

ANNUAL REPORT:  
TERROR LAKE HYDROELECTRIC PROJECT  
1989 SALMON EGG AND FRY SURVIVAL, ESCAPEMENT MAGNITUDE  
AND SPAWNER DISTRIBUTION

By:  
Dave Prokopowich  
and  
Dennis Gretsch

Regional Information Report<sup>1</sup> No. 4K90-12

Alaska Department of Fish and Game  
Division of Commercial Fisheries  
211 Mission Road  
Kodiak, Alaska 99615

March 1990

<sup>1</sup>The Regional Information Report Series was established in 1987 to provide an information access system for all unpublished division reports. These reports frequently serve diverse ad hoc informational purposes or archive basic uninterpreted data. To accommodate timely reporting of recently collected information, reports in this series undergo only limited internal review and may contain preliminary data; this information may be subsequently finalized and published in the formal literature. Consequently, these reports should not be cited without prior approval of the author or the Division of Commercial Fisheries.

#### AUTHORS

David Prokopowich is the Kodiak Area Assistant Management Biologist for herring and salmon for the Alaska Department of Fish and Game, Division of Commercial Fisheries, 211 Mission Road, Kodiak, AK 99615.

Dennis Gretsch is a seasonal Fishery Biologist working with the Kodiak Area herring and salmon management staff for the Alaska Department of Fish and Game, Division of Commercial Fisheries, 211 Mission Road, Kodiak, AK 99615.

#### ACKNOWLEDGEMENTS

Alaska Department of Fish and Game personnel involved in pre-emergent salmon sac fry sampling were David Prokopowich, Kevin Brennan, Ed Sampson, Steve Brown and Mike Thompson, Alaska Department of Fish and Game personnel involved in estimating salmon escapement magnitude and distribution were Larry Malloy, David Prokopowich, Kevin Brennan, Charlie Swanton and Larry Nicholson.

#### PROJECT SPONSORSHIP

This investigation was partially funded by the Alaska Energy Authority. (A breakdown of project expenditures is included in Appendix A.)

TABLE OF CONTENTS

	<u>Page</u>
List of Tables.....	iv
List of Figures.....	iv
List of Appendices.....	v
Abstract.....	vi
Introduction.....	1
Pre-Emergent Fry Sampling.....	1
Methods and Procedures.....	1
Results.....	2
Terror River.....	2
Kizhuyak River.....	2
Escapement Estimates and Distribution Mapping.....	2
Methods and Procedures.....	2
Results.....	3
Terror River.....	3
Kizhuyak River.....	3
Literature Cited.....	21
Appendices.....	22

## LIST OF TABLES

<u>Table</u>	<u>Page</u>
1. Terror River pre-emergent fry sampling results, 1989.....	4
2. Comparison of pre-emergent fry indexes for the Terror River 1982-1989.....	5
3. Kizhuyak River pre-emergent fry sampling results, 1989.....	6
4. Comparison of pre-emergent fry indexes for the Kizhuyak River 1982-1989.....	7
4A. Footnotes for understanding salmon escapement data.....	8
5. Terror River aerial survey results, 1989.....	9
6. Odd-year pink salmon escapements, Terror and Kizhuyak Rivers, 1960-1989.....	10
7. Chum salmon escapements, Terror and Kizhuyak Rivers, 1982-1989.....	11
8. Kizhuyak River aerial survey results, 1989.....	12

## LIST OF FIGURES

<u>Figure</u>	<u>Page</u>
1. Location of Terror River and Kizhuyak River, Kodiak Island, Alaska.....	13
2. Terror Lake Hydroelectric Project.....	14
3. Terror River pre-emergent fry sampling sites, 1989.....	15
4. Kizhuyak River pre-emergent fry sampling sites, 1989.....	16
5. Terror River pink salmon distribution, 1989.....	17
6. Terror River chum salmon distribution, 1989.....	18
7. Kizhuyak River pink salmon distribution, 1989.....	19
8. Kizhuyak River chum salmon distribution, 1989.....	20

**LIST OF APPENDICES**

**Appendix A: Commercial Fisheries Division expenditures, Terror River Hydroelectric Project, 1989.**

## ABSTRACT

The pre-emergent fry indices on the Terror River and Kizhuyak River were generally fair to good. High waters during the fall of 1988 resulted in scouring in both river systems. However spring climatic conditions were mild and an average to lower than average pink salmon return is expected in 1990. The peak indexed pink salmon escapement in 1989 was 672,000 in the Terror River and 332,000 in the Kizhuyak River. The peak chum salmon escapements in 1989 were 39,000 in the Terror River and 55,000 in the Kizhuyak River. These are the highest pink salmon escapements for these rivers since this study began. These peak escapements are the result of commercial salmon fishery closures relating to the Exxon Valdez oil spill.

Key Words: Terror Lake Hydroelectric Project, Salmon, Oncorhynchus, Pre-emergent fry, Spawning distribution, Escapement

## INTRODUCTION

Prior to development of the Terror Lake hydroelectric project potential beneficial and detrimental impacts on the salmon populations of the Terror River and Kizhuyak River were identified (AEIDC, 1981). Changes in stream flow and temperature directly affect salmon spawning and egg survival. In 1981 the Alaska Department of Fish and Game (ADF&G), Commercial Fisheries Division (CFD), entered into an agreement with the Kodiak Electric Association (KEA) to assess the magnitude of change, if any, in the pink salmon (Oncorhynchus gorbuscha) and chum salmon (Oncorhynchus keta) populations in these two rivers. Study began in 1982 to measure pre-project levels of spawning and egg survival and have continued through facility construction and subsequent operations. Specifically, CFD wishes to evaluate (1) salmon egg and fry survival, (2) timing of salmon fry emergence; and (3) trends in salmon escapement magnitude and spawner distribution. The Alaska Energy Authority (AEA) took over the project in 1983.

The Terror and Kizhuyak Rivers are located in north central Kodiak Island (Figure 1). The areas of study encompassed approximately the lower 1.5 miles of each river. The Terror River extends some 7.5 miles, running down from Terror Lake (Figure 2). An earthen and concrete dam was constructed at the lake outlet to increase the lake's volume and control outflow. A 5 mile tunnel was drilled to divert water down to a powerhouse in the Kizhuyak Basin.

It should be noted that data collected during the CFD annual studies may not necessarily be conclusive enough to assess specific changes within the salmon populations in question (Malloy 1981). An interim data analysis report will be completed in the fall of 1990, and a final report will be prepared after the end of the study period in 1991. This report details the efforts of CFD during the 1989 season.

## PRE-EMERGENT FRY SAMPLING

### Methods and Procedures

Pre-emergent fry sampling involved hydraulically excavating sac fry and eggs from spawning habitat. Sampling locations for both rivers are shown in figures 3 and 4. Personnel and equipment were transported to the sites with a Bell Long Ranger helicopter. Ten samples were collected at each pre-selected sampling area. For each sample a circular collection frame, two feet in diameter, was placed on the stream bed circumscribing the area to be excavated. A Homelite XLS pump forced an air/water mixture through a steel probe which was manually worked into the stream bed. All light materials, including eggs and fry, that bubbled up out of the gravel were swept by the current into a tapered net attached to the downstream side of the collection frame. The net

was emptied into a plastic bin and the fry and eggs identified and counted. Fry development, as indicated by the percent absorption of the yolk sac, was noted. A relative index of live fry abundance was developed for each portion of the river sampled.

## Results

### Terror River

Sampling was accomplished on 7 April 1989 and is summarized in (Table 1). The live fry indices for this river were lower than most study years, particularly the upper river sampling sites (Table 2). High water from heavy rains in the fall of 1988 resulted in scouring of the spawning areas. However, spring climatic conditions were mild and an average to less than average return is expected for 1990.

### Kizhuyak River

Sampling was accomplished between 27 March and 3 April 1989 and is summarized in (Table 3). The live fry indices on this river were lower than most study years (Table 4). Indices for ADF&G sample sites Beaver Pond Creek were at or near past years average indices. High water from heavy rains in the fall of 1988 resulted in scouring of the spawning areas. Spring climatic conditions were mild which should result in at least an average return for 1990.

## ESCAPEMENT MAGNITUDE AND DISTRIBUTION

### Methods and Procedure

Escapement enumeration and spawner distribution mapping was conducted by aerial survey from a Bell Long Ranger helicopter and small fixed wing aircraft (Cessna 206, Supercub). Surveys were attempted twice weekly through the duration of spawning, as weather permitted. Additionally extra surveys were flown to assess escapements resulting from commercial fishery closures relating to the Exxon Valdez oil spill. On each flight the observer estimated the number of each salmon species in the bays, intertidal zones, and the river systems. Pink salmon season escapements were figured by adding the highest counts approximately 30 or more days apart. For example, for a particular river a high escapement count of 10 August would be added to a high count of 18 September to arrive at a total indexed escapement estimate for the season<sup>1</sup>. Chum salmon escapement estimates are made from the peak counts at each system. These counts also serve as a reliable index of total

---

<sup>1</sup>CFD calculated indexed escapements for all major pink salmon systems in a similar manner.

escapements. Both types of escapement estimates are comparable from one year to the next. Spawner distribution was also noted during aerial surveys, and was recorded on a 1:24,000 field map. A foot survey of each river system was to be conducted near the peak of spawning to further document species magnitude and distribution. Unfortunately, because of weather and the extended weir camp operations the foot surveys were not conducted in 1989.

## Results

### Terror River

The indexed pink salmon escapement, estimated by combining high counts made on 19 July and 25 August, 1989 was 672,000. The aerial survey data are listed in Table 5. This indexed escapement is the highest ever observed in the Terror River (Table 6). As mentioned earlier this high escapement was the result of commercial salmon fishery closures relating to the Exxon Valdez oil spill. The peak chum salmon escapement count was made 25 August 1989 at 39,000 fish (Table 7). This count is also the highest count observed since the study began as a result of commercial salmon fishery closures.

Spawning distribution is shown in Figures 5 and 6. Spawners were observed in the upper Terror sections above Four Mile Creek. Overall spawning distribution shows little change from previous years, with spawners utilizing the entire range of spawning habitat (D. Prokopowich, Alaska Department of Fish and Game, Kodiak, personal communication).

### Kizhuyak River

The indexed pink salmon escapement, estimated by combining high counts made on 19 July, 23 August, 21 September 1989 was 332,000 fish. The aerial survey data are listed in Table 8. This indexed escapement is the highest ever observed in the Kizhuyak River (Table 6).

A peak chum salmon escapement count was made on 13 September 1989 at 55,000 fish. This count equals the previous high count observed since this study began in 1982 (Table 7). These peak counts are attributed to closure of the commercial salmon fishery relating to the Exxon Valdez oil spill.

Spawner distribution is shown in Figures 7 and 8. Pink and chum salmon were well distributed throughout the spawning habitat (K. Brennan, Alaska Department of Fish and Game, Kodiak, personal communication).

Table 1. 1989 Terror River Pre-Emergent Fry Sampling Results

Sampling/Location	Number Samples	Sample Dates	Live		Dead		1989 LF/M <sup>2</sup> Index	% Sample W/Fry	Range of Fry Development	H <sub>2</sub> O Temp.	Comments
			Fry	Eggs	Fry	Eggs					
Lower Terror SW Forks-Tidal	10	4/7/89	112 <sup>P</sup>	0	10	92	60.26 <sup>p</sup>	100	.20 - .90	3°C	
Lower Terror NE Subtidal	10	4/7/89	436 <sup>P</sup>	0	4	765	234.57 <sup>P</sup>	90	.20 - .90	5°C	
			201 <sup>ch</sup>	-	-	-	108.14 <sup>ch</sup>	-	-	-	
Upper Terror Thermograph	10	4/7/89	0	0	0	0	0	0	-	4°C	
Ouzel Creek	10	4/7/89	469 <sup>P</sup> 20 <sup>dv</sup>	0	13	160	232.32 <sup>P</sup> 10.76 <sup>ch</sup>	60	.90 - .95	5.5°C	Emergent Chum Fry
Bear Creek	N/S	4/7/89	-	-	-	-	-	-	-	-	Beaver Pond Frozen
Consternation Creek	10	4/7/89	6 <sup>P</sup>	0	23	30	3.23 <sup>P</sup>	20	.40	1.5°C	
ADF&G Sampling Sites Mainstream Terror	50	3/27/89	321 <sup>P</sup>	0	0	337	34.54 <sup>P</sup>	24	.80 - .95	2.5°C	

p = pink salmon  
ch = chum salmon  
dv = dolly varden

Table 2. Comparison of Pre-Emergent Fry Indexes 1982 - 1989 Terror River: Live Fry/M<sup>2</sup>

<u>Location/Year</u>	<u>1982</u>	<u>1983</u>	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>	<u>1989</u>
Lower Terror S.W. Fork Intertidal	17.75	240.49	0	70.42 <sup>P</sup> .54 <sup>ch</sup>	73.17	573.51	250.17	60.26 <sup>P</sup>
Lower Terror N.E. Intertidal	569.74 <sup>P</sup> 156.56 <sup>P</sup>	0	371.71 <sup>P</sup> 415.98 <sup>ch</sup>	185.61 <sup>P</sup>	0	525.63 <sup>P</sup> 278.81 <sup>ch</sup>	263.62 <sup>P</sup> 265.81 <sup>ch</sup>	234.57 <sup>P</sup> 108.14 <sup>ch</sup>
Upper Terror Thermograph	0	15.60 <sup>P</sup>	0	501.95	0	102.22	0	0
Ouzel Creek	8.07 <sup>P</sup> 2.69 <sup>P</sup>	0	2.15 <sup>P</sup>	32.82	0	64.02 <sup>P</sup> .54 <sup>ch</sup>	0	252.32 <sup>P</sup> 10.76 <sup>dv</sup>
Bear Creek	N/S	.54 <sup>ch</sup>	331.74 <sup>P</sup>	0	230.8 <sup>P</sup>	N/S	N/S	N/S
Consternationn Creek	1.62 <sup>P</sup>	.54 <sup>P</sup>	0	0	0	0	0	.40 <sup>P</sup>
ADF&G Sample Sites Mainstream-Terror	25.93	22.38	2.04 <sup>P</sup> 5.70 <sup>ch</sup>	107.60 <sup>P</sup>	.22	71.02 <sup>P</sup>	16.14 <sup>P</sup> 2.69 <sup>ch</sup>	34,54 <sup>P</sup>

p = pink salmon  
ch = chum salmon  
dv = dolly varden

Table 3. 1989 Kizhuyak River Pre-Emergent Fry Sampling Results

Sampling/Location	Number Samples	Sample Dates	Live		Dead		1989 LF/M <sup>2</sup> Index	% Sample W/Fry	Range of Fry Development	H <sub>2</sub> O Temp.	Comments
			Fry	Eggs	Fry	Eggs					
Lower Chum Channel	N/S	4/3/89	-	-	-	-	-	-	-	4°C	Outlet Blocked
Kizhuyak-Above Chum Channel	10	4/3/89	0	0	0	0	0	0	-	4.5°C	
Kizhuyak 2nd Below Chum Channel	10	4/7/89	0	0	0	0	0	0	-	3°C	
Kizhuyak N.E. Fork-Tidal	10	4/7/89	27	0	0	2	14.53 <sup>P</sup>	10	.40 - .50	3°C	
Kizhuyak Above Watchout	10	4/3/89	0	0	0	0	0	0	-	4.5°C	
Kizhuyak Below Watchout	10	4/3/89	0	0	0	0	0	0	-	4.5°C	
ADF&G Sample Sites Beaver Pond Creek	40	3/27/89	1,423 <sup>P</sup> 292 <sup>ch</sup>	0 -	8 -	337 -	191.39 <sup>P</sup> 39.27 <sup>ch</sup>	44	.60 - .90 .80	4°C	

p = pink salmon  
 ch = chum salmon  
 dv = dolly varden

Table 4. Comparison of Pre-Emergent Fry Indexes 1982 - 1989 Kizhuyak River: Live Fry/M<sup>2</sup>

<u>Location/Year</u>	<u>1982</u>	<u>1983</u>	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>	<u>1989</u>
Lower Terror Channel	393.82 <sup>P</sup>	0	112.98 <sup>P</sup>	76.39 <sup>P</sup>	23.13 <sup>P</sup>	709.08 <sup>P</sup>	N/S	N/S
Kizhuyak-Above Chum Channel	22.6	-	146.87 <sup>P</sup>	1.05 <sup>P</sup>	117.82 <sup>P</sup>	81.78 <sup>P</sup>	0	0
Kizhuyak River Below Chum Channel	97.92 <sup>P</sup>	5.92 <sup>P</sup>	N/S	-	-	232.41 <sup>P</sup>	5.38 <sup>P</sup>	0
Kizhuyak River N.E. Fork	0	1.61 <sup>P</sup>	.54 <sup>P</sup>	266.84 <sup>P</sup>	0	0	62.41 <sup>P</sup>	14.53 <sup>P</sup>
Kizhuyak River Above Forks/Watchout	0	0	0	-	2.69 <sup>P</sup>	38.74 <sup>P</sup>	0	0
Kizhuyak River Below Watchout	-	-	-	-	-	-	272.23 <sup>P</sup>	0
ADF&G Sample Sites								
Beaver Pond Creek	1,042.78 <sup>P</sup> 11.23 <sup>ch</sup>	53.8 <sup>P</sup>	493.48 <sup>P</sup>	8.61 <sup>P</sup>	171.22 <sup>P</sup>	1.61 <sup>P</sup>	191.93 <sup>P</sup> 84.33 <sup>ch</sup>	191.39 <sup>P</sup> 39.27 <sup>ch</sup>

p = pink salmon  
 ch = chum salmon  
 dv = dolly varden

Table 4A. Footnotes for understanding salmon escapement data.

**Visibility:** Indicates water visibility in the following two categories:  
**S=Stream M=Mouth B=Bay A=All three categories or any two categories**

**Fish in Stream:**

**-** : Stream not surveyed for this species.

**0** : Stream surveyed for this species, none observed.

**N** : Any numerical designation reflects indexed number of live fish observed; portion of stream surveyed includes 100% of fish in stream for survey date. Any deviations from this are denoted in comments, e.g. carcasses and percentage of system surveyed for that portion of stream expected to contain fish for a specific survey date.

**Categories of Fish Occurrence**

**a/STREAM:** Fish which occur and remain within the spawning area of a stream or which occur in a freshwater portion of a stream during spawning migration; this will also include fish observed in the mouth on the last survey of the year . These fish are not vulnerable to normal illegal fishing methods and means.

=====

**b/MOUTH:** Build-up of fish in saltwater which is normally closed to commercial fishing. These fish generally are not vulnerable to legal fishing, but they may be vulnerable to illegal fishing. This category includes designated lagoons, as described in the closed waters portion of the Commercial Fishing Regulations. These fish are considered to be homing in on the stream for which they are documented and will be counted as fish in the stream on the last survey of the year.

=====

**c/BAY:** Build-up fish, in saltwater which is normally either open to commercial fishing or closed to commercial fishing (closed water sanctuaries), which may be at least partially vulnerable to both legal and illegal fishing. These fish will not be included in the stream count unless special denotation is made in the remarks column and will only apply on the last survey of the year.

Table 5. Terror River Aerial Survey Results, 1989.

Alaska Department of Fish and Game  
Salmon Escapement Surveys, 1989  
(Aerial Surveys Unless Noted in Remarks)

Stream	Date MM-DD	Observer	Visibility Str Hou Bay	-----Fish in Stream-----				Build Up Mouth	Fish Bay	Observer Remarks
				Reds	Coho	Pink	Chum			
<b>Terror River</b>										
253-331	6-15	Brennan	g g	0	0	0	0	-	-	1315 Hrs. No stream survey.
253-331	7-5	Brennan	f f f	0	0	0	0	-	2500P	1040 Hrs.
253-331	7-7	Brennan	p p p	0	0	0	0	150Ch	8000P 5000Ch	1100 Hrs. Water murky. Fish way out. Likely more present.
253-331	7-11	Chatto	g f	0	0	0	4500	200Ch	-	1100 hrs. Low tide. Surveyed upstream and over flats. Most fish from mouth upstream to 2-1/2 miles. Stream flow low. Very few jumpers in flats. Visibility on flats not good.
253-331	7-11	Brennan	p p p	0	0	2000	2400	15000P 5000Ch	-	1330 Hrs. No fish in outer bay; most fish in deep channels on flats. Surveyed only 2 miles of river. Bay looks very sparse for this time. No sign in outer bay, only near flats.
253-331	7-11	Malloy	f f f	0	0	4600	1500	-	12000P 2500Ch	10,000 in creek. Within Terror Bay closed water - jumpers throughout bay area. Water rough.
253-331	7-12	Nicholson	f	0	0	10000	0	-	-	1845 Hrs.
253-331	7-18	Brennan	f f f	0	0	600	2000	28000P 5000Ch	27000P 11000Ch	1100 hrs. Low tide. Scattered schools of pinks and chum 0.25 miles to 1.5 miles upstream from tidal flats in both channels. Concentrations of fish primarily above the USGS stream gauge. Only a few schools of 10-20 fish seen in last 0.5 miles of survey. Consternation Creek had a few pinks (50-100) in the lower end. Many of the chums seen had severe fungus (estimating that they had been in system two to three weeks).
253-331	7-19	Blackett	f f	0	0	25000	2250	-	-	1245 hrs. Tide mid-low. Lots of glare on water in flats. Many jumpers in outer flats.
253-331	8-1	Hander	f f	0	0	33000	0	50000P	-	Started survey below 4-mile creek.
253-331	8-4	Prokopovic h	e e	0	0	93000	10000	102000P	-	1002 hrs. Mid high tide. Mixed chum and pink off mouth in flats. Estimate 50 K fish total 80% pink, 20% chum. Water level moderate flow. Lots of carcasses.
253-331	8-10	Hander	p g	0	0	25000	0	40000P 10000Ch	-	Initial preflight survey. Fish (pinks) still moving into stream from bay, highest concentrations starting from the mouth of the river ranging 2 miles upstream. Most carcasses found washed downstream due to high water. Estimate 20,000 carcasses on first 1/2 mile of stream.
253-331	8-20	Swanton	g g g	0	0	40000	0	10000P	10000P	Intertidal, delta channels, to USGS stream gauge (1.5 miles) 60,000 pink and 1,500 chum. To Consternation Creek (0.5 miles) 55,000 pink and 5,000 chum. Consternation Creek (0.2 miles) 2,000 pinks. To Four Mile Creek (2.25 miles) 70,000 pink and 3,000 chum. Four Mile to falls (1.0 mile) 5,000 pinks (pinks present beyond the gauge in Four Mile Creek). Ouzel and Bear Creeks almost dry; only a few pinks in downstream portions. An unknown number of fish jumping in bay. Estimating 20,000 pink salmon carcasses. Massive schools of pink salmon in areas made estimation of numbers difficult, plus chums difficult to distinguish (there were probably more).
253-331	8-23	Blackett	g f p	0	0	192000	9500	-	-	1510 hrs. Plus 43,000 carcasses. Of total 290 K in lower stream (below wire) 70 K above, and 20 K in sloughs.
253-331	8-25	Brennan	f f f	0	0	367000	23000	80000P 16000Ch	200000P	Estimating 18,000 pink carcasses, 12,500 chum carcasses in stream. From mouth to cable - 85,000 pinks; sloughs - 19,000 pinks.
253-331	8-29	Prokopovic h	g g g	0	0	162000	12500	30000P	118000P	1120 hrs. Low tide, water level good.
253-331	8-29	Hander	g g	0	0	70000	0	3000P	-	At river terminus 8,000 late run pinks. Intertidal, delta channels, to USGS stream gauge (1.15 miles) 105,000 pink, 2,000 chum, 35 coho. To Consternation Creek (0.5 miles) 2,000 pinks. Consternation Creek (0.25 miles) 500 pinks. To Four Mile Creek (2.25 miles) 1000 pink and 45 coho. Ouzel and Bear Creeks (0.2 miles from junction) 100 pinks. Four Mile Creek to Falls (1.0 miles) 0 salmon. Early run pink salmon spawning in upstream areas almost gone. There is still an abundance of late run pinks in lower river and delta channels and new fish in bay. Some schools of mixed pinks makes estimates of fish numbers difficult, plus it is difficult to distinguish chum salmon (there may have been more). Most all of carcasses have been washed downstream into the bay. Terror Bay was littered with carcasses.
253-331	9-11	Blackett	g g g	0	85	108600	2000	8000P	-	1245 hrs. Relatively few live fish left; Main stem pretty clean. Carcasses: Bay-150,000; mouth/sloughs-50,000; stream-75,000.
253-331	9-18	Brennan	f f f	0	0	9000	11000	-	-	32,000 pink, 200 chum, and 400 coho from delta channels to USGS stream gauge (1.15 miles). 100 coho beyond to Consternation Creek (> 0.5 miles). Surveyed Consternation, Ouzel, Bear, and Four Mile Creeks (3.25 miles) - 0 salmon. Carcasses in intertidal area and bay estimated at 5 to 6 times the pink salmon live count. Upstream areas above Four Mile and Consternation Creeks surveyed by foot and helicopter on 09/20/1989. Spawning of pink and chum anticipated to be finished by October 5.
253-331	9-21	Blackett	g g f	0	500	32000	200	-	-	1648 hrs., surveyed entire river excluding tributaries.
253-331	11-1	Barnes	g	0	77	0	0	-	-	

Table 6. Odd-year pink salmon escapements, Terror and Kizhuyak Rivers, 1961-1989

Year	Terror River Escapement	Kizhuyak Escapement
1961	22,000	8,000
1963	79,500	9,000
1965	17,300	3,700
1967	24,700	8,950
1969	46,000	8,700
1971	40,000	4,000
1973	22,000	8,300
1975	43,500	11,000
1977	56,000	19,300
1979	80,000	29,600
1981	92,000	55,250
1983	42,250	18,000
1985	86,800	35,800
1987	72,000	47,000
1989	672,000	322,500
<b>Average 1961-1989</b>	$\bar{x}$ 93,070	$\bar{x}$ 17,770

Table 7. Chum salmon escapements, Terror and Kizhuyak Rivers, 1982-1989.

Year	Terror River Escapement	Kizhuyak River Escapement
1982	12,900	12,000
1983	10,050	3,170
1984	10,000	9,000
1985	3,000	7,000
1986	10,000	55,000
1987	15,000	17,000
1988	15,000	27,500
1989	39,000	55,000
Average 1982-1989	$\bar{x}$ 14,369	$\bar{x}$ 23,209

Table 8. Kizhuyak River Aerial Survey Results, 1989.

Alaska Department of Fish and Game  
Salmon Escapement Surveys, 1989  
(Aerial Surveys Unless Noted in Remarks)

Stream	Date MM-DD	Observer	Visibility Str Hou Bay	Fish in Stream				Build Up Fish		Observer Remarks
				Reds	Coho	Pink	Chum	Mouth	Bay	
<u>Kizhuyak River</u>										
259-365	6-15	Brennan	g g	0	0	0	0	-	-	1340 hrs. No stream survey.
259-365	7- 5	Brennan	f p	0	0	0	0	-	7500Ch	1020 hrs. Rough estimate of fish jumping in middle. No stream survey.
259-365	7-11	Malloy	e e e	0	0	0	0	100Ch	-	Good water flow; looked at lower end of both forks and mainstream and chum sloughs. Bay visibility excellent.
259-365	7-19	Blackett	f f	0	0	2500	0	-	-	Surveyed tributary and main channels from tidal flats to 1.5 miles upstream (just beyond stream gauge). Low tide. No chum salmon. No pinks in tributary. 2,500 pinks in braided channels of main river from 0.5 miles to 1.25 miles upstream of the lower tidal flats. A few pinks (20-30) were above the Watchout Creek tributary. Scattered schools of 100-200 pinks in the bay off stream mouth.
259-365	7-31	Brennan	g g g	0	0	14400	2000	16000P	52000P	1642 hrs. Tide falling.
259-365	8-23	Blackett	g f p	0	0	236000	3600	-	-	Intertidal, delta channels, to Watchout Creek (1.5 miles) 128,000 pink and 2,000 chum. Chum Channel (0.5 miles) 8,000 pink and 1,500 chum. Spring Creek (0.6 miles) 8,000 pinks. Watchout Creek (1.0 mile) 35,000 pinks. To Hydro Tailrace (2.25 Mile) 55,000 pink and 100 chum. Hydro Tailrace (0.2 miles) 1,000 pinks (3 chinook reported by residents). To Falls Creek (0.9 miles) 1,000 pinks. River above tailrace was nearly dry in places. An unknown number of salmon jumping in the bay. Estimating 5,000 pink carcasses. Massive schools of pinks in river make estimation of numbers difficult, plus chum difficult to distinguish (there were probably more).
259-365	8-30	Brennan	f f p	0	0	70000	14000	28000P	-	1550 hrs. Plus 12,000 carcasses.
259-365	9-11	Blackett	g g g	0	200	123000	8200	-	-	Intertidal, delta channels, to Watchout Creek (1.5 miles) 80,000 pink and 4,000 chum. Chum Channel (0.5 miles) 25,000 pink and 1,200 chum. Spring Creek (0.6 miles) 8,000 pink and 1,500 chum. Watchout Creek (1.0 mile) 8,000 pink, 500 chum, and 200 coho. To Hydro Tailrace (2.25 miles) 2,000 pink and 1,000 chum. Hydro Tailrace and to Falls Creek (0.9 miles) 0 salmon. Substantial sedimentation from powerhouse to Watchout Creek. No new fish seen in bay. Many carcasses in bay and in piles in delta areas. Some massive schools of pink salmon make estimation of numbers difficult, plus difficult to distinguish chum salmon (there may have been more).
259-365	9-13	Brennan	f f f	0	0	34500	55500	-	-	1535 hrs. Fish predominantly in sloughs and lower 1/2 mile of river. Plus 40,000 carcasses in sloughs; 32,000 carcasses in river; and 45,000 carcasses in bay.
259-365	9-21	Blackett	g g f	0	600	84000	1700	-	-	Intertidal, delta channels, to Watchout Creek (1.5 miles) 49,000 pink, 200 chum, 100 coho. There were only a few hundred pink salmon left in the mainstem; the greatest number (35,000) were in a spring source creek (slough) at the southeast end of the bay that drains through the delta. Chum Channel (0.5 miles) 15,000 pink and 500 chum. Spring Creek (0.6 miles) 20,000 pink and 1,000 chum. Watchout Creek (1.0 miles) 500 coho. Watchout Creek to Hydro Tailrace (2.25 miles) to Falls Creek (0.9 miles) 0 salmon. Carcasses of pink and chum in the intertidal area estimated at 2 to 3 times the live count. Spawning of pink and chum anticipated to be finished by October 5.

Figure 1. Location of Terror River and Kizhuyak River, Kodiak Island, Alaska.

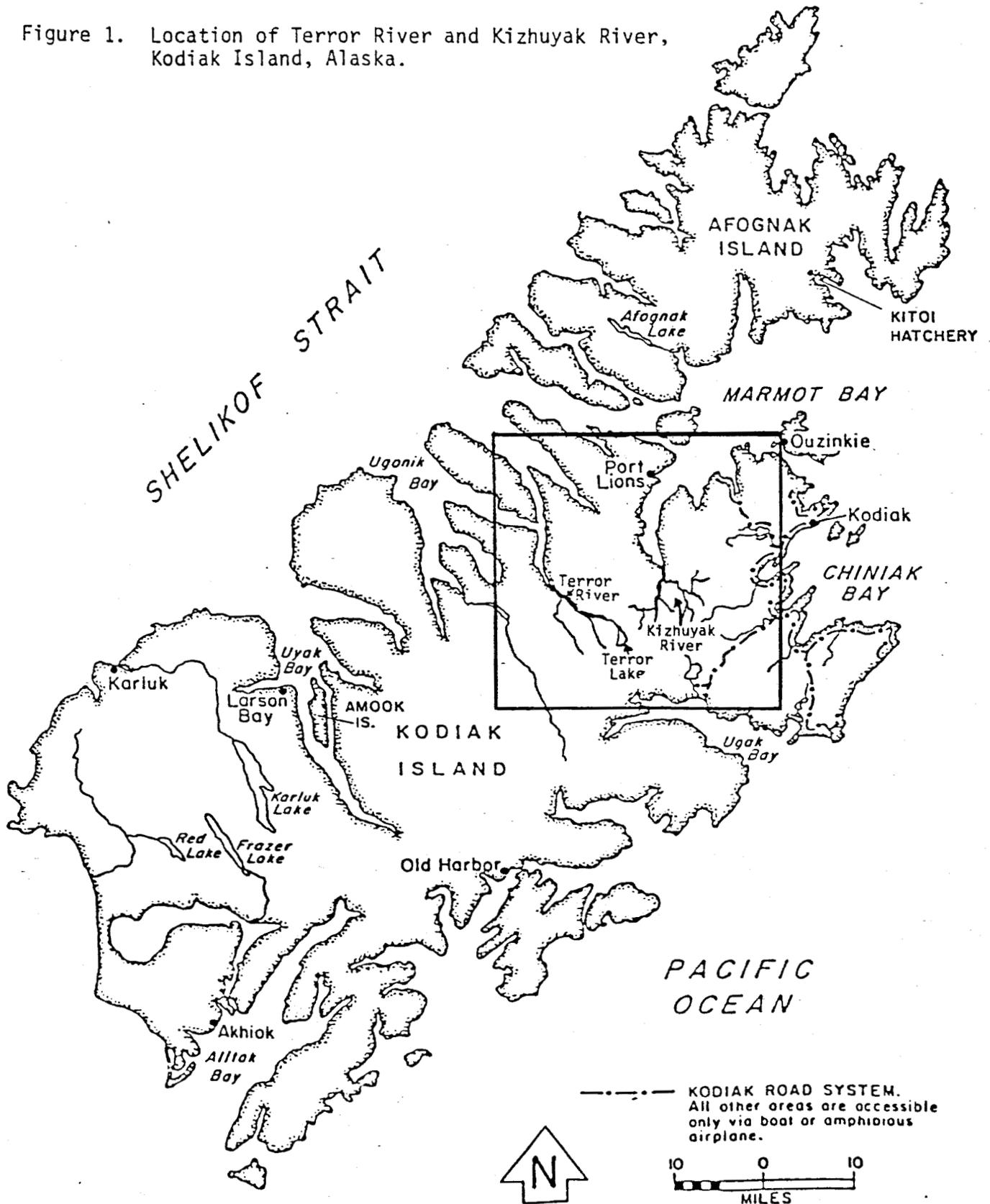


Figure 2. Terror Lake Hydroelectric Project.

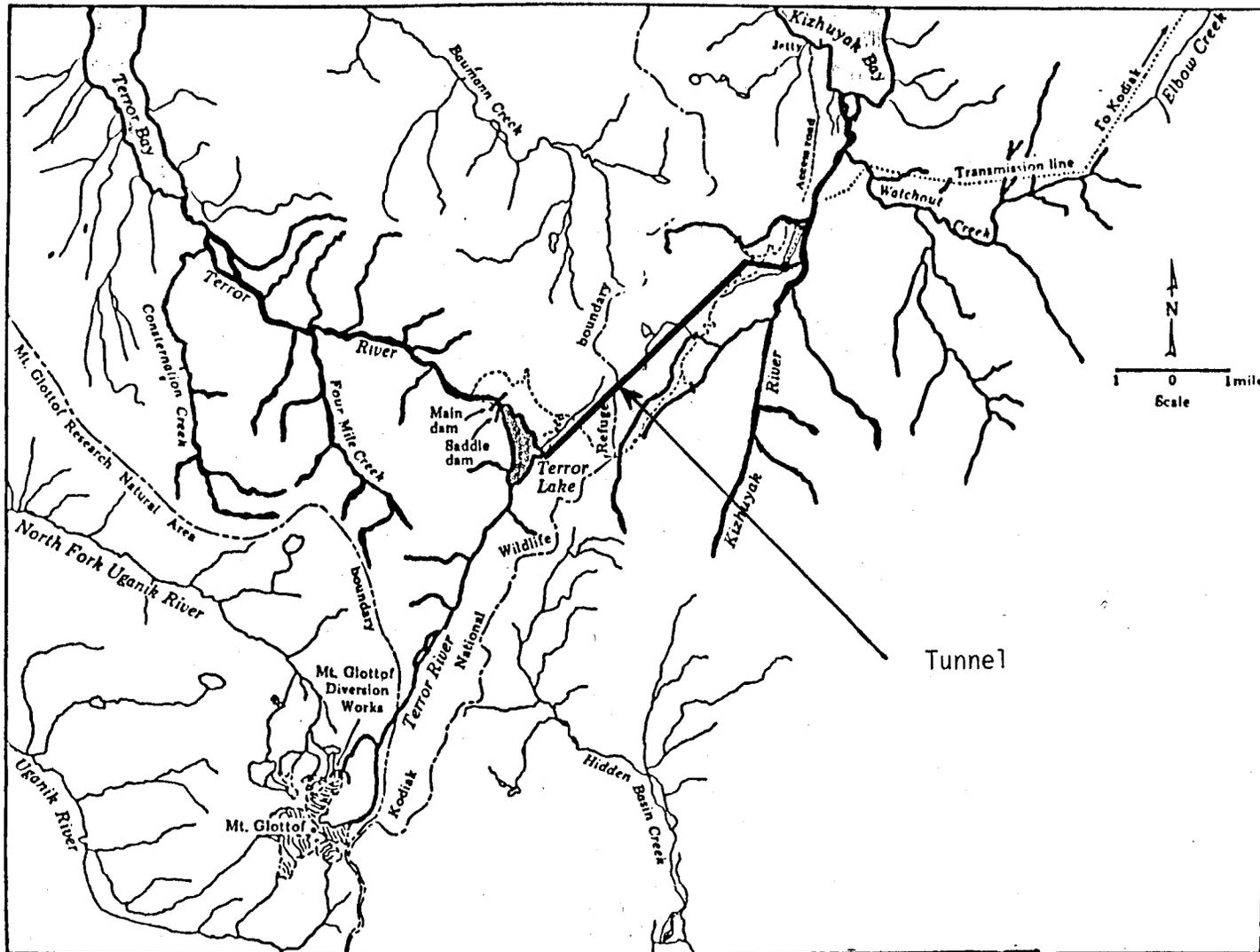


Figure 3. Terror River pre-emergent fry sampling sites, 1989

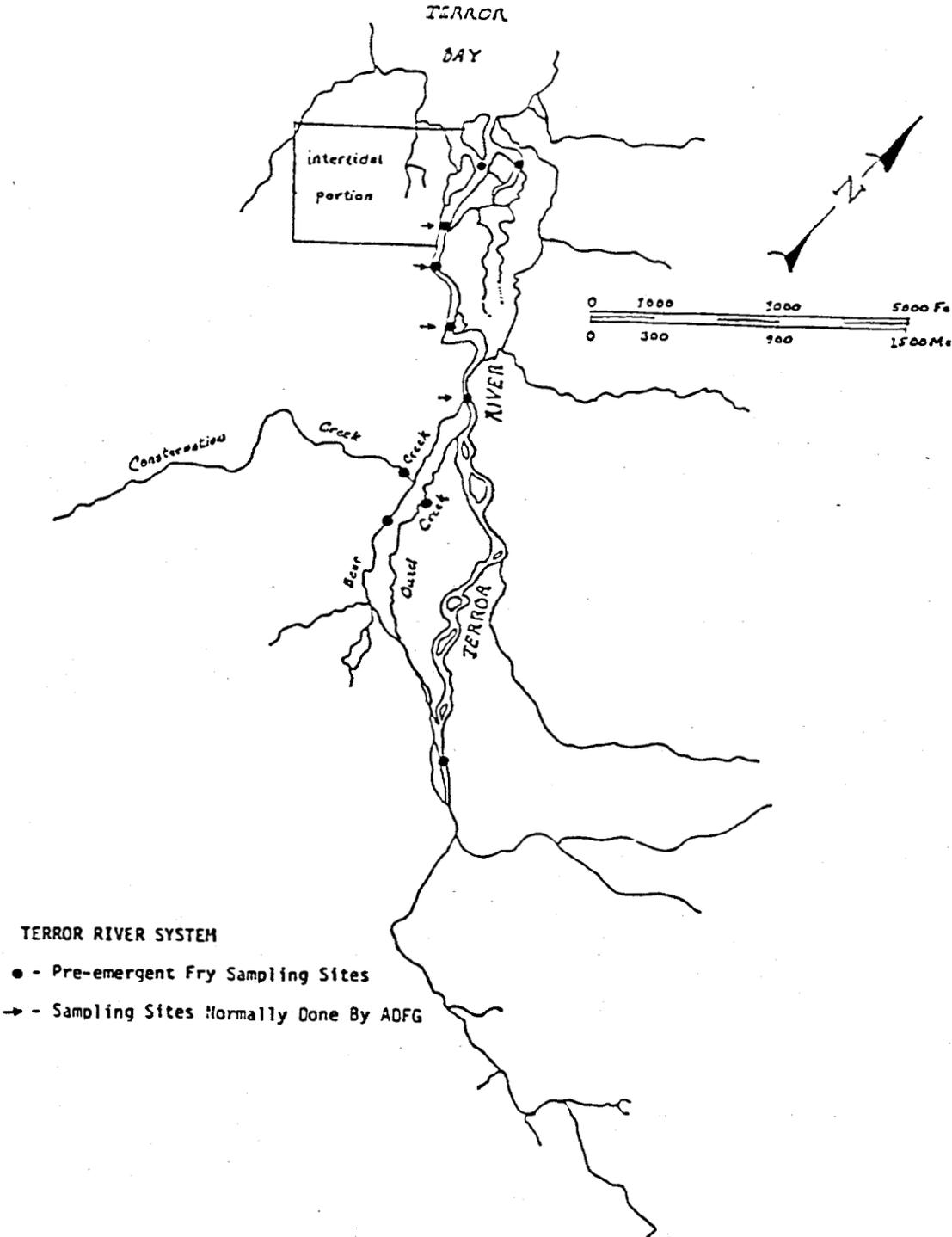


Figure 4. Kizhuyak River pre-emergent fry sampling sites, 1989

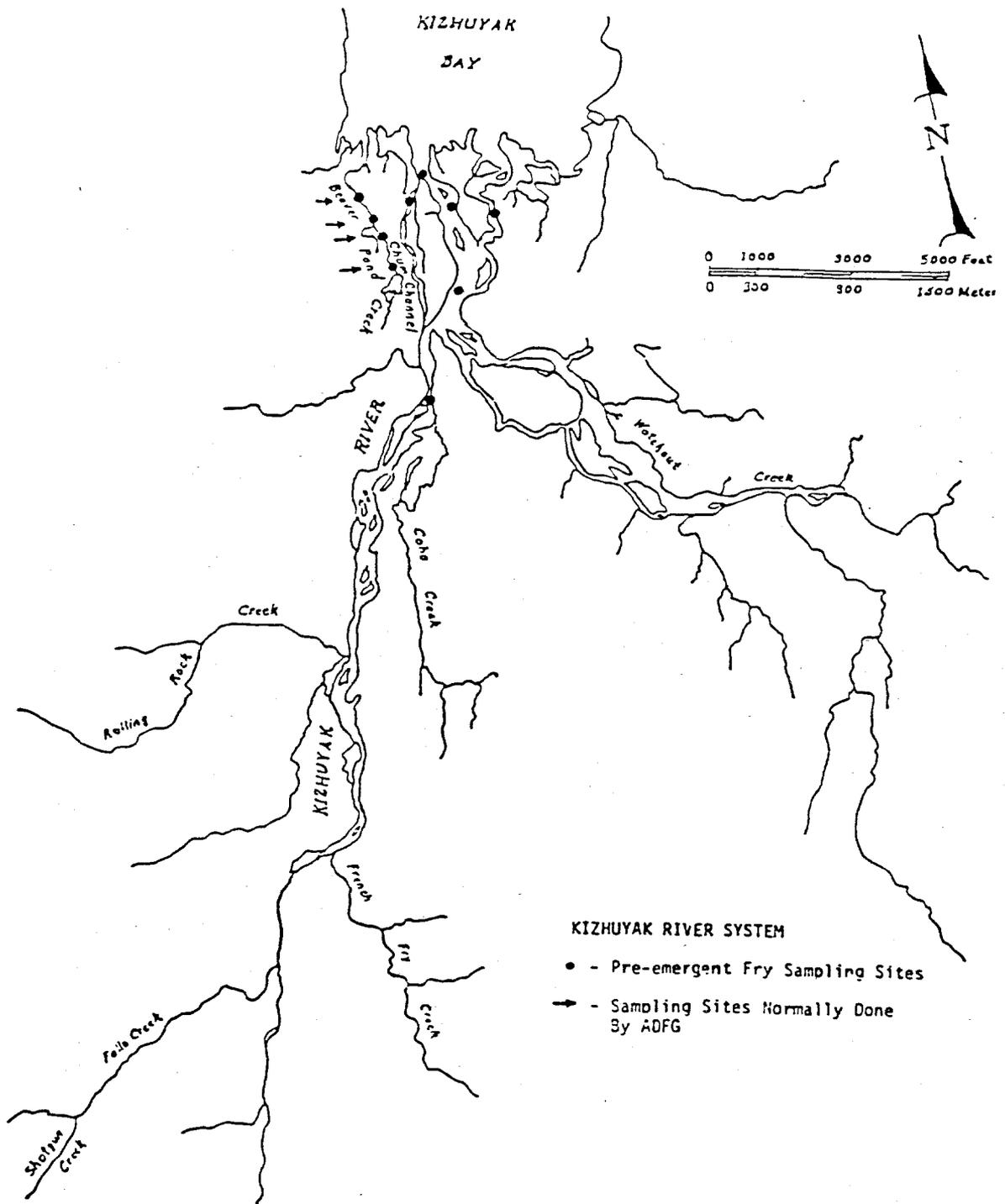


Figure 5. Terror River pink salmon distribution, 1989

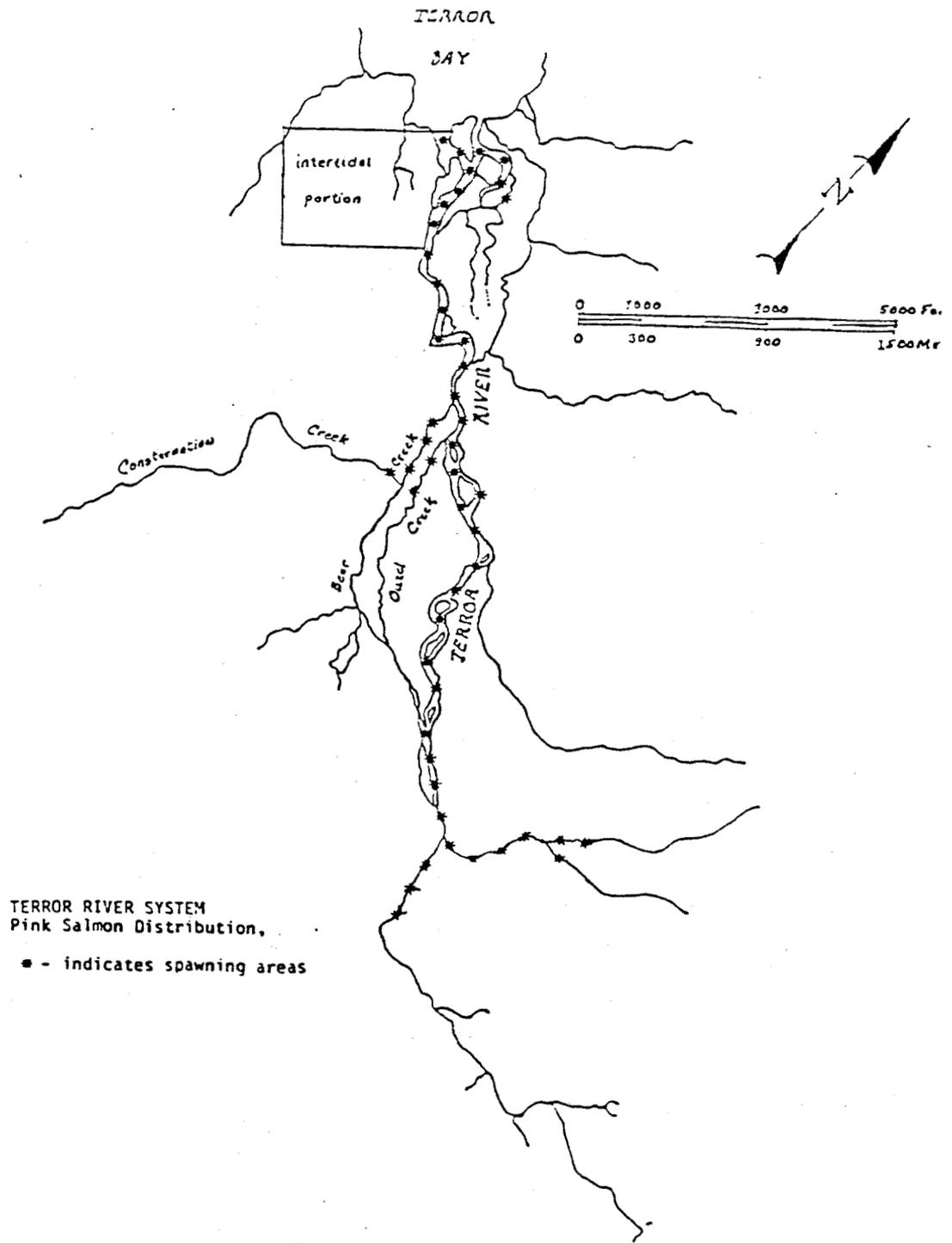


Figure 6. Terror River chum salmon distribution, 1989

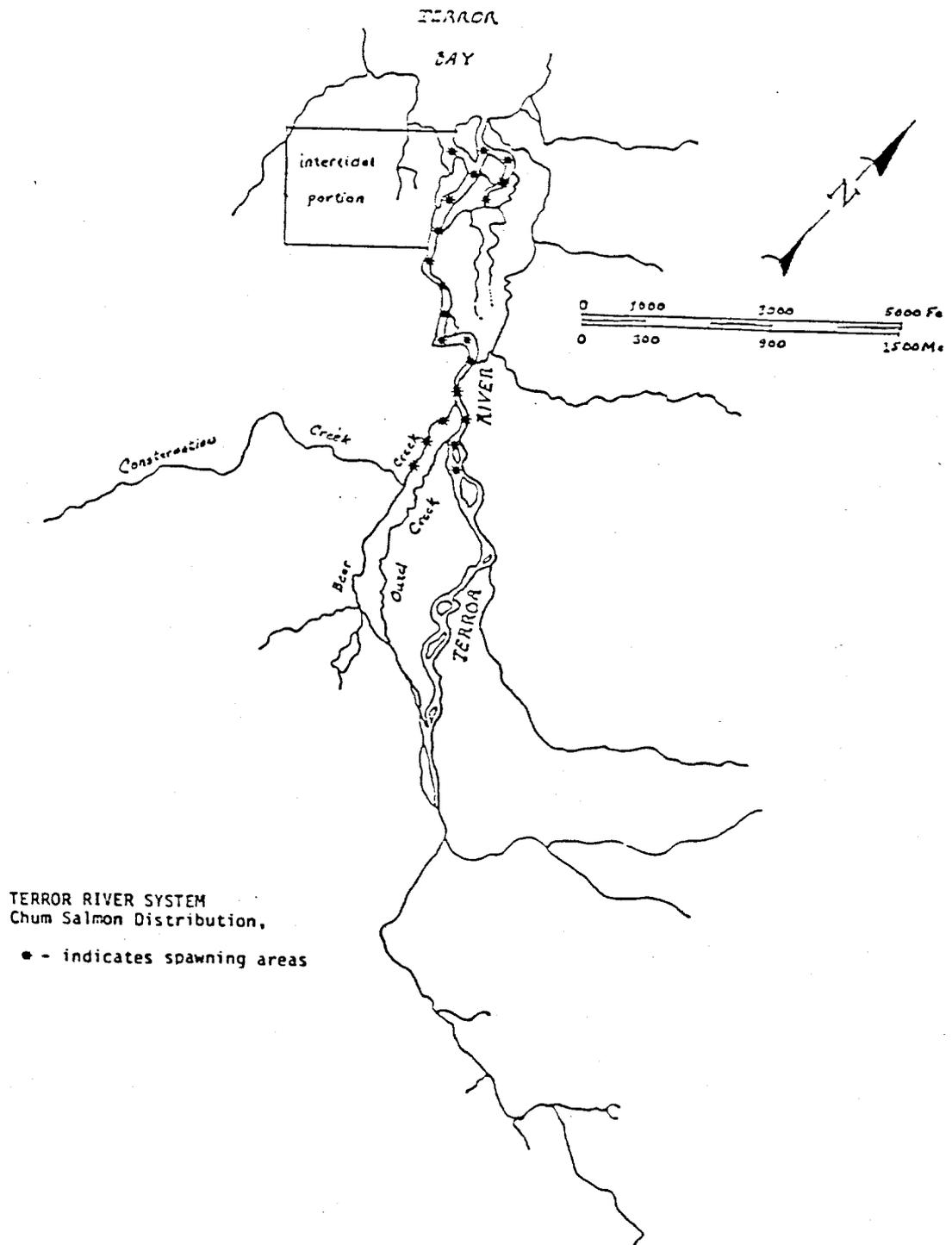


Figure 7. Kizhuyak River pink salmon distribution, 1989

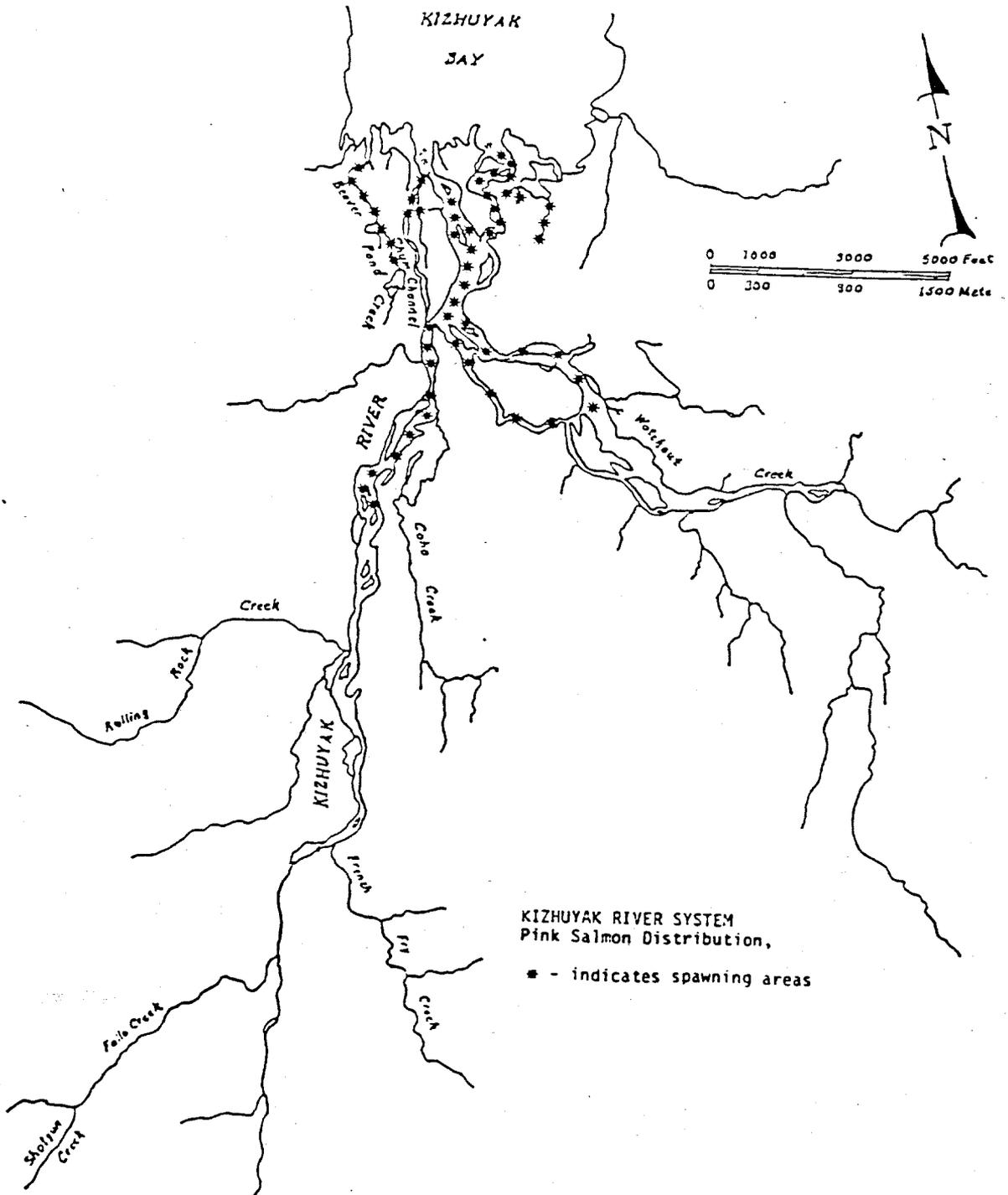
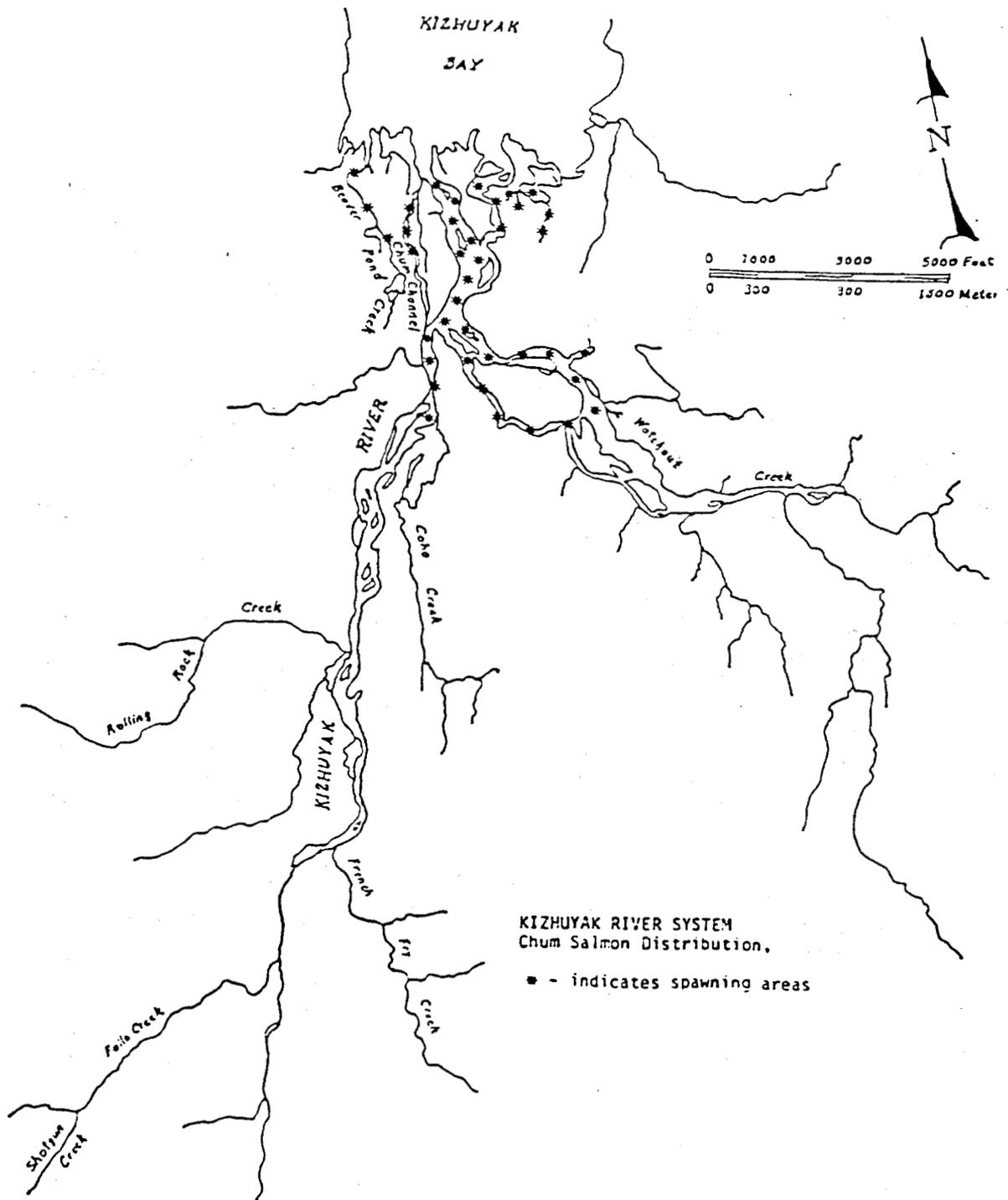


Figure 8. Kizhuyak River chum salmon distribution, 1989



LITERATURE CITED

- AEIDC (Arctic Environmental Information and Data Center). 1981. An assessment of environmental effects of construction and operation of the proposed Terror Lake hydroelectric facility, Kodiak, Alaska. Final Report, University of Alaska, Anchorage.
- Malloy, L. 1981. Project Proposal: Kizhuyak River and Terror River salmon studies. Unpublished Report; Alaska Department of Fish and Game, Kodiak.

Appendix A. Commercial Fisheries Division Expenditures, Terror River Hydro-electric Project, 1989.

ALASKA DEPARTMENT OF FISH & GAME

PAGE 93

FY1989

ORDER CODE 11039981

VENDOR NAME	DESCRIPTION	INVOICE NUMBER	INVOICE DATE	TRANSACTION CODE	DOCUMENT TYPE/NUMBER	ACCOUNT CODE	AMOUNT	VERIFIED	RECORD NUMBER
ED SAMPSON	PAYROLL	PCN 1816S	03/15	310	0000002	71190	\$1,634.55		05391
STEVE BROWN	PAYROLL	PCN 1408S	03/15	310	0000002	71190	\$2,470.24		05392
ED SAMPSON	PAYROLL	PCN 1816S	04/15	310	0000004	71190	\$3,085.17	0415	05432
AK. HELICOPTERS	CA 23763	23944	04/18	310	JNU 0000000	73864	\$1,225.50		03858
AK. HELICOPTERS	CONTRACT CHARTR	23154	09/27	310	1462257	73864	\$841.50	1130	01764
MT. VIEW SPORTS	MISC. MOSE.	20560	02/06	310	1569235	74482	\$198.30	0315	02844
KODIAK MARINE	GLOVES	35795	03/20	310	1609980	74482	\$26.46	0430	03421
NYLON NET CO.	FRY SAMPLE NET	273761	01/23	310	1569232	74820	\$221.45		02802
SUTLIFFS	PADLOCK	80336	03/12	310	FW2 1628492	74820	\$5.95		03823
SUTLIFFS	MISC. MOSE.	82797	03/24	310	1616408	74820	\$165.00	0430	03460
SUTLIFFS	ENGINE OIL	84834	04/03	310	1623522	74820	\$16.93		03805
GOODSELL CHAIN	PUMP	56535	12/15	310	1548117	74820	\$564.00		02578

The Alaska Department of Fish and Game administers all programs and activities free from discrimination based on race, color, national origin, age, sex, religion, marital status, pregnancy, parenthood, or disability. The department administers all programs and activities in compliance with Title VI of the Civil Rights Act of 1964, Section 504 of the Rehabilitation Act of 1973, Title II of the Americans with Disabilities Act of 1990, the Age Discrimination Act of 1975, and Title IX of the Education Amendments of 1972.

If you believe you have been discriminated against in any program, activity, or facility, or if you desire further information please write to ADF&G, P.O. Box 25526, Juneau, AK 99802-5526; U.S. Fish and Wildlife Service, 4040 N. Fairfax Drive, Suite 300 Webb, Arlington, VA 22203 or O.E.O., U.S. Department of the Interior, Washington DC 20240.

For information on alternative formats for this and other department publications, please contact the department ADA Coordinator at (voice) 907-465-6077, (TDD) 907-465-3646, or (FAX) 907-465-6078.