

FISHERY DATA SERIES NO. 90-26

CREEL AND ESCAPEMENT STATISTICS
FOR THE TOGIAK RIVER DURING 1989¹

By

Dan O. Dunaway

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

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TABLE OF CONTENTS

	<u>Page</u>
LIST OF TABLES.....	ii
LIST OF FIGURES.....	iii
LIST OF APPENDICES.....	iv
ABSTRACT.....	1
INTRODUCTION.....	2
METHODS.....	7
Creel Survey.....	7
Spawning Escapement Surveys.....	12
Size, Sex, and Age Sampling.....	12
RESULTS.....	12
Creel Statistics.....	12
Spawning Escapement.....	13
Size, Sex, and Age Compositions.....	13
DISCUSSION.....	13
ACKNOWLEDGEMENTS.....	20
LITERATURE CITED.....	20
APPENDIX A.....	22

LIST OF TABLES

<u>Table</u>	<u>Page</u>
1. Estimated effort (angler-hours) by temporal component and strata, for the sport fishery in the lower Togiak River, 1989.....	14
2. Catch per angler-hour and harvest per angler-hour by species and temporal component for the sport fishery in the lower Togiak River, 1989.....	15
3. Catch and harvest rates (fish per angler-hour) of coho salmon by guided and unguided anglers for the sport fishery in the lower Togiak River, 1989.....	16
4. Estimated catch and harvest by species for the sport fishery in the lower Togiak River, 1989.....	17
5. Escapement indices for returns of coho salmon in the Togiak River, 1980-1989.....	18
6. Mean lengths (mm) and weights (g) of coho salmon, by sex and age group, from samples collected from the Togiak River sport fishery, 1989.....	19

LIST OF FIGURES

<u>Figure</u>	<u>Page</u>
1. The Wild Trout Management Area of Bristol Bay, Alaska..	3
2. The creel survey study site on the lower Togiak River, Alaska.....	4
3. Estimated annual sport fishing effort in angler-days on the Togiak River, 1977-1988 (Mills 1989).....	5
4. Annual harvest of coho salmon in the sport fishery in the Togiak River during the years 1977-1989.....	6

LIST OF APPENDICES

<u>Appendix</u>	<u>Page</u>
A1. Angler counts for the sport fishery on the lower Togiak River, 1989.....	23
A2. Summary of daily angler-effort (angler-hours) and harvest rates (HPUE, fish per angler-hour) for coho, chum, and sockeye salmon, Dolly Varden, and rainbow trout from angler interviews on the lower Togiak River, 1989.....	24
A3. Summary of daily angler-effort (angler-hours) and catch rates (CPUE, catch per angler-hour) for coho, chum, and sockeye salmon, Dolly Varden, and rainbow trout from angler interviews on the lower Togiak River, 1989.....	25

ABSTRACT

A roving creel survey was conducted on a 38.4 kilometer (24 mile) section of the lower Togiak River from 11 August through 14 September 1989. An estimated 4,599 angler-hours of sport fishing effort were expended on the lower river. This effort resulted in a catch (fish kept plus fish released) of 2,936 coho salmon *Oncorhynchus kisutch*, 70 chum salmon *Oncorhynchus keta*, 7 sockeye salmon *Oncorhynchus nerka*, 233 Dolly Varden *Salvelinus malma*, and 42 rainbow trout *Oncorhynchus mykiss*. Of this catch, an estimated 1,976 coho salmon, 7 chum salmon, 7 sockeye salmon, 92 Dolly Varden, and 7 rainbow trout were harvested (kept). Poor weather during September and October precluded an estimate of spawning escapement of coho salmon into the Togiak drainage in 1989. Age 2.1 coho salmon were the most abundant age group in the sport harvest (98 percent).

KEY WORDS: Coho salmon, *Oncorhynchus kisutch*, chum salmon, *Oncorhynchus keta*, sockeye salmon, *Oncorhynchus nerka*, rainbow trout, *Oncorhynchus mykiss*, Dolly Varden, *Salvelinus malma*, creel survey, sport harvest, sport catch, sport effort, escapement, age composition, Togiak River, Bristol Bay.

INTRODUCTION

The Togiak River is located within the Togiak National Wildlife Refuge, approximately 104 km (65 mi) northwest of the town of Dillingham (Figures 1 and 2). The river supports significant runs of five species of Pacific salmon *Oncorhynchus* spp. including the second largest runs of chinook salmon *Oncorhynchus tshawytscha*, and coho salmon *Oncorhynchus kisutch*, in Bristol Bay. Abundant populations of Dolly Varden *Salvelinus malma* and rainbow trout *Oncorhynchus mykiss* also reside in the Togiak River. A commercial gill net fishery in nearby Togiak Bay harvests an average of 40,000 coho salmon per year (ADFG 1989a and 1989b). In addition, a subsistence fishery targeting on salmon takes approximately 1,400 coho salmon per year mainly within the river. Most sport fishing on the Togiak River is done by fly-in and float-trip anglers, but a recently established coho salmon derby has attracted local participants. In recent years, there have been occasional conflicts between recreational and subsistence fishermen.

The coho salmon run attracts much of the sport fishing effort to the Togiak River. Prior to 1984, sport effort and harvests of coho salmon were relatively constant, averaging slightly more than 1,000 angler-days and 260 fish per year (Figures 3 and 4, Mills 1987-1989). Angler effort on the Togiak River peaked in 1984 at nearly 3,500 angler-days and has since declined to a stable 1,000 angler-days per year (Figure 2, Mills 1987-1989). Disregarding the 1986 harvest estimate (which may be an anomaly), the sport harvest of coho salmon seems to be gradually increasing since 1984 (Figure 4). The 1987 sport harvest was curtailed in mid-season by emergency order in response to a very low number of returning fish.

In 1989, the daily bag and possession limits of salmon other than chinook salmon (including sockeye *O. nerka*, chum *O. keta*, pink *O. gorbuscha*, and coho salmon) were five fish in combination. Since the Togiak River was located within the Bristol Bay Wild Trout Zone, terminal tackle was restricted to unbaited, single hook artificial lures from 8 June through 31 October (ADFG 1989c).

Data for the Togiak River include estimates of escapement by the Alaska Department of Fish and Game (ADFG), Commercial Fisheries Division, (ADFG 1988), and the statewide harvest mail surveys (Mills 1987-1989). Two low intensity creel surveys were conducted jointly between ADFG and U.S. Fish and Wildlife Service (USFWS) in 1984 and 1985 and two more thorough surveys were conducted in 1986 and 1987 (Minard and Lisac 1984 and Minard 1989). Though much data already exists, two considerations prompted the 1989 Togiak coho salmon creel survey: (1) given recent low escapements, and increasing harvests, the sport fishery must be closely monitored to prevent excessive harvests, and (2) the controversies between user groups made it necessary to obtain a more complete characterization of the sport fishery. Specific objectives of the survey were to:

1. estimate the effort participating in the sport fishery in the lower Togiak River from 11 August through 14 September 1989;

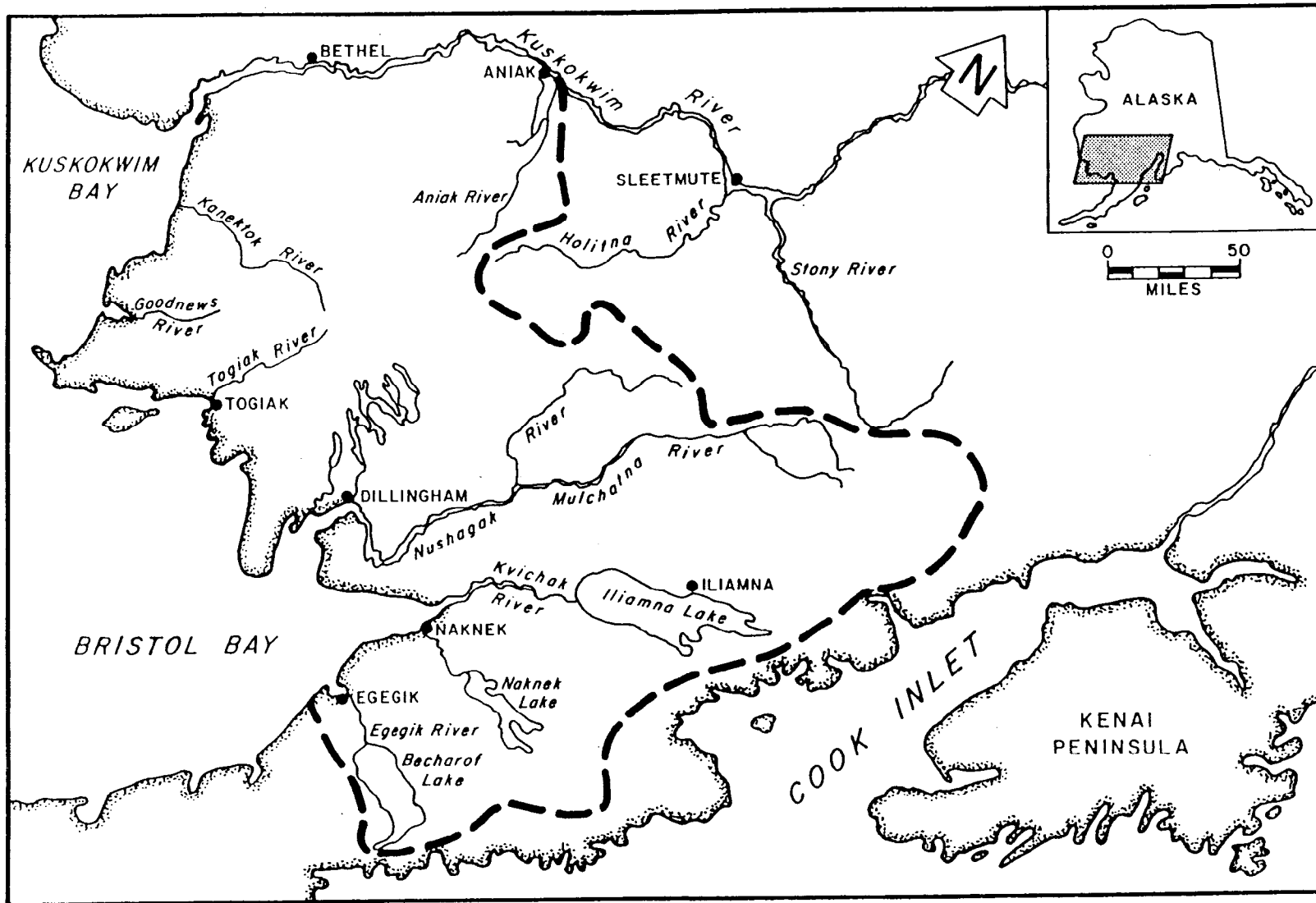


Figure 1. The Wild Trout Management Area of Bristol Bay, Alaska.

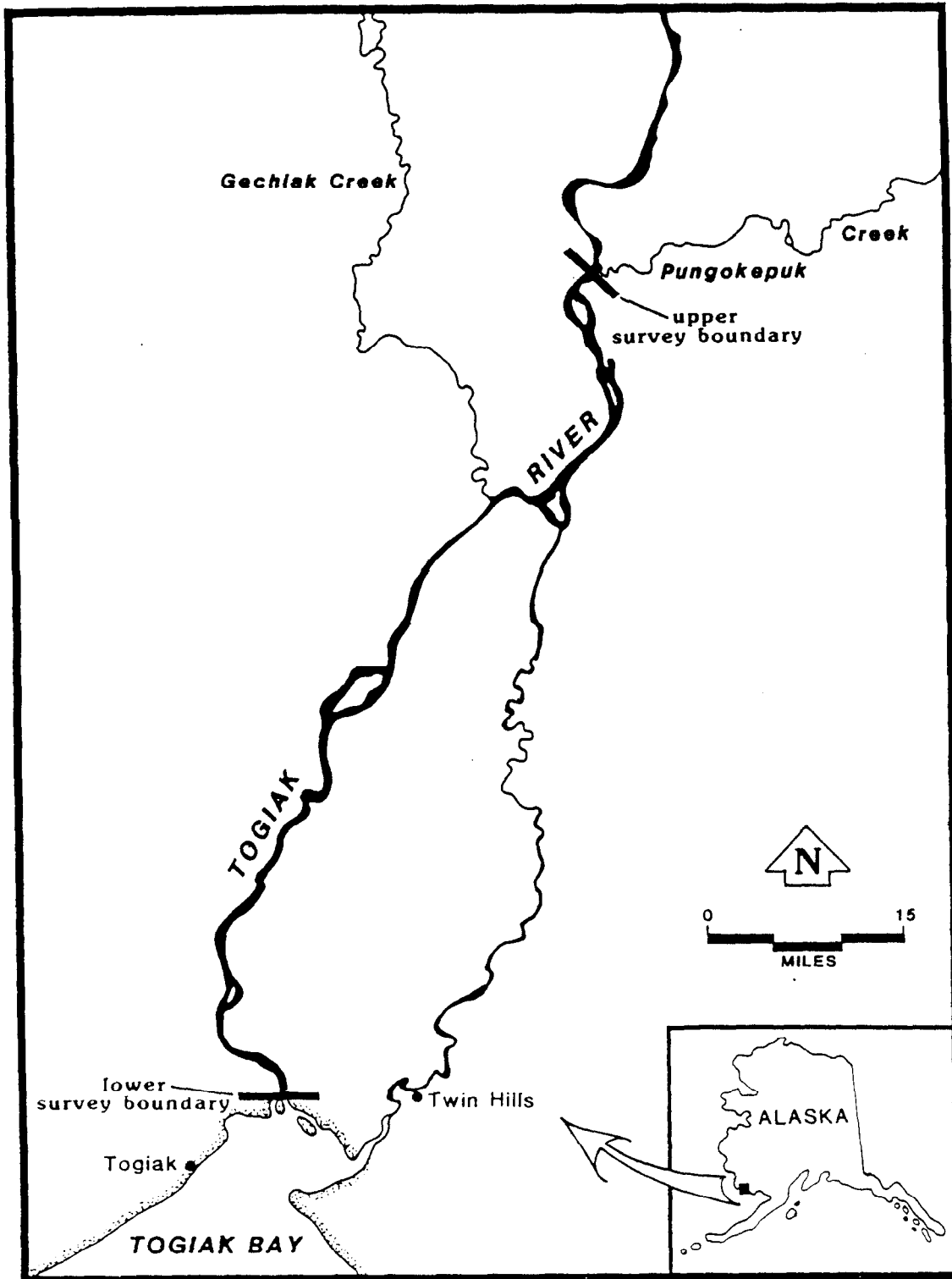


Figure 2. The creel survey study site on the lower Togiak River, Alaska.

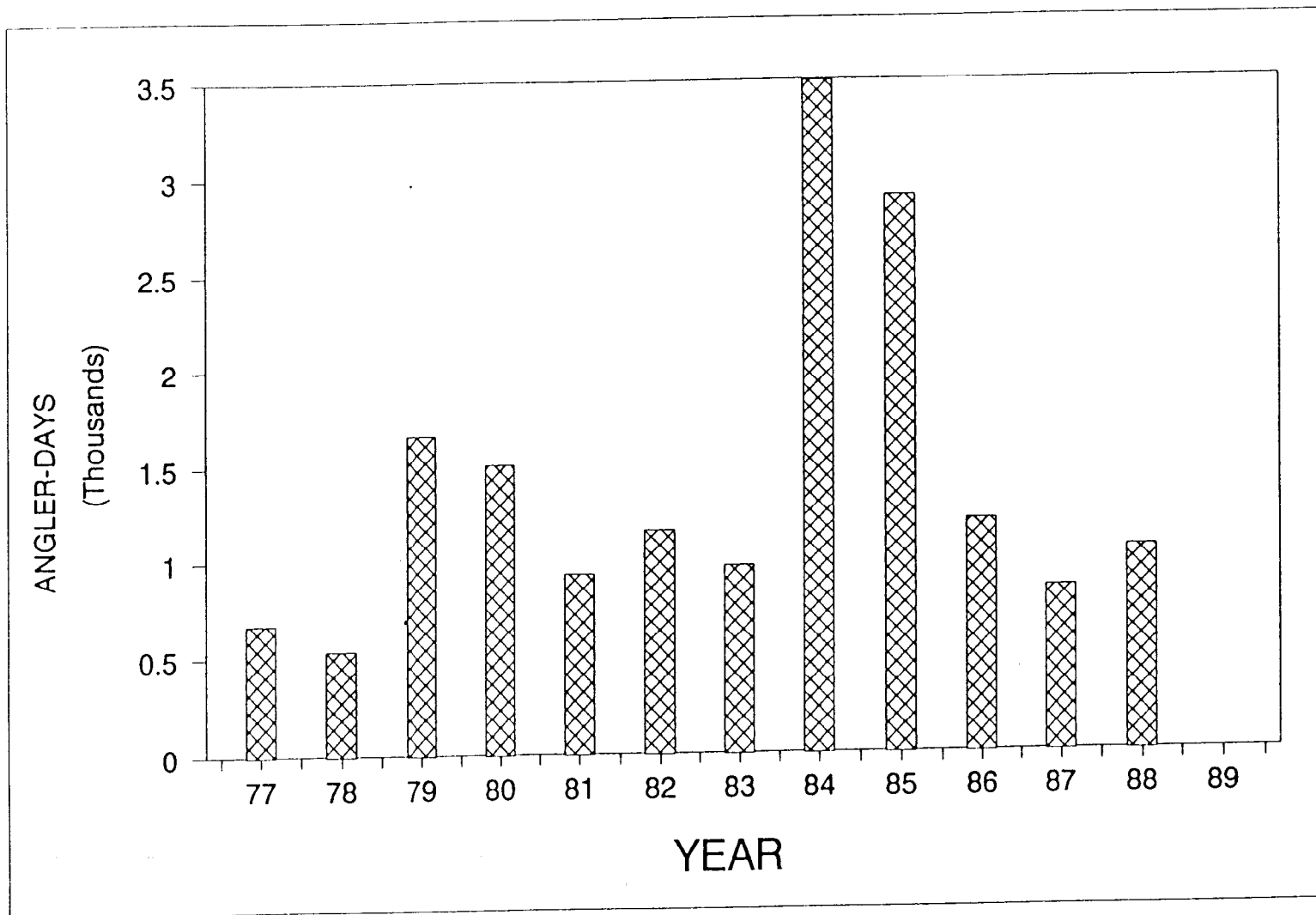


Figure 3. Estimated annual sport fishing effort in angler-days on the Togiak River, 1977-1988 (Mills 1989).

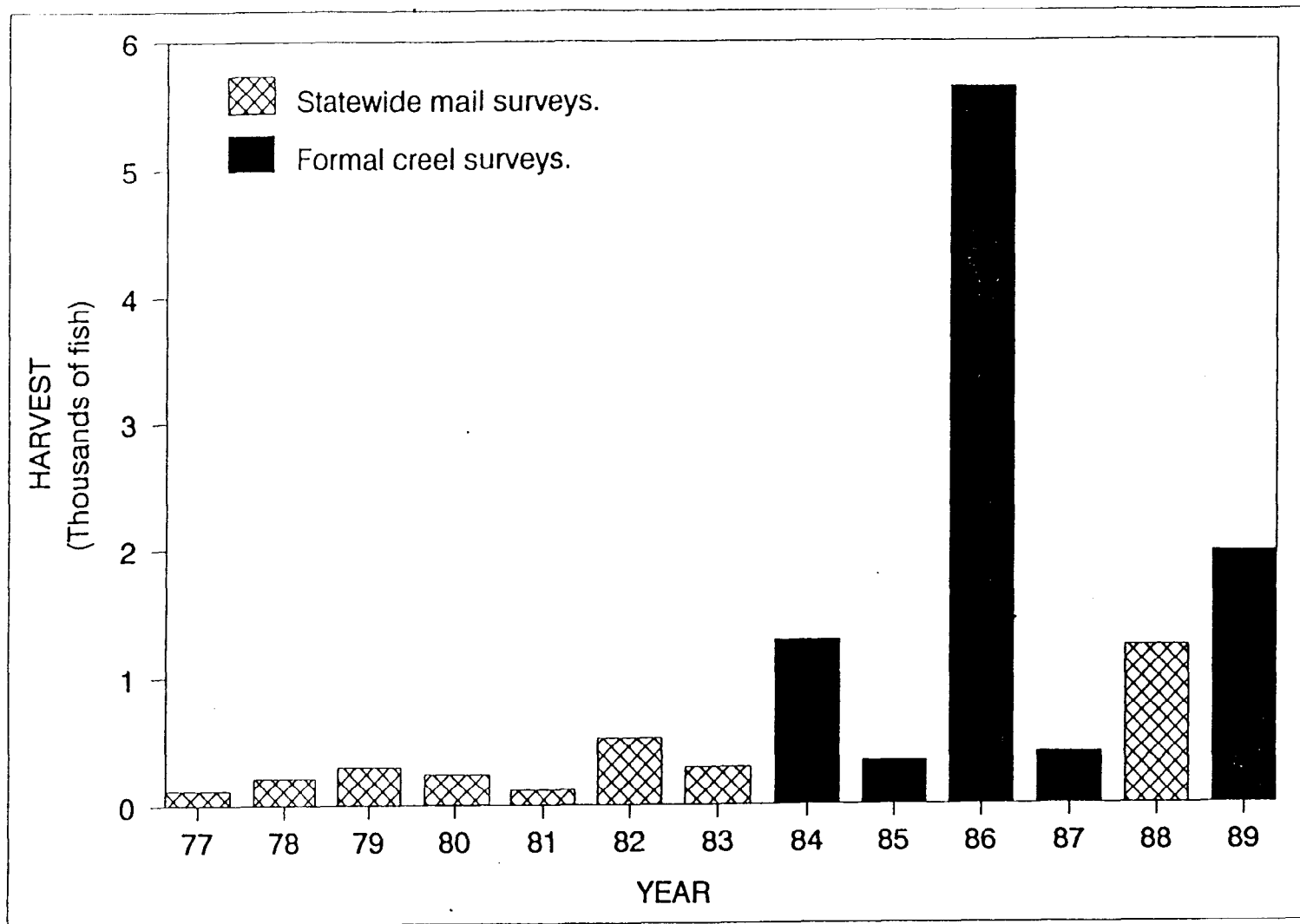


Figure 4. Annual harvest of coho salmon in the sport fishery in the Togiak River during the years 1977-1989.

2. estimate the number of coho, sockeye, and chum salmon and Dolly Varden and rainbow trout caught (fish landed) and harvested (fish retained) in the sport fishery on the lower Togiak River from 11 August through 14 September 1989;
3. estimate the number of coho salmon in the spawning escapement to the Togiak River drainage during 1989; and,
4. estimate the size and age compositions of coho salmon harvested in the sport fishery in the Togiak River during 1989.

METHODS

Creel Survey

The survey was conducted over the lower 38 km of the Togiak River from its mouth at Togiak Bay, upstream to the mouth of the Pungokebuk River (Figure 2). Previous surveys have found that 80% of the fishing effort for coho salmon is concentrated in this section of the river. The 11 August to 14 September study period was established to cover the bulk of the coho sport fishery. All analysis treated the study period as a single temporal component. The fishing day was considered to be 12 hours long and was divided into three time strata: Period A (0800-1159 hours), Period B (1200-1559 hours), and Period C (1600-2000 hours).

A roving creel survey (Neuhold and Lu 1957) using a stratified, multistage random sampling design was used to count anglers, conduct angler interviews, and sample the sport harvest. Count and count/interview sessions were scheduled randomly and strata were sampled with relatively equal intensity. Counts of anglers were used to estimate fishing effort in units of angler-hours, while angler interviews provided estimates of catch and harvest rates (fish per angler-hour). Catch and harvest rate estimates were derived from interviews with anglers who had not completed fishing for the day (referred to as incomplete trips). Data from incomplete trips may bias the estimates of catch and harvest rates, but the daily fly-in nature of the fishery made completed trip interviews nearly impossible to obtain.

One count/interview session was scheduled for each day. Within each designated count/interview session, one angler count was conducted and the remaining time was spent interviewing anglers and obtaining age and size information from the sport harvest. Each count/interview session started at the upstream boundary of the survey area. A coin was tossed to determine if an angler count or angler interviews were to be conducted first. For counting anglers, a boat was driven through the survey area at a near constant rate of speed and all anglers actively fishing were counted. The count was completed within 90 minutes and was considered an instantaneous count (Neuhold and Lu 1957)¹.

¹ The initial survey plan divided the river into two 19.2 km (12 mi) sections. Each section was to have separate count/interview sessions. The angler counts in each section were to be completed in less than 60 minutes to meet the assumptions of Neuhold and Lu (1957). Upon initiating the

It was not possible to differentiate between guided and unguided anglers during the count.

All interviews were of individual anglers and were not party interviews. The survey clerk attempted to obtain a random sample of 5% to 10% of the available anglers so that the number of anglers interviewed was kept proportional to effort during the sample unit (Neuhold and Lu 1957, DiConstanzo 1956). For each angler contacted, the following information was recorded: the number of hours fished, the number of fish in the angler's possession, by species, the number of fish released by the angler, by species, and whether the angler was guided or not guided. Additionally, data on gear type (fly or spin), outboard motor size, and angler demographics were obtained and recorded.

Completed-trip angler information was collected from voluntary report forms given to interviewed anglers. The voluntary report form requested the time fishing started and ended, the catch by species, and the number of fish retained, by species. Anglers were asked to mail the postage-paid forms to the Alaska Department of Fish and Game, Dillingham office.

Effort was estimated for the temporal component of the fishery using a stratified random sampling approach by period. Within the temporal component, effort (E_j) was estimated as follows:

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

where:

- i = subscript denoting the time of day level of stratification (periods);
- p = total number of periods in temporal component j (e.g., $p=3$ for periods A, B, and C for the temporal component in the survey);
- H_i = the total number of hours of possible fishing time in period i during temporal component j ; and

field work, the original plan was found to be impractical due to time, personnel, and geographical constraints.

The expense and difficulty of getting to the Togiak River caused most anglers to remain on the river for a minimum of several hours. Therefore, it was decided that the two counts could be replaced by a single 90 minute angler count for the entire study area without significantly departing from the assumptions of an instantaneous count.

$$\bar{x}_i \quad - \quad \text{the mean angler count for period } i \text{ during temporal component } j;$$

$$= \frac{1}{m_i} \sum_{k=1}^{m_i} x_{ik}; \quad [2]$$

where:

- m_i - the number of counts of anglers conducted during period i and temporal component j .
- k - subscript denoting the count on a day.

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

$$\hat{V}(E_j) \quad - \quad \sum_{i=1}^p H_i^2 (s_i/m_i); \quad [3]$$

where:

$$s_i^2 \quad - \quad \left[\frac{\sum_{k=1}^{m_i} (x_{ik} - \bar{x}_i)^2}{m_i - 1} \right]; \text{ and} \quad [4]$$

- x_{ik} - a count of anglers made during day k , period i , and temporal component j .

The total number of angler-hours of effort for the season was estimated by summing the estimates of effort for each of the temporal components. 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 temporal component estimate.

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

$$\overline{CPUE}_j \quad - \quad \frac{\sum_{h=1}^{d_j} \sum_{o=1}^{m_h} c_{jho}}{\sum_{h=1}^{d_j} \sum_{o=1}^{m_h} e_{jho}}; \quad [5]$$

where:

- d_j - the number of days sampled for angler interviews during temporal component j ;
- m_h - the number of anglers interviewed during sample h and temporal component j ;
- c_{jho} - the catch by angler o interviewed during sample h and temporal component j ; and

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

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

$$\hat{V}(\overline{CPUE}_j) = (\overline{C}_j/\overline{E}_j)^2 [s_c^2/\overline{C}_j^2 + s_e^2/\overline{E}_j^2 - (2r_j s_c s_e/\overline{C}_j \overline{E}_j)]; \quad [6]$$

where:

$$\overline{C}_j = \left(\sum_{h=1}^{d_j} \sum_{o=1}^{m_h} c_{jho} \right) / \sum_{h=1}^{d_j} m_h; \quad [7]$$

$$\overline{E}_j = \left(\sum_{h=1}^{d_j} \sum_{o=1}^{m_h} e_{jho} \right) / \sum_{h=1}^{d_j} m_h; \quad [8]$$

$$s_c^2 = (1/d_j) \left[\sum_{h=1}^{d_j} (\overline{c}_{jh} - \overline{C}_j)^2 / (d_j - 1) + \sum_{h=1}^{d_j} (1/m_h) \sum_{o=1}^{m_h} (c_{jho} - \overline{c}_{jh})^2 / (m_h - 1) \right]; \quad [9]$$

$$\overline{c}_{jh} = \sum_{o=1}^{m_j} c_{jho} / m_h; \quad [10]$$

$$s_e^2 = (1/d_j) \left[\sum_{h=1}^{d_j} (\overline{e}_{jh} - \overline{E}_j)^2 / (d_j - 1) + \sum_{h=1}^{d_j} (1/m_h) \sum_{o=1}^{m_h} (e_{jho} - \overline{e}_{jh})^2 / (m_h - 1) \right] \quad [11]$$

$$\overline{e}_{jh} = \sum_{o=1}^{m_j} e_{jho} / m_h; \text{ and} \quad [12]$$

r_j - correlation coefficient

$$r_j = \frac{\sum_{h=1}^{d_j} \sum_{o=1}^{m_h} (c_{jho} - \overline{C}_j)(e_{jho} - \overline{E}_j)}{\left[\sum_{h=1}^{d_j} \sum_{o=1}^{m_h} (c_{jho} - \overline{C}_j)^2 \right] \left[\sum_{h=1}^{d_j} \sum_{o=1}^{m_h} (e_{jho} - \overline{E}_j)^2 \right]}. \quad [13]$$

The catch of each species during temporal component j was estimated by:

$$\hat{C}_j = \overline{E}_j (\overline{CPUE}_j). \quad [14]$$

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

$$V(\hat{C}_j) = \hat{E}_j^2 V(\hat{CPUE}_j) + \hat{CPUE}_j^2 V(\hat{E}_j) - V(\hat{E}_j) V(\hat{CPUE}_j) \quad [15]$$

Harvest rates and total harvest of each species was estimated for each temporal component by substituting appropriate harvests for catches in equations 5-15.

Total catch and harvest of a particular species for the season within each fishery was estimated by summing the estimates of catch and harvest for each of the temporal components. Because these are independent estimates, the variances of the total catch and harvest estimates are the sums of the individual variances for each temporal component.

Approximate 95% confidence interval (CI) limits were obtained for angler effort, catch, and harvest estimates as follows, by assuming normality (Cochran 1977):

$$95\% \text{ CI} = \hat{Y} \pm 1.96 (\hat{V}[Y])^{0.5} \quad [16]$$

where:

- \hat{Y} - estimate of the total parameter of interest (e.g., E, C, or H for effort, catch, or harvest), note that individual stratum estimates (as obtained by equations 1 and 14, above) can be used or totals across strata; and
- $\hat{V}[Y]$ - estimate of the variance of the total parameter of interest (as obtained by equations 3 and 15, above).

The lower limit of the CI obtained by the above procedure was recorded as zero (0) if the result was a negative number.

The assumptions necessary for these analyses are:

1. incompleting-trip angler CPUE though likely to be biased, provide a reasonable estimate of completed-trip angler CPUE;
2. interviewed anglers were representative of the total angler population and anglers were interviewed in proportion to their abundance on the day of the interview;
3. no significant fishing effort occurred between 2000 hours and 0800 hours;
4. catch and effort by individual anglers are normally distributed random variables;

5. catch rate and duration of fishing trip are independent (DiConstanzo 1956); and
6. catch and harvest rates do not vary between periods within days.

Spawning Escapement Surveys

The numbers of the spawning coho salmon in the Togiak River drainage are estimated from aerial counts conducted from fixed wing aircraft during the month of October.

Size, Sex, and Age Sampling

All coho salmon retained by interviewed anglers were measured for mid-eye to fork-of-tail length (to the nearest millimeter), weighed (to the nearest 10 grams), and sexed based on external characteristics. Three scales were removed from the preferred area² of each fish and mounted on an adhesive coated card. Cards were thermohydraulically pressed against acetate cards and the resulting scale impressions were displayed on a microfiche projector for age determination³.

The proportional age composition of the sport harvest was estimated when sample sizes were sufficient. Letting p_h equal the estimated proportion of age group h , the variance of p_h was estimated using (Scheaffer et al. 1979):

$$V(\hat{p}_h) = \frac{\hat{p}_h(1-\hat{p}_h)}{(n_T-1)} \quad [17]$$

where n_T is the number of scales read. Mean length and weight at age by sex with the associated standard errors were estimated using standard statistical procedures (Sokal and Rohlf 1981, Boxes 4.2 and 7.1, pages 56 and 139).

RESULTS

Creel Statistics

The creel survey of the sport fishery on the lower Togiak River was conducted from 11 August to 14 September 1989. Daily counts of anglers are presented, by day, in Appendix A1. Daily harvest and catch rates for all interviewed anglers for coho, chum, and sockeye salmon, Dolly Varden, and rainbow trout are presented in Appendices A2 and A3.

² The left side of the fish approximately two rows above the lateral line and on the diagonal row downward from the posterior insertion of the dorsal fin (Clutter and Whitesel 1956).

³ Numeral preceding the decimal is the number of freshwater annuli, whereas the numeral following the decimal is the number of marine annuli (European method). Total age from brood year is the sum of the two numerals plus one.

Total sport effort on the lower section of the Togiak River was estimated to be 4,599 angler-hours during the survey period (Table 1). The catch rate for coho salmon (all anglers) was 0.64 fish per hour and the harvest rate averaged 0.43 fish per hour (Table 2).

Guided anglers comprised over 75% of the anglers on the Togiak River during the study period (Table 3). Guided and unguided anglers caught coho salmon at similar rates but unguided anglers appeared to harvest the fish at a slightly lower rate.

A total of 2,936 coho salmon were caught in the sport fishery during the survey period of which 1,976 (67%) were harvested (Table 4). Of the 70 chum salmon caught, seven (10%) were kept and all seven sockeye salmon captured were retained. Thirty-nine percent of the 233 Dolly Varden caught were kept while the harvest of rainbow trout was 17% of the catch. Estimated harvest and catch figures for all species are considered to be minimum estimates due to the limited extent (time and area) of this creel survey. The survey was conducted well after the chinook salmon run so no data were collected for this important species.

It is unknown if estimates of CPUE generated from incompletd-trip interviews were biased since very few completed-trip interviews were collected. It is reasonable to assume that interviewed anglers were representative of all anglers since interviews were obtained from approximately one-half of the anglers. Since most of the effort is guided and is conducted in a fairly regimented manner, it is not likely that significant fishing effort occurred during the unsurveyed portions of the day. Finally, it is not likely that catch and harvest rates vary between periods within a day. Previous work on the Togiak Rivers did not suggest that these parameters vary significantly or predictably over the day.

Spawning Escapement

Extremely rainy weather during October 1989 made the Togiak River too high and turbid to count salmon. Therefore, no spawning escapement estimate is available for Togiak River coho salmon in 1989. Escapement data for the previous 9 years appear in Table 5.

Size, Sex, and Age Compositions

Males comprised 60% of the coho salmon (n = 149) harvested in the sport fishery (Table 6). Age 2.1 fish were the most abundant age group in the harvest (98%). Mean length and weight of harvested coho salmon was 606 mm (SE = 3.28, n = 150) and 4.3 kg (SE = 8.08, n = 145). The largest coho salmon sampled during the survey was 599 mm (23.6 inches) long and weighed 8.6 kg (18.9 pounds).

DISCUSSION

The estimated sport harvest of 1,976 coho salmon from the lower Togiak River in 1989 is somewhat greater than the 1988 estimate of 1,238 fish, and suggests

Table 1. Estimated effort (angler-hours) by temporal component and strata, for the sport fishery in the lower Togiak River, 1989.

Temporal Component ^a	Strata ^b	Counts			Effort			
		Number	Mean	SE	Ang-Hrs	SE	95% CI ^c	Rel Pre ^d
1	A	10	9.4	3.8	1,316	534.2	269 - 2,363	79.6%
	B	12	12.9	2.9	1,808	406.1	1,012 - 2,604	44.0%
	C	13	10.5	2.2	1,475	304.3	878 - 2,072	40.4%
Season					4,599	736.9	3,155 - 6,043	31.4%

^a Component 1: 8/11-9/14.

^b Strata A: 0800-1159, Strata B: 1200-1559, Strata C: 1600-2000.

^c Confidence interval.

^d Relative precision = $(1.96 * SE / \text{point est.})$ where $\alpha = 0.05$.

Table 2. Catch per angler-hour and harvest per angler-hour by species and temporal component for the sport fishery in the lower Togiak River, 1989.

Species	Sampling Component*	Catch Rate		Harvest Rate	
		Fish/Hr	SE	Fish/Hr	SE
Coho Salmon	1	0.6383	0.2308	0.4296	0.165
Chum Salmon	1	0.0153	0.0446	0.0015	0.0292
Sockeye Salmon	1	0.0015	0.0065	0.0015	0.0065
Dolly Varden	1	0.0506	0.0811	0.0199	0.0549
Rainbow Trout	1	0.0092	0.0351	0.0015	0.0065

* Component 1: 8/11-9/14.

Table 3. Catch and harvest rates (fish per angler-hour) of coho salmon by guided and unguided anglers for the sport fishery in the lower Togiak River, 1989.

Temporal Component ^a	No. Interviews		Catch Rate		Harvest Rate	
	Guided	Unguided	Guided	Unguided	Guided	Unguided
1	159	48	0.6307	0.5828	0.4396	0.2952
Season	159	48	0.6307	0.5828	0.4396	0.2952

^a Component 1: 8/11-9/14.

Table 4. Estimated catch and harvest by species for the sport fishery in the lower Togiak River, 1989.

Species	Temporal Component ^a	Catch				Harvest			
		Number	SE	95% CI ^b	Rel Pre ^c	Number	SE	95% CI ^b	Rel Pre ^c
Coho	1	2,936	1,148	685 - 5,187	76.7%	1,976	813	382 - 3,570	80.6%
Chum	1	70	203	0 - 468	568.1%	7	133	0 - 267	3714.9%
Sockeye	1	7	30	0 - 65	828.4%	7	30	0 - 65	828.4%
Dolly Varden	1	233	370	0 - 958	311.1%	92	250	0 - 582	532.1%
Rainbow Trout	1	42	159	0 - 354	743.3%	7	875	0 - 65	828.4%

^a Component 1 8/11-9/14.

^b Confidence interval.

^c Relative precision = $(1.96 * SE / \text{point est.})$ where $\alpha = 0.05$.

Table 5. Escapement indices^a for returns of coho salmon in the Togiak River, 1980-1989.

Year	Escapement Index
1980	21,710
1981	14,500
1982	23,300
1983	NE ^b
1984	20,280
1985	11,070
1986	3,520
1987	4,210
1988	7,660
<u>Average</u>	<u>13,281^c</u>
<u>1989</u>	<u>NE^b</u>

^a Estimates are based on unexpanded aerial surveys.

^b No estimates due to poor weather in 1983 and 1989.

^c Standard Error = 7,892

Table 6. Mean lengths (mm) and weights (g) of coho salmon, by sex and age group, from samples collected from the Togiak River sport fishery, 1989.

	Age Group						TOTAL
	UNKNOWN	1.1	1.2	2.1	2.2	3.1	
<u>FEMALES</u>							
Percent		8.1		30.1		0.7	39.0
Mean Length	625	582		601		598	598
SE ^a	16.46	13.37		4.95			4.65
Sample Size	3	11		41		1	56
Mean Weight	420	376		395		380	392
SE ^b	37.86	31.11		10.92			10.19
Sample Size	3	11		39		1	54
<u>MALES</u>							
Percent		12.5	1.5	41.2	2.9	2.2	60.3
Mean Length	601	602	601	617	594	597	610
SE ^a	16.58	13.25	35.50	4.57	34.21	22.66	4.44
Sample Size	11	17	2	56	4	3	93
Mean Weight	428	429	430	466	443	423	452
SE ^b	37.05	26.29	20.00	13.51	91.35	37.56	10.87
Sample Size	11	16	2	55	3	3	90
<u>BOTH SEXES</u>							
Percent		20.6	1.5	72.1	2.9	2.9	100.0
Mean Length	606	594	601	610	594	597	606
SE ^a	13.50	9.63	35.50	3.43	34.21	16.02	3.28
Sample Size	14	28	2	98	4	4	150
Mean Weight	426	408	430	436	443	413	429
SE ^b	29.62	20.35	20.00	9.67	91.35	28.69	8.08
Sample Size	14	27	2	95	3	4	145

^a Standard error of length.

^b Standard error of weight.

an increasing trend (Figure 4, Mills 1989). While there has been some growth of the recreational fishery for coho salmon, it appears to be within acceptable biological limits. No changes in seasons, bag, or possession limits are recommended at this time.

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APPENDIX A

Appendix A1. Angler counts for the sport fishery on the lower Togiak River, 1989.

Date	Strata ^a			Date	Strata ^a		
	A	B	C		A	B	C
11-Aug			2	03-Sep	4		
12-Aug	0			04-Sep			22
13-Aug		21		05-Sep		34	
14-Aug			25	06-Sep			7
15-Aug	31			07-Sep		8	
16-Aug			8	08-Sep	0		
17-Aug		6		09-Sep		0	
18-Aug			12	10-Sep			1
19-Aug		14		11-Sep			4
20-Aug	24			12-Sep	0		
21-Aug		25		13-Sep	4		
22-Aug		8		14-Sep			2
23-Aug			7				
24-Aug			17				
25-Aug		0					
26-Aug		11					
27-Aug	0						
28-Aug	7						
29-Aug			14				
30-Aug	24						
31-Aug			16				
01-Sep		11					
02-Sep		17					

^a Strata A: 0800-1159 hours, Strata B: 1200-1559 hours, Strata C: 1600-2000 hours.

Appendix A2. Summary of daily angler-effort (angler-hours) and harvest rates (HPUE, fish per angler-hour) for coho, chum, and sockeye salmon, Dolly Varden, and rainbow trout from angler interviews on the lower Togiak River, 1989.

Date	Sample Size	Effort		Coho			Chum			Sockeye			Dolly Varden			Rainbow Trout		
		Mean	SE	Mean	SE	CPUE	Mean	SE	CPUE	Mean	SE	CPUE	Mean	SE	CPUE	Mean	SE	CPUE
8/11	2	0.3	0.00	0.50	0.500	2.000	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000
8/12	2	7.0	0.00	2.00	0.000	0.286	0.50	0.500	0.071	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000
8/13	4	3.5	1.09	2.00	0.408	0.575	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000
8/14	7	5.6	0.77	3.00	0.951	0.535	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000
8/15	7	0.6	0.03	0.14	0.143	0.227	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000
8/16	3	2.4	2.28	0.33	0.333	0.136	0.00	0.000	0.000	0.00	0.000	0.000	0.67	0.667	0.273	0.00	0.000	0.000
8/17	16	3.2	0.46	0.31	0.151	0.096	0.00	0.000	0.000	0.00	0.000	0.000	0.50	0.354	0.154	0.00	0.000	0.000
8/18	9	3.2	0.85	0.33	0.236	0.105	0.00	0.000	0.000	0.11	0.111	0.035	0.00	0.000	0.000	0.11	0.111	0.035
8/19	9	1.0	0.12	1.00	0.333	0.981	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000
8/20	12	1.3	0.16	0.92	0.260	0.702	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000
8/21	12	3.9	0.16	2.33	0.376	0.596	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000
8/22	10	3.2	0.37	0.80	0.327	0.250	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000
8/23	9	6.1	0.63	1.89	0.512	0.311	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000
8/24	12	4.7	0.66	1.75	0.509	0.372	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000
8/26	5	1.4	0.39	0.20	0.200	0.141	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000
8/27	2	1.1	0.00	1.50	0.500	1.389	0.00	0.000	0.000	0.00	0.000	0.000	0.50	0.500	0.463	0.00	0.000	0.000
8/28	4	1.0	0.02	1.75	1.031	1.716	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000
8/29	2	1.8	0.00	1.00	0.000	0.571	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000
8/30	6	0.7	0.14	0.33	0.211	0.461	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000
8/31	4	2.4	0.13	1.00	0.577	0.421	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000
9/01	7	1.9	0.37	0.86	0.143	0.447	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000
9/02	11	2.9	0.38	2.27	0.428	0.787	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000
9/03	8	1.6	0.42	0.38	0.263	0.234	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000
9/04	9	5.5	1.01	0.78	0.547	0.142	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000
9/05	19	4.9	0.37	2.63	0.627	0.539	0.00	0.000	0.000	0.00	0.000	0.000	0.05	0.053	0.011	0.00	0.000	0.000
9/06	2	0.7	0.33	1.50	1.500	2.256	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000
9/08	4	4.8	0.00	3.75	0.250	0.789	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000
9/11	3	2.1	1.03	1.33	0.667	0.623	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000
9/12	4	1.5	0.00	0.50	0.289	0.333	0.00	0.000	0.000	0.00	0.000	0.000	0.25	0.250	0.167	0.00	0.000	0.000
9/13	3	1.7	0.00	0.67	0.667	0.399	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000
9/14	2	4.3	0.00	3.00	0.000	0.706	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000

Appendix A3. Summary of daily angler-effort (angler-hours) and catch rates (CPUE, fish per angler-hour) for coho, chum, and sockeye salmon, Dolly Varden, and rainbow trout from angler interviews on the lower Togiak River, 1989.

Date	Sample Size	Effort		Coho			Chum			Sockeye			Dolly Varden			Rainbow Trout		
		Mean	SE	Mean	SE	CPUE	Mean	SE	CPUE	Mean	SE	CPUE	Mean	SE	CPUE	Mean	SE	CPUE
8/11	2	0.3	0.00	0.50	0.500	2.000	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000
8/12	2	7.0	0.00	10.00	0.000	1.429	0.50	0.500	0.071	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000
8/13	4	3.5	1.09	2.00	0.408	0.575	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000
8/14	7	5.6	0.77	3.71	0.714	0.662	1.14	0.553	0.204	0.00	0.000	0.000	0.14	0.143	0.025	0.29	0.286	0.051
8/15	7	0.6	0.03	0.29	0.184	0.455	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000
8/16	3	2.4	2.28	0.33	0.333	0.136	0.00	0.000	0.000	0.00	0.000	0.000	0.67	0.667	0.273	0.00	0.000	0.000
8/17	16	3.2	0.46	1.00	0.376	0.308	0.00	0.000	0.000	0.00	0.000	0.000	1.25	0.968	0.385	0.00	0.000	0.000
8/18	9	3.2	0.85	0.33	0.236	0.105	0.00	0.000	0.000	0.11	0.111	0.035	0.44	0.444	0.140	0.11	0.111	0.035
8/19	9	1.0	0.12	1.00	0.333	0.981	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000
8/20	12	1.3	0.16	1.00	0.246	0.766	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000
8/21	12	3.9	0.16	3.67	0.829	0.936	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000
8/22	10	3.2	0.37	2.00	0.516	0.625	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.10	0.100	0.031
8/23	9	6.1	0.63	3.67	1.027	0.605	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000
8/24	12	4.7	0.66	2.08	0.452	0.443	0.08	0.083	0.018	0.00	0.000	0.000	0.08	0.083	0.018	0.08	0.083	0.018
8/26	5	1.4	0.39	0.20	0.200	0.141	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000
8/27	2	1.1	0.00	1.50	0.500	1.389	0.00	0.000	0.000	0.00	0.000	0.000	0.50	0.500	0.463	0.00	0.000	0.000
8/28	4	1.0	0.02	2.50	0.866	2.451	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000
8/29	2	1.8	0.00	1.00	0.000	0.571	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000
8/30	6	0.7	0.14	0.83	0.401	1.152	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000
8/31	4	2.4	0.13	1.00	0.577	0.421	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000
9/01	7	1.9	0.37	1.14	0.261	0.596	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000
9/02	11	2.9	0.38	2.36	0.491	0.819	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000
9/03	8	1.6	0.42	1.13	0.854	0.701	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000
9/04	9	5.5	1.01	3.33	1.546	0.608	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000
9/05	19	4.9	0.37	3.21	0.767	0.657	0.00	0.000	0.000	0.00	0.000	0.000	0.16	0.158	0.032	0.00	0.000	0.000
9/06	2	0.7	0.33	2.50	2.500	3.759	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.50	0.500	0.752
9/08	4	4.8	0.00	4.00	0.000	0.842	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000
9/11	3	2.1	1.03	1.33	0.667	0.623	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000
9/12	4	1.5	0.00	0.75	0.250	0.500	0.00	0.000	0.000	0.00	0.000	0.000	0.25	0.250	0.167	0.00	0.000	0.000
9/13	3	1.7	0.00	0.67	0.667	0.399	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000
9/14	2	4.3	0.00	3.50	0.500	0.824	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000