

FISHERY DATA SERIES NO. 90-34

STEELHEAD *Oncorhynchus mykiss*
CREEL CENSUS AND RECREATION SURVEY
ON THE THORNE RIVER,
SOUTHEAST ALASKA, 1988-89¹

By

Glenn M. Freeman
and
Stephen H. Hoffman

Alaska Department of Fish and Game
Division of Sport Fish
Anchorage, Alaska

September 1990

¹ This investigation was partially financed by the Federal Aid in Sport Fish Restoration Act (16 U.S.C. 777-777k) under project F-10-4, Job No. T-1-4 and the United States Forest Service Sykes Act, December 12, 1975, Public Law 93-452 (16 U.S.C. 565 A-1 to A-3 and 670 G, 670 H, and 670 O).

The Alaska Department of Fish and Game operates all of its public programs and activities free from discrimination on the basis of race, religion, color, national origin, age, sex, or handicap. Because the department receives federal funding, any person who believes he or she has been discriminated against should write to:

O.E.O.
U.S. Department of the Interior
Washington, D.C. 20240

TABLE OF CONTENTS

	<u>Page</u>
LIST OF TABLES	ii
LIST OF FIGURES	ii
LIST OF APPENDICES	ii
ABSTRACT	1
INTRODUCTION	2
METHODS	4
Creel Survey	4
Recreational User Survey	8
RESULTS	8
Creel Survey	8
Recreational User Survey	12
DISCUSSION	17
ACKNOWLEDGEMENTS	18
LITERATURE CITED	18
APPENDIX A	19

LIST OF TABLES

<u>Table</u>	<u>Page</u>
1. Sport fishing effort and catch estimates on the Thorne River from September 26, 1988 through June 4, 1989	9
2. Estimated biweekly steelhead sport fishing effort and catch, Thorne River, 1988-89	11
3. Age, length, and weight of steelhead sampled from the Thorne River sport fishery, 1988-89	15

LIST OF FIGURES

<u>Figure</u>	<u>Page</u>
1. Angler/recreational user survey area along the Thorne River, eastern Prince of Wales Island, 1988-89	3
2. Estimated total biweekly sport fishing effort on the Thorne River from September 26, 1988 to June 4, 1989	10
3. Estimated biweekly steelhead catch per unit of effort (CPUE) on the Thorne River between September 26, 1988 and June 4, 1989	13
4. Estimated steelhead catch on the Thorne River from September 26, 1988 to June 4, 1989	14
5. Estimated biweekly cutthroat trout and Dolly Varden catch per unit of effort (CPUE) on the Thorne River, 1989	16

LIST OF APPENDICES

<u>Appendix</u>	<u>Page</u>
A1. Survey used during on-site interviews of recreation users on the Thorne River, 1988-89	20
A2. Recreation survey questionnaire distributed to recreational users at the Thorne River, 1988-89	22

ABSTRACT

A steelhead *Oncorhynchus mykiss* angler and recreation user survey was conducted on the Thorne River in southeast Alaska from September 26, 1988 through June 4, 1989. Biweekly and total sport fishing catch and effort estimates were computed for the study period. The total estimated adult steelhead catch was 160 (standard error = 60) fish, with an estimated harvest of 67 (standard error = 34) fish. Sport fishing effort and success were highest in April and May. Road construction and poor weather were believed to impair steelhead fishing during the fall and winter. Recreational users were reasonably content with the status quo on the Thorne River, but the majority favored steelhead enhancement.

KEY WORDS: Southeast Alaska, Prince of Wales Island, Thorne River, steelhead, *Oncorhynchus mykiss*, creel survey, harvest, effort, sport fishing, recreation user, angler survey.

INTRODUCTION

Thorne River is the largest stream system on Prince of Wales Island (PWI) and supports a popular steelhead *Oncorhynchus mykiss* fishery. Wild fall- and spring-run steelhead are present in the Thorne River from October to June. No enhancement of the wild steelhead population in Thorne River has occurred. The daily bag limit for steelhead is one fish. Other fish species endemic to the Thorne River which contribute to the sport fishery include coho *Oncorhynchus kisutch*, sockeye *O. nerka*, pink *O. gorbuscha*, and chum salmon *O. keta*; cutthroat *O. clarki* and rainbow trout *O. mykiss*; and Dolly Varden *Salvelinus malma*. The river flows into Thorne Bay near the city of the same name.

The mainstem and north fork of Thorne River total about 30 miles in length, with an average stream width of 150 ft. Public access to the Thorne River is limited to the island road system and to boating from Thorne Bay. Roadside access to the river is available at numerous locations along one primary and several secondary United States Forest Service (USFS) roads (Figure 1). Approximately nine miles of the mainstem and north fork are accessible within a thirty minute walk from the road system. Substantial reaches along the lower river are within a few hundred yards of a road.

The economy of Thorne Bay (population 525) is based heavily on the timber industry, which is provided by the Tongass National Forest and managed by the USFS. Excluding Thorne Bay, the nearest community to Thorne River along the PWI road system is Klawock (population 900), located some 30 miles southwest. Neither the USFS nor the Alaska Department of Fish and Game (ADF&G) have conducted surveys to collect extensive quantitative and qualitative angler and recreation user data on the Thorne River. Information gained from an angler/recreational user survey will facilitate future management decisions through incorporation of public use patterns and desires.

In 1988, the ADF&G and the USFS Thorne Bay Ranger District entered into a cooperative agreement to assess the public use along Thorne River on eastern Prince of Wales Island, southeast Alaska. This stream was identified by both agencies as a key PWI system about which angler and recreational user information was needed.

Objectives of this project were to:

1. Estimate the steelhead sport fishing catch, effort, and harvest on the Thorne River by Prince of Wales Island residents and non-residents from September 26, 1988 through June 4, 1989.
2. Collect age-weight-length (AWL) data on steelhead harvested on the Thorne River.
3. Determine angler and public recreational use patterns along the Thorne River.

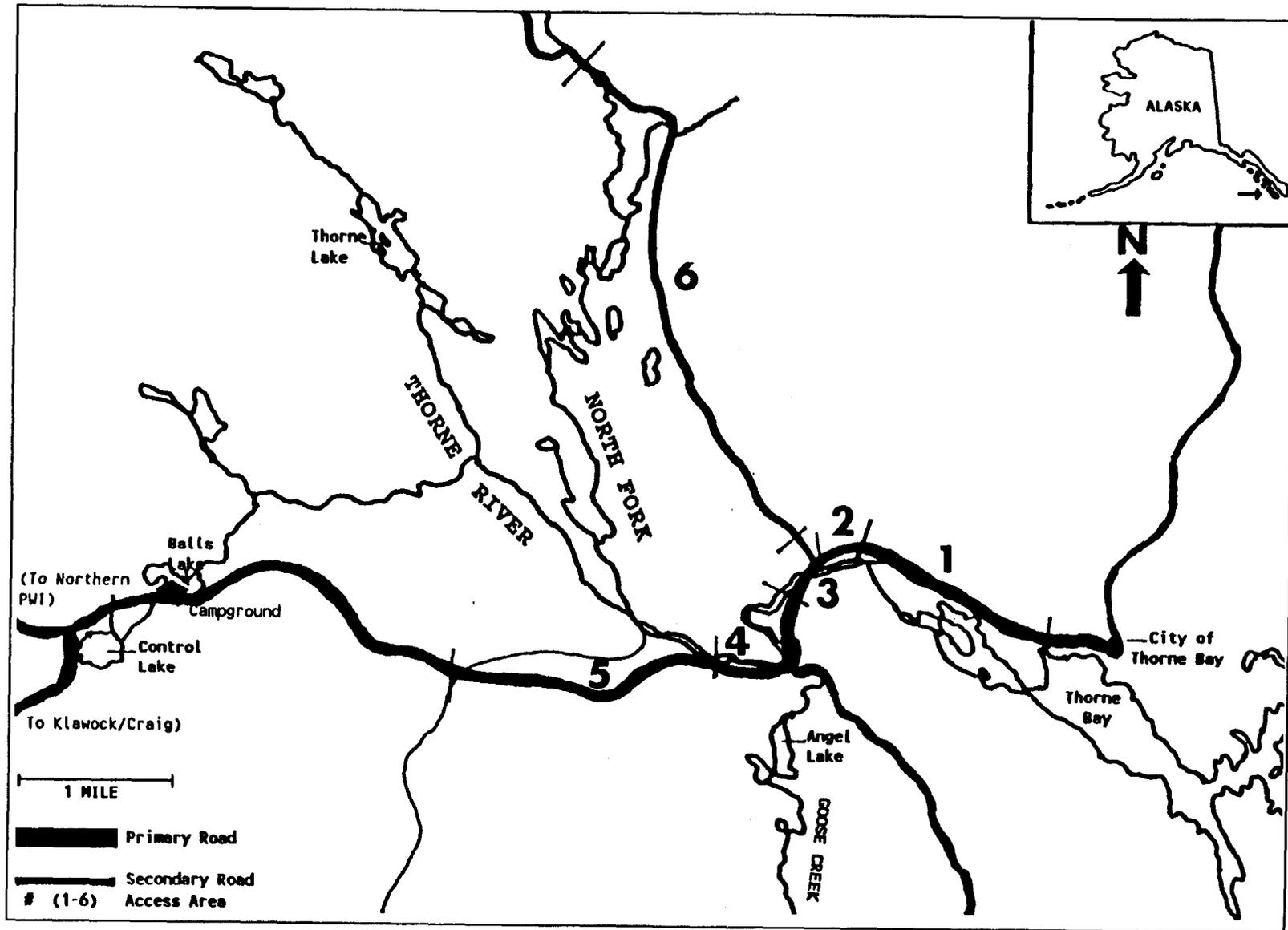


Figure 1. Angler/recreational user survey area along the Thorne River, eastern Prince of Wales Island, 1988-89.

METHODS

Creel Survey

A direct expansion creel survey was conducted along the Thorne River from September 26, 1988 through June 4, 1989. The river was divided into six access areas for sampling and estimation purposes. These six areas included all known areas along the mainstem and north fork which were within a half hour walk from road access (Figure 1). More heavily used boat and canoe access points were also incorporated into the six access areas. The study period was stratified into 18 biweekly periods (14-day increments). Within the biweekly strata, days were subdivided into weekday and weekend strata, with legal holidays included in the weekend strata. Additionally, each day outside the period from November 7, 1988 through January 15, 1989 (i.e., five biweekly periods) was equally subdivided into early day and late day substrata. Daily sampling periods totaled from 4.0 to 6.75 hours per day, corresponding to half the total daylight hours on a given day. Early and late day stratification was not used between November 7 and January 15 because of the small number of daylight hours during this period.

In the process of scheduling sampling periods, two contiguous weekdays were randomly selected for "non-sampling" each week to provide time off for staff. The remaining three weekdays per week, and all Saturdays and Sundays, were sampled. For each available sampling period, one of the six access areas was selected randomly. Thus, it was possible for one access area to be sampled twice on a given day. A one-half hour break was scheduled between sampling periods to allow for travel between access areas and a staff break.

Interviews of anglers and recreational users were conducted by an ADF&G fishery technician stationed in Thorne Bay. When sampling, the technician was stationed in a vehicle at one pre-assigned access area and interviewed anglers after they had completed their trip (generally as they returned to their vehicle). The number of anglers not interviewed during a sampling period was also recorded. Data collected during each interview included: target species; complete or incomplete trip; guided or unguided trip; residency status; terminal gear type used; time fished to the nearest half hour; and number of fish of each species caught or kept. For the purposes of this study, a resident was one who was presently domiciled on Prince of Wales Island. Anglers who released a steelhead were asked whether the adipose fin of that steelhead was missing.

Harvest and effort were estimated from the direct expansion completed-trip interview type creel survey using the following equations. These equations are valid for the case when all completed-trip anglers leaving the fishery are interviewed, as well as the case when some anglers are missed. All completed-trip anglers in the area and time stratum being sampled must, however, be counted. The first step involved the estimation of angler effort:

$$\begin{aligned} \hat{E}_h &= \text{estimated boat-hours in the } h\text{th stratum of the fishery;} \\ &= R_h \left[\frac{e_{h..}}{r_{h.}} \right] \quad (1) \\ h &= \text{subscript denoting stratum (as defined by the combination of} \\ &\quad \text{seasonal period, access location type, type of fishing day);} \end{aligned}$$

R_h = total number of hours (available for fishing) in the hth stratum;

$e_{h..}$ = total effort in hours expended by anglers interviewed within the hth stratum;

$$= \sum_{i=1}^{n_h} \hat{e}_{hi}. \quad (2)$$

i = subscript denoting an individual sample within the hth stratum;

n_h = number of samples collected within the hth stratum;

\hat{e}_{hi} = estimated effort for the ith sample within the hth stratum;
= $O_i \bar{e}_{hi}$. (3)

O_i = number of anglers counted in the ith sample within the hth stratum (including interviewed anglers and "missed" anglers);
= $O_i + P_i$ (4)

o_i = number of anglers interviewed during the ith sample;

p_i = number of anglers not interviewed (i.e., "missed") during the ith sample;

$$\bar{e}_{hi} = \frac{\sum_{j=1}^{o_i} e_{hij}}{O_i} \quad (5)$$

j = subscript denoting the boat-party interviewed during the ith sample within the hth stratum;

e_{hij} = effort (in angler-hours) of the jth angler interviewed in the ith sample in the hth stratum;

r_h = total number of hours sampled in the hth stratum;

$$= \sum_{i=1}^{n_h} r_{hi} \quad (6)$$

r_{hi} = hours sampled during the ith sample in the hth stratum;

$\hat{V}_h(\hat{E}_h)$ = the variance estimate for the estimate of E_h , obtained by the standard formula for the estimation of the variance of a product of a constant and a variance (Lehmann 1975, equation A.19, page 330);

$$= R_h^2 \hat{V}\left[\frac{e_{h..}}{r_h}\right] \quad (7)$$

$\hat{V}[\frac{e_{h..}}{r_h}]$ = the variance estimate for the effort rate (i.e., the ratio of $e_{h..}$ to r_h), which is estimated approximately by the standard formula for the variance of the ratio of random variables (Jessen 1978, equation 5.8, page 128, omitting the finite population correction factor);

$$\approx \left[\frac{\bar{e}_{h..}}{\bar{r}_h} \right]^2 \left\{ \left[\frac{s_e^2}{\bar{e}_{h..}^2} \right] + \left[\frac{s_r^2}{\bar{r}_h^2} \right] - \left[\frac{2\text{cov}_h(e,r)}{\bar{e}_{h..}\bar{r}_h} \right] \right\} \quad (8)$$

$\bar{e}_{h..}$ = mean effort (in angler-hours) for the n_h samples in the hth stratum;

$$= \frac{e_{h..}}{n_h} \quad (9)$$

\bar{r}_h = mean hours sampled for the n_h samples in the hth stratum;

$$= \frac{r_h}{n_h} \quad (10)$$

s_e^2 = variance estimate associated with estimating the effort component of the effort rate, obtained by using a modified two-stage sampling approach estimator (Cochran 1977);

$$= \left[\frac{R_h - r_h}{R_h} \right] \left[\frac{s_{B_e}^2}{n_h} \right] + \left[\frac{r_h}{R_h n_h} \right] \left[\frac{s_{w_e}^2}{n_h} \right] \quad (11)$$

$s_{B_e}^2$ = the between samples variance for effort;

$$= \frac{\sum_{i=1}^{n_h} (\bar{e}_{hi.} - \bar{e}_{h..})^2}{n_h - 1} \quad (12)$$

$s_{w_e}^2$ = the within sample (between angler) variance for effort;

$$= \sum_{i=1}^{n_h} \left\{ \left[\frac{(O_i - o_i)}{O_i} \right] [O_i^2] \left[\frac{1}{o_i} \right] \left[\frac{\sum_{j=1}^{o_i} (e_{hij} - \bar{e}_{hi.})^2}{(o_i - 1)} \right] \right\} \quad (13)$$

s_r^2 = variance estimate associated with estimating the hours sampled component of the effort rate;

$$= \left[\frac{(R_h - r_h)}{R_h} \right] \left[\frac{1}{n_h} \right] \left[\frac{\sum_{i=1}^{n_h} (r_{hi} - \bar{r}_h)^2}{(n_h - 1)} \right] \quad (14)$$

$\text{cov}(e,r)$ = the covariance estimate between the effort and hours sampled components of the effort rate estimate;

$$= \left[\frac{(R_h - \bar{r}_h)}{R_h} \right] \left[\frac{1}{n_h} \right] \left[\frac{\sum_{i=1}^{n_h} (\hat{e}_{hi} - \bar{e}_{h..}) (r_{hi} - \bar{r}_h)}{n_h - 1} \right] \quad (15)$$

The final step in estimating the effort for the entire season involves combining the stratum estimates:

$$\begin{aligned} \hat{E} &= \text{overall estimated effort} \\ &= \sum_{h=1}^q E_h \end{aligned} \quad (16)$$

q = number of strata

$\hat{V}(\hat{E})$ = estimated variance of E, assuming independence of the stratum estimates;

$$= \sum_{h=1}^q \hat{V}_h(\hat{E}_h) \quad (17)$$

Harvest is estimated similarly by substituting the corresponding catch statistics in place of the effort statistics into equations 1-17 above.

The approach presented above for the variance estimation is valid for a stratified simple random sampling design with only one stage of sample selection. Our use of this approach was not entirely correct, in that selection of time to sample within a unique combination of stratum definitions, was not a random process. As such, the location to sample within access location stratum represents a second stage of sampling. Due to the complexities of the sample allocation process and due to the limitations of sampling density, we were not able to estimate the variance for the second stage (i.e., by using squared differences between sample means and means by location [and/or sample period]). However, the use of a single-stage sampling approach is conservative in that the resulting variance estimates will be larger than if a multi-stage estimator could be applied.

Approximate 95% confidence intervals (CI) were obtained for harvest and effort estimates by assuming normality. Accordingly CI limits were obtained as follows:

$$\hat{H} \pm 2 (\hat{V}(\hat{H}))^{1/2} \quad (18)$$

The lower limit of the CI was set equal to either the value obtained by equation 26, or to the actual number of fish observed in the sampled harvest, whichever was greater. Since the harvest and effort estimates were not expected to be exactly normal these CI limits are only approximate. In particular we expected the upper limits to be non-conservative (i.e., the upper tail coverage was less than the stated alpha level, or 0.025), because of the assumed upper tail skew to these type of statistics.

Harvested steelhead were sampled by the technician as they were encountered during interviews. Ten scales were collected from each steelhead sampled, and were mounted on gum cards. The scales were subsequently pressed onto acetate slides and read for age. Age classes are reported using the methods of Narver

and Withler (1977) (e.g., a fish aged 3.2S1 is 6 years of age which spent three winters in fresh water before migrating to sea, resided there 2 years before returning to spawn, and spent an additional year at sea after that spawning). Weight was measured to the nearest pound, with weights of eviscerated and whole fish distinguished. Lengths of fish (mid-eye to the fork of tail) were measured to the nearest millimeter.

Terminal gear types used by anglers were classified into four categories: spinners; flies; bait; and artificials. The percentage use of each gear type was calculated from all complete trip and all incomplete trip interviews from anglers who targeted on steelhead.

Recreational User Survey

Anglers and other recreational users encountered during the creel survey were asked a series of ten questions, developed by the USFS, which related to their recreation experiences and opinions (Appendix A1). Interviewees were asked whether they had been previously interviewed during this program to avoid duplication through repeat sampling.

A more detailed questionnaire, also developed by the USFS, was given to each person interviewed along with a postage paid, pre-addressed envelope (Appendix A2). The more detailed survey was distributed to provide those interviewed with an opportunity to elaborate on their use and opinions concerning the Thorne River. Questionnaires were not distributed to those who had previously responded to one.

RESULTS

Creel Survey

The total estimated time fished by sport anglers along the Thorne River from September 26, 1988 through June 4, 1989 was 3,259 angler-hours, with 95% confidence intervals (CI) from 2,035 to 4,483 angler-hours (Table 1). During that period 72% of sport fishing effort, or 2,331 angler-hours, was targeted on steelhead, with 95% CI from 1,265 to 3,397 angler-hours. The remainder of sport fishing effort during the period targeted primarily on cutthroat trout and Dolly Varden (27% or 887 angler-hours, with 95% CI from 327 to 1,447 angler-hours). Salmon effort was estimated at 41 angler-hours (1%), with 95% CI from 3 to 95 angler-hours.

Approximately 79% of the total estimated sport fishing effort which targeted on steelhead or other trout occurred between March 27 and June 4, 1989. Steelhead fishing effort peaked from mid-April to early May and was low from December 5 through March 26 (Figure 2). During most of the survey, however, the U.S. Department of Transportation, Federal Highways Administration supervised reconstruction of FH-42, the primary road along the mainstem Thorne River. Access to the river was reduced along the FH-42 road by construction activities, particularly from September 1988 through March 1989.

The total estimated steelhead harvest through the study period was 67 fish, with 95% CI from 5 to 135 fish (Table 1). An estimated 93 steelhead were released during the same period (95% CI from 6 to 191). No hatchery steelhead were encountered.

Table 1. Sport fishing effort and catch estimates on the Thorne River from September 26, 1988 through June 4, 1989.

	Estimate	SE ^a	95% CI ^b
Angler Hours	3,259	612	2,035 - 4,483
Steelhead Hours	2,331	533	1,265 - 3,397
Salmon Hours	41	27	3 - 95
Cutthroat/Dolly Varden Hours	887	280	327 - 1,447
Steelhead Kept	67	34	5 - 135
Steelhead Released	93	49	6 - 191
Coho Salmon Kept	0	0	0
Coho Salmon Released	16	15	1 - 46
Cutthroat Trout Kept	704	301	102 - 1,306
Cutthroat Trout Released	1,245	682	73 - 2,609
Dolly Varden Kept	464	271	30 - 1,006
Dolly Varden Released	2,170	747	676 - 3,664

^a Standard error (approx.)

^b Confidence interval (approx.)

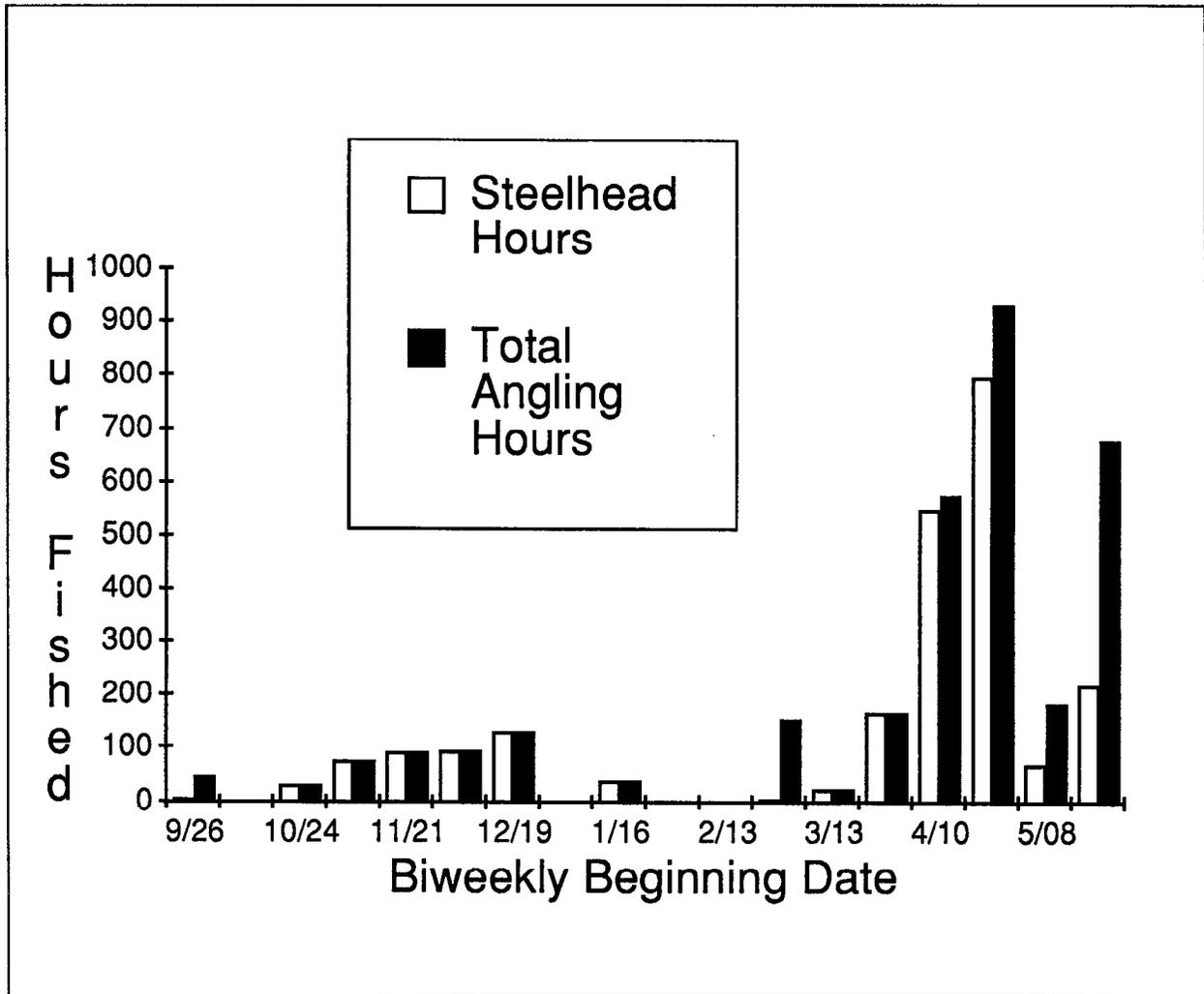


Figure 2. Estimated total biweekly sport fishing effort on the Thorne River from September 26, 1988 to June 4, 1989.

Table 2. Estimated biweekly steelhead sport fishing effort and catch, Thorne River, 1988-89.

Biweekly Period	Anglers Int (#) ^a	Estimated Effort			Estimated Steelhead Catch					
		Hours	SE ^b	CI ^c	Kept	SE ^b	CI ^c	Released	SE ^b	CI ^c
09/26-10/09	1	8	8	1 - 23	0	0	0	0	0	0
10/10-10/23	0	0	0	0	0	0	0	0	0	0
10/24-11/06	2	33	33	1 - 99	0	0	0	0	0	0
11/07-11/20	3	77	50	6 - 176	13	12	1 - 37	0	0	0
11/21-12/04	2	94	91	7 - 276	0	0	0	13	13	1 - 39
12/05-12/18	5	96	66	9 - 228	0	0	0	0	0	0
12/19-12/31	8	133	86	9 - 305	0	0	0	0	0	0
01/01-01/15	0/0	0	0	0	0	0	0	0	0	0
01/16-01/29	1/1	42	41	3 - 124	0	0	0	0	0	0
01/30-02/12	0/0	0	0	0	0	0	0	0	0	0
02/13-02/26	0/0	0	0	0	0	0	0	0	0	0
02/27-03/12	1/3	8	8	1 - 24	0	0	0	0	0	0
03/13-03/26	2/2	26	25	2 - 76	0	0	0	0	0	0
03/27-04/09	11/11	168	77	15 - 322	0	0	0	0	0	0
04/10-04/23	21/22	552	214	125 - 979	40	29	3 - 98	40	39	3 - 117
04/24-05/07	26/31	800	397	51 - 1,593	0	0	0	17	17	1 - 51
05/08-05/21	13/19	72	49	5 - 169	14	14	1 - 42	0	0	0
05/22-06/04	2/22	222	216	10 - 654	0	0	0	22	22	1 - 65

^a Random steelhead angler interviews / random angler interviews (total)

^b Standard error

^c 95% Confidence interval (approximate)

Numbers of completed-trip interviews of steelhead anglers peaked during four consecutive biweekly periods, from March 27 through May 21 (Table 2). Biweekly catch per unit of effort (CPUE) ranged from 0 to 0.19 fish per hour fished, with an overall rate of 0.07 fish per hour (Figure 3). The highest CPUE occurred in mid-May and mid-November. Most steelhead were caught in April and May (Figure 4).

Over half of the steelhead anglers interviewed used bait (55%). Other terminal gear types used, in descending order, were spinners (21%), other artificials (16%), and flies (8%).

Of 22 steelhead sampled, ages were estimated for 21 of the fish (Table 3). The scales of one sampled fish had regenerated, so age analysis was unsuccessful. A summary of steelhead age and lengths is listed in Table 3. Seven age classes were represented in our samples. Eight of the 21 steelhead sampled (38%) were age 3.3. Five (i.e., 24%) of these steelhead had returned as repeat spawners. Sampled steelhead ranged from 600 to 800 mm in length.

Steelhead ranged in weight from 1.4 to 5.4 kg. The average weight of uncleaned fish was 4.4 kg, with a standard deviation (SD) of 0.9 (Table 3). Cleaned steelhead averaged 3.3 kg (SD=1.0).

Catch and harvest estimates for other species caught in the Thorne River sport fishery during the study period were: 16 coho salmon (0 kept); 1,949 cutthroat trout (704 kept); and 2,634 Dolly Varden (464 kept) (Table 1). Anglers who targeted on cutthroat trout and Dolly Varden experienced CPUE from 0 to 1.9 fish per hour fished, with peak fishing in May (Figure 5.).

Seventy-eight percent of all anglers interviewed were PWI residents and 22% were non-residents. Non-residents comprised 29% of the steelhead anglers interviewed, and 93% of the non-residents interviewed targeted on steelhead.

Recreational User Survey

Of 112 recreational users (including anglers) interviewed during the on-site survey, 55% were residents of Thorne Bay, 17% were from other PWI communities, 16% were from other states, and the remaining 12% resided in Ketchikan, Juneau, or elsewhere in Alaska (Appendix A1). Most recreational users had visited the Thorne River five or less times since October 1988, and mostly in parties of 2 to 3. Ninety percent of those interviewed spent three hours or less on the river.

Most of the recreational users interviewed had seen less than seven other people on their visit. Their responses for an acceptable number of people to see were mixed, but were primarily from 0 to 6. Two-thirds of those interviewed felt that fishing pressure was not excessive. Support for improvement of recreation facilities on the river was mixed, with more parking the leading response by supporters. About half of the recreational users were in favor of steelhead regulation changes, and preferred changes varied. Most interviewed supported steelhead enhancement.

Approximately 10% or 29 of those who received mail-in surveys responded (Appendix A2). Most respondents were unguided, unretired residents of Thorne Bay who visited the Thorne River and other stream systems on PWI to fish and planned to

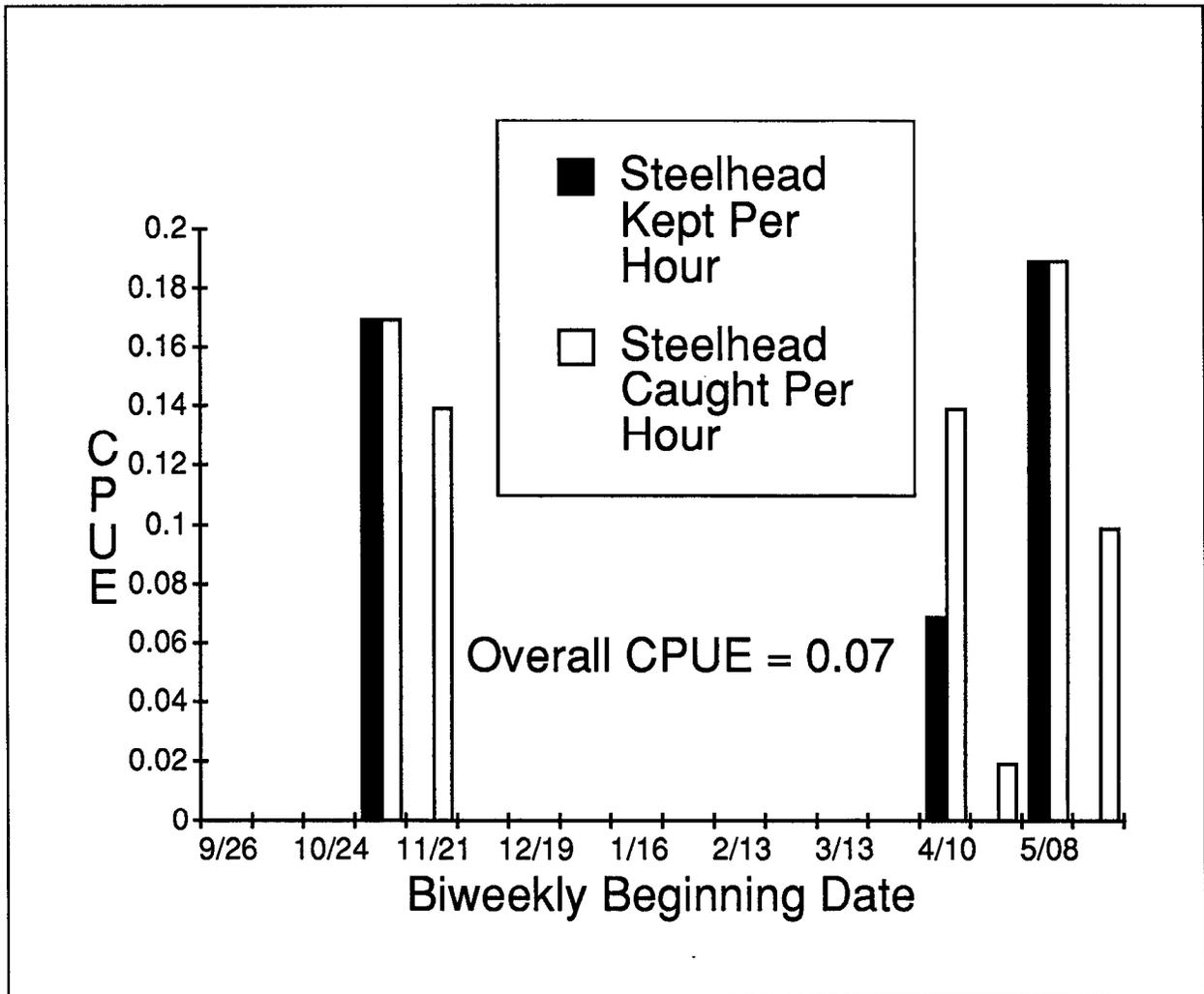


Figure 3. Estimated biweekly steelhead catch per unit of effort (CPUE) on the Thorne River between September 26, 1988 and June 4, 1989.

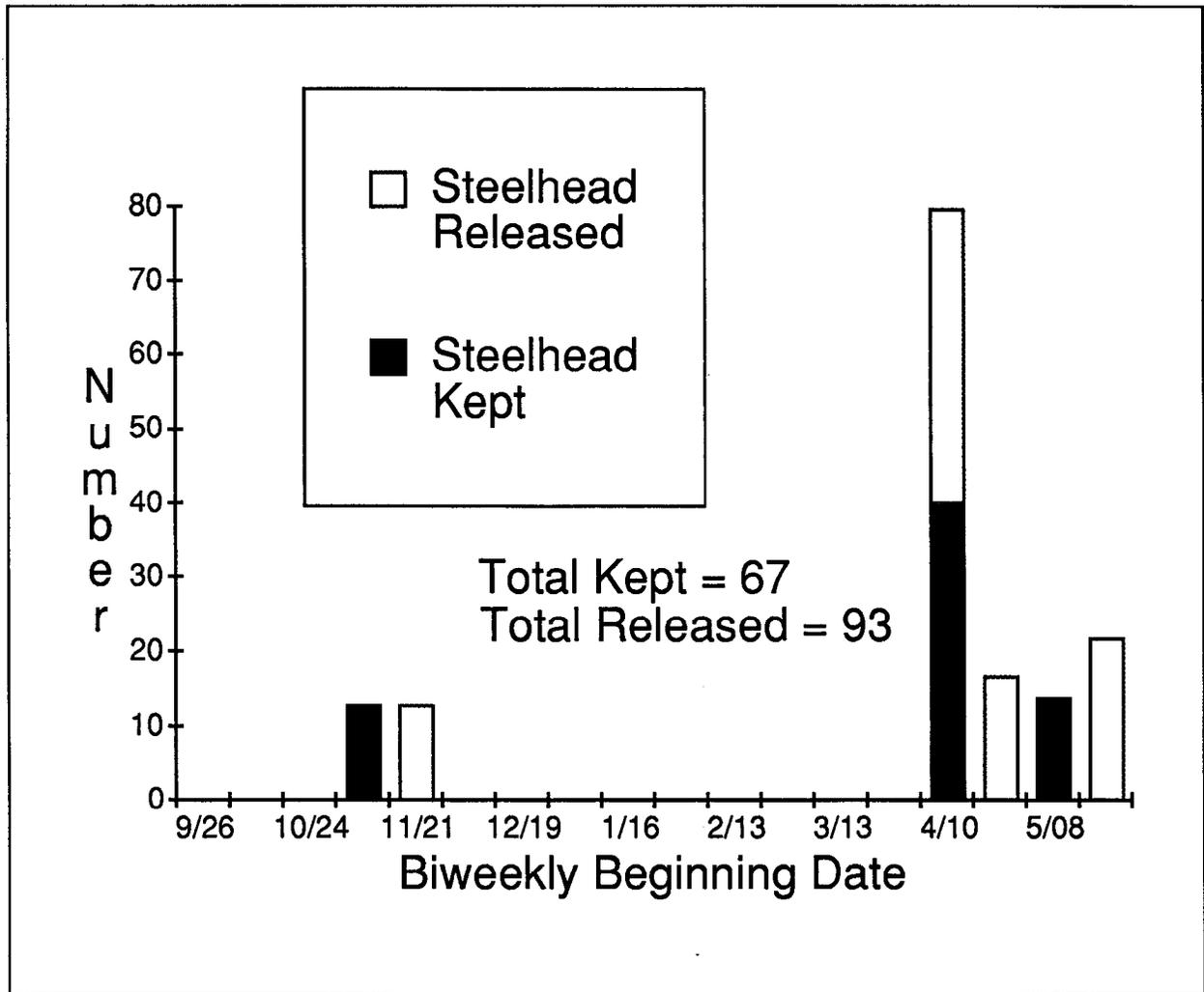


Figure 4. Estimated steelhead catch on the Thorne River from September 26, 1988 to June 4, 1989.

Table 3. Age, length, and weight of steelhead sampled from the Thorne River sport fishery, 1988-89.^a

Age ^b	Number of Fish	Weight (kg) ^c			Length (mm) ^d		
		Mean	SD ^e	Range	Mean	SD ^e	Range
2.2S1	1	5.0 (1)	0	5.0	-	-	-
2.3	3	4.6 (2)	0.5	4.1-5.0	738 (2)	18	720-755
3.2	4	-	-	-	650 (4)	55	600-740
3.2S1	3	3.2 (1)	0	2.7	695 (2)	20	675-715
3.3	8	5.0 (3)	0.4	4.5-5.4	749 (7)	39	680-800
4.1S1	1	2.7 (1)	0	2.7	640 (1)	0	640
4.2	1	-	-	-	715 (1)	0	715
TOTAL	21	4.4 (8)	0.9	2.7-5.4	710 (17)	57	600-800

^a Numbers in parentheses following estimated means are the numbers of fish measured.

^b Aging method of Narver and Withler (1977)

^c Only fish that had not been eviscerated

^d Mid-eye to fork of tail

^e Standard deviation

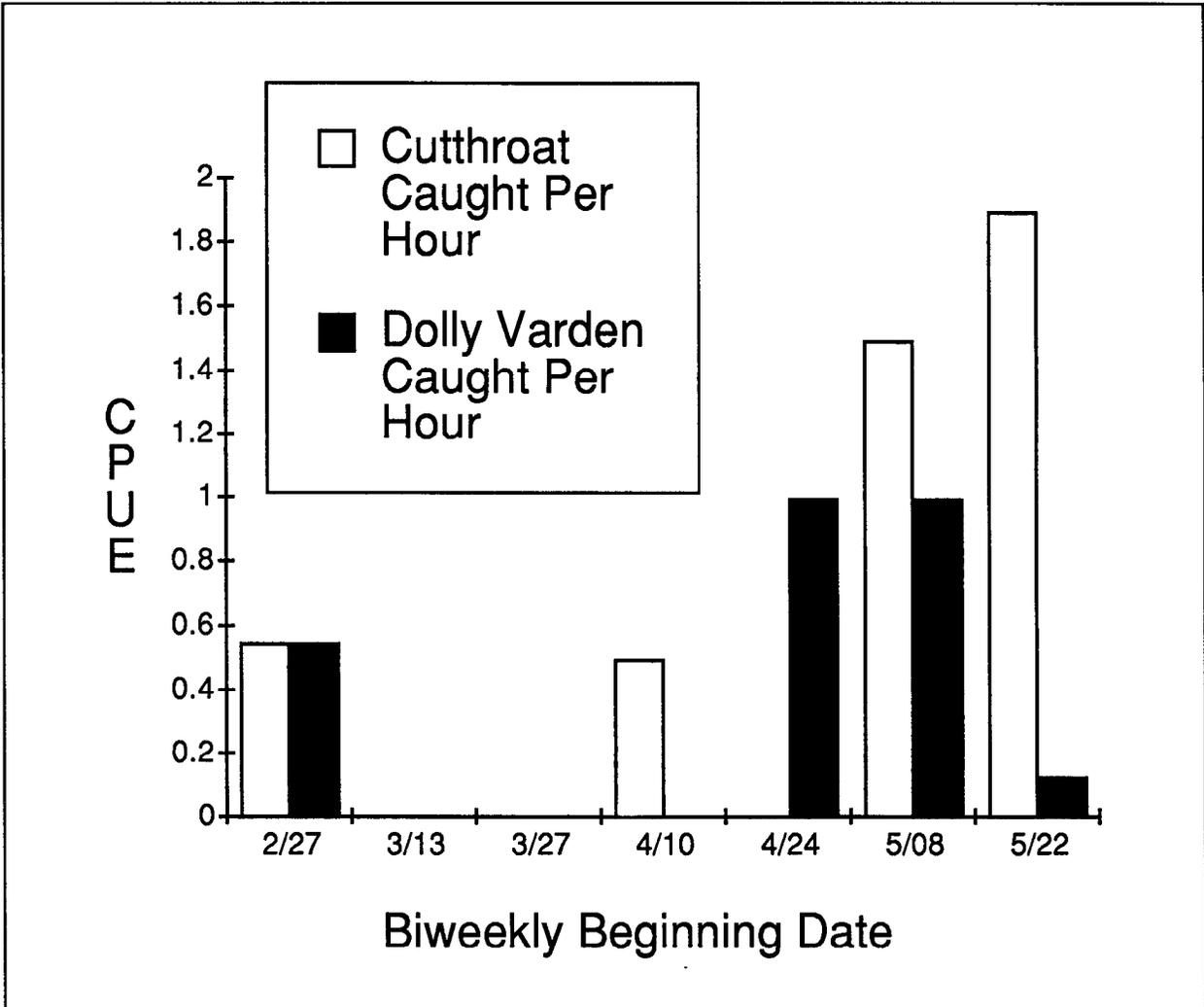


Figure 5. Estimated biweekly cutthroat trout and Dolly Varden catch per unit of effort (CPUE) on the Thorne River, 1989.

return. Almost 70% of the respondents said they visit the Thorne River more than 20 times per year. Questions which generated the most directed opinions involved boating regulations; twenty respondents favored additional boating regulations. Most felt that commercial drift boats and jet boats should not be allowed on the river. Areas considered a moderate problem or worse by more than five respondents included: too few garbage cans; litter along the banks and river; insect bites; inconsiderate people; overhanging trees and limbs; and lack of law enforcement.

DISCUSSION

The estimated steelhead harvest on the Sweetwater-Thorne River system in calendar year 1988 was 218 fish based on results of the Alaska Statewide Sport Fisheries Harvest Report (Mills 1989). The estimated Thorne River steelhead harvest of 67 fish during this study was markedly lower. The statewide survey estimate represents harvests from a larger area, but we have generally assumed that the Thorne River system is the most important steelhead producer than the Sweetwater system. A more likely explanation is that the statewide report covered a period that is not directly comparable to that covered in our study. The statewide survey estimated harvests during the calendar year 1988, while ours covered fall 1988 through spring 1989. There may have been a larger harvest of steelhead during the spring of 1988 on the Thorne River than during the spring of 1989.

The fall 1988 to spring 1989 steelhead season was not typical for several reasons. The most notable of these were extended ice coverage on the river during winter, and limited vehicle access near the river throughout much of the study period. Anglers interviewed concurred that these factors reduced the angling effort during fall and winter. Ice coverage restricted steelhead fishing between February 1 and March 27, 1989. Intermittent ice cover which occurred from late December 1988 through January 1989 may have also affected angling effort and success. Parking was frequently impacted at traditional turnouts because of road reconstruction and snow removal activities. Reasonable vehicle parking was not available for extended periods in the fall at Access Area 5 (Figure 1). During most years, the middle and upper reaches provided good fall run steelhead fishing. Angler use of those areas was minimal during fall 1988, but fall run steelhead catches were respectable on the river in November. Those areas should have been productive. Steelhead angling effort was low throughout the study period within Access Area 6, along the north fork. The north fork road was nearly impassible because of snow, ice, and absence of road grading from late December until early April.

Steelhead angling effort and catches increased markedly in mid-April. Warm weather in April following a cold winter appeared to attract anglers, many of whom had not fished the river earlier in the season.

Anglers who targeted on cutthroat trout and Dolly Varden experienced CPUE of at least one fish per hour for one or both species from April 24 through June 4. The observed sharp increase in angler success which began in April appeared to coincide with pink, and possibly chum, salmon fry emergence. Although angling effort was high during the period from April 24 to May 7, the steelhead CPUE was very low. Clear, warm weather throughout that period appeared to attract anglers. Corresponding low stream flows during that period may have affected CPUE for steelhead.

Recreationists in general were reasonably content with the existing recreational opportunities on the Thorne River. However, most interviewees favored steelhead enhancement and many were offended by litter in or adjacent to the river. Additional parking was a popular request, and it was afforded during the latter stages of the road reconstruction.

ACKNOWLEDGEMENTS

We wish to recognize Scott Walker of the Division of Sport Fish for his invaluable field presence and data collection and summary contributions. We wish to thank the U.S. Forest Service, Thorne Bay Ranger District, including Recreation & Lands staff Debbie Norton and Bruce Campbell for development of the recreation surveys and for other professional contributions to this cooperative project. The expertise of Jerry Koerner of the Division of Commercial Fisheries in age analysis of steelhead scales is gratefully acknowledged. Allen Bingham of the Division of Sport Fish, Research and Technical Services was valuable in developing the study design, equations, and computer programs for estimating angling effort and harvest. We also wish to thank Dennis Hubartt of the Division of Sport Fish for providing timely and professional computer assistance.

LITERATURE CITED

- Cochran, W.G. 1977. Sampling techniques. John Wiley and Sons, New York, New York, USA.
- Jessen, R. J. 1978. Statistical survey techniques. John Wiley and Sons, New York, New York, USA. 520 pp.
- Lehmann, E. L. 1975. Non parametrics. Statistical methods based on ranks. Holden-Day, Inc., San Francisco, California, USA. 457 pp.
- Mills, M. M. 1989. Alaska statewide sport fisheries harvest report. Alaska Department of Fish and Game, Fishery Data Series Number 122, Juneau, Alaska, USA. 142 pp.
- Narver, R. A., and F. C. Withler. 1977. Age and size of steelhead trout, *Salmo gairdneri*, in anglers catches from Vancouver Island, British Columbia streams. Fisheries Research Board of Canada. Circular 91:1-26.

APPENDIX A

Appendix A1. Survey used during on-site interviews of recreation users on the Thorne River, 1988-89.^a

THORNE RIVER RECREATIONAL SURVEY
(please circle choice)

Date _____
Time _____
Survey Site _____

1. WHAT COMMUNITY ARE YOU FROM?
A. Thorne Bay (62) B. Klawock (5) C. Craig (9)
D. Coffman Cove (1) E. Ketchikan (6)
F. Other _____ (fill in community) (29), includes:
Other on PWI (3); Other in Alaska (7); California (6);
Washington (5); Other states (8)
2. HOW MANY TIMES DURING THE STEELHEAD SEASON HAVE YOU VISITED THORNE RIVER?
(SINCE OCTOBER 1ST)
A. 0 - 5 (80) B. 5 - 20 (24) C. 20 - 40 (7)
D. 40 - 75 (1) E. Over 75 (0)
3. HOW MANY PEOPLE ARE IN YOUR PARTY?
A. 1 (14) B. 2 - 3 (78) C. 4 - 6 (20)
D. 8 - 10 (0) E. More than 10 (0)
4. HOW MUCH TIME DID YOU SPEND ON THE RIVER DURING THIS VISIT?
A. 1 Hour (50) B. 2 Hours (24) C. 3 Hours (26)
D. 4 - 6 Hours (10) E. 8 - 10 Hours (1) F. Other _____ (0)
5. HOW MANY PEOPLE DID YOU SEE DURING THIS VISIT?
A. None (54) B. 1 - 3 (35) C. 4 - 6 (21)
D. 7 - 9 (2) E. 10 - 15 (0) F. 16 - 25 (0)
G. Other _____ (0)
6. WHAT IS AN ACCEPTABLE AMOUNT OF PEOPLE TO SEE WITHOUT FEELING CROWDED?
A. 0 (21) B. 1 (12) C. 2 (25)
D. 3 - 4 (13) E. 5 - 6 (20) F. 7 - 10 (7)
G. Other (6), includes: Over 10 (3); "Don't know" (3)

-(Continued)-

7. HOW DO YOU PERCEIVE THE FISHING PRESSURE ON THE RIVER?
- A. Too much pressure (29) B. Right amount of pressure (51)
C. Can handle more users (20) D. Didn't notice (6)
Other: "Don't know" (5)
8. WOULD YOU SUPPORT IMPROVED RECREATION FACILITIES ON THE RIVER?
(Circle all that apply)
- A. Boat launch (21) B. Improve existing trails (33)
C. Increased access sites (36) D. Camping facilities (34)
E. Improved parking (41)
Other (61), includes: "No" (53)"; Don't know" (8)
9. WOULD YOU SUPPORT STEELHEAD FISHING REGULATIONS INCLUDING:
(Circle all that apply)
- A. Catch/release only (45) B. No bait (23)
C. Barbless hook (33) D. Punchcard-season limit (34)
E. No change to existing (44)
Other (14), includes: "Don't know"(9); "No" (5)
10. DO YOU SUPPORT STEELHEAD ENHANCEMENT? (Native Stock)
- A. Yes (92) B. No (11)
Other (9), includes: "Don't know" (8); "No hatchery" (1)

^a Number of responses for each possible answer are shown in parentheses.
Number of different respondents (n) = 112.

16. COULD YOUR RECREATION EXPERIENCE HAVE BEEN IMPROVED? CIRCLE ALL ITEMS THAT WOULD HAVE HELPED.
- A. Fishing Success (12) B. Increased Camping Space (3)
C. Increased Parking Space (4) D. Direct Boat Landing Into River (2)
E. More Contact With Others (0) F. Less Contact With Others (9)
G. Improve Existing Trails (4) H. Create More Trails (3)
"Leave As Is", "Stop Logging Noise Near River" (1 ea.)
17. SHOULD BOATING USE ON THE RIVER BE REGULATED?
- A. Yes (20) B. No (7)
- If Yes, how _____? No Motors (6); No Jet Sleds, No Boats During Low Flows, No Commercial Boats, Mouth of Creek Only (2 ea.); Canoe Only, Under 10 H.P., Under 50 H.P., Small Engines Only (1 ea.)
18. SHOULD COMMERCIAL DRIFT BOATS BE ALLOWED ON THE RIVER?
- A. Yes (2) B. No (26)
- If Yes, between which stretch ___? Between Goose Creek and Mouth (1); Unspecified (1)
19. SHOULD JET BOATS BE ALLOWED ON THE RIVER?
- A. Yes (5) B. No (22)
- If Yes, between which stretch___? Tidal Basin, Water Level Dependent, Under 50 H.P. (1 ea.); Unspecified (2)
20. SHOULD BOATING BE REGULATED ABOVE 8-1/2 MILE HOLE?
- A. Yes (13) B. No (12)
- If Yes, how _____? No Motors (3); Water Level Dependent, Under 50 H.P., Don't Know (1 ea.); Unspecified (7)
21. SHOULD A BOAT RAMP BE DEVELOPED ON THE RIVER?
- A. Yes (4) B. No (23)
"Canoe Access Site" (1)
22. IF A BOAT LAUNCH WERE DEVELOPED, WHERE SHOULD IT BE PLACED?
- A. Estuary to Gravelly Creek (2)
B. Gravelly Creek to Thorne River bridge (3)
C. Thorne River bridge to Goose Creek (4)
D. Goose Creek to 8-1/2 Mile Hole (5)
No Response (14); "None" (1)
23. DO YOU EXPECT TO VISIT THE THORNE RIVER AGAIN?
- A. Yes (27) B. No (0) C. Maybe (1)

-(Continued)-

24. HAVE YOU USED OTHER RIVERS ON PRINCE OF WALES ISLAND?
A. Yes (22) B. No (5)

If Yes please specify _____: Staney Creek (13); Klawock River (8); Harris River (5); Karta River, Eagle Creek (4 ea.); Red Bay Creek (3); "108" Creek, "Lots," Sarkar Rapids (2 ea.); Steelhead Creek, Hatchery Creek, Logjam Creek, Twelvemile Creek, Dog Salmon Creek, Old Franks Creek, Rio Beaver Creek, Indian Creek, Maybeso River, Salmon Bay Creek, El Cap Creek, Big Creek, Alder Creek, Tunga Inlet, Lake Ellen Creek (1 ea.)

25. ARE YOU RETIRED?
A. Yes (2) B. No (26)

Thanks for your help! Your time spent on filling out the questionnaire will help in this project. I expect to use information from you and other river users to help in understanding the types of recreation experiences that occur along the Thorne River. Any comments about your river experience or suggestions about managing the river are welcomed. Please use the next page to write your comments.

If you would like a copy of the results, please fill out your name and address below.

Name: _____

Address: _____

-(Continued)-

PART II

Information about problems you may have experienced during your river trip would be helpful to river managers. To what extent did you find each of the following to be a problem during your trip? (Circle the number that best describes how serious you found EACH to be.)

- 1 - not a problem
 2 - slight problem
 3 - moderate problem
 4 - serious problem
 5 - very serious problem

1. Too few garbage cans.....	1(15)	2(2)	3(4)	4(4)	5(4)
2. Erosion of stream banks.....	1(22)	2(3)	3(4)	4(0)	5(0)
3. Litter in river.....	1(15)	2(3)	3(6)	4(2)	5(3)
4. Litter on banks.....	1(8)	2(7)	3(8)	4(2)	5(3)
5. Obstructions in river (logs, limbs)	1(21)	2(2)	3(5)	4(0)	5(0)
6. Vandalism	1(18)	2(6)	3(3)	4(1)	5(0)
7. Water pollution.....	1(21)	2(2)	3(3)	4(1)	5(1)
8. Off-road vehicles in river area.	1(22)	2(4)	3(1)	4(0)	5(0)
9. People being inconsiderate.....	1(18)	2(3)	3(5)	4(1)	5(0)
10. Inadequate maintenance on existing trails					
.....	1(20)	2(3)	3(4)	4(0)	5(0)
11. Too few developed trails.....	1(20)	2(4)	3(2)	4(1)	5(0)
12. Too many people on the river....	1(16)	2(6)	3(4)	4(1)	5(0)
13. Insect bites.....	1(17)	2(2)	3(4)	4(2)	5(3)
14. Motorized boats on the river....	1(20)	2(2)	3(2)	4(1)	5(1)
15. Airplanes flying overhead.....	1(25)	2(0)	3(2)	4(0)	5(0)
16. Too few rules and regulations...	1(22)	2(1)	3(4)	4(0)	5(0)
17. Erosion of stream banks.....	1(27)	2(0)	3(0)	4(0)	5(0)
18. Trees and branches overhanging the river					
.....	1(23)	2(0)	3(5)	4(1)	5(0)
19. People playing loud radios.....	1(26)	2(0)	3(1)	4(0)	5(0)
20. Insufficient information about things to do and see in the area					
.....	1(21)	2(3)	3(3)	4(0)	5(1)
21. Too few commercial establishments					
.....	1(18)	2(6)	3(3)	4(1)	5(0)
22. Inadequate toilet facilities at put-in and take-out points					
.....	1(21)	2(2)	3(3)	4(1)	5(1)
23. Too few toilet facilities along river between put-in and					
take-out points.....	1(22)	2(4)	3(1)	4(0)	5(0)
24. Not enough law enforcement.....	1(19)	2(2)	3(4)	4(1)	5(1)
25. Too much law enforcement.....	1(26)	2(1)	3(0)	4(0)	5(0)
26. People fishing.....	1(22)	2(4)	3(1)	4(0)	5(0)
27. Roads within sight of a river...	1(23)	2(3)	3(1)	4(0)	5(0)
28. Too many signs along the river..	1(21)	2(1)	3(0)	4(0)	5(0)
29. People being rowdy.....	1(24)	2(2)	3(1)	4(0)	5(0)
30. Someone in your group receiving an injury					
.....	1(27)	2(0)	3(0)	4(0)	5(0)

-(Continued)-

Appendix A2. (page 6 of 6)

31. Human body waste.....	1(24)	2(0)	3(2)	4(1)	5(0)
32. Damage to or loss of personal property	1(26)	2(1)	3(0)	4(0)	5(0)
33. Navigation problems due to low water levels	1(22)	2(2)	3(0)	4(2)	5(0)
34. Navigation problems due to high water levels	1(23)	2(3)	3(0)	4(1)	5(0)
35. Nuisance wildlife.....	1(25)	2(2)	3(0)	4(0)	5(0)
36. Poor quality campsites.....	1(23)	2(2)	3(1)	4(1)	5(2)
37. Campsites occupied by others....	1(24)	2(2)	3(1)	4(0)	5(0)
38. Campsite locations not clearly identified	1(24)	2(0)	3(1)	4(2)	5(1)
39. Other things (please specify)..... :					
"Keep from logging watershed" (3); "Keep trails as is" (2); "Motorboats only in high water," "Keep as Last Frontier," "Too much logging near river," "Keep river non-commercialized," "Canoes only," "Don't make Thorne River a wilderness area," "Leave as is," "Excessive steelhead fishing pressure" (1 ea.)					

^a Number of responses for each possible answer are shown in parentheses.
Number of respondents (n) = 29.

