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An Assessment ~~Study~~ of the Anadromous Fish Populations
in the Upper Susitna River Watershed Between
Devil Canyon and the Chulitna River

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INTRODUCTION

The Susitna River watershed, located in the northern sector of the Cook Inlet basin, encompasses an area exceeding 19,000 square miles. Its fishery resources contribute a major proportion of the Cook Inlet commercial salmon harvest and provide a recreational base of sport fishing for Anchorage and the surrounding area. The Susitna River, of glacial origin in the Alaska range, is a migrational corridor for the five species of Pacific salmon from Devil Canyon to its point of discharge into Cook Inlet (Figure 1). The primary spawning and rearing areas are the clear water lakes and streams in the watershed.

Anticipated populaton development in southcentral Alaska has stimulated interest in harnessing hydropower for electrical energy. The Corps of Engineers has proposed a dam for Devil Canyon at a site located approximately three miles above Portage Creek, the northern most salmon rearing and spawning stream of the Susitna watershed.

Recent information is not available on the extent of salmon utilizing the Susitna River and its tributaries between Devil Canyon and its confluence with the Chulitna River. Field investigations conducted by the Fish and Wildlife Service in 1956 document the presence of salmon in the Susitna River and in four tributary streams between Gold Creek and the proposed damsite (Anonymous, 1957). Anadromous species were not found to range above Devil Canyon. To obtain information pertinent toward assessing the impact of a hydroelectric complex at Devil Canyon, on anadromous fish habitat in the upper Susitna River between the proposed site and the Chulitna River, an inventory program was initiated in 1974 to

Anonymous 1957 Progress Report, 1956 Field Investigations Devil Canyon Damsite, Susitna River Basin. U.S. Fish and Wildlife Service, Juneau, Alaska, 15pp.

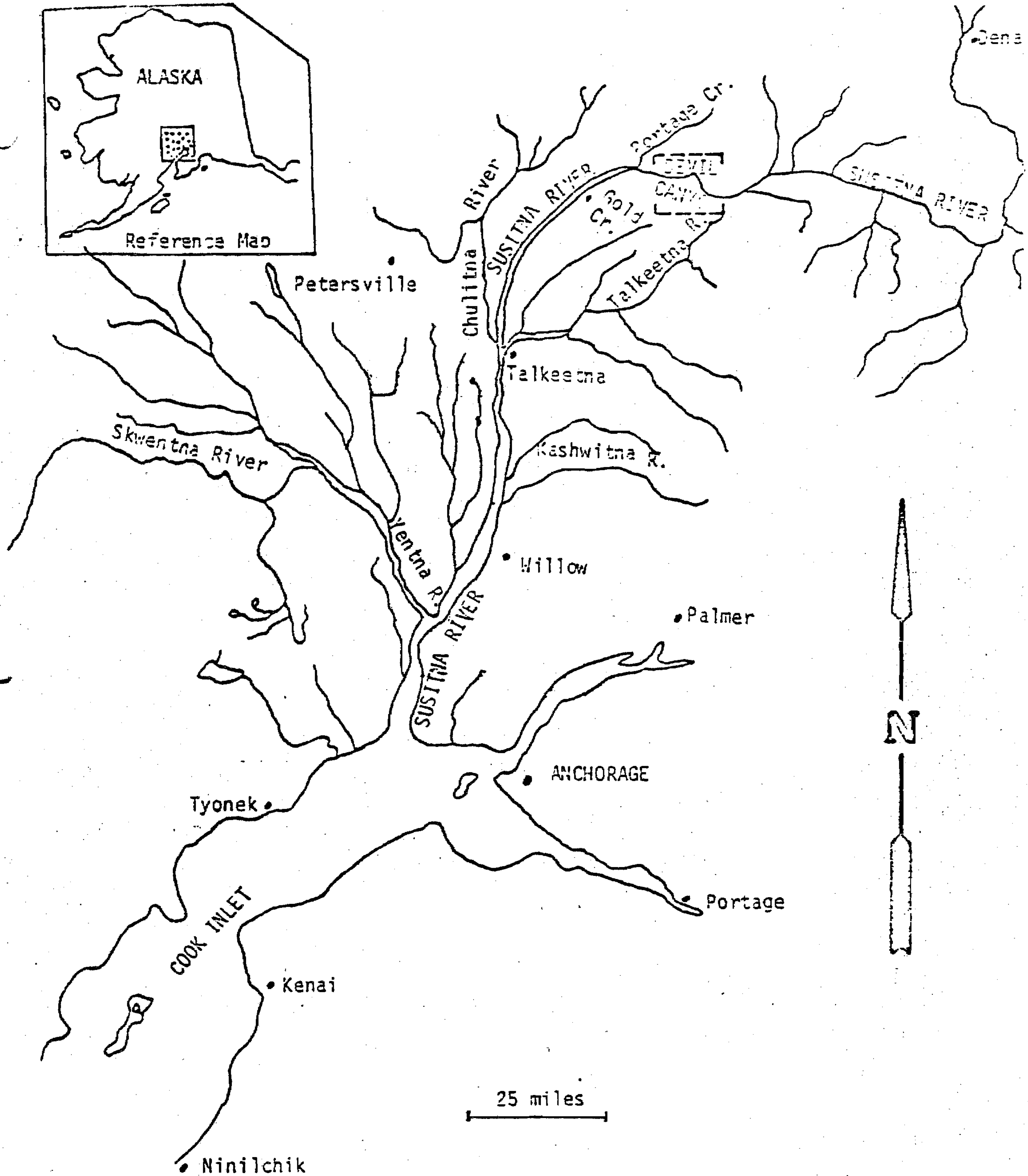

Figure 1. Devil Canyon in reference to the Susitna River watershed and northern Cook Inlet, Devil's Canyon Project, 1974.

determine spawning distribution, relative abundance, migrational timing, representative age-length-sex composition by species, and juvenile nursery areas.

The following report is a summary of the techniques employed and results obtained during the 1974 field season commencing July 1 and extending through September 27.

MATERIALS AND METHODS

An aerial reconnaissance of the study area was conducted June 30th to evaluate the physical characteristics of the river, to locate potential fishwheel sites and a stream survey camp. Construction of two portable fishwheels for the project commenced July 1 and extended to July 18. The fishwheels were the two paddle - two basket design (Figure 2). The basket frames were constructed from one-inch diameter water pipe and electrical conduit. Each basket was 7.5 feet long and 6 feet wide. The paddle frames also constructed from water pipe were the same dimensions as the baskets. Plywood panels, 6.5 feet in length formed the surface area of each paddle. Herring seine was tied on each basket and the fish chutes were constructed of plywood. The baskets and paddles were sprocketed into a 9.5 foot long steel axle with bearings. Floatation was provided by styrofoam logs shielded by a plywood covering. Steel axle mounts, which were adjustable in height, permitted maintenance changes in the fishing depth of the baskets. A live box was attached to the river bank side of each fishwheel for holding fish.

Fishwheels were operated from July 23 through September 11 at sites on the Susitna River. One fishwheel was located adjacent to the east bank of the river approximately 5 miles upstream from the town of Talkeetna, Alaska and a second at a site adjacent to the west bank of the river approximately 2.3 miles downstream of the first (Figure 3). Both fishwheels were operated on a scheduled twenty-four hour a day basis. Fishing efforts were not continuous due to structural

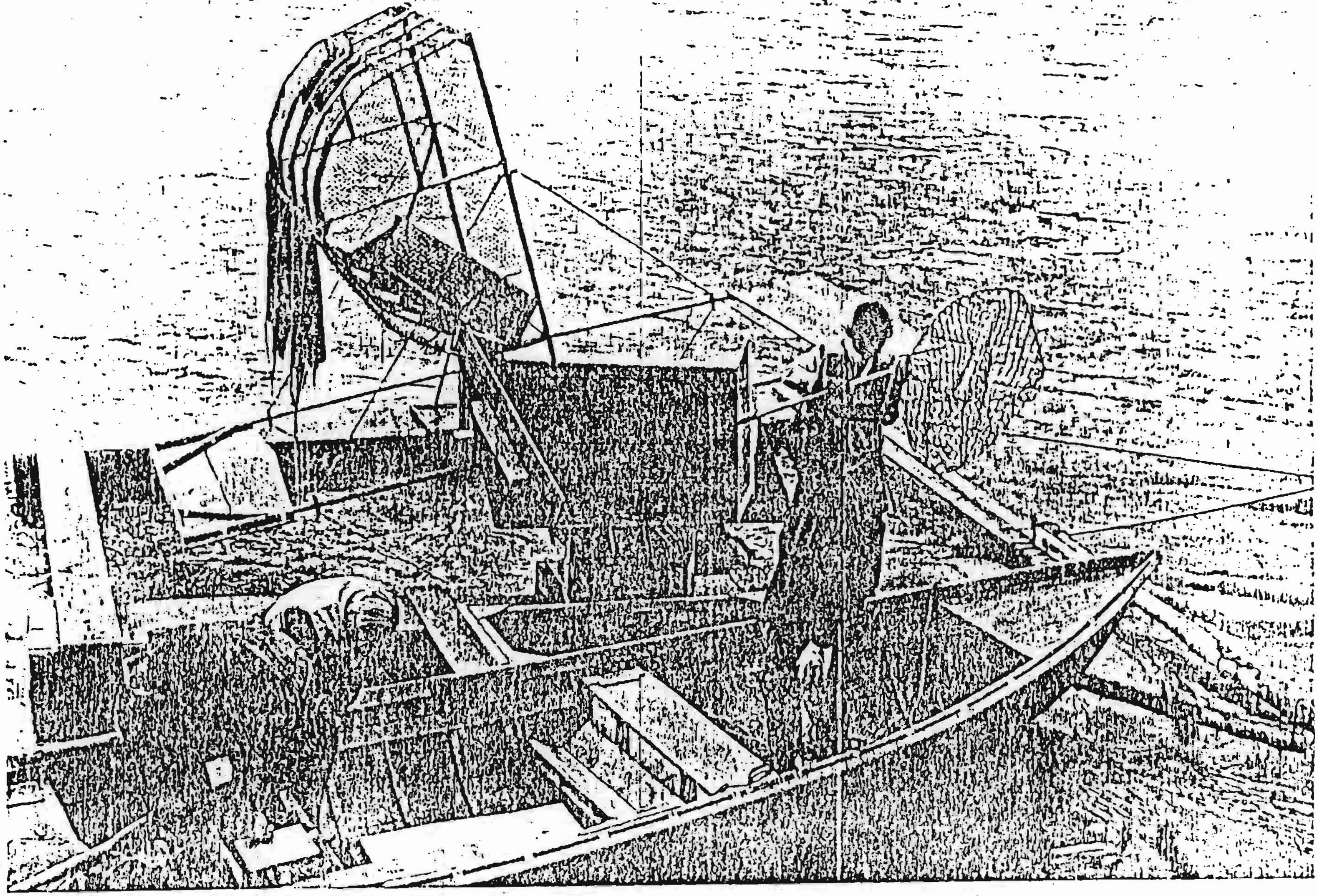

Figure 2. Fishwheel located off the east bank of the Susitna River, Devil's Canyon Project, 1974.

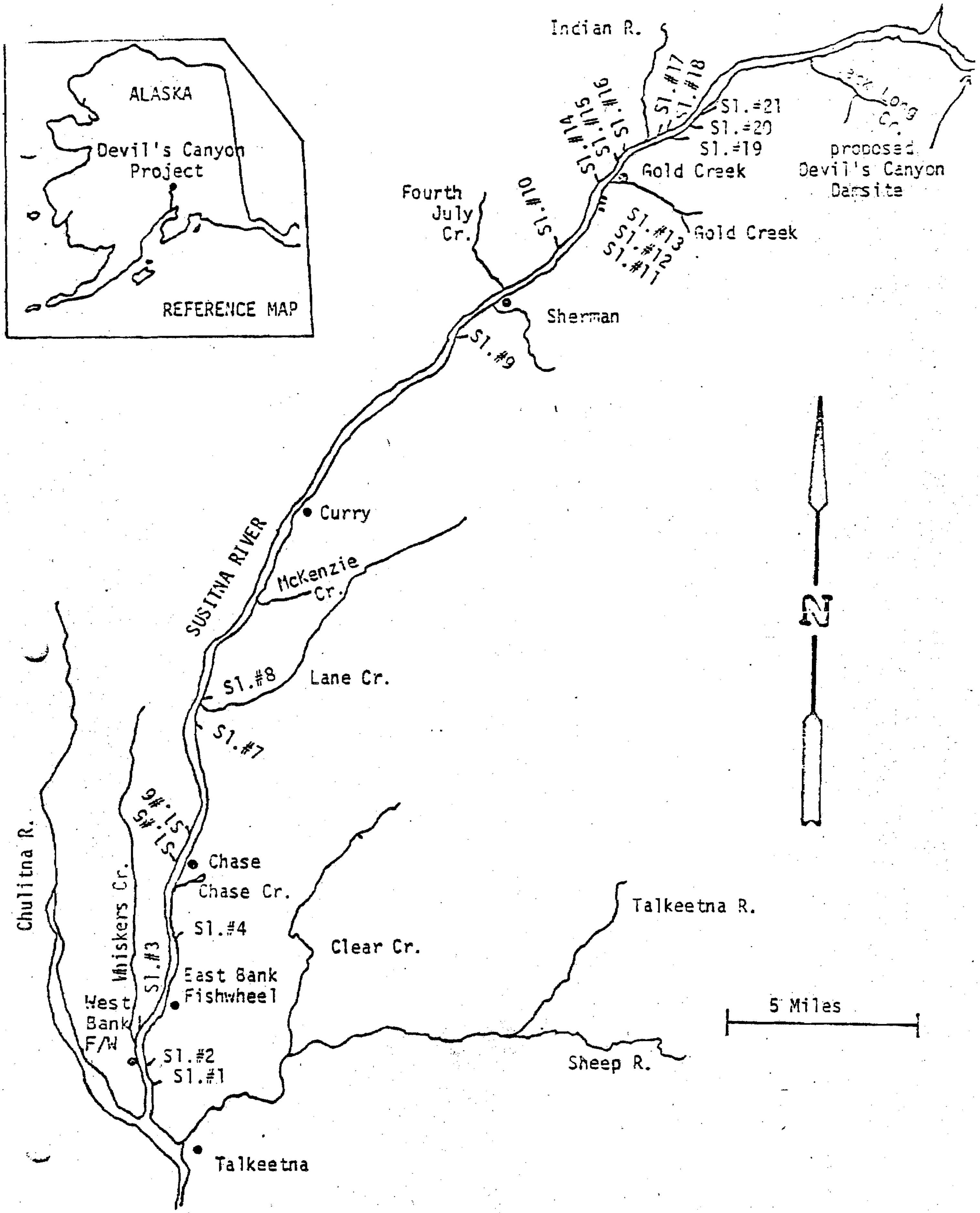

Figure 3. Map of the area encompassed in the Devil's Canyon study on the upper Susitna River, Devil's Canyon Project, 1974.

fatigue in the axles resulting from inferior arc welds and river debris. The east and west bank wheels were operated at approximately 2.25 and 2.5 revolutions per minute, respectively. Due to unpredictable fluctuations in river level, the wheels were fished within 2 feet of the river bottom. Each wheel was equipped with a 30 foot onshore lead angled approximately 45 degrees out from the downstream end of the floats. The west bank fishwheel was operated at the end of a slack water section of the river channel, and the east bank wheel was fished at the terminus of an eddy. Both fishwheels were positioned out from the banks by 20-30 foot spruce logs.

Fishwheel catches were recorded by species and salmon were tagged just below their dorsal fins with color and number coded 1 inch diameter Peterson discs. Buffer discs were also applied. Age-length-sex data were collected for all species with the exception of pink salmon. After salmpling, the fish were immediately released.

A stream survey camp was established August 1 and maintained through September 27 at the mouth of Gold Creek approximately 15 miles below the proposed Devil Canyon damsite. During the month of August and September aerial, boat, and foot reconnaissance surveys were undertaken to denote spawning and rearing areas between the canyon and the confluence of the Chulitna and the Susitna Rivers. Tributary streams and sloughs were surveyed for adult spawners. Sloughs were also surveyed for rearing fry. Spawning areas were usually surveyed weekly, but occasionally unfavorable weather prohibited boat travel or afforded substandard survey conditions, thus aegating the maintenance of a strict survey schedule. The two man crew stationed at the fishwheel camp surveyed the section of the Susitna River from the community of Chase to the Chulitna River.

Escapement surveys were conducted by a two man team; one individual enumerated live spawners while the second man counted carcasses. Tagged fish were recorded by tag color and when visibility conditions permitted, also by tag number. Seining, rod and reel, dip netting, and a minimum of gill netting was conducted during these surveys to obtain representative age, length and sex composition samples of escapement. Seining was the preferred method employed on the streams and dip netting in the sloughs. All individuals captured with the exception of pink salmon, were scale sampled, measured (mid-eye to fork of tail) to the nearest millimeter, and sexed. The fish were fin clipped to avoid resampling.

Sloughs were surveyed in their entirety. Index markers representing survey termination points were established on the streams at distances usually one half mile upstream from their confluences with the Susitna River. Total stream escapement monitoring was not achieved due to manpower restrictions. Water and air temperatures were recorded during each survey, and water discharge data were taken with a flow rod. While all adult and fry surveys were conducted by foot, a wide beamed sixteen-foot river boat, powered by a 40hp. outboard was employed for traveling between survey areas on the Susitna River. A similar craft was used to service the fishwheels. Logistic support to the field stations was accomplished by aircraft and railroad.

Rearing fry investigations were conducted in the sloughs; records were kept on the number of fry observed, and when practical, a 15 foot minnow seine was fished to obtain fry identification samples. A portion of the salmon fry catch was sampled for species age and length (tip of snout to fork of tail) composition.

Climatological observations were recorded daily at the fishwheel camp. The weather factors monitored included air and water temperatures, relative water level and general atmospheric conditions. A Ryan thermograph was operated from

September 2 through 7 to monitor the lower Susitna River water temperatures at the fishwheel camp. A second thermograph was utilized upriver during the same period near the Gold Creek survey camp.

The European formula, denoting age by number of winters spent in freshwater followed by a decimal point and number of winters reared in saltwater, is used for recording age data in this report.

RESULTS

Migrational Investigations

A total of 1,015 salmon (*Oncorhynchus sp.*), were caught during the period July 23 through September 11 in the two fishwheels. This total included 160 pink (*O. gorbuscha*), 568 chum (*O. keta*), 244 coho (*O. kisutch*). 39 sockeye (*O. nerka*), and 4 king salmon (*O. tschawytscha*). Approximately 92 percent of the total sample was caught in the east bank fishwheel. Tables 1 and 2 represent the species catch by date, for the east and west bank fishwheels, respectively. Comparison of catch by date between the two wheels indicates that a minor proportion of the fish migration occurred along the west bank of the river at the west bank fishwheel site. A graph of the mean hourly catch by day at the east bank fishwheel is presented in Figure 4. Approximately 76 percent of the pink salmon migration occurred in the seven day period of July 30 through August 5. The chum salmon migration peaked on August 12 when 10.9 percent of the total catch occurred; approximately 46 percent of the total chum catch was obtained during the period of August 11 through 17. The daily catch rate of coho salmon at the fishwheel camp was relatively stable compared to that of the pink or chum salmon; approximately 52 percent of the coho catch occurred during the period of August 12 through August 24. Sockeye salmon catches were relatively low. Ten of the 39 sockeye salmon caught were captured in the east bank fishwheel on August 15 and 16. The

Table 1. East bank fishwheel catch of salmon by species from July 23 through September 11, Devil's Canyon Project, 1974.

Date	No. Hours Fished	Pink Daily	Pink Cumulative	Chum Daily	Chum Cumulative	Coho Daily	Coho Cumulative	Sockeye Daily	King Daily
July									
23	24	0	0	0	0	0	0	0	1
24	24	2	2	0	0	0	0	1	0
25	24	4	6	0	0	0	0	1	1
26	24	0	6	0	0	0	0	1	0
27	16.5	1	7	1	1	0	0	2	0
28	0								
29	14	1	8	0	1	0	0	0	0
30	23	44	52	0	1	3	3	4	0
31	1	0	52	0	1	0	3	0	0
August									
1	24	23	75	1	2	4	7	0	0
2	24	16	91	3	5	2	9	2	0
3	24	8	99	3	8	3	12	1	1
4	24	16	115	6	14	4	16	0	0
5	24	11	126	8	22	4	20	0	0
6	24	6	132	6	28	5	25	0	0
7	12	0	132	1	29	0	25	0	0
8	24	1	133	24	53	5	30	0	0
9	24	3	136	18	71	2	32	0	0
10	24	1	137	7	78	4	36	0	0
11	24	3	140	40	118	3	39	0	0
12	24	4	144	61	179	6	45	0	0
13	20.5	1	145	18	197	9	54	0	0
14	24	3	148	48	248	14	68	1	0
15	24	3	151	21	266	9	77	6	0
16	24	2	153	43	309	8	85	4	1
17	24	1	154	21	330	7	92	0	0
18	24	0	154	17	347	7	99	2	0
19	23.5	1	155	13	360	7	106	0	0
20	24	0	155	16	376	11	117	2	0
21	20.5	0	155	16	392	12	129	3	0
22	24	1	156	13	405	9	138	0	0
23	24	0	156	17	422	8	146	1	0
24	21.5	0	156	15	437	8	154	0	0
25	11	0	156	8	445	1	155	0	0
26	24	0	156	22	467	5	160	2	0
27	24	0	156	12	497	4	164	1	0
28	24	0	156	3	482	1	165	1	0
29	24	0	156	10	492	5	170	1	0
30	24	0	156	4	496	5	175	0	0
31	24	0	156	14	510	5	180	1	0
September									
1	24	0	156	19	529	7	187	0	0
2	16.5	0	156	7	536	5	192	0	0
3	3	0	156	0	536	0	192	0	0
4	24	0	156	3	539	3	195	0	0
5	24	0	156	4	543	4	199	0	0
6	24	0	156	3	546	1	200	0	0
7	24	0	156	1	547	1	201	0	0
8	24	0	156	0	547	0	201	0	0
	24	0	156	0	547	0	201	0	0
10	24	0	156	0	547	2	203	0	0
11	13	0	156	0	547	0	203	0	0
Season Total	1,061	156		547		203		37	4

Table 2. West bank fishwheel catch of salmon by species from July 23 through September 8, Devil's Canyon Project, 1974.

Date	No. hours fished	Pink Daily	Pink Cumulative	Chum Daily	Chum Cumulative	Coho Daily	Coho Cumulative	Sockeye Daily	King Daily
July									
23	24	0	0	0	0	0	0	0	0
24	24	0	0	0	0	0	0	0	0
25	24	0	0	0	0	0	0	0	0
26	6	0	0	0	0	0	0	0	0
27-29	0								
30	4	0	0	0	0	0	0	0	0
31	24	2	2	0	0	0	0	0	0
August									
1	11.5	2	4	0	0	0	0	0	0
2-6	0								
7	4.5	0	4	0	0	0	0	0	0
8	24	0	4	1	1	1	1	0	0
9	24	0	4	0	1	0	1	0	0
10	24	0	4	0	1	1	2	0	0
11	24	0	4	2	3	0	2	0	0
12	24	0	4	1	4	0	2	0	0
13	24	0	4	1	5	0	2	0	0
14	24	0	4	1	6	1	3	0	0
15	24	0	4	1	7	0	3	0	0
16	0								
17	9.5	0	4	1	8	0	3	0	0
18	24	0	4	2	10	2	5	1	0
19	24	0	4	0	10	2	7	0	0
20	24	0	4	2	12	2	9	0	0
21	24	0	4	0	12	1	10	0	0
22	24	0	4	0	12	1	11	0	0
23	24	0	4	1	13	0	11	0	0
24	24	0	4	2	15	2	13	0	0
25	6	0	4	0	15	0	13	0	0
26-27	0								
28	14	0	4	0	15	0	13	0	0
29	24	0	4	0	15	0	13	0	0
30	24	0	4	1	16	1	14	0	0
31	24	0	4	1	17	5	19	0	0
September									
1	24	0	4	2	19	7	26	1	0
2	24	0	4	1	20	3	29	0	0
3	24	0	4	0	20	3	32	0	0
4	24	0	4	1	21	3	35	0	0
5	24	0	4	0	21	3	38	0	0
6	24	0	4	0	21	2	40	0	0
7	24	0	4	0	21	1	41	0	0
8	20	0	4	0	21	0	41	0	0
Season Total	771.5	4		21		41		2	0

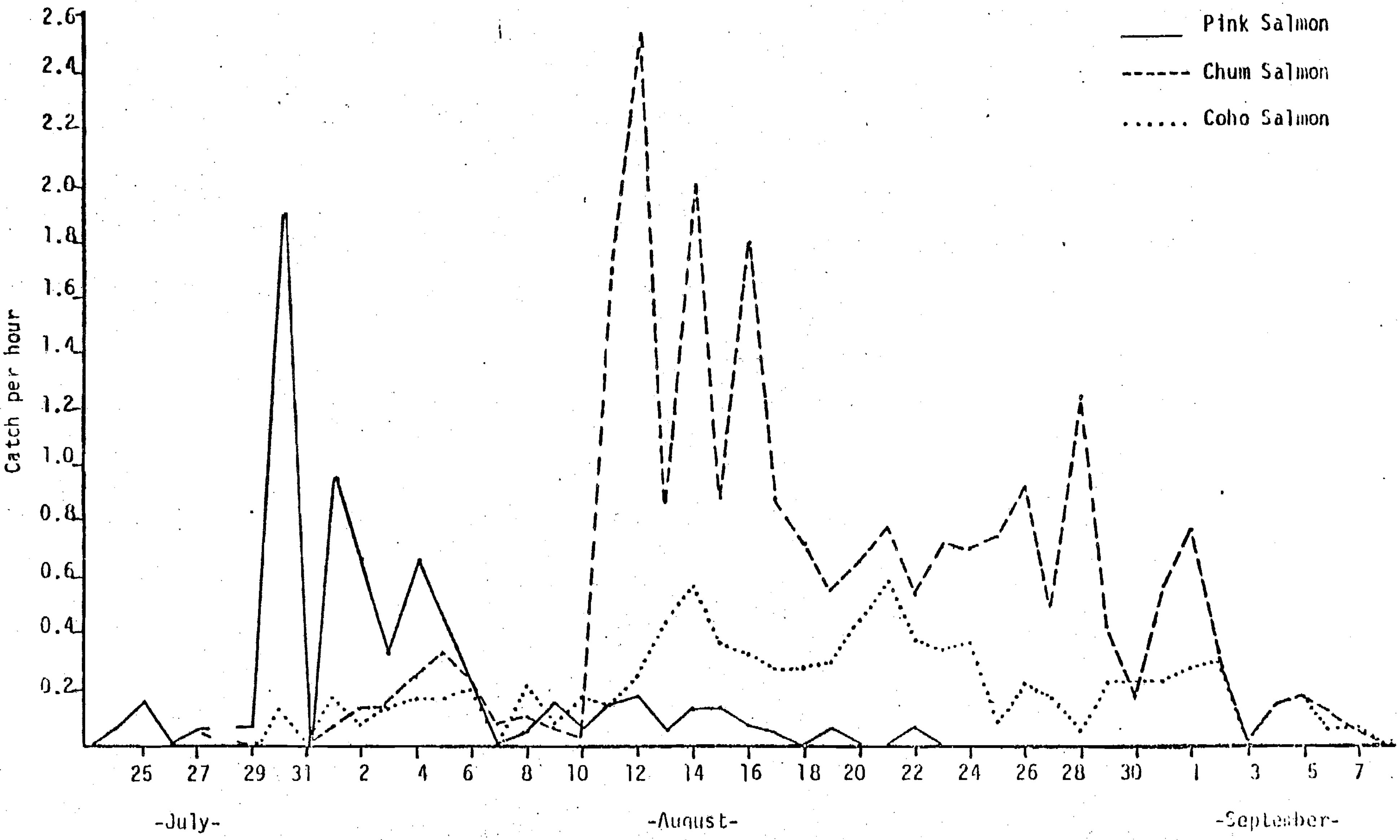

Figure 4. Average hourly catch by species per day of east bank fishwheel operation at the Devil Canyon fishwheel camp, Devil's Canyon Project, 1974.

king salmon migration occurred prior to the installation of the fishwheels and only four members of the species were captured at the camp.

The Petersen mark and recapture formula was used to obtain estimates of the pink, chum and sockeye salmon populations migrating in the Susitna River at the fishwheel camp (Table 3). The Petersen and confidence limit formulas and the population estimates with 95 percent confidence limits are:

$$N = \frac{m\,c}{r} \quad \pm \quad N\sqrt{\frac{(N-m)(N-c)}{mc\ (N-1)}}$$

where:

N = estimate of the population
m = number of fish tagged in the population
c = number of fish sampled
r = number of tagged fish sampled

Chum	24,286 ± 2,602
Pink	5,252 ± 998
Sockeye	1,008 ± 224

Insufficient numbers of spawning coho salmon were observed to obtain a credible estimate of the population. The limited data suggests the coho population ranged from 4,000 to 9,000 fish.

These estimates were based upon cummulative escapement survey data, on the number of live untagged to live tagged spawners in the sloughs and index areas of the streams, collected under "fair, good, or excellent" survey conditions as judged by the survey crew (Appendix Table 1). Tag loss and tagging induced mortality, not considered in computing the estimates, would reduce by direct proportion the population estimates. However, since spawning ground surveys revealed no tag scared fish and tags removed from carcasses usually required pliers, tag loss was probably minimal. In addition, tagging induced mortality was also probably minimal due to the capture and mark procedures used and the usual robustness of adult salmon during their final migration to spawning grounds. Thus, while some positive bias would be introduced by not including adjustments for these two factors, it is unlikely that the bias would be significant from a practical viewpoint.

Table 3. Number of marked fish submitted into the populations and the number of tagged to untagged fish observed on the spawning grounds with the resultant population estimates, Devil's Canyon Project, 1974.

Species	Number Fish Tagged (m) (Fishwheel)	Number Fish Sampled (live counts)			Population Estimates (N)
		Untagged	Tagged(r)	Total(c)	
Chum	568	3090	74	3164	24,286
Pink	160	732	23	755	5,252
Sockeye	39	322	13	336	1,008
Coho	244	130	5	135	—

The population estimates do not reflect spawning ground densities above the fishwheel camp, but rather only the populations that were susceptible to capture at the fishwheel sites. Significant tag returns by sportsmen fishing below the camp in conjunction with visual sightings of tagged fish by Department biologists surveying salmon index areas south of Talkeetna, indicate that a proportion of the salmon tagged were not destined to spawn above the fishwheel camp but rather below it (Table 4 and Figure 5). The practical implications are: (1) either some marked fish tended to become disoriented due to disruption associated with the capture-tagging process and proceeded to migrate downstream finally spawning in a place different from their homestream, (2) both marked and unmarked fish

Table 4. Record of tagged salmon recovered below the Devil's Canyon fishwheel camp, Devil's Canyon Project, 1974.

Species	Tagging Date	Recovery Date	Location	Activity
Sockeye	8/16-18	9/17	Swan Lake	Spawning
Sockeye	8/14	9/6 and 9/17	Swan Lake	Spawning
Pink	7/30	8/3	Sheep Cr.	Spawning
Pink	8/6	8/18	Clear Cr.	Spawning
Chum	8/1	8/7	Montana Cr.	Milling
Chum	8/9-10	8/23	Montana Cr.	Spawning
Coho	8/1	8/8	Birch Cr.	Milling
Coho	8/1	8/14	Birch Cr.	Milling
Coho	8/14-15	8/22	Susitna R.	Migrating
Coho	8/14-15	8/24	Talkeetna R.	Milling
Coho	8/11	8/31	Trappers Sl.	Spawning
Coho	8/12-13	8/31	Trappers Sl.	Spawning
Coho	8/9-10	9/1	Sunshine Cr.	-

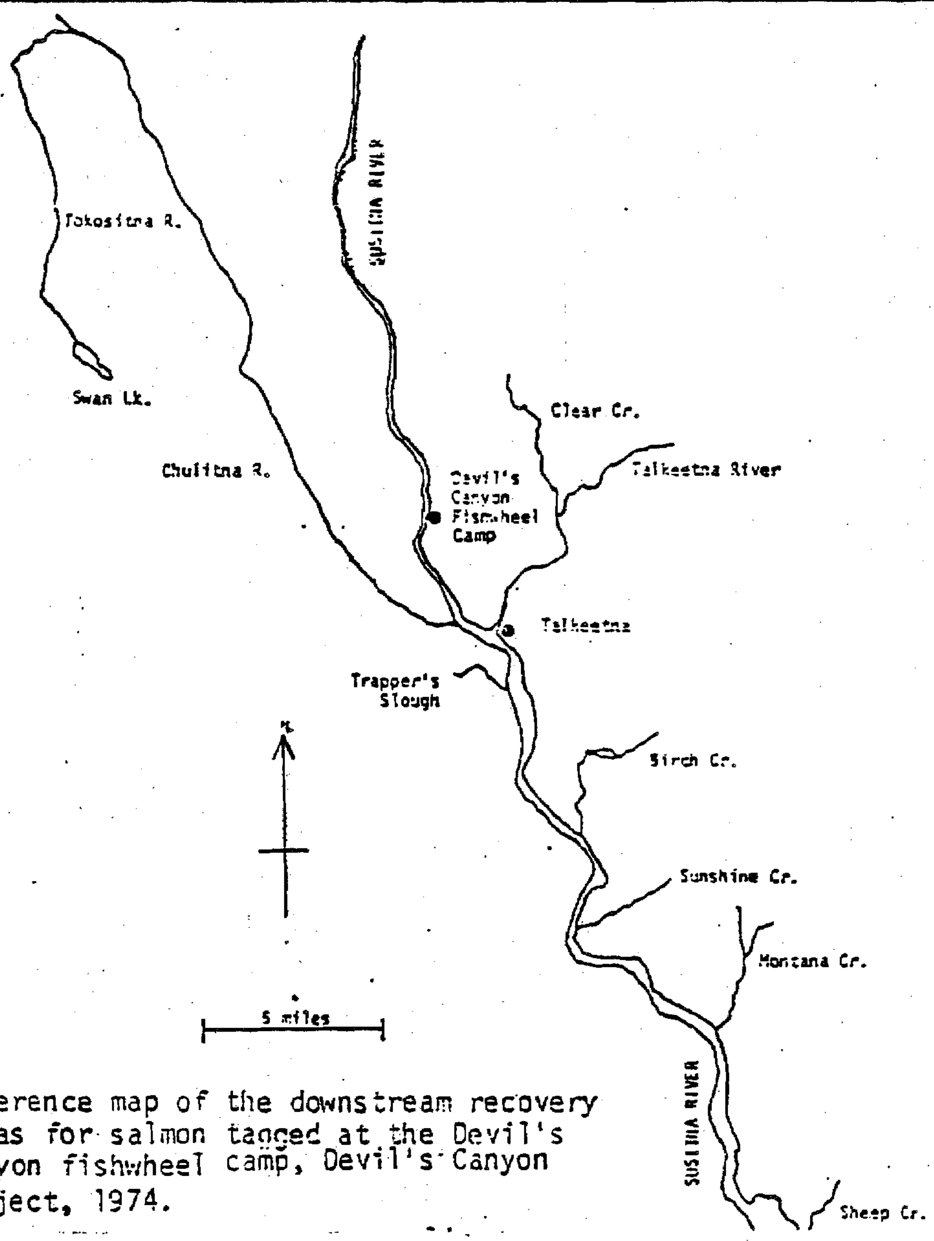

Figure 5. Reference map of the downstream recovery areas for salmon tagged at the Devil's Canyon fishwheel camp, Devil's Canyon Project, 1974.

passing the tagging site were not all destined for spawning areas upstream of the site and some later migrated downstream to spawn in areas below the site or (3) some combination of these two situations. In any case the result is that the population estimates would be over-estimates of actual spawning above the tagging site. In the case of (1) above, the population estimates would also be over-estimates of the number of fish migrating past the site.

Chum salmon age samples collected at the fishwheel camp depict the escapement as being composed primarily of 3 and 4 year old fish (Table 5). Approximately 48 percent of the chum salmon were produced from the 1971 parent year stock. The sex ratio was 1 female to 1.6 males.

Escapement sampling of coho salmon revealed that the prominent age class of the migrants was 2.1 or 4 year old fish from 1970 brood year, and the sex composition was 1 female to 1.1 males (Table 6).

Length frequency distributions are given in Figures 6 and 7 for chum and coho salmon catches at the fishwheel camp. Chum salmon averaged 584.0 millimeters in length and similarly coho 516.3 millimeters.

Sockeye salmon sampled from the fishwheel catches were produced from the 1969 through 1971 parent year (Table 7). Approximately one third of the sockeye had wintered one year in fresh water and two winters in the ocean prior to their returns as adults to the spawning grounds. Precocious males (1.1 age) comprised 29.6 percent of the sample. The sex composition was 3 females to 1 male.

Rearing Fry and Escapement Investigations

On surveys conducted to locate potential salmon rearing and spawning sloughs on the Susitna River between Portage Creek and the Chulitna River, 21 sloughs were found (Figure 3). Rearing fish were observed in all 21 of these back water areas. Adult salmon were present in nine of the 21 sloughs surveyed.

Table 5. Analysis of chum salmon age and sex data by percent from escapement samples collected at the fishwheel camp, Devil's Canyon Project, 1974.

Year of Return		Age Class 0.2	Age Class 0.3	Age Class 0.4	Brood Year 1969	Brood Year 1970	Brood Year 1971	Sample Size
1974	Percent	47.7	33.9	18.4	18.4	33.9	47.7	100.0
	Number	228	162	88	88	162	228	478

	Sex Ratio Male	Sex Ratio Female	Sample Size
Percent	61.8	38.2	100.0
Number	350	216	566

Table 6. Analysis of coho salmon age and sex data by percent from escapement samples collected at the fishwheel camp, Devil's Canyon Project, 1974.

Year of Return		Age Class 1.1	Age Class 2.0	Age Class 2.1	Brood Year 1970	Brood Year 1971	Sample Size
1974	Percent	19.4	0.8	79.8	79.8	20.2	100.0
	Number	25	1	103	103	26	129

	Sex Ratio Male	Sex Ratio Female	Sample Size
Percent	52.5	47.5	100.0
Number	138	125	263

Table 7. Analysis of sockeye salmon age and sex data by percent from escapement samples collected at the fishwheel camp, Devil's Canyon Project, 1974.

Year of Return		Age Class 1.1	Age Class 1.2	Age Class 1.3	Age Class 2.1	Age Class 2.2	Brood Year 1969	Brood Year 1970	Brood Year 1971	Sample Size
1974	Percent	29.6	33.3	7.4	14.8	14.8	22.2	48.1	29.6	100.0
	Number	8	9	2	4	4	6	13	8	27

	Sex Ratio Male	Sex Ratio Female	Sample Size
Percent	25.0	75.0	100.0
Number	8	24	32

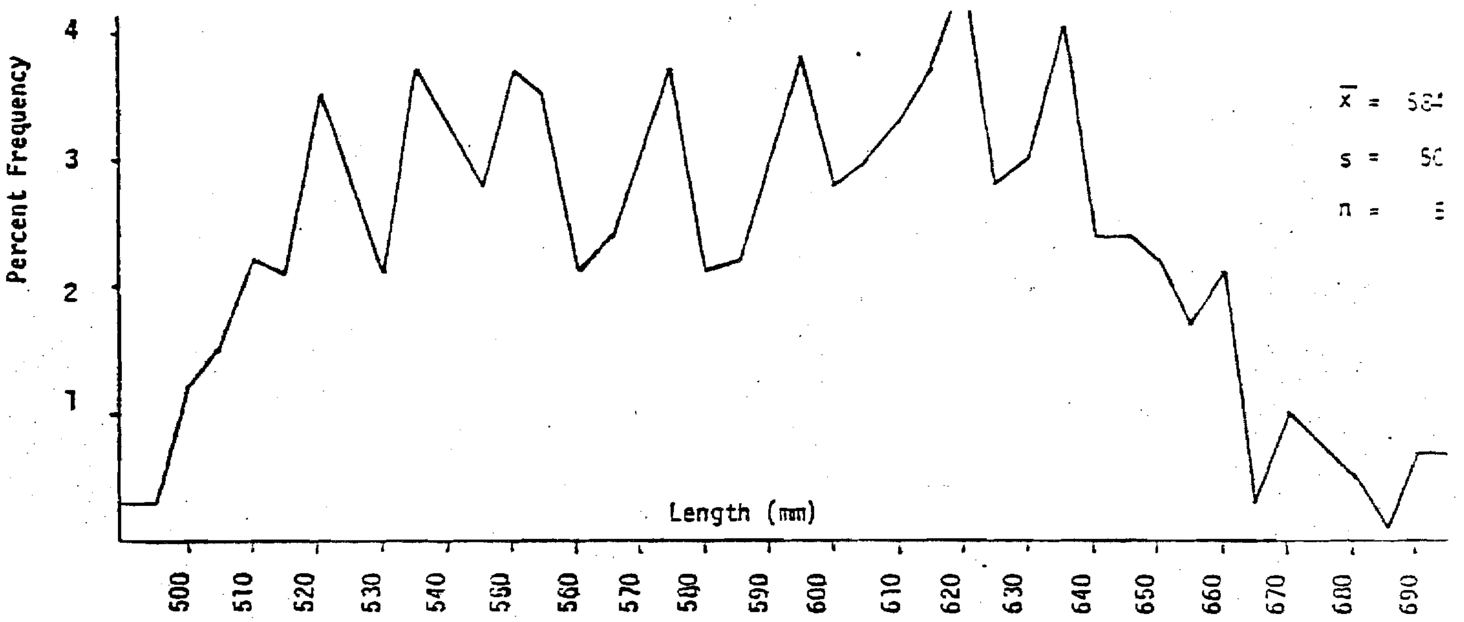

Figure 6. Length frequency of the chum salmon catch from the east and west bank fishwheels, Devil's Canyon Project, 1974.

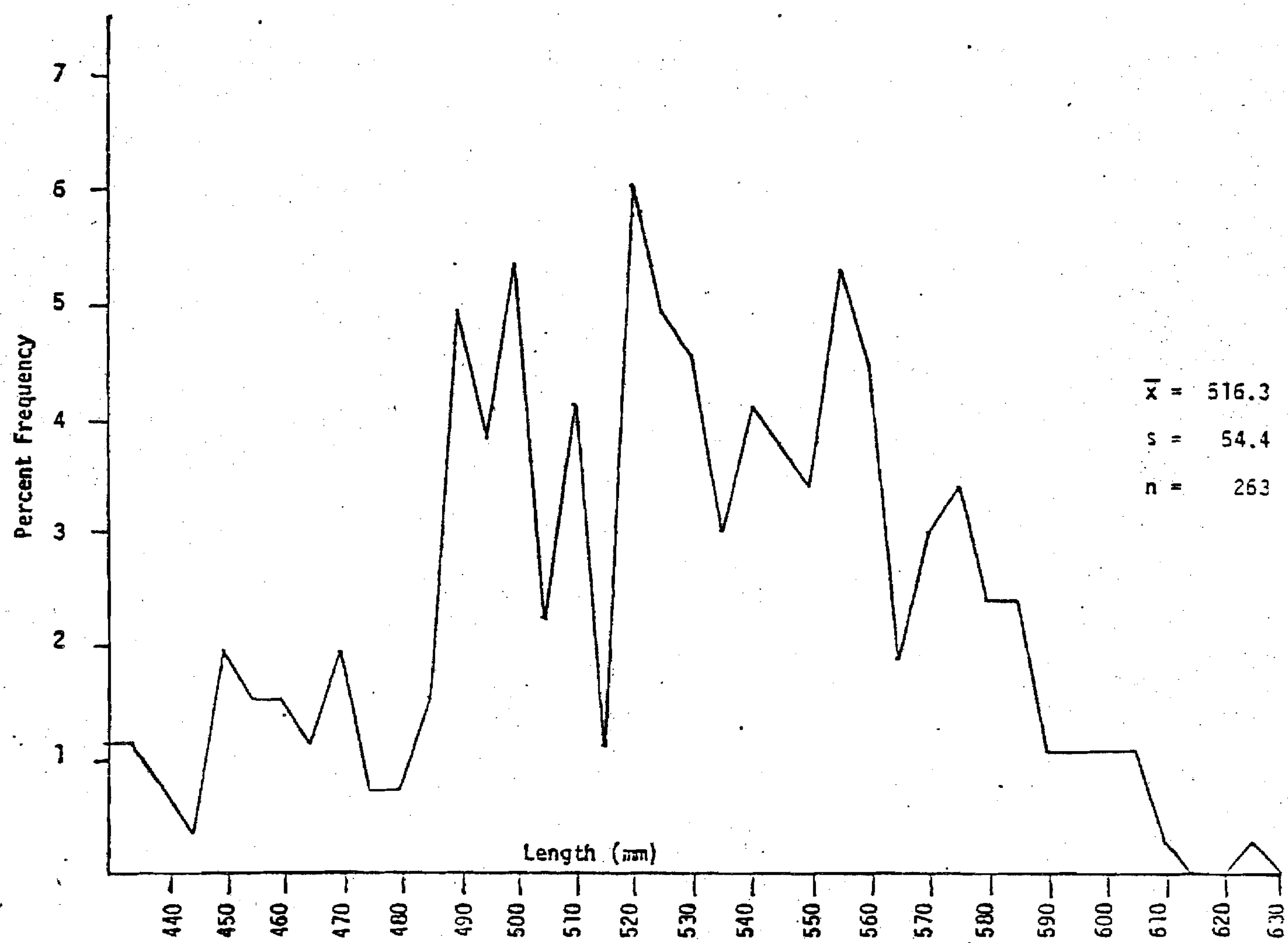

Figure 7. Length frequency of the coho salmon catch from the east and west bank fishwheels, Devil's Canyon Project, 1974.

Appendix Tables 2-5 summarize the rearing fry and adult salmon densities observed in each of these sloughs.

Coho fry populations were noted in 12 of the 21 sloughs surveyed and the fry aged from seven of these were produced exclusively from the 1973 parent stock (0.0 age). Samples collected in Sloughs No. 3, No. 4, No. 5 and No. 6 were comprised of both 0.0 age and 1.0 age coho fry (Table 8).

Sockeye fry samples were collected in Sloughs No. 3 and No. 5; these fish were produced from the 1973 brood stock (Table 9). King salmon fry of the 0.0 age class were obtained only from Slough No. 3 and were produced from the 1973 parent year (Table 11).

Fry sampling were conducted on Chase, Lane and Whiskers Creeks. Coho fry were found in all three creeks. King and sockeye fry were also found in Chase Creek; the results are presented in Tables 9-11.

Chum salmon spawning occurred in Sloughs No. 6, No. 9, No. 11, No. 14, No. 16, No. 17, No. 19, No. 20 and No. 21. Spawning densities exceeded 100 fish in three of these sloughs (No. 9, No. 20 and No. 21). The peak chum salmon spawning period occurred during the first three weeks of September (Figure 8).

Sockeye salmon were observed co-spawning with chums in Sloughs No. 9, No. 11, No. 19 and No. 21. The highest density of sockeye spawners occurred in Slough No. 11 with 79 recorded on September 22. Sockeye spawning extended from the second week of August through the month of September.

Escapement survey counts conducted in the clear water tributary streams do not reflect the total number of spawning salmon in these streams, but only the population density by species within the index areas (Appendix Table 5). On Fourth July Creek and Lane Creek salmon spawning was not considered significant above the index markers as the bulk of spawning occurred well below these markers.

Table 8. Age and length samples of coho salmon fry collected at Sloughs No.1, No.3, No.5, No.6, No.9, No.10, No.15, No.16 No.17 and No.20, Devil's Canyon Project, 1974.

Slough No.	Date	Sample Size	0.0 Age Class Percent Composition	0.0 Age Class Mean Length (mm)	0.0 Age Class Standard Deviation	1.0 Age Class Percent Composition	1.0 Age Class Mean Length (mm)	1.0 Age Class Standard Deviation
3	8/18	8	0.0			100.0	97.1	9.2
	9/2	8	87.5	54.6	4.2	12.5	105.	-
4	8/21	8	12.5	53.0	-	87.5	106.7	5.2
5	9/5	6	66.7	61.2	2.7	33.3	96.5	12.0
6	9/9	18	83.3	59.1	4.6	16.7	83.3	7.5
9	8/9	8	100.0	56.1	4.2	0.0		
10	8/16	4	100.0	59.7	5.7	0.0		
	8/19	4	100.0	58.5	0.5	0.0		
	8/21	8	100.0	63.5	2.7	0.0		
14	8/6	4	100.0	52.5	5.3	0.0		
	8/30	8	100.0	59.2	4.7	0.0		
15	8/8	8	100.0	49.4	2.8	0.0		
	8/19	8	100.0	50.6	3.3	0.0		
16	8/7	8	100.0	42.1	3.3	0.0		
	8/19	8	100.0	53.9	4.0	0.0		
17	8/8	8	100.0	49.9	4.1	0.0		
	8/21	8	100.0	57.1	4.3	0.0		
20	8/2	8	100.0	55.7	6.6	0.0		
	8/8	8	100.0	55.9	4.5	0.0		

Table 9. Age and length samples of sockeye salmon fry collected at Slough No.3, Slough No.5 and Chase Creek; Devil's Canyon Project, 1974.

Area Surveyed	Date	Sample Size	0.0 Age Class: Percent Composition	Mean Length (mm)	Standard Deviation
Slough No.3	8/22	2	100.0	60.5	0.7
	9/2	8	100.0	61.7	4.3
Slough No.5	9/5	8	100.0	54.9	7.3
Chase Cr.	8/21	1	100.0	58.	-
	8/31	2	100.0	57.5	6.4

Table 10. Age and length samples of coho salmon fry collected at Chase, Lane and Whiskers Creeks, Devil's Canyon Project, 1974.

			0.0 Age Class			1.0 Age Class		
Area Surveyed	Date	Sample Size	Percent Composition	Mean Length (mm)	Standard Deviation	Percent Composition	Mean Length (mm)	Standard Deviation
Chase Cr.	8/16	10	100.0	68.8	10.5	0.0		
	8/31	10	90.0	63.1	8.6	10.0	125.0	
Lane Cr.	8/28	1	100.0	50.0	-	0.0		
Whiskers Cr.	8/5	26	100.0	51.8	6.8	0.0		
	8/2	3	100.0	56.6	3.7	0.0		
	8/30	5	100.0	55.4	6.9	0.0		
	9/7	8	100.0	59.0	4.0	0.0		

Table 11. Age and length samples of king salmon fry collected at Slough No. 3 and Chase Creek, Devil's Canyon Project, 1974.

Area Surveyed	Date	Sample Size	0.0 Age Class: Percent Composition	Mean Length (mm)	Standard Deviation
Slough No.3	8/18	5	100.0	57.0	6.4
Chase Cr.	8/16	3	100.0	55.6	10.1

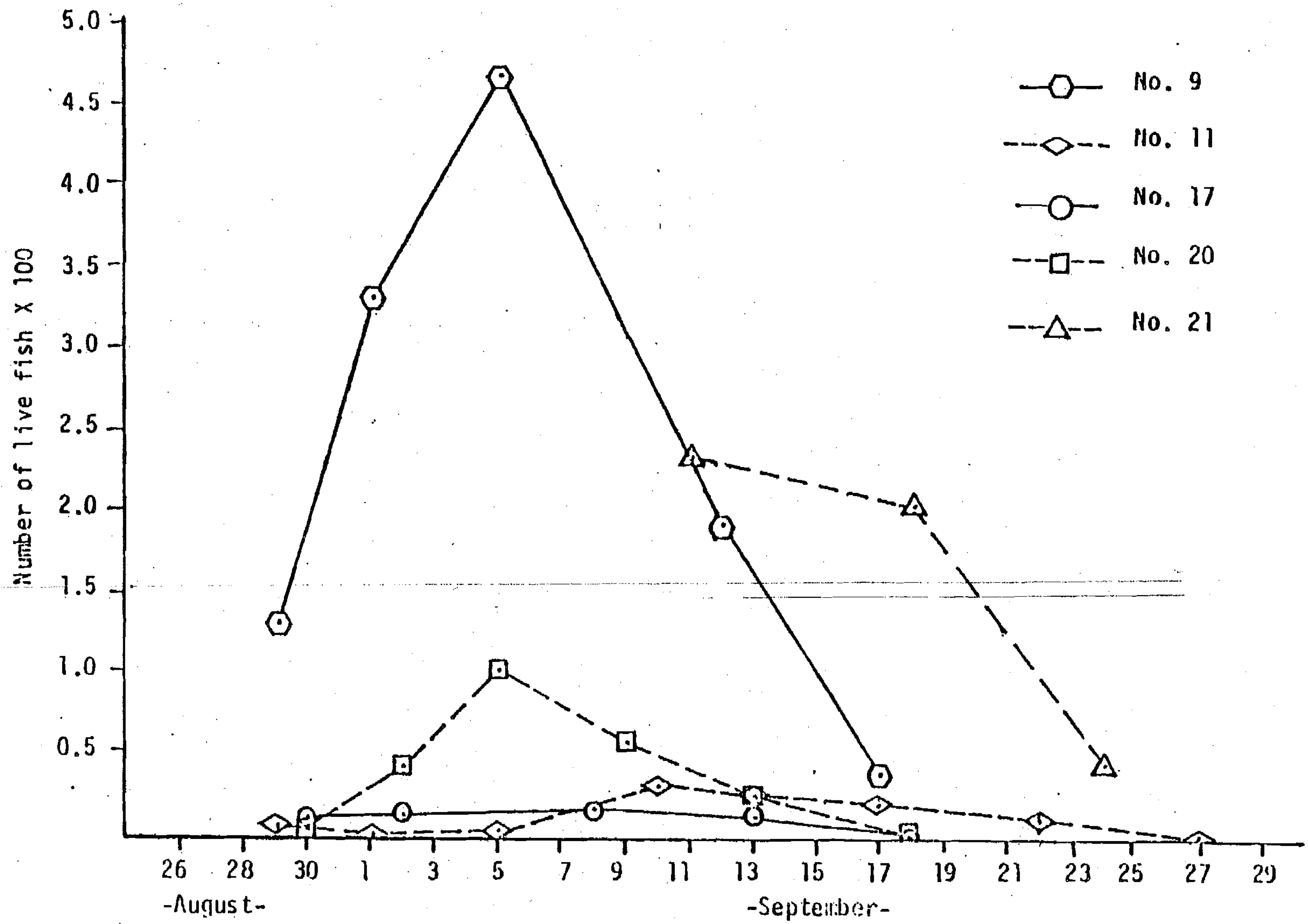

Figure 8. Chum salmon escapement surveys of live individuals in Sloughs No. 9, No. 11, No. 17, No. 20, and No. 21, Devil's Canyon Project, 1974.

Pink salmon were found in Indian River, Fourth July, Lane, Portage and Gold Creeks.[1/] The major peak of pink salmon spawning occurred during the first three weeks of August (Figure 9). Chum salmon also spawned in these streams with the exception of Lane and Gold Creeks. Chum spawning occurred primarily during the last two weeks of August and the first three weeks of September.

Coho salmon spawned in Indian River, Fourth July, Portage, Whiskers and Chase Creeks. Escapement survey data suggests the peak of spawning occurred during the first two weeks of September.

Surveyors did not observe sockeye salmon spawning in any of the tributary streams although one unspawned carcass was found on Chase Creek. Local residents report that sockeye spawn in Chase Lake located approximately one quarter mile above the index area.

The peak survey counts of pink, chum, coho and sockeye salmon in the sloughs and within the index areas of the streams are presented in Table 12. Based upon these raw data, the minimum population of salmon by species spawning, in the Susitna River watershed between Portage Creek and the Chulitna River, is as follows:

Pink Salmon	1,036
Chum Salmon	2,753
Coho Salmon	307
Sockeye Salmon	104

The peak stream index counts presented in Table 12 do not represent the absolute salmon abundance in these streams, but only a portion of their peak abundance levels. The author suggests that major spawning occurs well above the index markers on Indian River and Portage Creek, and contends that the index marker on the latter stream may represent less than 20 percent of the streams optimum spawning area.

1/ One spawned pink salmon was observed August 16, in Gold Creek, 100 yards above its confluence with Susitna River. Local residents reported that 16 pinks were spawning in the canyon of Gold Creek, during the first week of August.

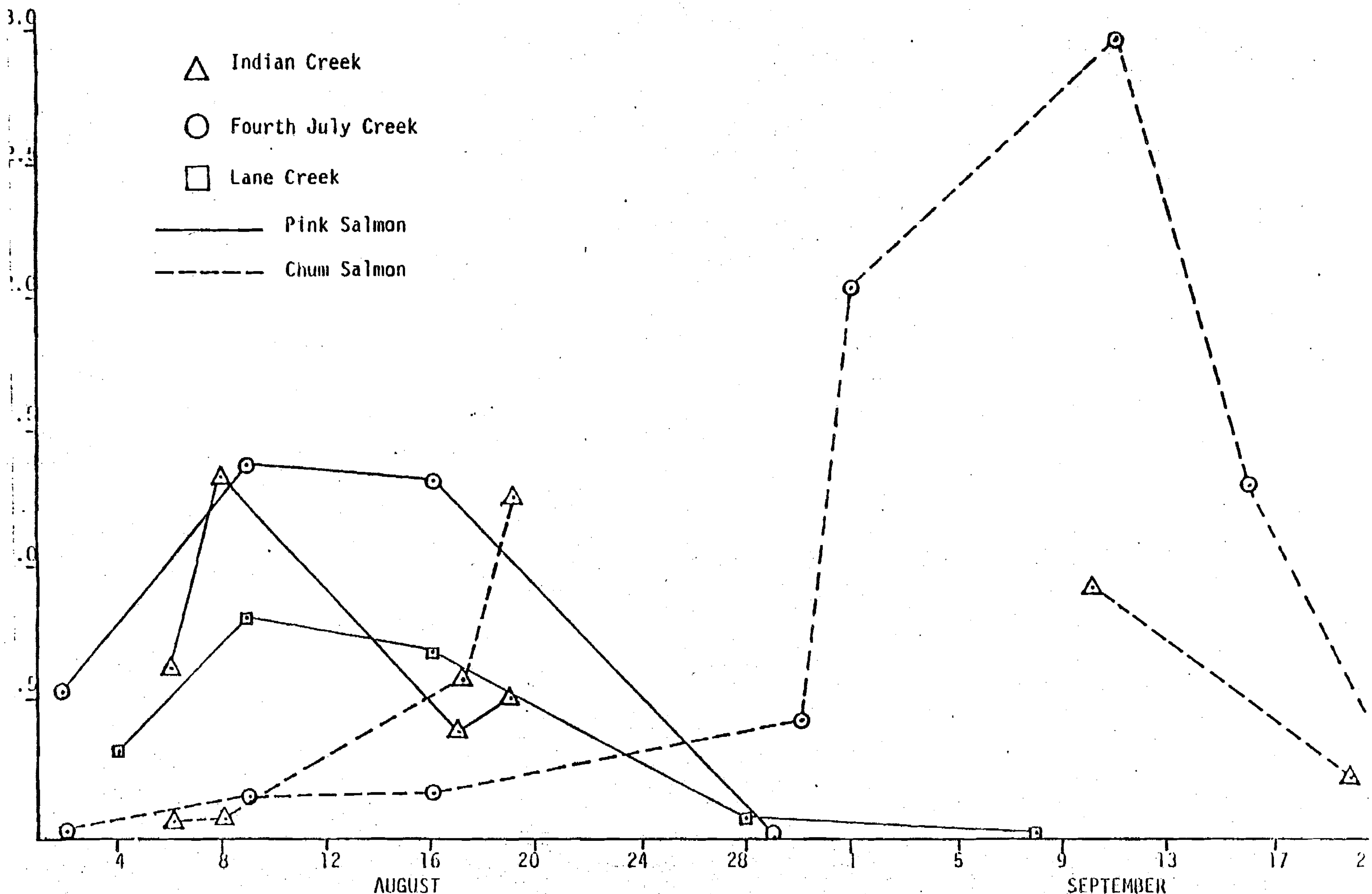

Figure 9. Pink and chum salmon escapement surveys of live individuals in Indian River, Fourth July Creek, and Lane Creek, Devil's Canyon Project, 1974.

Table 12. Peak chum, pink, coho and sockeye salmon escapement survey counts, Devil's Canyon Project, 1974.

Pink Salmon Surveys

Area Surveyed	Date	Density Live	Dead	Total
Indian R.	8/19	483	94	577
Fourth July Cr.	8/16	133	26	159
Portage Cr.	8/18	183	35	218
Lane Cr.	8/9	81	1	82
	Total	880	156	1,036

Sockeye Salmon Surveys

Area Surveyed	Date	Density Live	Dead	Total
Slough No.9	9/5&12	8	0	8
Slough No.11	9/22	79	0	79
Slough No.19	8/21	3	0	3
Slough No.21	9/18	13	0	13
Chase Cr.	8/16&21	0	1	1
	Total	103	1	104

Coho Salmon Surveys

Area Surveyed	Date	Density Live	Dead	Total
Indian R.	9/10	64	0	64
Fourth July Cr.	9/11	26	0	26
Portage Cr.	8/18	150	0	150
Whiskers Cr.	8/30	27	0	27
Chase Cr.	9/1	40	0	40
	Total	307	0	307

Chum Salmon Surveys

Area Surveyed	Date	Density Live	Dead	Total
Slough No.6	8/28	1	0	1
Slough No.9	9/5	466	45	511
Slough No.11	9/17	19	14	33
Slough No.14	8/30	2	0	2
Slough No.16	8/19&30	2	0	2
Slough No.17	9/13	12	12	24
Slough No.19	9/24	0	4	4
Slough No.20	9/5	101	6	107
Slough No.21	9/18	205	463	668
	Sub Total	808	544	1352
Indian R.	9/10	182	349	531
Fourth July Cr.	9/11	300	294	594
Portage Cr.	8/18	265	11	276
	Total	1555	1198	2753

Chum salmon aged from escapement samples collected on the spawning grounds were approximately 86 percent three and four year old fish produced from the 1970 and 1971 parent stocks. A summary of the age and length data collected by stream and slough are outlined in Table 13.

Age samples obtained from coho salmon spawning in the tributary streams infer that the escapement was predominantly four year old fish (2.1 age) from the 1970 brood year. Table 14 presents a summary of the coho salmon age and length data collected by stream. Sockeye salmon age data were collected in Sloughs No. 11 and No. 12, the results are summarized in Table 15. A majority (64.3 percent) of the sockeye had spent one winter in fresh water and two winters in the ocean prior to their return as adults from the 1970 brood year.

Individual maps were composed for sixteen of the twenty-one sloughs surveyed (Appendix Figure 1-14). The primary salmon spawning areas and the relative surface composition of the bottom substrate in these sloughs are denoted on the maps. Warm water seepages (springs) were observable in all but six of the sloughs (No. 1, No. 2, No. 3, No. 4, No. 5 and No. 8).

Predation on spawning fish by raptors and carnivorous mammals was relatively light on the streams and sloughs surveyed. Bald eagles were observed feeding on salmon in Indian River, and Fourth July Creek. Brown bear sign, although sparce, was observed on Sloughs No. 9, No. 20 and No. 21. Black bear sign was noted on Chase Creek, Whiskers Creek, Indian River and Slough No. 9.

Historic Information

Historic information obtained by the stream survey crew during interviews with local residents suggest that "10 years ago Sloughs No. 12 and No. 13 supported 'large' spawning populations of chum salmon, but in recent years rechannelization of the Susitna River near these sloughs has de-watered major

Table 13. Analysis of chum salmon age and length data by percent from escapement samples collected at Slough No. 9, Slough No. 20, Slough No. 21, Indian River, Portage Creek and Fourth July Creek, Devil's Canyon Project, 1974.

Area Sampled	Sample Size	Age Class				Brood Year				Sample Size	Mean Length (mm)	Standard Deviation
		0.2	0.3	0.4	0.5	1968	1969	1970	1971			
Slough No.9	39	35.9	46.2	17.9	0.0	0.0	17.9	46.2	35.9	40	579.2	35.9
Slough No.20	20	50.0	40.0	10.0	0.0	0.0	10.0	40.0	50.0	20	500.7	49.3
Slough No.21	36	52.8	36.1	11.1	0.0	0.0	11.1	36.1	52.8	40	563.7	38.5
Indian River	20	65.0	20.0	10.0	5.0	5.0	10.0	20.0	65.0	21	579.0	41.9
Portage Cr.	13	46.2	46.2	7.7	0.0	0.0	7.7	46.2	46.2	13	559.2	41.2
Fourth July Cr.	23	26.1	47.8	26.1	0.0	0.0	26.1	47.8	26.1	25	591.5	39.2

Table 14. Analysis of coho salmon age and length data by percent from escapement samples collected at Chase Creek, Indian River, Portage Creek, Whiskers Creek and Fourth July Creek, Devil's Canyon Project, 1974.

Area Sampled	Sample Size	Age Class 1.1	Age Class 2.0	Age Class 2.1	Age Class 3.1	Brood Year 1969	Brood Year 1970	Brood Year 1971	Sample Size	Mean Length (mm)	Standard Deviation
Chase Cr.	7	0.0	0.0	100.0	0.0	0.0	100.0	0.0	16	534.9	43.4
Indian R.	13	7.7	0.0	92.3	0.0	0.0	92.3	7.7	24	508.1	53.1
Portage Cr.	16	6.3	0.0	81.3	12.5	12.5	81.3	6.3	28	519.5	49.2
Whiskers Cr.	5	0.0	0.0	100.0	0.0	0.0	100.0	0.0	10	540.6	48.5
Fourth July Cr.	4	0.0	25.0	50.0	25.0	25.0	50.0	25.0	5	538.0	81.9

Table 15. Analysis of sockeye salmon age and length data by percent from escapement samples collected at Slough No. 11 and Slough No. 21, Devil's Canyon Project, 1974.

Area Sampled	Sample Size	Age Class 1.1	Age Class 1.2	Age Class 2.1	Brood Year 1970	Brood Year 1971	Sample Size	Mean Length (mm)	Standard Deviation
Slough No.11	14	28.6	64.3	7.1	71.4	28.6	20	524.2	60.4
Slough No.21	1	0.0	100.0	0.0	100.0	0.0	-	-	-

portions of the spawning grounds." Last year two chums were observed by a local resident in Slough No. 12. It was further reported that "in Slough No. 13 chum and sockeye salmon spawned in 'high' densities in the mid 1960's, but in the last five years the numbers of fish have declined, possibly due to migrational barriers (beaver dams) prohibiting the salmon accessibility to portions of the spawning grounds."

"Large" escapements of king, chum and pink salmon in Gold Creek were observed by the residents of Gold Creek in the 1960's, but "in recent years only 'low' numbers of salmon, primarily pinks, have spawned in this stream."

An "unnamed" creek, an east side tributary stream of the Susitna River at Sherman, Alaska was reported by residents to have had its "last 'large' escapement of pink salmon in 1966. During the summer of 1967 the stream de-watered in all but its 'upper' section. Spawning salmon have not been observed in this stream since 1966." In 1974 during the months of July and August stream flow was sub-surface in the first one hundred yard section of the stream; surface flow occurred at the mouth of the stream in early September.

Climatological Observations

Climatological data were collected daily, at approximately 1800 hours, at the fishwheel camp from July 23 through September 11 (Table 16). The maximum and minimum air temperatures recorded were 75°F. and 48°F., respectively. The maximum recorded water temperature was 62°F. and Minimum 48°F. Atmospheric observations conducted during the 51 day period indicated that six days were cloudless or had cloud cover not exceeding 5 percent of the sky, and nine days were completely overcast. The Susitna River level fluctuated a maximum of 3.3 feet from July 24 through September 11. The maximum twenty-four hour period fluctuation in the river's level occurred on August 27 and 28 when the river rose 2.3 feet.

Table 16. Climatological observations at the fishwheel camp, Devil's Canyon Project, 1974.

Date	Time (Military)	Air Temp. (°F)	Water Temp. (°F)	Water Guage (feet)	Cloud Co (percent
July					
23	1850	68	58	-	90
24	1920	64	58	1.8	80
25	1800	66	58	1.9	90
26	1800	72	62	2.0	20
27	1900	70	62	1.9	10
28	1800	75	62	1.8	20
29	1800	67	62	1.9	50
30	1800	66	62	1.7	60
31	2000	65	62	1.8	95
August					
1	1800	68	61	1.8	80
2	1800	68	61	1.9	20
3	1800	66	58	2.0	90
4	1800	70	61	2.0	20
5	1800	74	62	2.1	30
6	1845	64	61	2.1	100
7	1955	60	58	2.0	100
8	1950	60	58	2.1	95
9	2000	59	56	2.3	80
10	1945	64	58	2.1	50
11	1800	66	58	1.8	10
12	1800	64	56	1.5	100
13	2035	60	57	1.3	30
14	1925	66	58	1.3	20
15	2000	68	60	1.3	20
16	1930	62	60	1.5	100
17	1800	66	62	2.0	70
18	1800	66	58	1.9	40
19	1800	62	57	1.9	70
20	1800	68	56	1.5	5
21	1820	67	55	1.4	10
22	1800	56	51	0.9	5
23	1800	62	51	0.4	20
24	1810	49	47	-0.1	100
25	1800	56	49	-0.4	90
26	1800	54	49	-0.4	100
27	2030	52	49	0.1	100
28	1750	57	52	2.4	70
29	1800	57	53	2.9	100
30	1850	58	54	2.6	70
31	2115	55	55	2.4	20
September					
1	1755	56	54	2.5	100
2	1800	60	54	2.4	20
3	1745	65	56	2.3	0
4	1800	66	54	2.2	0
5	1915	52	51	1.8	5
6	1830	52	49	1.2	10
7	1800	56	49	0.7	20
8	2020	48	49	0.3	0
9	1700	52	49	0.1	30
10	2000	53	48	-0.2	95
11	1750	52	48	-0.2	60

Thermograph readings of Susitna River water temperatures from September 4 through September 11 at the Gold Creek and fishwheel stations are presented in Figure 10. The data suggests significant diurnal warming and nocturnal cooling of the river at the fishwheel station but relatively low fluctuation in daily water temperatures at Gold Creek (Figures 10 and 11).

Water flow measurements recorded on Indian River, Lane, Fourth July and Gold Creeks are as follows:

Indian River	71.1 c.f.s. (8/6/74) 217.6 c.f.s. (9/2/74)	Lane Creek	12.5 c.f.s. (8/16/74) 34.8 c.f.s. (8/28/74)
Fourth July Creek	8.6 c.f.s. (8/9/74) 75.7 c.f.s. (9/1/74)	Gold Creek	40.5 c.f.s. (9/4/74)

These streams were at or near peak flood stages during the period of August 28 through September 4.

DISCUSSION AND SUMMARY

Fishwheels operating in the lower portion of the study area provided migrational timing, age-length-sex composition and abundances levels by salmon species. Chum and pink salmon dominated the catches. The major pink salmon migration occurred during the last week of July and the first week of August, and correspondingly for chum salmon in the second and third weeks of August. Three and four year old fish comprised 81.6 percent of the chum salmon catch. Coho salmon were abundant in the river from mid-August to mid-September. Age samples indicated that coho escapement was predominately four year old fish.

Twenty-one sloughs were identified and surveyed for the first time; rearing coho fry were observed in twelve of these, and spawning chum salmon in nine of the sloughs. In four of the sloughs sockeye salmon co-spawned with chum salmon.

Pink salmon spawned in Indian River, Fourth July, Lane, Portage and Gold Creeks; chum salmon also spawned, in these streams, with the exceptions of Lane and Gold Creeks.

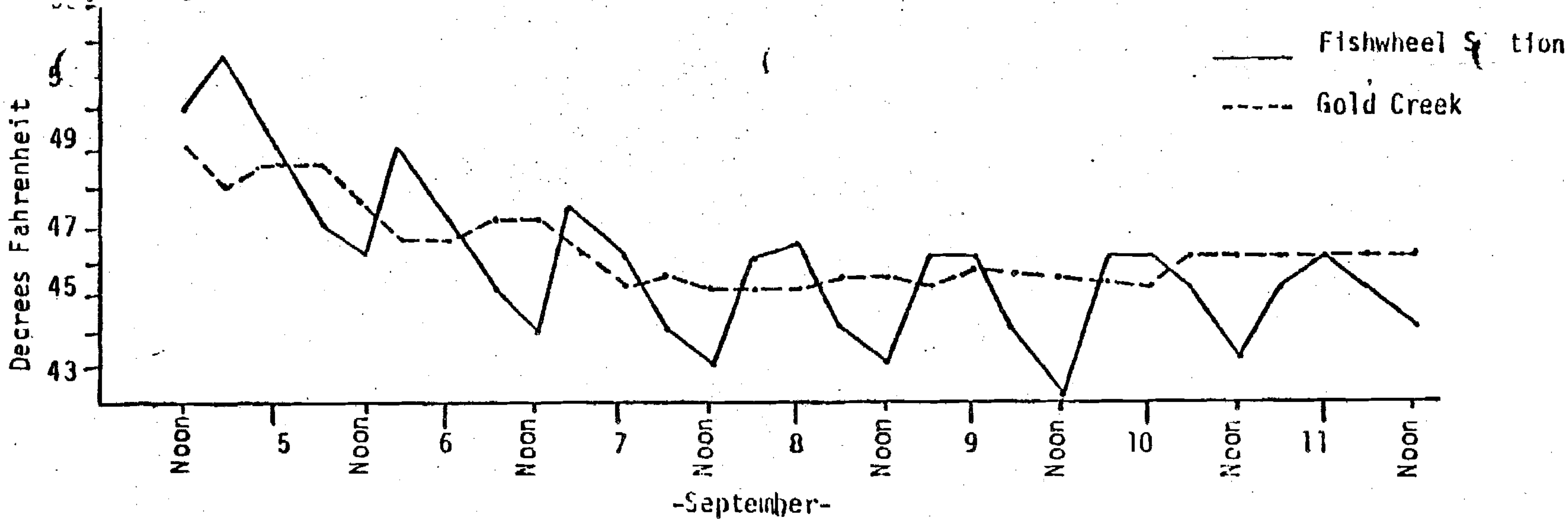

Figure 10. Profile of Susitna River water temperatures recorded daily at six hour intervals, with a Ryan Thermograph, at Gold Creek and Devil Canyon fishwheel camp, Devil's Canyon Project, 1974.

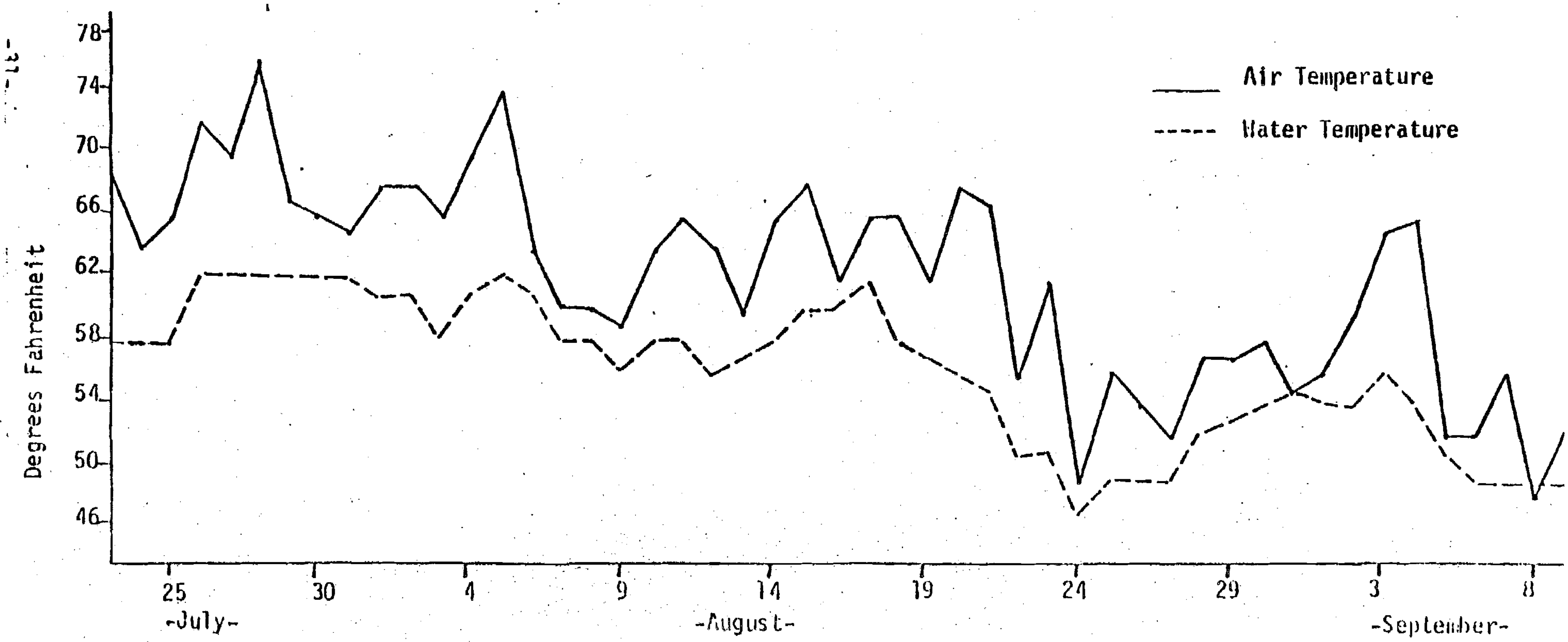

Figure 11. Profile of water and air temperatures recorded daily(≈1800 hours) at the east bank fishwheel,

Pink salmon spawned primarily during the first through third weeks of August. The major period of chum spawning in the streams occurred from mid-August to mid-September, and during the first three weeks of September in the sloughs.

Spawning coho salmon were recorded in Indian River, Fourth July, Portage, Whiskers, and Chase Creeks.

An estimated 24,286 chum, 5,252 pink and 1,008 sockeye salmon migrated at the fishwheel station as determined from the tag and recovery program. The coho salmon population was estimated to range from 4,000 to 9,000 individuals. Tag returns from chum, pink and sockeye salmon spawning below the fishwheel station suggest that a significant but unknown proportion of the salmon captured in the fishwheels were milling fish and not migrating to spawning grounds above the tagging station.

A minimum of 1,036 pink, 2,753 chum, 307 coho and 104 sockeye salmon spawned in the streams and sloughs of the Susitna River between the Chulitna River tributary and Portage Creek as determined from peak slough and stream index escapement counts.

Twelve of the sloughs surveyed were barren of spawning salmon. Although Slough No. 10 is included in these, it contained a relatively abundant population of rearing coho fry, during the month of August. Springs are prevalent in this slough, and the surface stratum is composed of approximately 95 percent sandy silt and 5 percent cobbles and boulders. The author suggests that the slough has the potential to support a spawning population of chum salmon, and it would be feasible to weir a portion of the slough and force spawn a donor stock of chum salmon above the structure.

The water levels in the sloughs are maintained in part by the Susitna River. Stream surveyors noted less rearing fry in the sloughs during low water periods, but significantly higher densities of fry milling in the confluences of the sloughs with the river. Physical access into the sloughs for the escapement was considered optimum during the period of August 28 to September 7 which coincided with a flood period on the Susitna River. Reduction in the water flow of the Susitna River in the last two weeks of September resulted in less than adequate accessibility for the salmon into the upper spawning pools of Slough No. 21.

Significant gravel displacement occurred in the streams during the late August-early September flood. A portion of the pink salmon spawn may have been destroyed as a consequence.

A continuation of field investigations is required to provide additional information necessary for evaluating potential increases and decrease in fisheries habitat resulting from the construction of a hydroelectric complex on the upper Susitna River. Monitoring the physical, chemical and biological properties of the sloughs during spring, summer, fall and winter seasons would provide qualitative data for determining the critical components limiting production in resident and anadromous fish populations. Assessing water quality directly below the proposed Devil Canyon dam is imperative prior to establishing standards acceptable for migrant and rearing fish. The following studies are required:

1) Monitoring seasonal fluctuations in water temperatures, dissolved gasses and suspended solids in the Susitna River at Chase and Gold Creeks.
2) Monitoring seasonal changes in relative water levels, pH, D.O., and water temperatures in the sloughs.
3) Repetitive adult spawner and fry surveys in the sloughs and streams to determine seasonal and annual density and distribution fluctuations.

4) Inriver species sampling to determine annual fluctuations in abundance levels, age composition, and migrational patterns of adult anadromous fish populations in the Susitna River north of Talkeetna.

5) Monitoring food cycle relationships in the sloughs as relate to fry production.

6) Composite sampling the bottom substrate in the sloughs.

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escapement surveys, Devil's Canyon Project, 1974.

Chum Salmon Surveys

Area Surveyed	Date	Survey Conditions	Number Fish Sampled (live counts) Untagged	tagged (r)	total (c)	Ratios (c/r)
Souugh No.6	8/28	Fair	1	0	1	0.0
Slough No.9	8/10	Fair	1	0	1	0.0
	8/16	Fair	2	0	2	0.0
	8/29	Fair	125	4	129	32.3
	9/1	Fair	324	7	331	47.3
	9/5	Good	458	8	466	58.3
	9/12	Good	187	1	188	188.0
	9/17	Good	37	0	37	0.0
Slough No.11	9/10	Good	26	1	27	27.0
	9/13	Good	20	1	21	21.0
	9/17	Fair	18	1	19	19.0
	9/22	Fair	10	1	11	11.0
	9/27	Excel	1	0	1	0.0
Slough No.14	8/30	Good	2	0	2	0.0
Slough No.16	8/19	Fair	2	0	2	0.0
Slough No.17	9/9	Good	14	0	14	0.0
	9/13	Excel	12	0	12	0.0
	9/24	Fair	3	0	3	0.0
Slough No.19	8/21	Fair	2	0	2	0.0
Slough No.20	8/21	Good	2	0	2	0.0
	9/5	Good	99	2	101	50.5
	9/9	Excel	56	0	56	0.0
	9/13	Excel	20	0	20	0.0
	9/18	Excel	1	0	1	0.0
Slough No.21	9/11	Good	206	9	215	23.9
	9/18	Good	197	8	205	25.6
	9/24	Good	40	3	43	14.3
Indian R.	8/6	Good	6	0	6	0.0
	8/7	Good	5	0	5	0.0
	8/8	Good	7	0	7	0.0
	8/17	Good	58	0	58	0.0
	8/19	Good	338	5	343	68.6
	9/10	Fair	176	6	182	30.3
Fourth July Cr.	8/2	Fair	2	0	2	0.0
	8/9	Fair	14	0	14	0.0
	9/1	Fair	200	4	204	51.0
	9/11	Good	290	10	300	30.0
	9/16	Good	128	3	131	43.7
Totals			3090	74	3164	42.8

Appendix
Table I. (continued)

Pink Salmon Surveys

Area Surveyed	Date	Survey Conditions	Number Fish Sampled (live counts) Untagged	Tagged (r)	Total (c)	Ratios (c/r)
Indian R.	8/2	Good	27	1	28	28.0
	8/4	Good	16	0	16	0.0
	8/6	Good	60	3	63	21.0
	8/7	Good	7	1	8	8.0
	8/8	Good	128	6	134	22.3
Fourth July Cr.	8/2	Fair	53	2	55	27.5
	8/9	Fair	133	6	139	23.2
	8/16	Fair	131	2	133	66.5
Lane Cr.	8/4	Good	28	0	28	0.0
	8/9	Good	80	1	81	81.0
	8/16	Good	68	1	69	69.0
	9/8	Good	1	0	1	0.0
Total			732	23	755	32.8

Sockeye Salmon Surveys

Area Surveyed	Date	Survey Conditions	Number Fish Sampled (live counts) Untagged	Tagged (r)	Total (c)	Ratios (c/r)
No. 9	8/29	Fair	1	0	1	0.0
	9/1	Fair	3	0	3	0.0
	9/5	Good	7	1	8	8.0
	9/12	Good	7	1	8	8.0
	9/17	Good	4	1	5	5.0
	9/23	Fair	1	0	1	0.0
No.11	8/9	Good	2	0	2	0.0
	8/16	Good	19	1	20	20.0
	9/10	Good	67	3	70	23.3
	9/16	Good	57	3	60	20.0
	9/17	Good	68	2	70	35.0
	9/27	Excel	56	1	57	57.0
No.19	8/21	Fair	3	0	3	0.0
	9/18	Good	1	0	1	0.0
No.21	9/11	Good	8	0	8	0.0
	9/18	Good	13	0	13	0.0
	9/24	Good	6	0	6	0.0
Total			323	13	335	25.8

Coho Salmon Surveys

Area Surveyed	Date	Conditions	Number Fish Sampled (live counts) Untagged	Tagged (r)	Total (c)	Ratios (c/r)
Indian R.	8/7	Good	3	0	3	0.0
	8/8	Good	9	0	9	0.0
	8/17	Good	6	0	6	0.0
	8/19	Good	17	0	17	0.0
	9/10	Fair	64	0	64	0.0
Fourth July Cr.	9/11	Good	22	4	26	6.5
	9/17	Good	9	1	10	10.0
Total			130	5	135	27.0

Appendix

Table 2. Escapement survey counts conducted on Sloughs No. 1, No. 2, No. 3, No. 4, No. 5, No. 6, No. 7 and No. 8, Devil's Canyon Project, 1974.

Slough No.	Date	Time (Military)	Temperature (°F) Air	Water	Survey Conditions	No. Fry observed	Fry Species Identified King	Coho	Sockeye	Gray-ling	White-fish	Sucker	Adult Salmon Density Chum Live	Dead	Total	Sockeye Live	Dead	Tota
1	8/18	1520	59	58	Fair	+					X	X	0	0	0	0	0	
2	8/14	1230	65	60	Fair	+					X		0	0	0	0	0	
3	8/18	1235	67	54	Fair	600	X	X	X	X	X		0	0	0	0	0	
	9/2	1320	60	51	Fair	600		X	X	X	X		0	0	0	0	0	
4	8/21	1430	64	58	Fair	25		X					0	0	0	0	0	
	9/1	1615	57	58	Fair	1							0	0	0	0	0	
5	8/4	-	-	-	Fair	200							0	0	0	0	0	
	8/16	1015	-	-	Fair	200							0	0	0	0	0	
	8/28	1300	57	52	Fair	0							0	0	0	0	0	
	9/5	1430	70	56	Good	1000		X	X				0	0	0	0	0	
	9/8	1400	72	53	Fair	0							0	0	0	0	0	
	9/27	1600	50	51	Fair	0							0	0	0	0	0	
6	8/16	1045	-	-	Fair	+		X					0	0	0	0	0	
	8/28	1330	57	52	Fair	-							1	0	1	0	0	
	9/8	1430	72	54	Fair	-							0	0	0	0	0	
	9/9	1845	54	56	Fair	500		X				X	0	0	0	0	0	
	9/27	1530	50	50	Fair	0							0	0	0	0	0	
7	8/16	1125	66	62	Good	500						X	0	0	0	0	0	
	8/28	1430	60	59	Good	500						X	0	0	0	0	0	
	9/8	1500	72	61	Good	-							0	0	0	0	0	
	9/27	1530	56	51	Excell	15							0	0	0	0	0	
8	8/28	1520	62	53	Fair	50		X		X		X	0	0	0	0	0	
	9/8	1530	59	51	Fair	0							0	0	0	0	0	

Appendix

Table 3. Escapement survey counts conducted on Sloughs No. 9, No. 10, No.11 and No. 12, Devil's Canyon Project, 1974.

Slough No.	Date	Time (Military)	Temperature (°F) Air	Temperature (°F) Water	Survey Conditions	No. Fry observed	Fry Species Identified: King	Coho	Sockeye	Gray-ling	White-fish	Sucker	Adult Salmon Density: Chum Live	Chum Dead	Chum Total	Sockey Live	Sockey Dead
9	8/10	1100	60	53	Fair	-							1	0	1	0	0
	8/16	1430	-	-	Fair	+		X					2	0	2	0	0
	8/29	1245	58	49	Fair	-							129	12	141	1	0
	9/1	1300	58	52	Fair	-							331	28	359	3	0
	9/5	1045	51	44	Good	-							466	45	511	8	0
	9/12	1400	58	44	Good	-							188	319	507	8	0
	9/17	1300	56	52	Good	0							37	363	400	5	0
	9/23	1200	51	47	Fair	0							0	361	361	1	0
10	8/16	1030	60	51	Fair	2000		X		X	X		0	0	0	0	0
	8/21	1700	50	42	Fair	200		X		X	X		0	0	0	0	0
	9/1	0900	57	41	Fair	15		X.		X	X		0	0	0	0	0
	9/5	0920	51	40	Fair	0							0	0	0	0	0
	9/12	1530	50	42	Good	-							0	0	0	0	0
	9/17	1445	57	44	Good	0							0	0	0	0	0
	9/23	1000	47	46	Poor	150		X					0	0	0	0	0
11	8/6	1000	58	42	Good	0							0	0	0	0	0
	8/9	1125	54	43	Good	50							0	0	0	2	0
	8/16	1600	-	-	Good	0							0	0	0	20	0
	8/19	1700	-	-	Good	0							0	0	0	40	0
	8/29	1045	55	44	Poor	0							5	0	5	19	0
	9/1	1700	57	46	Poor	0							0	0	0	14	0
	9/5	1400	61	46	Poor	0							2	0	2	17	0
	9/10	1120	54	40	Good	0							27	1	28	70	0
	9/13	1600	60	44	Good	0							21	5	26	60	0
	9/17	1530	59	44	Fair	0							19	14	33	70	0
	9/22	1015	49	45	Fair	0							11	12	23	79	0
	9/27	1100	52	44	Excell	0							1	11	12	57	3
12	8/12	1300	51	43	Good	1							0	0	0	0	0
	8/29	0930	55	42	Fair	0							0	0	0	0	0
	9/10	1055	52	41	Excell	0							0	0	0	0	0
	9/13	1545	60	50	Excell	0							0	0	0	0	0
	9/17	1520	59	46	Excell	0							0	0	0	0	0
	9/22	1000	49	44	Excell	0							0	0	0	0	0

Appendix

Table 4. Escapement survey counts conducted on Sloughs No. 13, No. 14, No. 15, No. 16, No. 17 and No. 18, Devil's Canyon Project, 1974.

Slough No.	Date	Time (military)	Temperature (°F) Air	Temperature (°F) Water	Survey Conditions	No. Fry observed	Fry Species Identified: King	Coho	Sockeye	Grayling	Whitefish	Sucker	Adult Salmon Density: Chum Live	Chum Dead	Chum Total	Sockeye Live	Sockeye Dead
13	8/6	0930	57	41	Good	400				X	X	X	0	0	0	0	0
	8/9	1025	51	43	Good	400				X	X	X	0	0	0	0	0
	8/12	1230	-	-	Good	400				X	X	X	0	0	0	0	0
	8/29	0900	54	48	Good	200				X	X	X	0	0	0	0	0
	9/10	1030	51	41	Good	0							0	0	0	0	0
	9/13	1530	62	52	Excell	0							0	0	0	0	0
	9/22	1000	49	48	Fair	0							0	0	0	0	0
14	8/30	1515	66	52	Good	500		X		X			2	0	2	0	0
	9/10	1000	51	44	Good	100		X		X			0	1	1	0	0
15	8/5	1350	58	46	Fair	2500		X		X	X		0	0	0	0	0
	8/19	1025	58	48	Fair	2500		X		X	X		0	0	0	0	0
	8/30	0930	60	51	Poor	1000		X		X	X		0	0	0	0	0
	9/2	0900	55	52	Fair	0							0	0	0	0	0
	9/6	0900	-	-	Good	0							0	0	0	0	0
	9/9	1120	58	42	Good	0							0	0	0	0	0
	9/18	1000	45	44	Good	0							0	0	0	0	0
	9/24	1500	57	49	Fair	0							0	0	0	0	0
16	8/8	0930	52	46	Fair	+		X					0	0	0	0	0
	8/19	1130	66	52	Fair	1000		X		X	X		2	0	2	0	0
	8/30	1020	64	53	Poor	-							2	0	2	0	0
	9/2	1030	54	52	Poor	0							0	0	0	0	0
	9/6	1130	59	45	Excell	0							0	0	0	0	0
	9/18	1015	45	44	Excell	0							0	0	0	0	0
	9/24	1445	58	50	Excell	0							0	0	0	0	0
17	8/8	1445	58	44	Good	300		X		X			0	0	0	0	0
	8/20	1030	55	46	Fair	200							0	0	0	0	0
	8/30	1215	62	48	Poor	-							8	0	8	0	0
	9/2	1100	53	46	Fair	-							11	1	12	0	0
	9/9	1200	62	44	Good	-							14	9	23	0	0
	9/13	1400	60	44	Excell	-							12	12	24	0	0
	9/18	1030	46	46	Excell	-							0	13	13	0	0
	9/24	1400	58	48	Fair	-							3	7	10	0	0
18	8/8	1555	52	49	Excell	400							0	0	0	0	0
	8/30	1230	63	50	Poor	0							0	0	0	0	0

Appendix

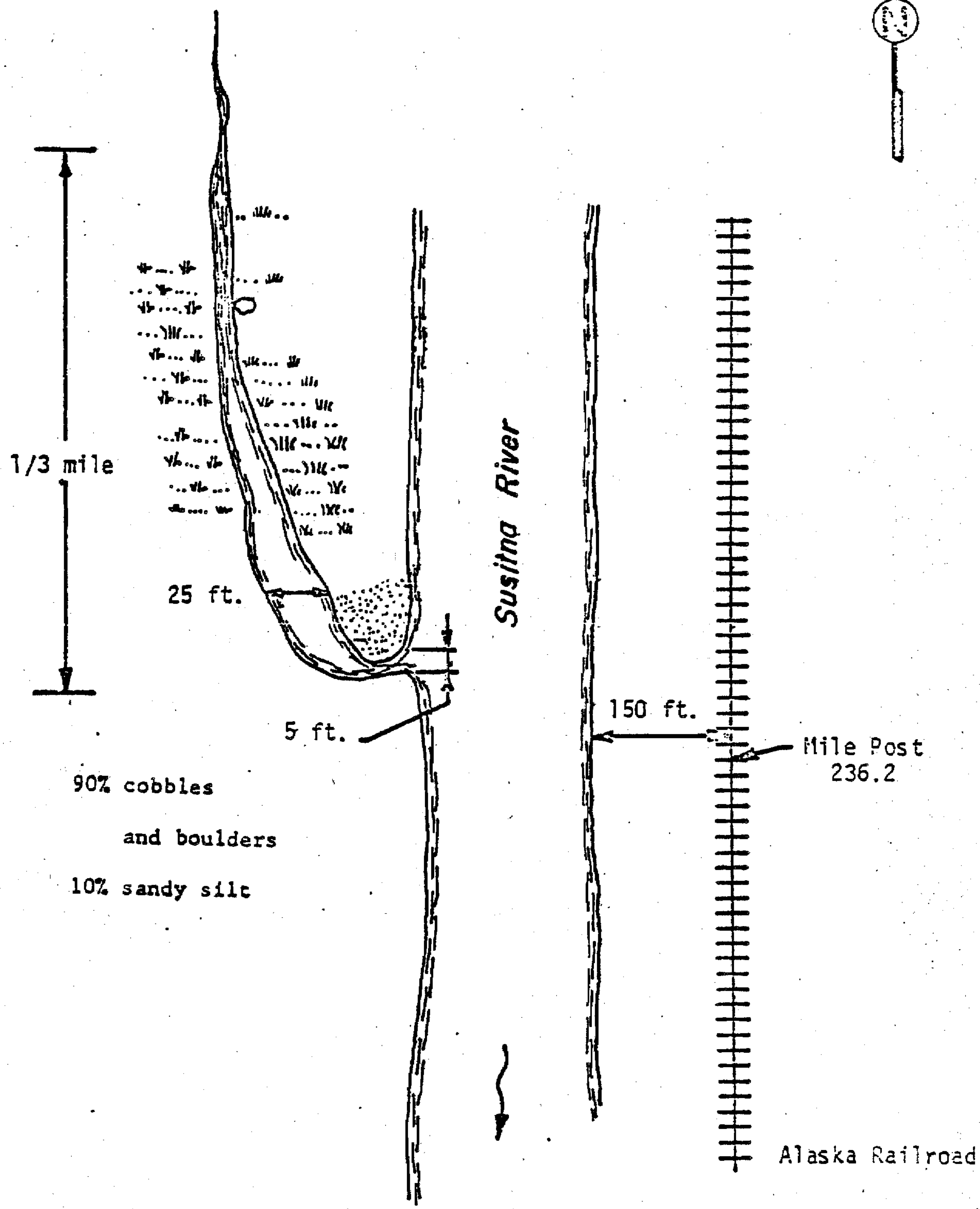
Table 5. Escapement survey counts conducted on Sloughs No. 19, No. 20 and No. 21, Devil's Canyon Project, 1974.

Slough No.	Date	Time (Military)	Temperature (°F) Air	Temperature (°F) Water	Survey Conditions	No. Fry observed	Fry Species Identified: King	Coho	Sockeye	Gray-ing	White-fish	Sucker	Adult Salmon Density: Chum Live	Chum Dead	Chum Total	Sockeye Live	Sockeye Dead
19	8/21	1200	54	43	Fair	100							2	0	2	3	0
	8/30	1415	-	-	Poor	0							0	0	0	0	0
	9/5	1940	56	40	Poor	0							0	0	0	0	0
	9/9	1230	64	40	Fair	0							0	0	0	0	0
	9/13	1345	60	44	Poor	0							0	0	0	1	0
	9/18	1100	47	42	Good	-							0	0	0	1	0
	9/24	1100	48	44	Fair	-							0	4	4	0	0
20	8/9	1650	57	52	Good	1000							0	0	0	0	0
	8/21	1340	60	52	Good	1000							2	0	2	0	0
	8/30	1310	70	52	Poor	-							5	0	5	0	0
	9/2	1130	56	51	Poor	-							39	2	41	0	0
	9/5	1900	57	46	Good	-							101	6	107	0	0
	9/9	1300	61	46	Excell	-							56	37	93	0	0
	9/13	1315	55	48	Excell	-							20	58	78	0	0
	9/18	1115	49	45	Excell	-							1	61	62	0	0
	9/24	1145	51	46	Excell	-							0	34	34	0	0
21	9/11	1000	52	44	Good	-							215	296	511	8	0
	9/18	1230	-	-	Good	-							205	463	668	13	0
	9/24	1200	53	47	Good	-							43	395	438	6	0
	9/26	1045	52	44	Good	125		X		X			Present				

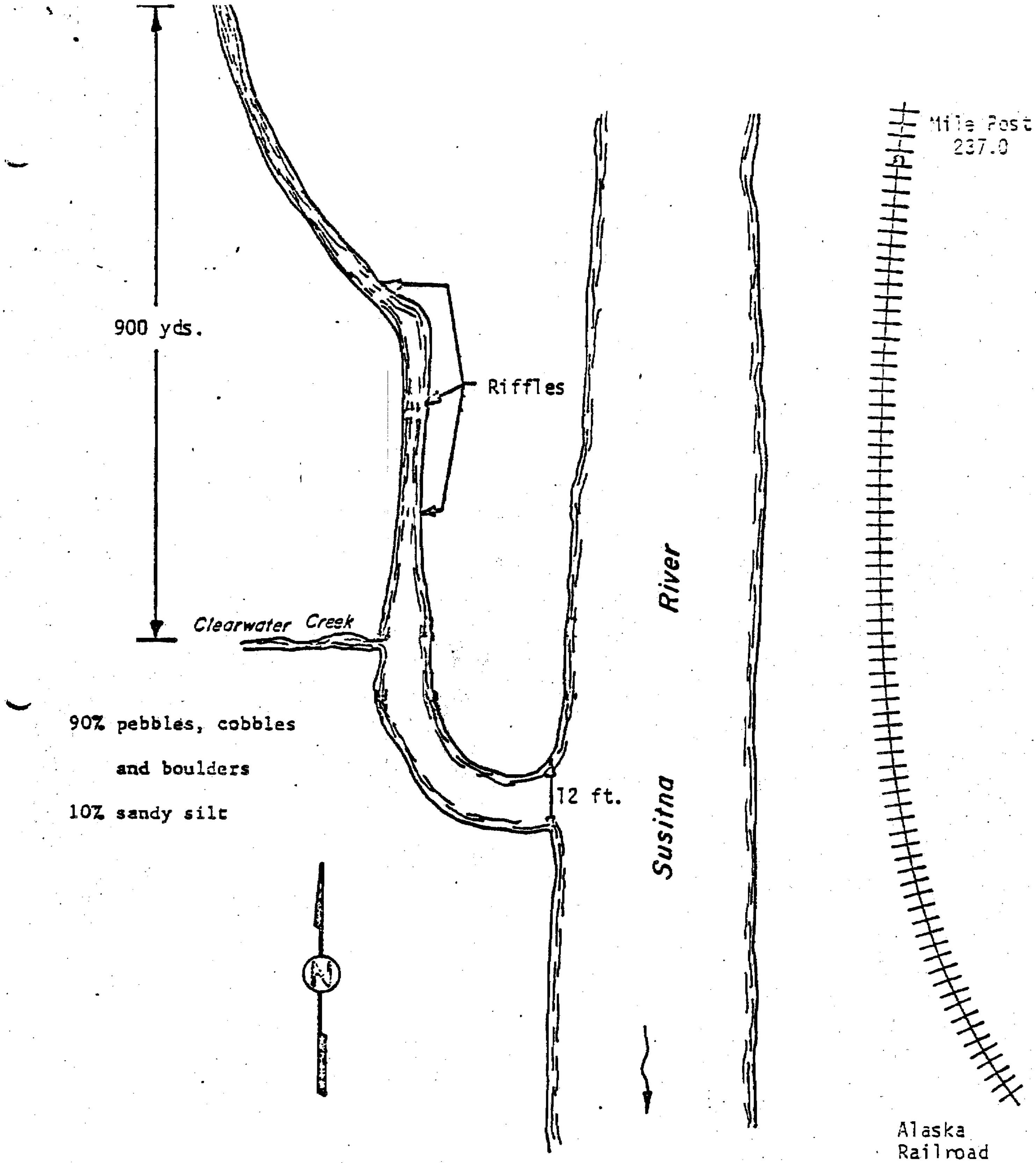
Appendix

Table 6. Escapement survey counts conducted on Indian River, Fourth July Creek, Jack Long Creek, Portage Creek, Lane Creek, Whiskers Creek and Chase Creek, Devil's Canyon Project, 1974.

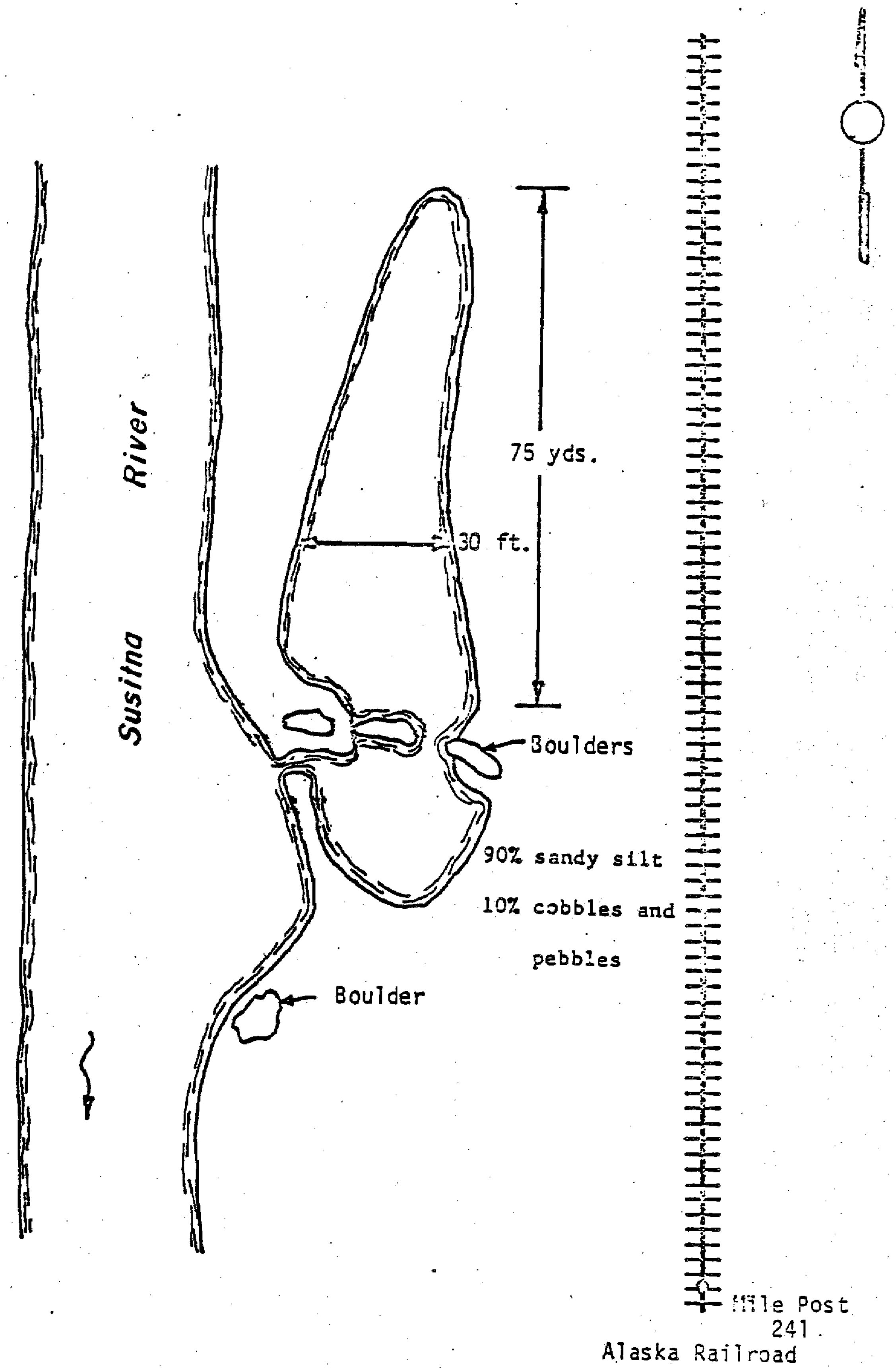
Stream	Date	Time (Military)	Temperature (°F) Air	Water	Survey Conditions	Survey Distance (Miles)	Salmon Density: King Live	King Dead	King Total	Pink Live	Pink Dead	Pink Total	Chum Live	Chum Dead	Chum Total	Coho Live	Coho Dead	Coho Total	Sockeye Live	Sockeye Dead	Sockeye Total
Indian River	8/2	1400	67	53	Good	0.1	2	0	2	28	0	28	0	0	0	0	0	0	0	0	0
	8/4	1900	-	-	Good	0.1	0	1	1	16	0	16	0	0	0	0	0	0	0	0	0
	8/6	1500	-	-	Good	0.5	0	0	0	63	0	63	6	0	6	0	0	0	0	0	0
	8/7	1600	-	-	Good	0.1	0	0	0	8	0	8	5	0	5	3	0	3	0	0	0
	8/8	1730	56	52	Good	0.5	0	3	3	134	0	134	7	0	7	9	0	9	0	0	0
	8/17	1350	58	53	Good	0.5	0	0	0	39	18	57	58	2	60	6	0	6	0	0	0
	8/19	-	-	-	Good	0.5	0	0	0	51	12	63	128	0	128	4	0	4	0	0	0
	8/19	-	-	-	Good	5.0	0	3	3	483	94	577	343	33	376	17	0	17	0	0	0
	9/10	1320	64	49	Fair	3.0	0	0	0	0	0	0	182	349	531	64	0	64	0	0	0
	9/10	-	-	-	Fair	0.5	0	0	0	0	0	0	92	120	212	2	0	2	0	0	0
	9/20	1130	55	48	Poor	0.5	0	0	0	0	0	0	20	149	169	0	0	0	0	0	0
Fourth July Cr.	8/2	1500	61	55	Fair	0.5	2	0	2	55	0	55	2	0	2	0	0	0	0	0	0
	8/9	1450	62	56	Fair	0.5	0	0	0	139	0	139	14	0	14	0	0	0	0	0	0
	8/16	1320	68	60	Fair	0.5	0	0	0	133	26	159	16	0	16	0	0	0	0	0	0
	8/29	1115	58	50	Poor	0.5	0	0	0	0	0	0	43	10	53	0	0	0	0	0	0
	9/1	1030	57	54	Fair	0.5	0	0	0	0	0	0	204	23	227	0	0	0	0	0	0
	9/11	1500	60	48	Good	0.5	0	0	0	0	0	0	300	294	594	26	0	26	0	0	0
	9/17	1100	58	49	Good	0.5	0	0	0	0	0	0	131	279	410	10	0	10	0	0	0
	9/23	1100	50	47	Poor	0.5	0	0	0	0	0	0	2	145	147	6	1	7	0	0	0
Portage Cr.	8/2	1430	62	53	Fair	0.5	2	0	2	200	0	200	2	0	2	5	0	5	0	0	0
	8/18	-	-	-	Fair	0.5	0	0	0	183	35	218	265	11	276	150	0	150	0	0	0
	9/3	1300	60	50	Poor	0.5	0	0	0	0	0	0	20	6	26	35	0	35	0	0	0
	9/16	1500	58	45	Poor	0.5	0	0	0	0	0	0	0	17	17	0	0	0	0	0	0
	9/26	1130	48	44	Poor	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lane Cr.	8/4	1500	70	52	Good	0.5	0	0	0	28	0	28	0	0	0	0	0	0	0	0	0
	8/9	1640	-	-	Good	0.5	0	0	0	81	1	82	0	0	0	0	0	0	0	0	0
	8/16	1135	68	52	Good	0.5	0	0	0	69	5	74	0	0	0	0	0	0	0	0	0
	8/28	1445	61	48	Poor	0.5	0	0	0	9	3	12	0	0	0	0	0	0	0	0	0
	9/8	1515	63	46	Good	0.5	0	0	0	1	1	2	0	0	0	0	0	0	0	0	0
Jack Long Cr.	9/16	1310	56	46	Excell	.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Whiskers Cr.	8/5	1015	63	56	Poor	.35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	8/30	1305	62	55	Poor	.35	0	0	0	0	0	0	0	0	0	27	0	27	0	0	0
	9/7	1040	56	55	Poor	.35	0	0	0	0	0	0	0	0	0	15	2	17	0	0	0
Chase Cr.	8/16	1135	66	61	Poor	1.0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
	8/21	-	-	-	Poor	1.0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
	8/31	1415	64	58	Poor	1.0	0	0	0	0	0	0	0	0	0	13	0	13	0	0	0
	9/1	1130	61	58	Poor	1.0	0	0	0	0	0	0	0	0	0	40	0	40	0	0	0



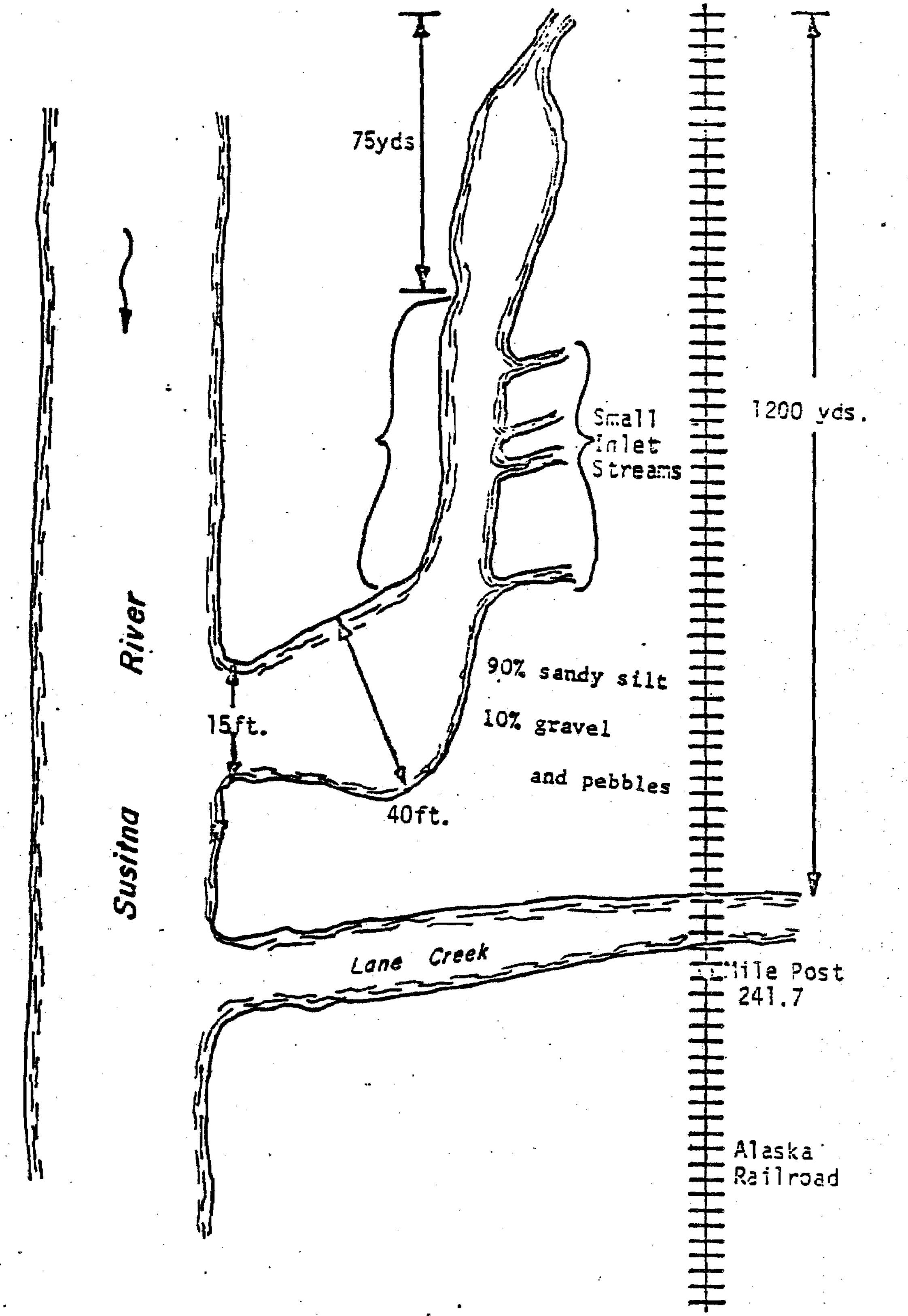
Appendix Figure 1 . Map of Slough No. 5 as composed on August 16, Devil's Canyon Project, 1974.



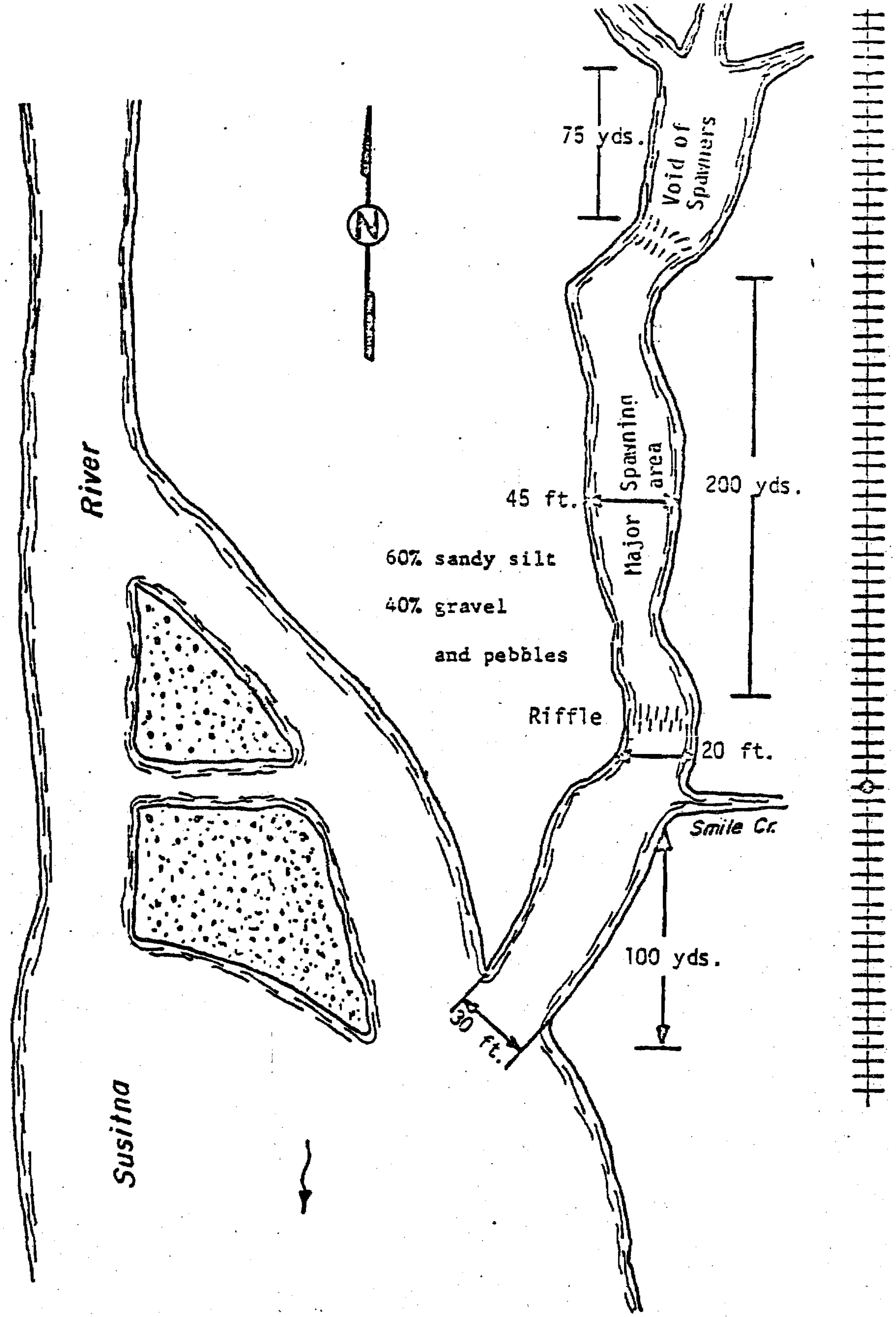
Appendix Figure 2 . Map of Slough No. 6 as composed on August 16, Devil's Canyon Project, 1974.



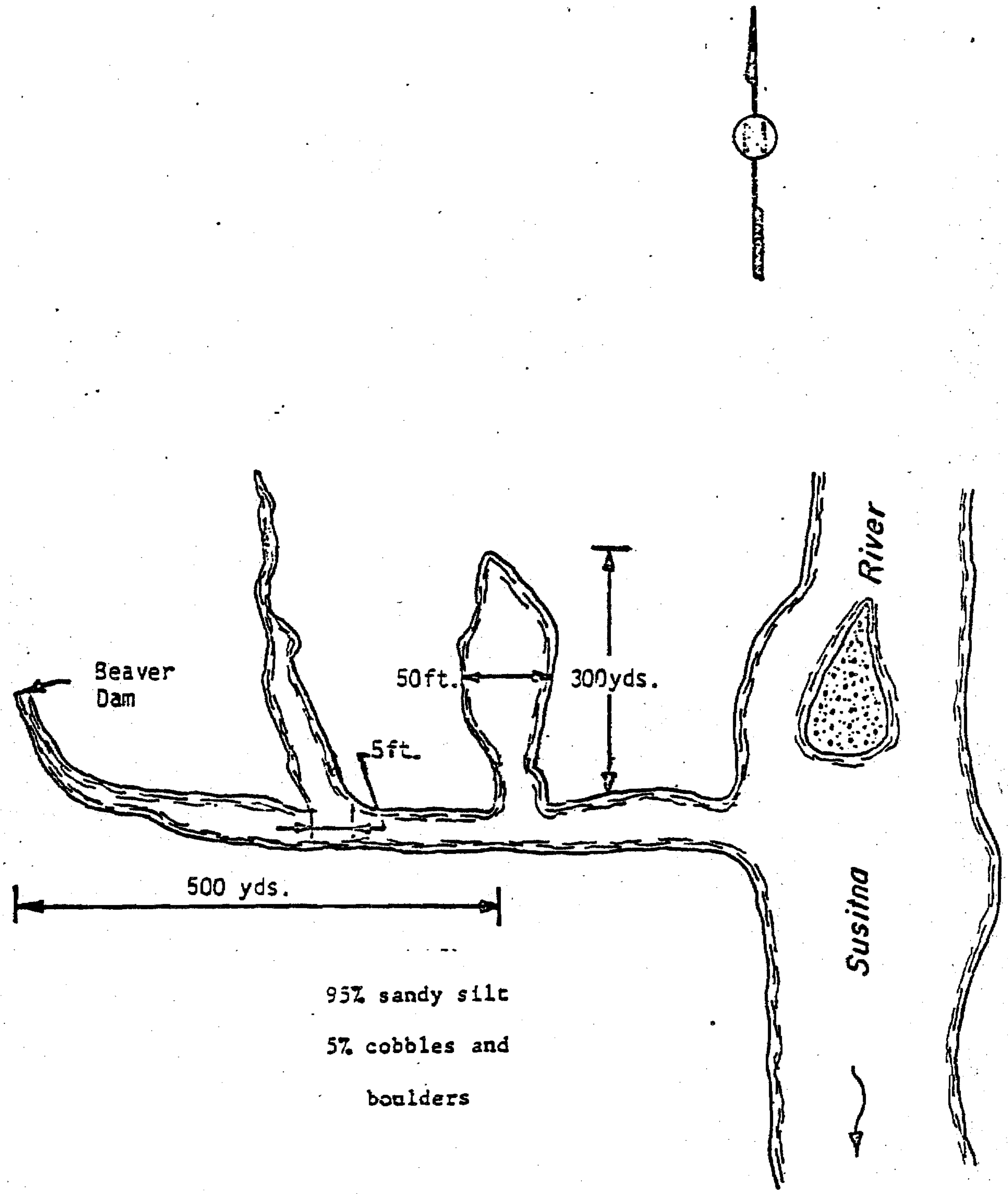
Appendix Figure 3 . Map of Slough No. 7 as composed August 16, Devil's Canyon Project, 1974.



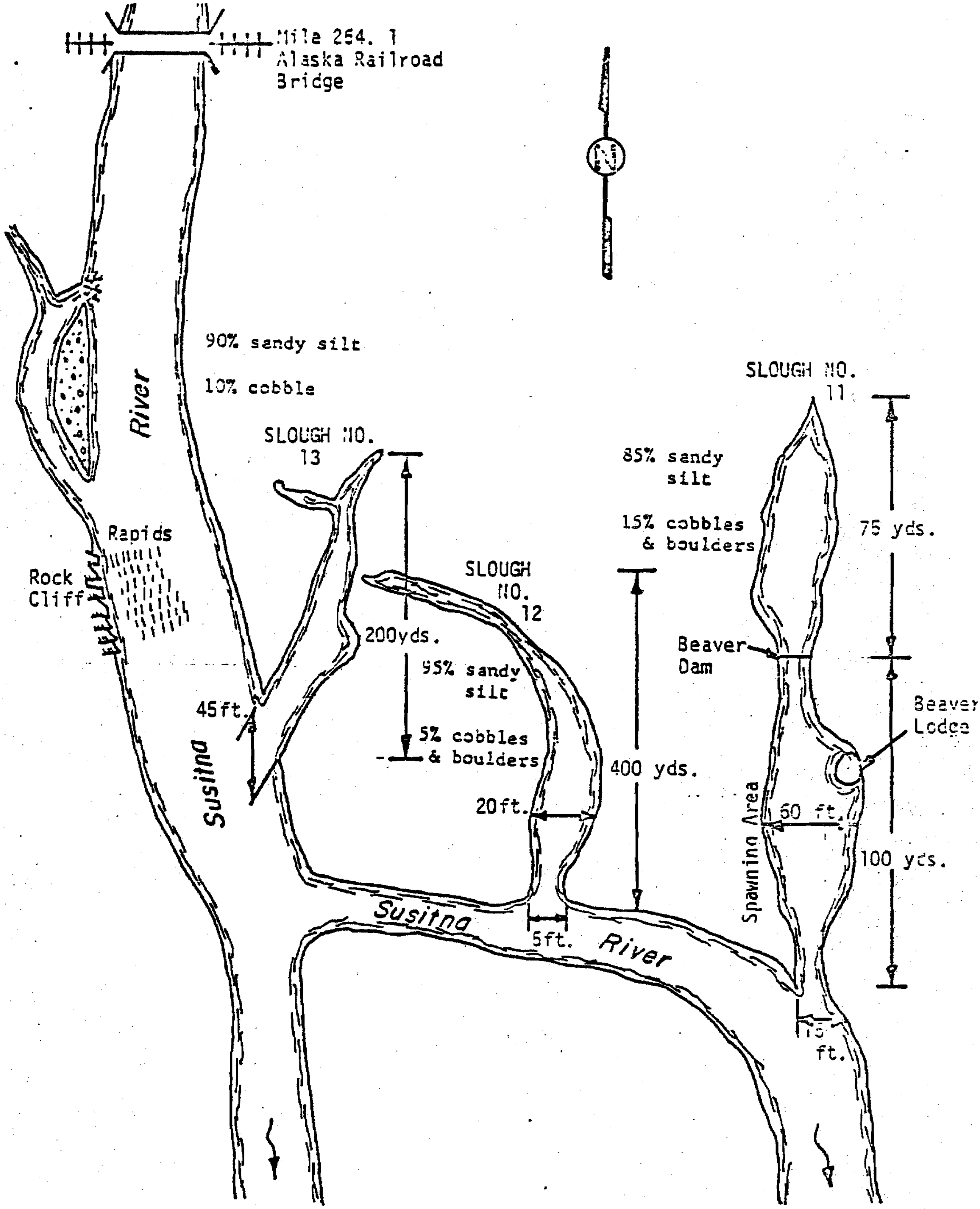
Appendix Figure 4 . Map of Slough No. 8 as composed on August 28, Devil's Canyon Project, 1974.



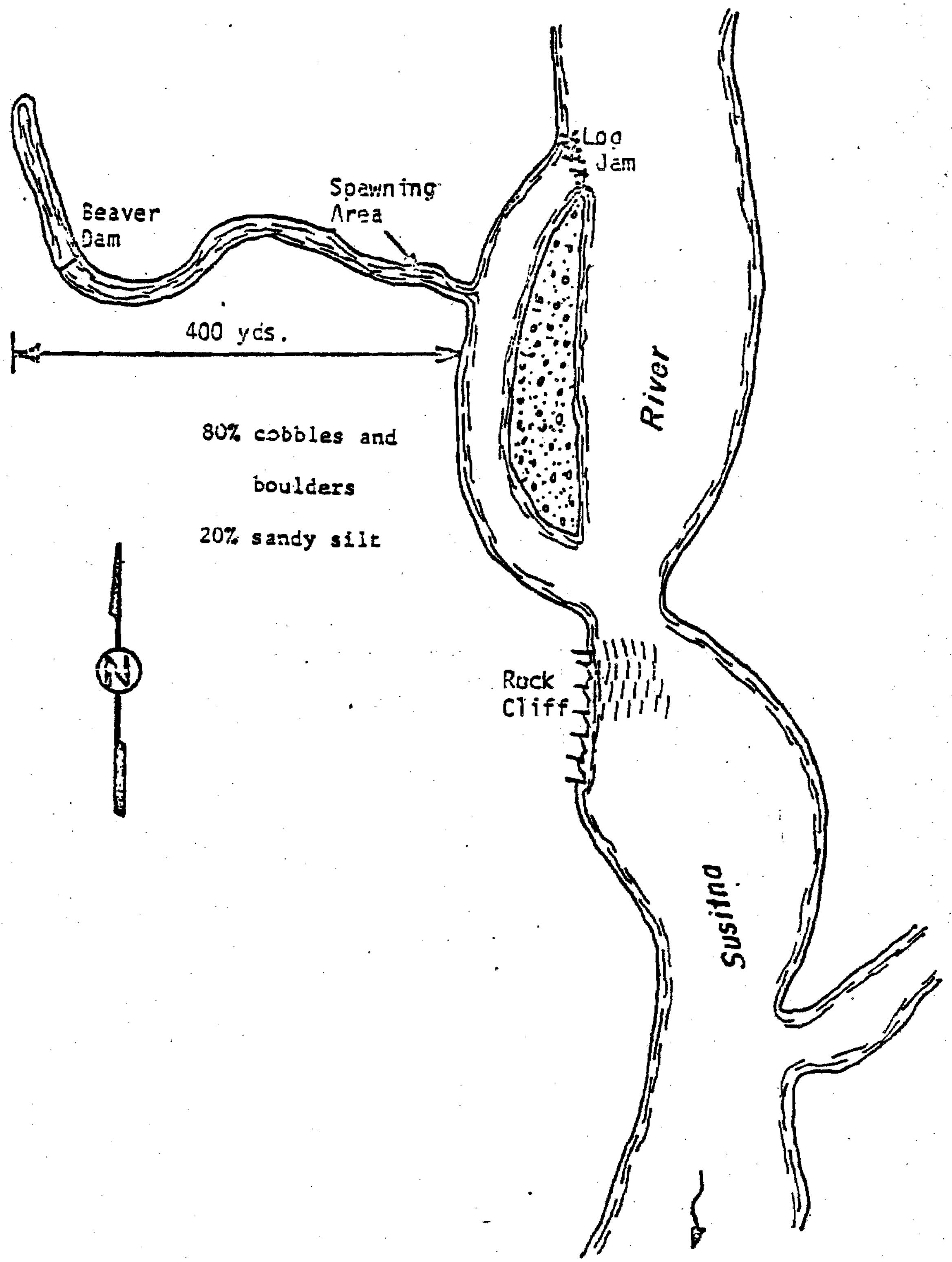
Appendix Figure 5 . Map of Slough No. 9 as composed on August 16, Devil's Canyon Project, 1974.



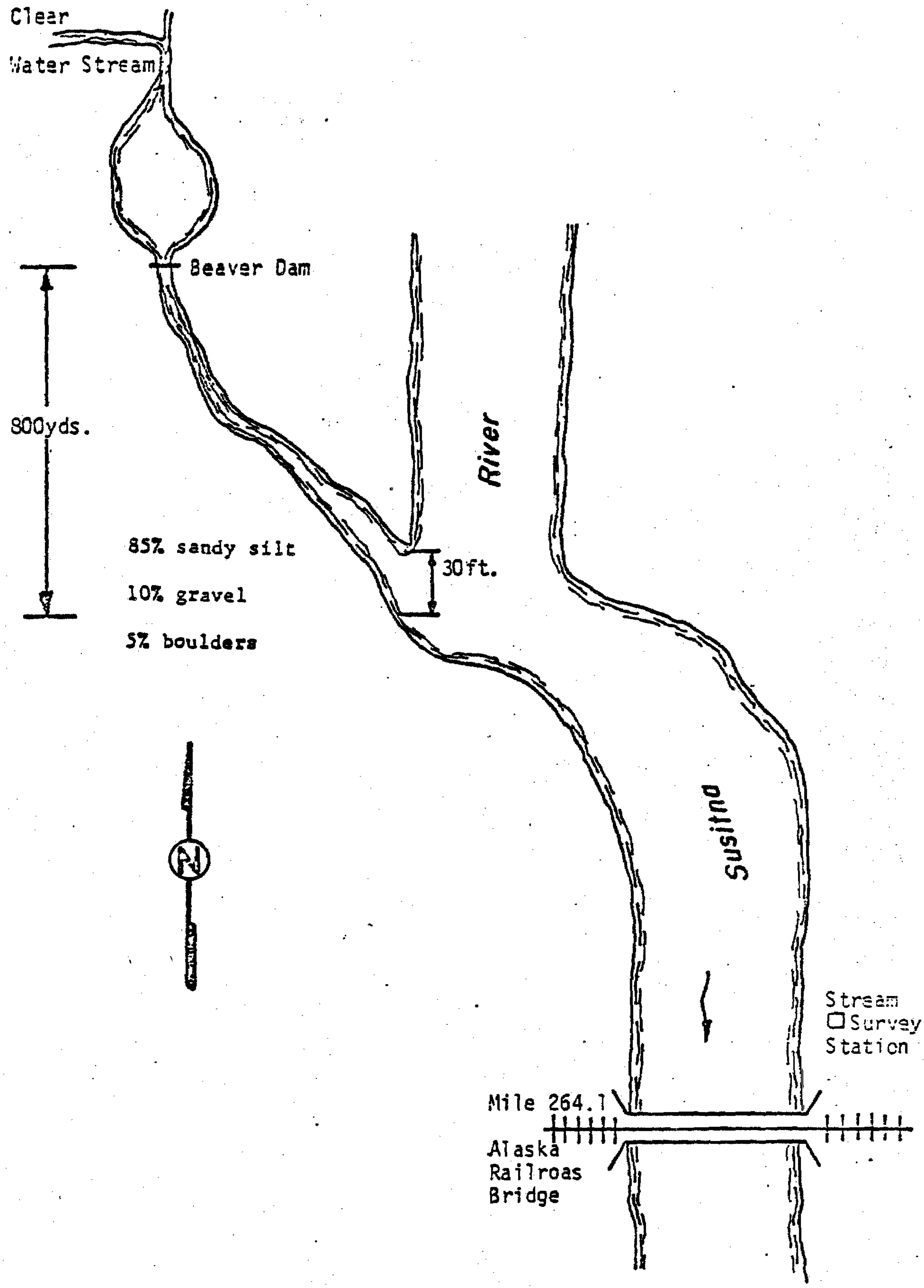
Appendix Figure 6 . Map of Slough No. 10 as composed on August 8, Devil's Canyon Project, 1974.



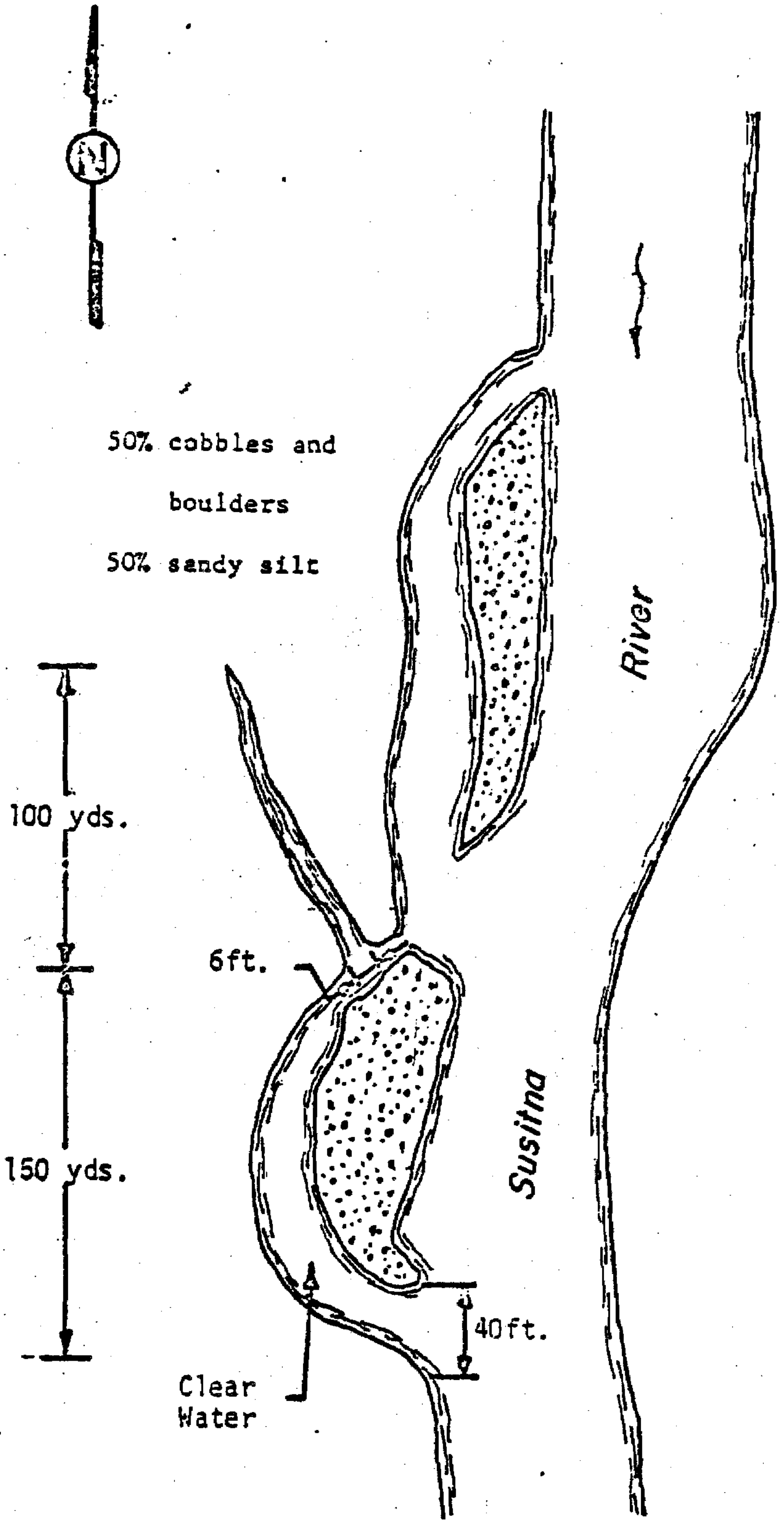
Appendix Figure 7 . Map of Sloughs No. 11, No. 12 and No. 13 as composed on August 9, Devil's Canyon Project, 1974.



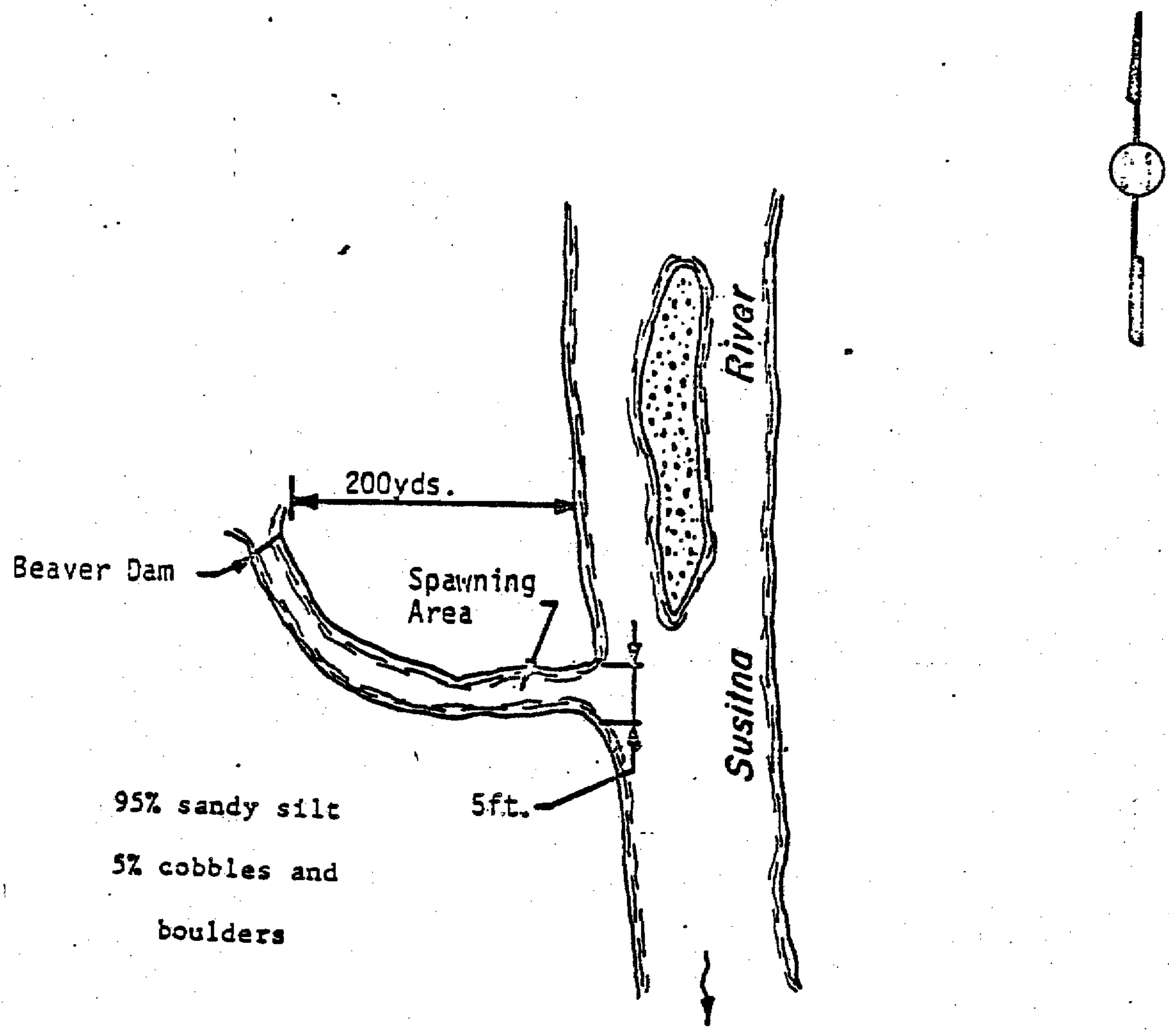
Appendix Figure 8 . Map of Slough No. 14 as Composed on August 30, Devil's Canyon Project, 1974.



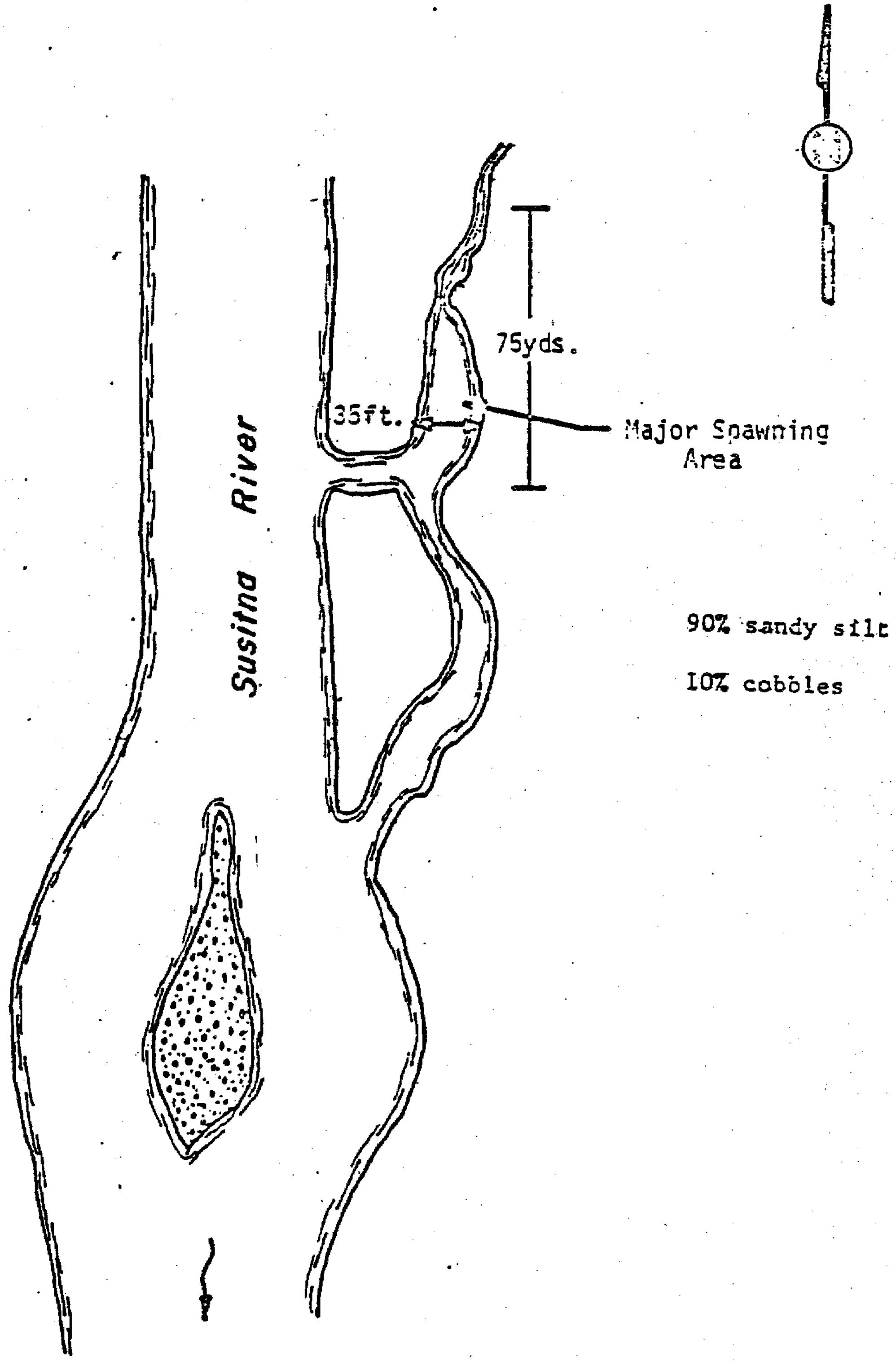
Appendix Figure 9 . Map of Slough No. 15, as composed on August 5, Devil's Canyon Project, 1974.



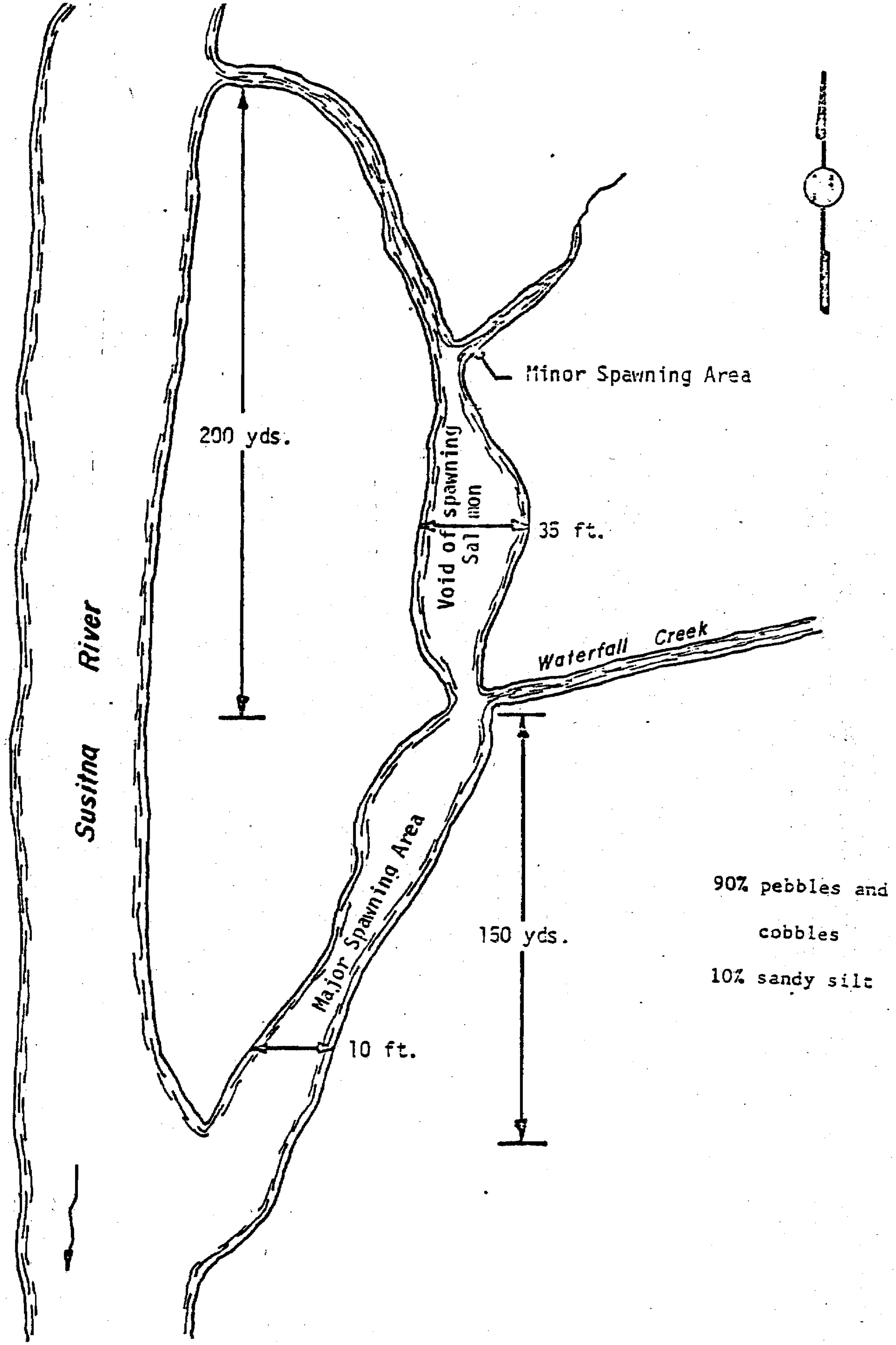
Appendix Figure 10 . Map of Slough No. 16 as composed on August 8, Devil's Canyon Project, 1974.



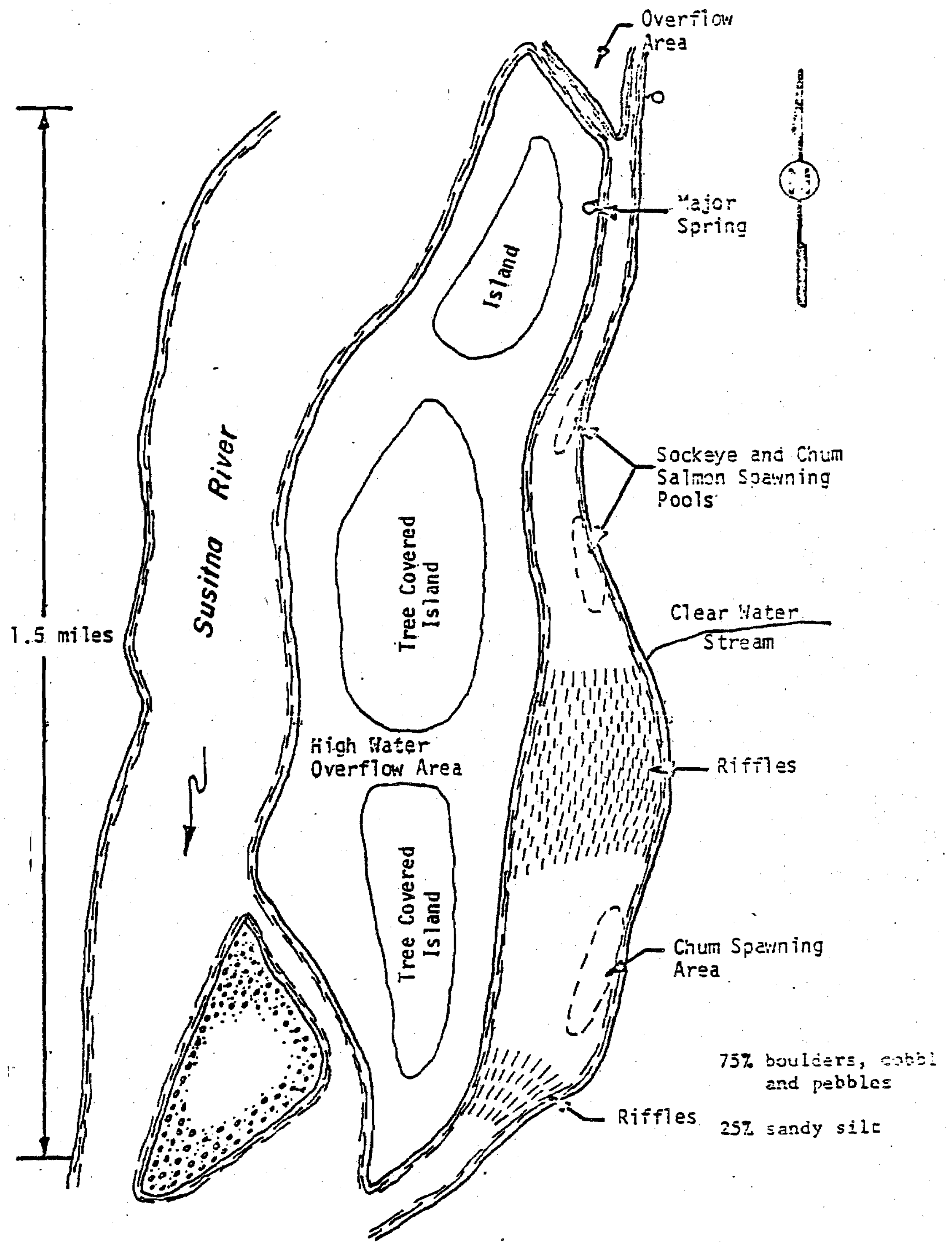
Appendix Figure 11 . Map of Slough No. 17 as composed on August 8, Devil's Canyon Project, 1974.



Appendix Figure 12 . Map of Slough No. 19 as composed on August 21, Devil's Canyon Project, 1974.



Appendix Figure 13 . Map of Slough No. 20 as composed on August 16, Devil's Canyon Project 1974.



Appendix Figure 14 . Map of Slough No. 21 as composed on September 24, Devil's Canyon Project, 1974.