no cover
 - b. debris falls, including submerged trees or roots
 - c. overhanging riparian vegetation including trees and shrubs
 - d. undercut banks
6. Physical morphology:
 - a. pool
 - b. riffle
 - c. run
7. Bottom substrate:
 - a. sand/silt: less than 2 cm dia
 - b. gravel: 2 cm-10 cm dia
 - c. rubble: 10 cm-40 cm dia
 - d. boulder: greater than 40 cm dia

Trap or seine set identification numbers, sample location numbers, beginning and ending set times, and the numbers of fish caught by species were initially recorded on handwritten forms. Physical habitat parameters were likewise recorded on these forms. Later, these data were transferred onto trap/seine mark-sense forms. Data from hook and line sampling were similarly recorded and then later transferred to mark-sense forms.

Age and Length Distribution:

Fish length data from each sample unit (traps, seine, hook and line) were recorded on individual AWL mark-sense forms. A Brunning 500 micro projector was used to age trout scales placed between glass slides. Trout age data were recorded on AWL mark-sense forms.

Percent by age was estimated for each gear by:

$$\hat{P}_{ij} = \frac{n_{ij}}{n_j} \quad (1)$$

where:

\hat{p}_{ij} = estimated proportion in age group i for gear type j,

n_{ij} = number in age group i for gear type j,

n_j = total number sampled in gear type j,

and the variance of \hat{p}_{ij} is estimated by:

$$\text{Var}(\hat{p}_{ij}) = \frac{\hat{p}_{ij}(1-\hat{p}_{ij})}{n_j-1} \quad (2)$$

The age and length distributions of the samples from each gear type within a system were compared in order to determine the size selectivity of the gear types. Length distributions were compared between gear types using a nonparametric Kolmogorov-Smirnov test (Conover 1980). Age compositions were compared using chi-square statistics. The mean length-at-age was compared among gear-types using 2-factorial ANOVA models which tested for interaction between gear and age (Snedecor and Cochran 1967). All tests were carried out at an alpha level of 0.05.

Creel Surveys

Roving creel surveys (Neuhold and Lu 1957) were conducted to estimate effort, catch, and harvest of rainbow trout by anglers fishing the lower reaches of Lake Creek during the fall. The entire drainage of Lake Creek was open to fishing for coho salmon and rainbow trout from 1 January to 31 December. However, physical barriers within the river restrict the majority of the anglers to the lower 3.2 km (2.0 mi) of the river. Primary access by anglers to this fishery is floatplane, wheelplane, and riverboat. Some fishing for rainbow trout is recognized to occur upstream of the creel survey area, however this fishing effort is considered small relative to effort within the surveyed stream reach.

A stratified random sample design was used for angler counts within the study area. The fishing day was defined to be 16 hours long (0600-2200 hours) from 5 August through 27 August. Starting 28 August and continuing through 4 September the fishing day was shortened to 14 hours (0600-2000 hours) because of reduced daylight. Days were stratified into three sample periods (A, B, and C) in which interviews and angler counts were conducted. Two hours were censused in period A (0600-1000); 2.5 hours in period B (1000-1600); and 2.5 hours in period C which varied from 1600 to 2000 or 2200 hours. The survey was stratified by weekdays and weekend/holidays. Three randomly selected weekdays (without replacement) and all weekend/holidays were surveyed.

A starting time was randomly selected from whole hours within each sample period to conduct angler counts. Counts were performed from a riverboat traveling the 3-mile length of the survey area. Counts took about 30 minutes to complete. A coin toss determined if a count occurred in an upstream or downstream direction. Each angler count was further segregated into three stream zones including:

Zone 1 - confluence of Lake Creek/Yentna River;

Zone 2 - confluence (Zone 1) upstream to regulatory markers about 1/4 mile upstream from Bulchitna Lake;

Zone 3 - upstream from Zone 2 to end of survey area.

Angler interviews were conducted during the time remaining in a sample unit not used for the angler count. Interviews were conducted throughout the length of the survey area i.e. interviews in all river zones. During periods of heavy fishing effort (when it was not possible to interview all anglers in the survey area) special attention was given to obtaining random interviews within each zone e.g. select a systematic approach such as contacting every third angler, every fifth angler, etc.

Survey clerks recorded the following information from each angler interviewed:

1. the number of hours spent fishing;
2. whether the angler had completed the fishing trip or not;
3. whether the angler fished the previous day;
4. whether the angler was guided or unguided;
5. the number and species of fish harvested (kept);
6. the number and species of fish captured (kept plus released fish);
7. the species of fish targeted;
8. whether the angler used lures, bait, or both; and
9. the river zone where effort occurred.

In addition, the following questions were asked all anglers:

1. Most of the Lake Creek drainage is now governed by regulations that require or promote the release of rainbow trout.

- a. Should these artificial lure/no kill trout requirements be expanded, eliminated, or left as is within the Lake Creek drainage?
 - b. Do you favor, oppose, or have no opinion on requiring mandatory release of rainbow trout at other Susitna Basin waters?
2. The use of unbaited artificial lures is now required on the lower 2-1/2 miles of Lake Creek after 1 September.
 - a. Do you favor, oppose, or have no opinion on this artificial lure requirement?
 - b. Should this artificial lure requirement start earlier in the season, start later in the season, or be left as is?

Estimation of Catch, Harvest and Effort:

Interviews were taken from anglers who had completed their fishing trip (complete anglers) and anglers who were still fishing (incomplete anglers). In order to test the hypothesis that catch and harvest per unit of effort did not differ between these two groups, the number of anglers with no catch and harvest at the time of the interview was compared. A chi-square statistic was used to test this hypothesis for rainbow trout and coho salmon, and the null hypothesis of no difference was rejected at the 5% alpha level.

Catch, harvest, and effort were estimated for each day sampled, and the totals for each stratum were estimated by expanding the daily means over all possible days.

Effort was estimated for day i for stratum h by expanding the mean angler count for that day,

$$\hat{E}_{hi} = H_{hi} * \bar{X}_{hi} \quad (3)$$

where:

- \hat{E}_{hi} = total effort in angler hours for day i ,
- H_{hi} = total number of hours in the fishing day,
- \bar{X}_{hi} = mean angler count for day i ,
- h = stratum h ,

and \bar{X}_{hi} was estimated by:

$$\bar{X}_{hi} = \frac{\sum_{j=1}^{r_h} X_{hij}}{r_h} \quad (4)$$

where:

X_{hij} = count j taken on day i , and

r_h = number of counts per day.

The variance of total effort is estimated by:

$$V(\hat{E}_{hi}) = H_{hi}^2 V(\bar{X}_{hi}) \quad (5)$$

where the variance of mean count is estimated by:

$$V(\bar{X}_{hi}) = \frac{\sum_{j=1}^{r_h} (X_{hij} - \bar{X}_{hi})^2}{(r_h - 1)} \quad (6)$$

Catch per unit of effort for day i is estimated using a jackknife method (Efron 1982), and

$$\overline{CPUE}_{hi}^* = \frac{\sum_{j=1}^{m_{hi}} \overline{CPUE}_{hij}^*}{m_{hi}} \quad (7)$$

where:

\overline{CPUE}_{hi}^* = jackknife estimate of catch per angler-hour.

\overline{CPUE}_{hij}^* is the catch per angler hour estimated from the sample of interviews taken on day i with angler j removed from the sample, such that,

$$\overline{CPUE}_{hij}^* = \frac{\sum_{k \neq j} c_{hik}}{\sum_{k \neq j} e_{hik}} \quad (8)$$

where:

$k \neq j$ = k is not j, that is angler j is removed from sample,

c_{hik} = catch for angler k on day i, and

e_{hik} = hours fished by angler k on day i.

The variance of the jackknife estimate of catch per unit of effort is estimated by:

$$s^{2*}_{hi} = \frac{(m_{hi} - 1)}{m_{hi}} \sum_{j=1}^{m_{hi}} (\overline{CPUE}_{hij}^* - \overline{CPUE}_{hi}^*)^2 . \quad (9)$$

The bias in the jackknife estimate of CPUE is corrected (Efron 1982) by:

$$\overline{CPUE}_{hi}^{\sim} = m_{hi} * \overline{CPUE}_{hi}^* - (m_{hi} - 1) * \overline{CPUE}_{hi}^* \quad (10)$$

where \overline{CPUE}_{hi} is the standard estimate (no anglers removed from sample) of catch per unit of effort on day i,

$$\overline{CPUE}_{hi} = \frac{\sum_{j=1}^{m_{hi}} c_{hij}}{\sum_{j=1}^{m_{hi}} e_{hij}} . \quad (11)$$

Total catch for day i in stratum h is the product of total effort and catch per unit of effort,

$$\hat{C}_{hi} = \hat{E}_{hi} * \overline{CPUE}_{hi}^{\sim} \quad (12)$$

and the variance of the estimate of catch is the variance of a product of two independent random variables,

$$V(\hat{C}_{hi}) = \hat{E}_{hi}^2 * s^{2*}_{hi} + \overline{CPUE}_{hi}^{\sim 2} * V(\hat{E}_{hi}) - V(\hat{E}_{hi}) * s^{2*}_{hi} . \quad (13)$$

Mean catch for days sampled in each stratum is estimated by:

$$\bar{C}_h = \frac{\sum_{i=1}^{d_h} \hat{C}_{hi}}{d_h} \quad (14)$$

where:

d_h = number of days sampled in stratum h.

The variance of mean catch is estimated by:

$$s_{1h}^2 = \frac{\sum_{i=1}^{d_h} (C_{hi} - \bar{C}_h)^2}{(d_h - 1)} . \quad (15)$$

Total catch for stratum h is estimated by expanding the mean over all days possible in the stratum,

$$\hat{\Delta} C_h = D_h * \bar{C}_h \quad (16)$$

and the variance of total catch is estimated by:

$$V(\hat{\Delta} C_h) = D_h^2 (1-f_1) \frac{s_{1h}^2}{d_h} + D_h \frac{\sum_{i=1}^{d_h} s_{hi}^2}{d_h} \quad (17)$$

where:

D_h = number of days in stratum h, and

f_1 = d_h/D_h .

The total harvest for stratum h is estimated in the same manner as catch, substituting harvests in the above equations.

The assumption is made that the anglers are interviewed in the same proportion to their abundance in all three periods sampled in any day. The variances are minimum estimates as within day variability cannot be estimated with this sample design.

Fish Creek Rainbow Trout Spawning Surveys

Rainbow trout spawning surveys were conducted by foot at Fish Creek during May and June. Observers wore polarized sun glasses and kept the sun behind their shoulder. All visible trout larger than about 200 mm in length were counted. Surveys encompassed Fish Creek from its junction with Clear Creek upstream to Momma Bear Lake. This stream reach was separated into two count sections each about 2 miles in length. Surveys were also conducted from Momma Bear Lake upstream approximately 2 miles (to an area of major stream braiding). Two surveys were performed to enumerate spawning trout and their distribution. The following data were also recorded during the surveys:

1. Date
2. Respective count section surveyed
3. Weather condition (clear, cloudy, etc.)
4. Stream level (high, moderate, low)
5. Water visibility (clear, turbid, etc.)
6. Number of trout observed
7. Spawning activity (presence of redds)
8. Water temperature
9. Number of fishermen.

RESULTS

Four hundred and twenty rainbow trout, from a total of 567 captured rainbow trout, were sampled for length and age at Lake Creek, Deshka River, and the Talachulitna River (Table 1). In Lake Creek a total of 121 fish were taken in 750 hoop trap hours, 22 fish in 91 fyke trap hours, 5 rainbow trout in 1,105 minnow trap hours and 43 in 36 hook and line hours. A total of 93 trout were taken in 1,469 hoop trap hours, 5 in 100 fyke trap hours, 2 in 2,192 minnow trap hours, and 1 trout in 6 hook and line hours at the Deshka River (Table 1). Hook and line was the only capture method used at the Talachulitna River, with 257 hours expended and 275 fish taken.

Age and Length Statistics

Fish sampled ranged from 170-475 mm in hoop traps and from 125-575 mm in hook and line samples in Lake Creek (Figure 2), from 150-400 mm in hoop traps in the Deshka River (Figure 3), and from 200-575 mm in hook and line samples from the Talachulitna River (Figure 4).

Lake Creek was the only river in which rainbow trout samples were large enough to do a comparison between two gear types. The length distribution of the 1989 Lake Creek rainbow trout sample significantly differed among gear types when compared using a nonparametric Kolmogorov-Smirnov statistic (Conover 1980, $D = 4858$, $p < 0.0001$). The mean fork length at Lake Creek for the hook and line rainbow trout sample was larger than the mean fork length for the hoop trap sample (Figure 2).

Ages were determined for 420 rainbow trout scales from the three rivers. Age group 1 through age group 7 were present in this sample, with few age 1 fish being captured. The predominant age groups in Lake Creek were age 3, 4, and 5 for hoop traps and age 4 and 5 for hook and line (Table 2). The age compositions differed significantly between these two gear types in Lake Creek (Table 2).

The oldest fish sampled from the Deshka River were age 5 (Table 3). Only 8% of the Deshka River rainbow trout that were aged were captured by methods other than hoop traps. Hook and line captured ages 2 thru 7 in the Talachulitna River and the predominant age groups were age 3, 4, and 5 (Table 4).

Table 1. Summary of hours fished and numbers of rainbow trout captured by various capture methods in Lake Creek, Deshka River, and the Talachulitna River, 1989.

Gear Type	Lake Creek			Deshka River			Talachulitna River		
	Hours Fished	Number of RT	Catch Rate	Hours Fished	Number of RT	Catch Rate	Hours Fished	Number of RT	Catch Rate
Hoop Trap	750	121	0.161	1469	93	0.063	0		
Fyke Trap	91	22	0.242	100	5	0.050	0		
Minnow Trap	1105	5	0.004	2192	2	0.001	0		
Hook & Line	36 ^a	43 ^a	1.194	6	1	0.167	257	275	1.070

^a Hours fished and rainbow trout captured by Alaska Department of Fish and Game employees only. It does not include hours fished and rainbow trout captured from the creel survey or by lodge owners.

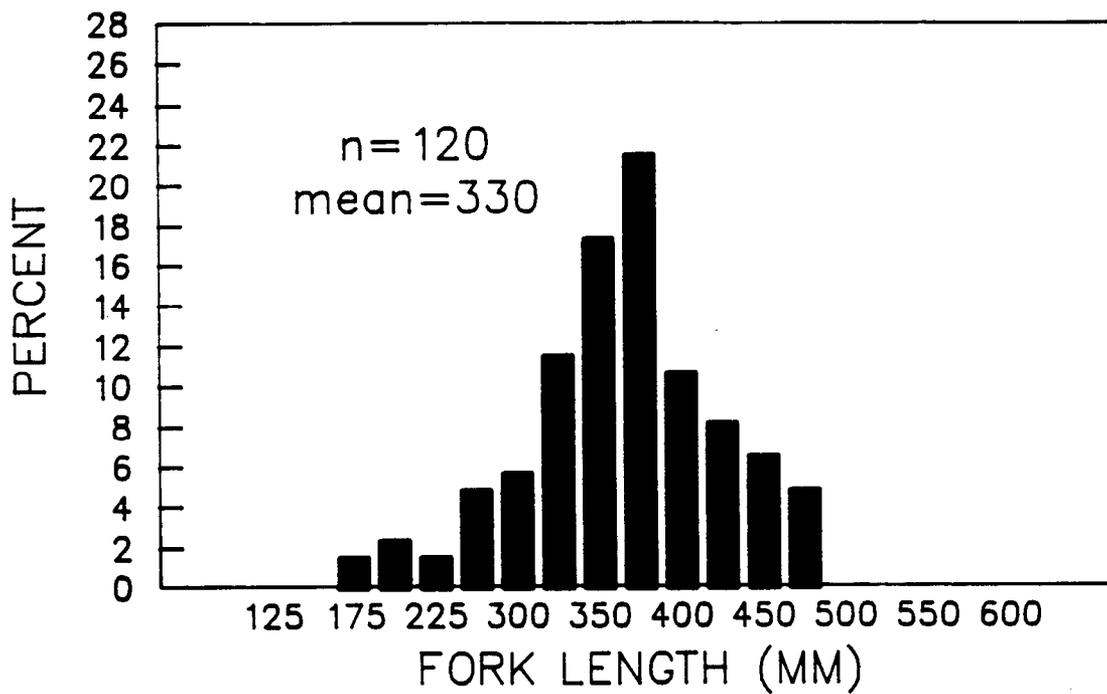
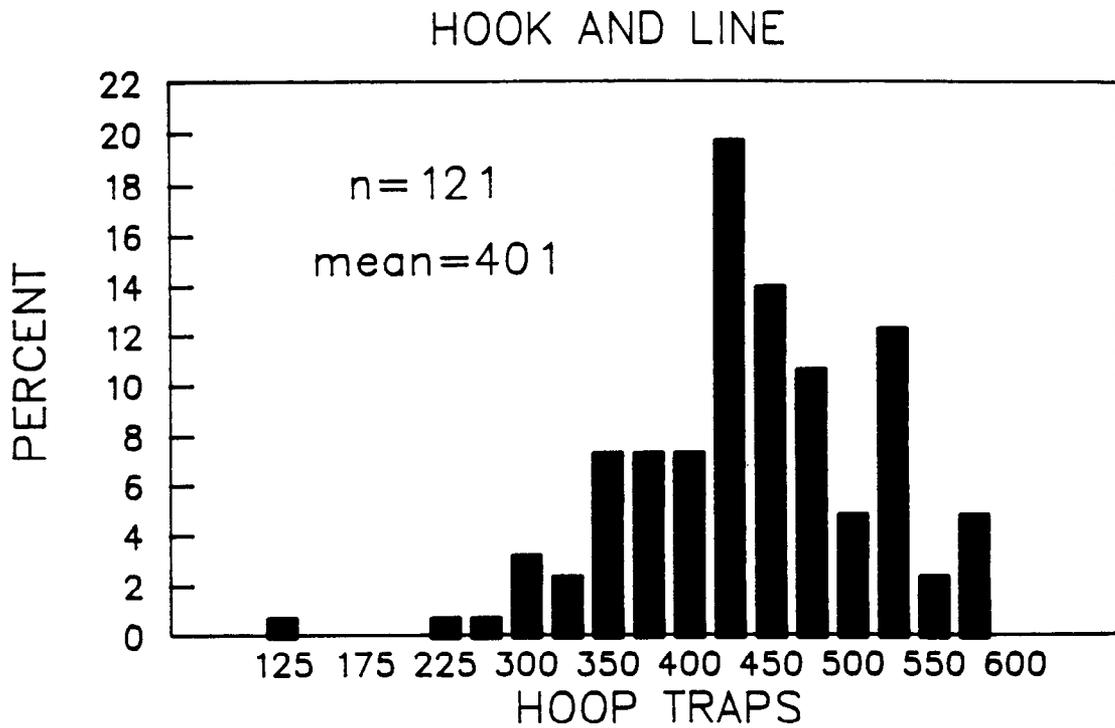


Figure 2. Length frequency distributions (25 mm intervals) of rainbow trout captured in Lake Creek, 1989.

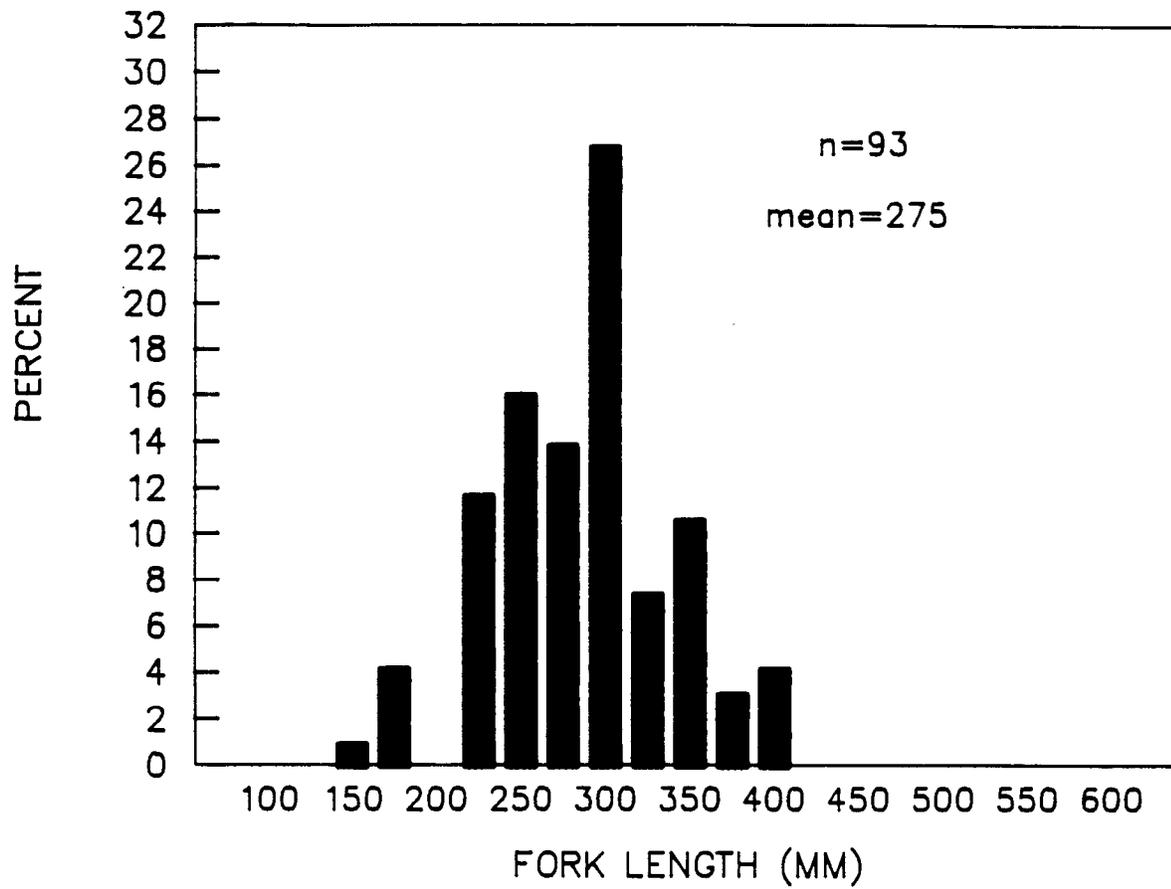


Figure 3. Length frequency distributions (25 mm intervals) of rainbow trout captured by hoop traps in the Deshka River, 1989.

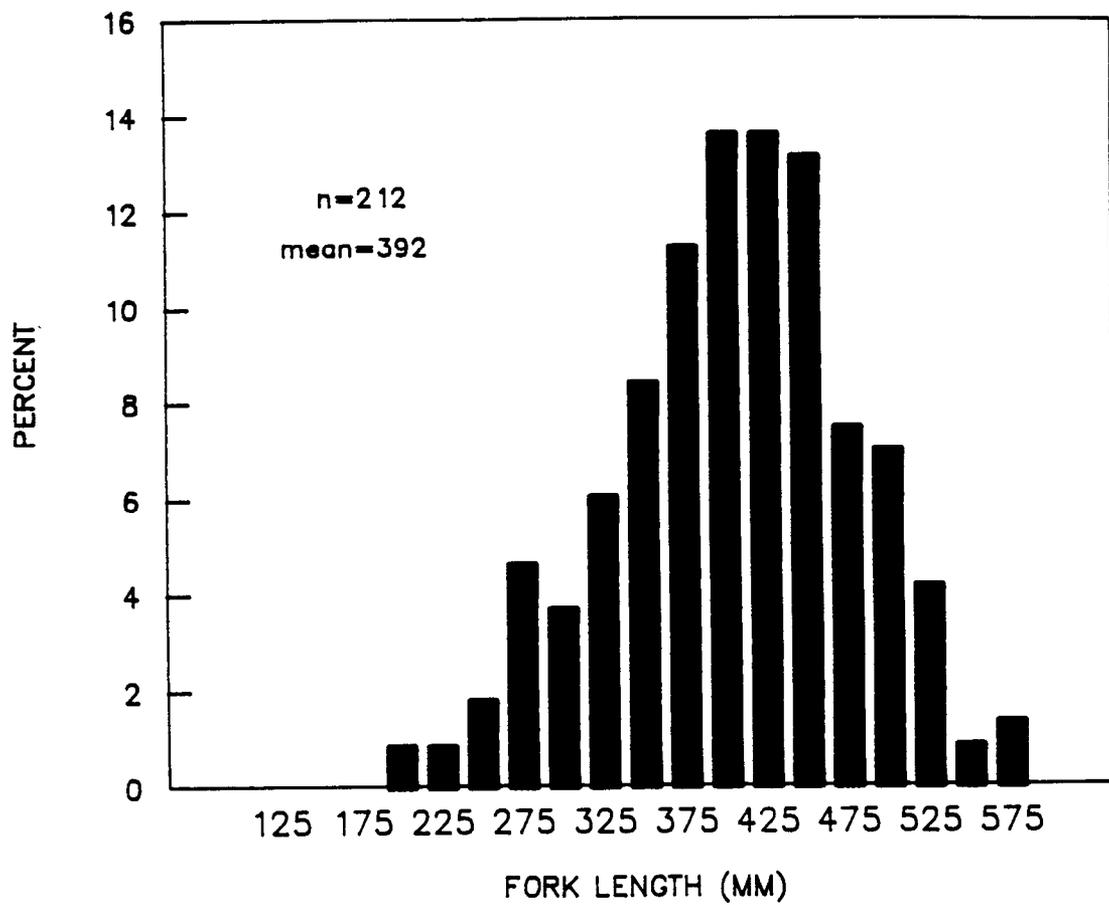


Figure 4. Length frequency distributions (25 mm intervals) of rainbow trout captured by hook and line in the Talachulitna River, 1989.

Table 2. Age composition of rainbow trout by capture methods and in the sport harvest in Lake Creek, 1989.

Age Group	Hoop Trap			Fyke Trap			Minnow Traps			Hook and Line		
	Percent	Sample Size	SE ^a	Percent	Sample Size	SE ^a	Percent	Sample Size	SE ^a	Percent	Sample Size	SE ^a
1				10.5	2	7.23	100.0	4	0.00			
2	12.0	11	3.40	36.8	7	11.37				2.2	2	1.56
3	28.3	26	4.72	42.1	8	11.64				14.4	13	3.73
4	37.0	34	5.06	5.3	1	5.26				25.6	23	4.62
5	20.7	19	4.24							37.8	34	5.14
6	2.2	2	1.53	5.3	1	5.26				15.6	14	3.84
7										4.4	4	2.18
<u>Total</u>	<u>100.0</u>	<u>92</u>		<u>100.0</u>	<u>19</u>		<u>100.0</u>	<u>4</u>		<u>100.0</u>	<u>90</u>	

^a Standard Error.

Ho: Age composition for hoop trap = age composition for hook and line.
 $\chi^2 = 25.76$ $df = 4$ $p < .005$

Table 3. Age composition of rainbow trout by capture methods in the Deshka River, 1989.

Age Group	Hoop Trap			FT, MT and H & L ^a		
	Percent	Sample Size	SE ^b	Percent	Sample Size	SE ^b
1				25.0	2	16.37
2	23.3	20	4.58			
3	52.3	45	5.42	75.0	6	16.37
4	19.8	17	4.32			
5	4.7	4	2.28			
<u>Total</u>	<u>100.0</u>	<u>86</u>		<u>100.0</u>	<u>8</u>	

^a Fyke traps = 5 samples
 Minnow Traps = 2 samples
 Hook and line = 1 sample

^b Standard error

Table 4. Age composition of rainbow trout captured by hook and line in the Talachulitna River, 1989.

Age Group	Percent	Sample Size	Standard Error
2	3.3	4	1.63
3	21.5	26	3.75
4	38.8	47	4.45
5	28.9	35	4.14
6	6.6	8	2.27
7	0.8	1	0.83
<u>Total</u>	<u>100.0</u>	<u>121</u>	

Mean length at age by gear type varied by river (Tables 5, 6, and 7). The Lake Creek rainbow trout caught by hook and line were larger at age than the hoop trap samples (Table 5). No significant interaction was found between gear type and age in the ANOVA but the differences in mean length at age between the gear types were significant (Table 5).

The smallest rainbow trout for all combined age groups by hoop trap were from the Deshka River. The largest rainbow trout captured in 1989 was from the Talachulitna River and measured 560 mm in fork length.

Creel Estimates

Effort:

The Lake Creek creel survey was conducted from 5 August through 4 September. Nine hundred and twenty-seven incomplete and 201 completed trip anglers were interviewed. Sixty nine angler counts ranged from 0 to 54 anglers per count (Appendix A1). Estimated angler-effort during the survey was 7,411 angler-hours (Table 8).

Coho Salmon Catch and Harvest:

Significantly fewer anglers who had completed their fishing trip had zero catches ($\chi^2=16.9$, $df=1$, $p<0.005$) or harvests ($\chi^2=21.8$, $df=1$, $p<0.005$). Therefore, only completed anglers were used in the estimation of catch and harvest of coho salmon. Four strata were used for estimation of coho salmon; a weekend and weekday strata from August 5 to August 25 and from August 26 to September 4.

Daily harvest and catch rates of coho salmon varied from 0.000 to 0.857 and 0.000 to 1.375 fish per hour, respectively (Appendix A2). The highest daily harvest rate and catch rate occurred on 14 and 17 August, respectively.

The estimated catch of coho salmon was 3,950 fish, of which 73% (2,905) were harvested (kept) by anglers (Table 9). All of the catch and harvest was taken during the first stratum from 5 August to 25 August.

Rainbow Trout Catch and Harvest:

There was no significant difference between anglers who had completed their fishing trip and those who were still fishing when interviewed in the number with zero catches ($\chi^2=0.75$, $df=1$, $p>0.25$) or harvests ($\chi^2=1.29$, $df=1$, $p>0.25$) of rainbow trout. Therefore, all anglers were used in the estimation of catch and harvest of rainbow trout. Three strata were used for estimation of rainbow trout; a weekend and weekday strata from August 5 to September 1 and the Labor Day weekend from September 2 to September 4.

The catch and harvest rates remained low for rainbow trout throughout most of the creel, as coho salmon were the target species. Catch rates increased substantially over the last 3 days of the creel, Labor Day weekend (Appendix A3). Daily harvest and catch rates of rainbow trout varied from 0.000 to 0.038 and 0.000 to 3.740 fish per hour, respectively (Appendix A3).

Table 5. Mean fork length in millimeters by age group of rainbow trout by capture methods and in the sport harvest in Lake Creek, 1989.

Age Group	Hoop Trap			Fyke Trap			Minnow Trap			Hook and Line		
	Mean Length	Sample Size	SE ^a	Mean Length	Sample Size	SE ^a	Mean Length	Sample Size	SE ^a	Mean Length	Sample Size	SE ^a
1				125	2	9.5	111	4	0.0			
2	211	11	9.5	211	7	11.0				237	2	13.0
3	294	26	6.1	287	8	10.9				304	13	7.5
4	339	34	6.4	438	1					366	23	6.2
5	374	19	8.3							407	34	6.0
6	449	2	9.5	460	1					463	14	8.2
7										518	4	16.8
Total	321	92	6.5	259	19	20.4	111	4		391	90	7.0

^a Standard error.

Model: Length = Gear + Age + Gear x Age.

Source	df	p-value	Significant
Gear	1	.0001	Yes
Age	5	.0001	Yes
Gear*Age	4	.6132	No

Table 6. Mean fork length in millimeters by age group of rainbow trout by capture methods in the Deshka River, 1989.

Age Group	Hoop Trap			FT, MT and H & L ^a		
	Mean Length	Sample Size	SE ^b	Mean Length	Sample Size	SE ^b
1				113	2	13.5
2	206	20	7.5			
3	277	45	3.7	272	6	9.5
4	335	17	5.3			
5	383	4	9.0			
Total	277	86	6.0	232	8	26.9

^a Fyke traps = 5 samples
 Minnow traps = 2 samples
 Hook and line = 1 sample
^b Standard error.

Table 7. Mean fork length in millimeters by age group of rainbow trout captured by hook and line in the Talachulitna River, 1989.

Age Group	Sample Size	Mean Length	SE ^a
2	4	193	9.70
3	26	280	5.70
4	47	380	6.10
5	35	418	6.08
6	8	493	9.25
7	1	560	.
Total	121	372	7.08

^a Standard error

Table 8. Estimated number of angler-hours of effort during each of the weekday and weekend/holiday components of the fishery in Lake Creek, 1989.

Stratum	WD/ ^a WE	Numb. of days		Effort		Variance of mean	Variance of effort estimate			
		All	Sampled	Mean	Total		Among Days	Among Anglers	Total	RP ^b
5 Aug - 25 Aug	WE	6	6	390	2,341	13,863	0	136,619	136,619	31
5 Aug - 25 Aug	WD	15	9	307	4,604	12,033	120,328	252,587	372,915	26
26 Aug - 4 Sep	WE	5	5	71	357	1,160	0	14,953	14,953	67
26 Aug - 4 Sep	WD	5	3	22	109	1,423	4,743	2,759	7,501	156
Total				7,411					531,988	19

^a WD = weekday
WE = weekend

^b RP relative precision of 95% confidence interval

Table 9. Estimated number of coho salmon harvested and number caught during each of the weekday and weekend/holiday components of the fishery in Lake Creek, 1989.

Stratum	WD/ ^a WE	Numb. of days		Catch		Variance of catch estimate					Harvest		Variance of harvest estimate				
		All	Sampled	Mean	Total	Variance of mean	Among Days	Among Anglers	Total	RP ^b	Mean	Total	Variance of mean	Among Days	Among Anglers	Total	RP ^b
5 Aug - 25 Aug	WE		4	163	977	14,791	44,372	31,929	76,301	55	147	883	12,882	38,647	25,857	64,505	56
5 Aug - 25 Aug	WD	15	6	198	2,973	33,115	745,098	176,777	921,874	63	135	2,022	8,819	198,430	53,742	252,171	49
	Total				3,950				998,175	50		2,905				316,676	38

^a WD = weekday
WE = weekend

^b RP relative precision of the 95% confidence interval

The highest daily harvest rate and catch rate occurred on 7 August and 4 September, respectively.

The estimated catch of rainbow trout was 663 fish, of which 8%, or 53, was harvested (kept) by anglers (Table 10).

Miscellaneous Statistics:

Of the four questions asked anglers concerning artificial lure and mandatory release of rainbow trout, 73% to 85% of the responding anglers from all strata and zones combined either had no opinion or reported left as is to the questions (Appendix A4). The majority of anglers who expressed an opinion favored mandatory release of rainbow trout and the use of artificial lures.

Combining all strata, bait and lure fisherman comprised 63% of the interviewed anglers in zone 1 and 27% of the anglers in zone 2. Lure fisherman comprised 31% of the anglers in zone 1 and 71% of the anglers in zone 2 (Appendix A5). Only 4% of the anglers at Lake Creek used only bait as terminal gear.

In all zones and strata combined, eighty-one percent of the anglers interviewed were guided anglers, but only 56% of these anglers had a guide physically present with them while fishing (Appendix A6). Forty-four percent of the guided anglers were dropped off by either a charter boat or air taxi operator.

Data on the number of harvested coho salmon per completed-trip angler and scale regeneration of rainbow trout are found in Appendices A7 and A8, respectively.

Fish Creek Rainbow Trout Spawning Surveys

A foot survey was conducted at Fish Creek from 21 thru 23 June 1989. The survey extended from the confluence with Clear Creek upstream 4 miles to Mamma Bear Lake and continued on upstream for another 2 miles. Good spawning substrate for rainbow trout was found throughout the lower 4 miles of Fish Creek. Remnants of abandoned spawning redds (most likely rainbow trout) were evident throughout that portion of Fish Creek from Mamma Bear Lake downstream approximately 1 mile. A total of 13 rainbow trout (200 mm and larger) were observed between Clear Creek and Mamma Bear Lake. A total of 4 rainbow trout were observed in the upper 2 miles of the survey area above Mamma Bear Lake. Substrate was larger and stream velocities were higher in this section. No redds or spawning rainbow trout were observed above Mamma Bear Lake.

DISCUSSION

Due to the greater than normal rainfall in August and September (8.79 inches and 4.74 inches, respectively, at Skwentna) catch and harvest rates and fishing effort along with trapping effort were reduced. Skwentna received approximately 2.25 times more rain in August than normal and in September approximately 1 inch of rain during the first 5 days of the month.

Table 10. Estimated number of rainbow trout harvested and number caught during each of the weekday and weekend/holiday components of the fishery in Lake Creek, 1989.

Stratum	WD/ ^a WE	<u>Numb. of days</u>		<u>Catch</u>		Variance of mean	<u>Variance of catch estimate</u>				<u>Harvest</u>		Variance of mean	<u>Variance of harvest estimate</u>			
		All	Sampled	Mean	Total		Among Days	Among Anglers	Total	RP ^b	Mean	Total		Among Days	Among Anglers	Total	RP ^b
5 Aug - 1 Sep	WE	8	8	4	34	28	0	145	145	69	2	16	8	0	40	40	78
5 Aug - 1 Sep	WD	20	9	7	133	123	3,008	608	3,616	89	2	37	19	455	10	563	126
2 Sep - 4 Sep	WE	3	3	165	496	28,434	0	46,084	46,084	85							
Total				663				49,845	66	53					603	90	

^a WD = weekday
WE = weekend

^b RP relative precision of 95% confidence interval.

Therefore, sampling rainbow trout was extremely difficult and at times impossible due to these high water levels and turbid conditions during a majority of the field season. Constant changes in water discharge produced inaccurate and at times unusable data. Hoop traps frequently shifted and failed to fish when they became clogged with debris. The use of fyke traps and seines were unmanageable in the above normal stream flows. The physical habitat variables at the various sampling sites were usually meaningless with the constant changes in the river.

Fish under approximately 175-200 mm were not contained by the hoop traps because the 1 inch mesh covering the traps was too large to prevent the smaller fish from swimming through the mesh. It was assumed that rainbow trout larger than approximately 450-475 mm shied away from the hoop traps as none were captured. The throat of the hoop traps was of sufficient size to catch larger fish because on occasion adult chum and coho salmon were captured.

Overall hook and line captured larger and older rainbow trout than hoop traps or fyke traps. One capture method accounted for the majority of fish sampled in the Deshka River and the Talachulitna River. Only in Lake Creek were sample sizes large enough to compare the age and length distributions from the different gear types (hoop traps and hook and line).

The creel survey was terminated on 4 September instead of 9 September due to low fishing effort and heavy rainfall. In 1988 the Lake Creek creel survey reported that 15% of the rainbow trout caught were harvested while in 1989 only 8% of the rainbow trout caught were harvested (Hepler and Lang 1989).

Only one survey of Fish Creek, a tributary of Clear Creek, was done during the field season in 1989. Several more surveys were scheduled but because of a shortage in manpower and lack of time only one foot survey was completed. More surveys are planned to be done in the future to determine the timing of rainbow trout spawning.

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APPENDIX A

Appendix A1. Angler counts during the fishery
for coho salmon and rainbow trout
in Lake Creek, 1989.

Date	Counts by Period ^a		
	A	B	C
805	9	17	15
806	7	41	12
807	14	25	26
808	6	29	38
809	11	43	32
810			
811			
812	10	54	35
813	18	29	44
814	10	19	21
815			
816			
817	4	37	31
818	0	36	17
819	20	52	13
820	8	33	22
821	0	14	19
822	3	42	20
823			
824			
825	0	11	3
826	0	15	0
827	0	3	0
828	0	0	0
829			
830			
831	0	0	0
901	0	4	10
902	0	3	11
903	2	4	16
904	0	12	8

^a 05 August 1989 through 27 August 1989
 Period A: 0600 to 1000 hrs;
 Period B: 1000 to 1600 hrs;
 Period C: 1600 to 2200 hrs.

28 August 1989 through 4 September 1989
 Period A: 0600 to 1000 hrs;
 Period B: 1000 to 1500 hrs;
 Period C: 1500 to 2000 hrs.

Appendix A2. Daily summary statistics for effort, coho salmon harvest and catch by completed anglers interviewed during the fishery in Lake Creek, 1989.

Date	WD/ ^a WE	Mean Count	Effort (angl./hrs.)		Number Intervs.	Catch rates		Catch		Harvest rates		Harvest	
			Total	Variance		Mean	Variance	Total	Var.	Mean	Variance	Total	Var.
890805	WE	13.67	219	1,479									
890806	WE	20.00	320	28,757									
890807	WD	21.67	347	3,783	15	0.376	0.015	130	2,330	0.330	0.010	114	1,532
890808	WD	24.33	389	23,239	27	0.499	0.004	194	6,271	0.426	0.003	166	4,607
890809	WD	28.67	459	22,556									
890811	WD				23	0.200	0.002			0.200	0.002		
890812	WE	33.00	528	41,557	15	0.056	0.001	29	374	0.056	0.001	29	374
890813	WE	30.33	485	14,535	24	0.665	0.032	323	13,551	0.623	0.026	302	11,487
890814	WD	16.67	267	2,930	4	0.929	0.005	248	2,874	0.857	0.000	229	2,152
890816	WD				15	0.296	0.005			0.296	0.005		
890817	WD	24.00	384	26,368	4	1.375	0.057	528	56,789	0.625	0.016	240	12,192
890818	WD	17.67	283	27,676	17	0.284	0.003	80	2,395	0.181	0.001	51	962
890819	WE	28.33	453	36,892	16	0.290	0.002	131	3,493	0.290	0.002	131	3,493
890820	WE	21.00	336	13,397	3	0.500	0.005	168	3,868	0.375	0.000	126	1,884
890821	WD	11.00	176	8,277	22	0.050	0.001	9	51	0.050	0.001	9	51
890822	WD	21.67	347	32,626									
890824	WD				3	0.333	0.111			0.333	0.111		
890825	WD	7.000	112	4,096									
890826	WE	5.000	80	6,400									
890827	WE	1.000	16	256									
890828	WD	0.000	0	0									
890831	WD	0.000	0	0									
890901	WD	4.667	65	1,655									
890902	WE	4.667	65	2,112									
890903	WE	7.333	103	3,746	8	0.000	0.000	0	0	0.000	0.000	0	0
890904	WE	6.667	93	2,439									

^a WD = weekday
WE = weekend

Appendix A3. Daily summary statistics for effort, rainbow trout harvest and catch by all anglers interviewed during the fishery in Lake Creek, 1989.

Date	WD/ ^a WE	Mean Count	Effort (angl./hrs.)		Number Intervs.	Catch rates		Catch		Harvest rates		Harvest	
			Total	Variance		Mean	Variance	Total	Var.	Mean	Variance	Total	Var.
890805	WE	13.7	219	1,479	31	0.074	0.002	16	104	0.037	0.001	8	26
890806	WE	20.0	320	28,757	53	0.005	0.000	2	3	0.005	0.000	2	3
890807	WD	21.7	347	3,783	62	0.095	0.001	33	147	0.038	0.000	13	41
890808	WD	24.3	389	23,239	104	0.003	0.000	1	2	0.000	0.000	0	0
890809	WD	28.7	459	22,556	49	0.000	0.000	0	0	0.000	0.000	0	0
890811	WD				23	0.000	0.000			0.000	0.000		
890812	WE	33.0	528	41,557	120	0.008	0.000	4	7	0.008	0.000	4	7
890813	WE	30.3	485	14,535	91	0.009	0.000	4	10	0.000	0.000	0	0
890814	WD	16.7	267	2,930	50	0.024	0.000	6	15	0.000	0.000	0	0
890816	WD				15	0.000	0.000			0.000	0.000		
890817	WD	24.0	384	26,368	55	0.042	0.000	16	103	0.000	0.000	0	0
890818	WD	17.7	283	27,676	92	0.003	0.000	1	1	0.003	0.000	1	1
890819	WE	28.3	453	36,892	103	0.013	0.000	6	17	0.000	0.000	0	0
890820	WE	21.0	336	13,397	67	0.006	0.000	2	4	0.006	0.000	2	4
890821	WD	11.0	176	8,277	64	0.000	0.000	0	0	0.000	0.000	0	0
890822	WD	21.7	347	32,626	56	0.007	0.000	3	7	0.007	0.000	3	7
890824	WD				3	0.000	0.000	.	.	0.000	0.000	.	.
890825	WD	7.0	112	4,096	11	0.000	0.000	0	0	0.000	0.000	0	0
890826	WE	5.0	80	6,400	15	0.000	0.000	0	0	0.000	0.000	0	0
890827	WE	1.0	16	256	3	0.000	0.000	0	0	0.000	0.000	0	0
890828	WD	0.0	0	0									
890831	WD	0.0	0	0									
890901	WD	4.7	65	1,655									
890902	WE	4.7	65	2,112	14	0.271	0.015	18	186	0.000	0.000	0	0
890903	WE	7.3	103	3,746	30	1.256	0.081	129	6,463	0.000	0.000	0	0
890904	WE	6.7	93	2,439	12	3.740	0.849	349	39,434	0.000	0.000	0	0

^a WD = weekday
WE = weekend

Appendix A4. Opinions of anglers interviewed during the fishery for coho salmon and rainbow trout at Lake Creek, 1989.

Most of the Lake Creek drainage is now governed by regulations that require or promote the release of rainbow trout.

- A. Should these artificial lure/no kill trout requirements be expanded, eliminated or left as is within the Lake Creek drainage?

Favor	23.3%	71 Interviews
Oppose	3.9%	12 Interviews
No opinion	72.8%	222 Interviews
<hr/>		
Total	100.0%	305 Interviews

- B. Do you favor, oppose or have no opinion on requiring mandatory release of rainbow trout at other Susitna basin waters?

Favor	14.7%	162 Interviews
Oppose	3.4%	37 Interviews
No opinion	81.9%	901 Interviews
<hr/>		
Total	100.0%	1100 Interviews

The use of unbaited artificial lures is now required on the lower 2-1/2 miles of Lake Creek after September 1.

- A. Do you favor, oppose or have no opinion on this artificial lure requirement?

Favor	11.6%	126 Interviews
Oppose	4.2%	46 Interviews
No opinion	84.2%	914 Interviews
<hr/>		
Total	100.0%	1086 Interviews

- B. Should this artificial lure requirement start earlier in the season, start later in the season or be left as is?

Earlier	15.5%	48 Interviews
Later	0.0%	0 Interviews
Left as is	84.5%	261 Interviews
<hr/>		
Total	100.0%	309 Interviews

Appendix A5. Composition of anglers, by zone, using bait, lures, or bait and lures during the coho salmon and rainbow trout creel survey at Lake Creek, 1989.

Gear	Number of Anglers							
	Zone 1		Zone 2		Zone 3		Zone 1-3	
Bait	34	(6.2%)	11	(2.2%)	0	(0.0%)	45	(4.0%)
Lures	170	(30.9%)	359	(71.2%)	62	(100.0%)	591	(53.0%)
Both ^a	346	(62.9%)	134	(26.6%)	0	(0.0%)	480	(43.0%)
Total	550	(100.0%)	504	(100.0%)	62	(100.0%)	1116	(100.0%)

^a Bait and lures.

Appendix A6. Composition of guided and unguided anglers during the coho salmon and rainbow trout creel survey at Lake Creek, 1989.

Type of Angler	Number of Anglers	Percent of Anglers	Type of Guided Angler	Number of Anglers	Percent of Guided Anglers
Guided	910	80.7	Guide present	514	56.5
Unguided	218	19.3	Charter/dropoff ^a	396	43.5
Total	1,128	100.0	Total	910	100.0

^a Angler fishing without a guide present.

Appendix A7. Composition of completed anglers with
and without harvested coho salmon in
Lake Creek, 1989.

Number of SS ^a harvested	Number of Anglers	Percent of all Anglers	Percent of Anglers with SS ^a harvested
0	94	48.2	
1	41	21.0	40.6
2	25	12.8	24.8
3	35	18.0	34.6
Total	195	100.0	100.0

^a Coho salmon.

Appendix A8. Percent regeneration of rainbow trout scales sampled from Lake Creek, Deshka River, and the Talachulitna River, 1987, 1988, and 1989.

Year	Lake Creek		Deshka River		Talachulitna River	
	Sample Size ^a	Percent Regenerated	Sample Size ^a	Percent Regenerated	Sample Size ^a	Percent Regenerated
1987	70	41.4			73	34.2
1988	178	52.9			147	46.9
1989	268	23.5	101	6.9	212	42.9

^a Sample sizes: Total number of rainbow trout sampled for scales.

