APPENDIX C

Qualitative Analysis of Salmon Spawning Habitat in Sloughs Located Within the Talkeetna to Devil Canyon Reach of the Susitna River.

APPENDIX C

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CONTRIBUTORS

Aquatic Habitat and Instream Flow Studies (AH) Project Leader and Principal Contact	Christopher Estes
AH Fish Habitat Utilization Subproject Leader and Appendix Report Coordinator	Andrew Hoffmann
Hydraulic Engineer	E. Woody Trihey
Data Processing Project Leader	Allen Bingham
Graphics	Sally Donovan Anne Reilly
Typing Staff	Peggy Skeers Loretta Channell
Editors	Christopher Estes Andrew Hoffmann Doug Vincent-Lang
Data Collection	Andrew Hoffmann Sheryl Salasky Don Volk Dean Beers Tom Crowe Rick Gustin Kim Sylvester
Data Analysis	Sheryl Salasky Len Vining Rick Sinnott Andrew Hoffmann Gene Sandone
Text	Sheryl Salasky Rick Sinnott Andrew Hoffmann Christopher Estes

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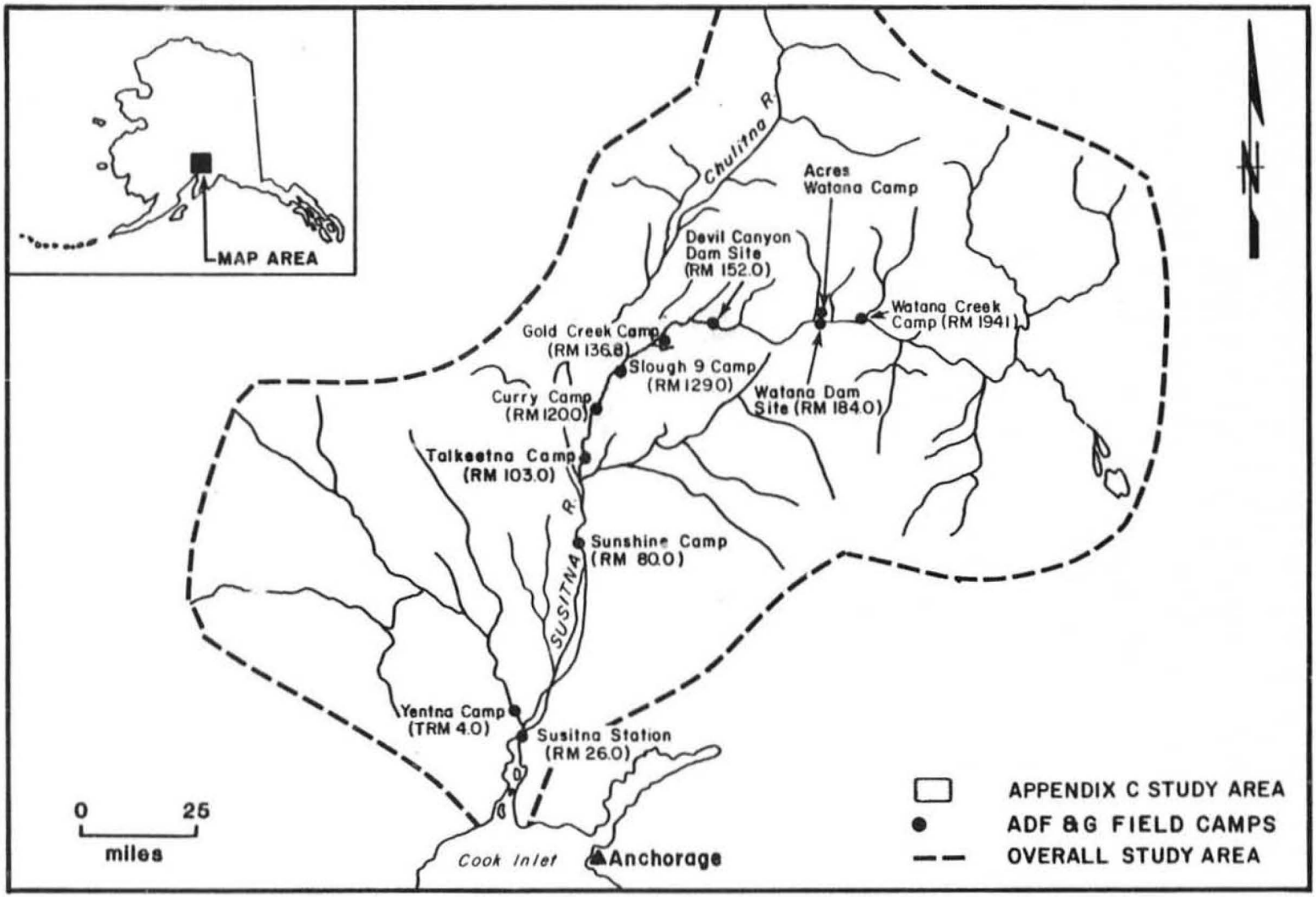
INTRODUCTION

This appendix addresses adult salmon (Oncorhynchus sp.) distribution and spawning habitat utilization. It represents an intermediate step in a narrowing focus of investigation. Appendix B analyzes the migration of adult chinook salmon, O. tschawytscha; coho salmon, O. kisutch; sockeye salmon, O. nerka; chum salmon, O. keta; and pink salmon, O. gorbuscha up the Susitna River and access conditions in the mouths of nine selected sloughs between Talkeetna and Devil Canyon. This appendix describes the distribution and abundance of adult salmon in 34 sloughs and 20 tributaries located in the Talkeetna to Devil Canyon reach of the Susitna River (Appendix Figure C-1). In addition, general habitat characteristics (substrate composition, upwelling ground water, and ice-free areas) at 13 of these sloughs were also evaluated and compared with the salmon distribution of adult salmon in these sloughs. A fourteenth slough (not included in the distribution and abundance analysis) was also included in the general habitat surveys. Appendix D compares available and utilized ranges of three hydraulic habitat variables (water depth and velocity, and substrate composition). These variables are analyzed in detail for spawning chum salmon suitability in three sloughs.

Each species of fish has adapted to a particular range of habitat conditions (Gorman and Karr 1978). In this way, a species lessens competition for a scarce resource (e.g., food or spawning habitat) by selecting a specific range of acceptable conditions. Spawning habitat for salmon is a limited resource in the Talkeetna to Devil Canyon reach



Appendix Figure C-1. Appendix C study area within the overall study area of the Susitna Hydroelectric Feasibility Study Program, Susitna River, Alaska, 1982.

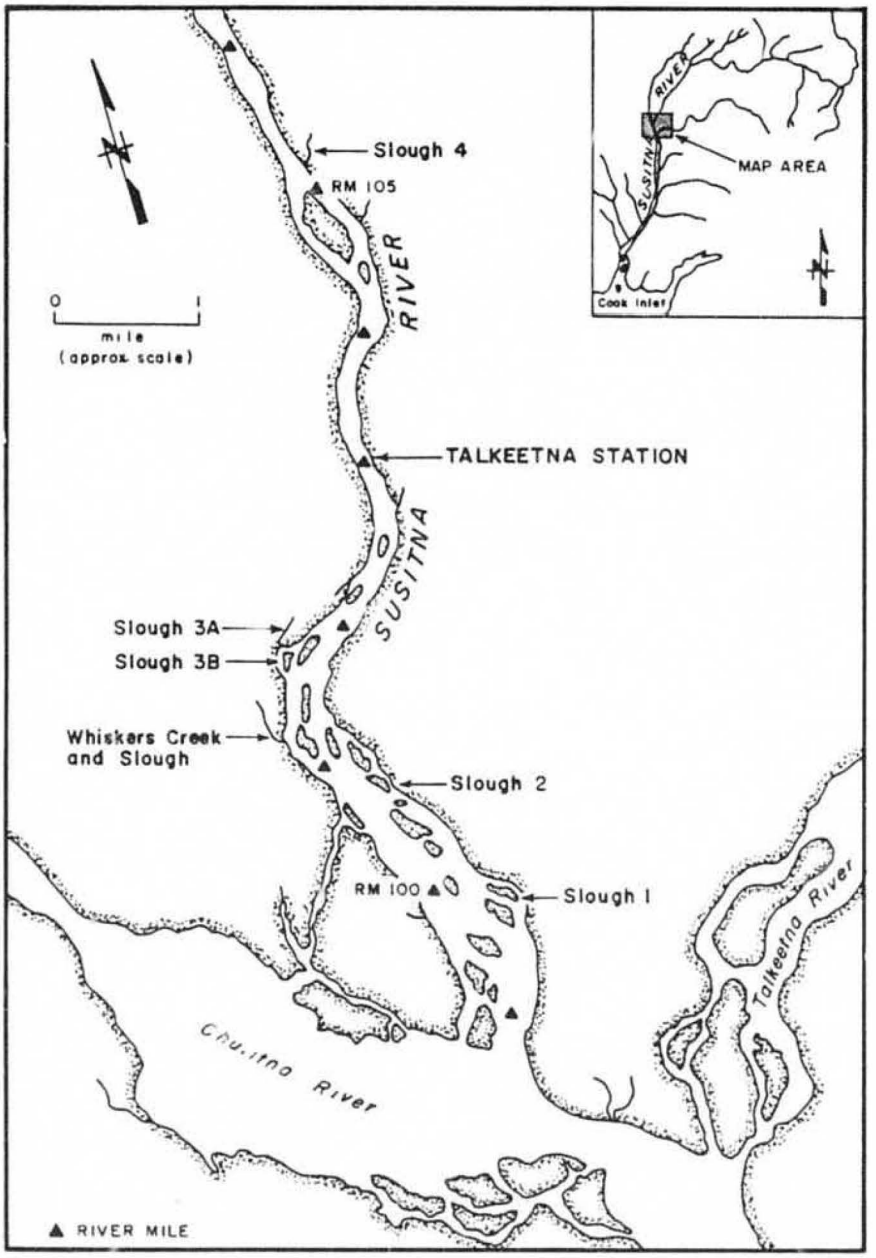
of the Susitna River. Few salmon, primarily chum salmon, spawn in the mainstem river or side channels. Tributaries provide the primary spawning habitat for chinook and coho salmon, whereas sloughs and tributaries provide the principal spawning habitat for chum, pink, and sockeye salmon.

Adult salmon usually return to their natal waters to spawn (Hasler 1966). Access into these spawning areas is the first critical obstacle to overcome and access into Susitna River sloughs depends on mainstem discharge (Appendix B). One of the major effects of the proposed hydroelectric project would be a change in flow regime. The slough habitats would be affected by these changes to a much greater extent than the tributaries.

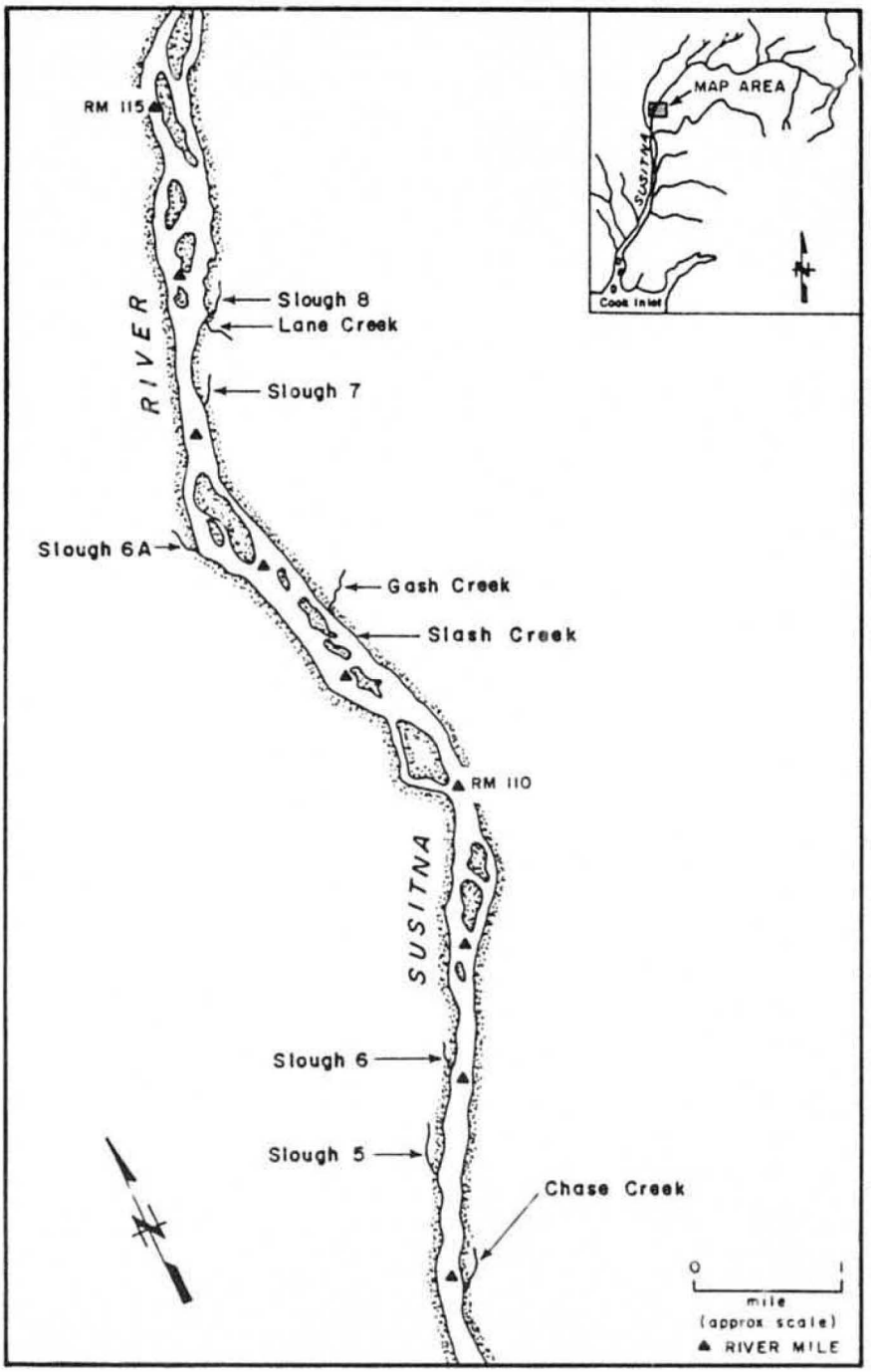
METHODS

Salmon Distribution and Abundance

Distribution and abundance of adult salmon in 34 principal sloughs and 20 tributaries of the Susitna River between the Chulitna River and upper Devil Canyon (Appendix Figures C-1 and C-2) were determined in 1981 and/or 1982. Survey methods and data are presented in the ADF&G Basic Data Reports (ADF&G 1981a, 1983b: Volume 2). Procedures are described in the 1981 and 1982 Procedures Manuals (ADF&G 1981b, 1983a). To complete this evaluation, peak numbers of live salmon in a slough were tabulated under the assumption that they indicate the relative importance of a slough for spawning salmon.



Appendix Figure C-2. Location of sloughs and tributaries of the Susitna River between the Chulitna River (RM 99) and upper Devil Canyon (RM 162).



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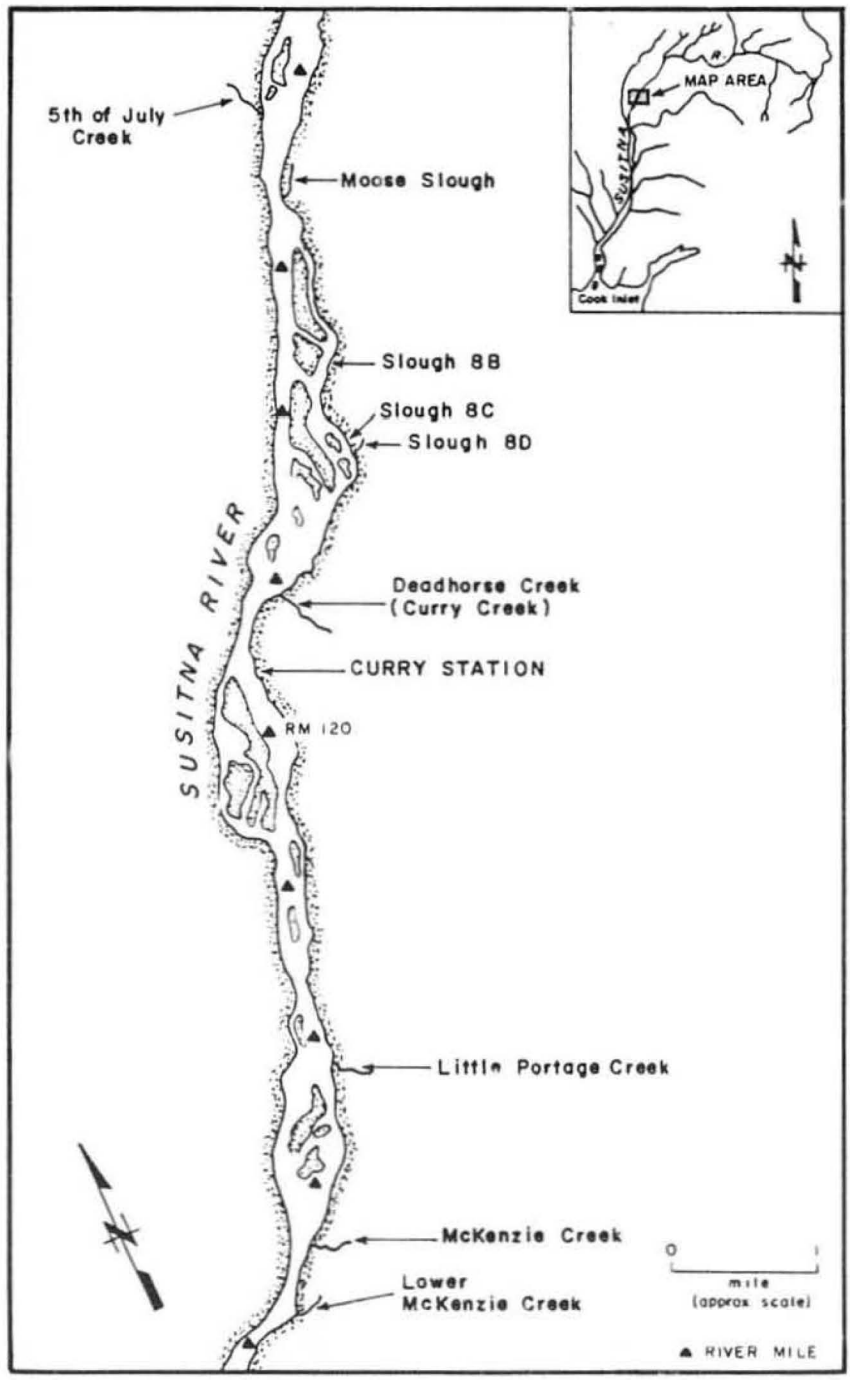

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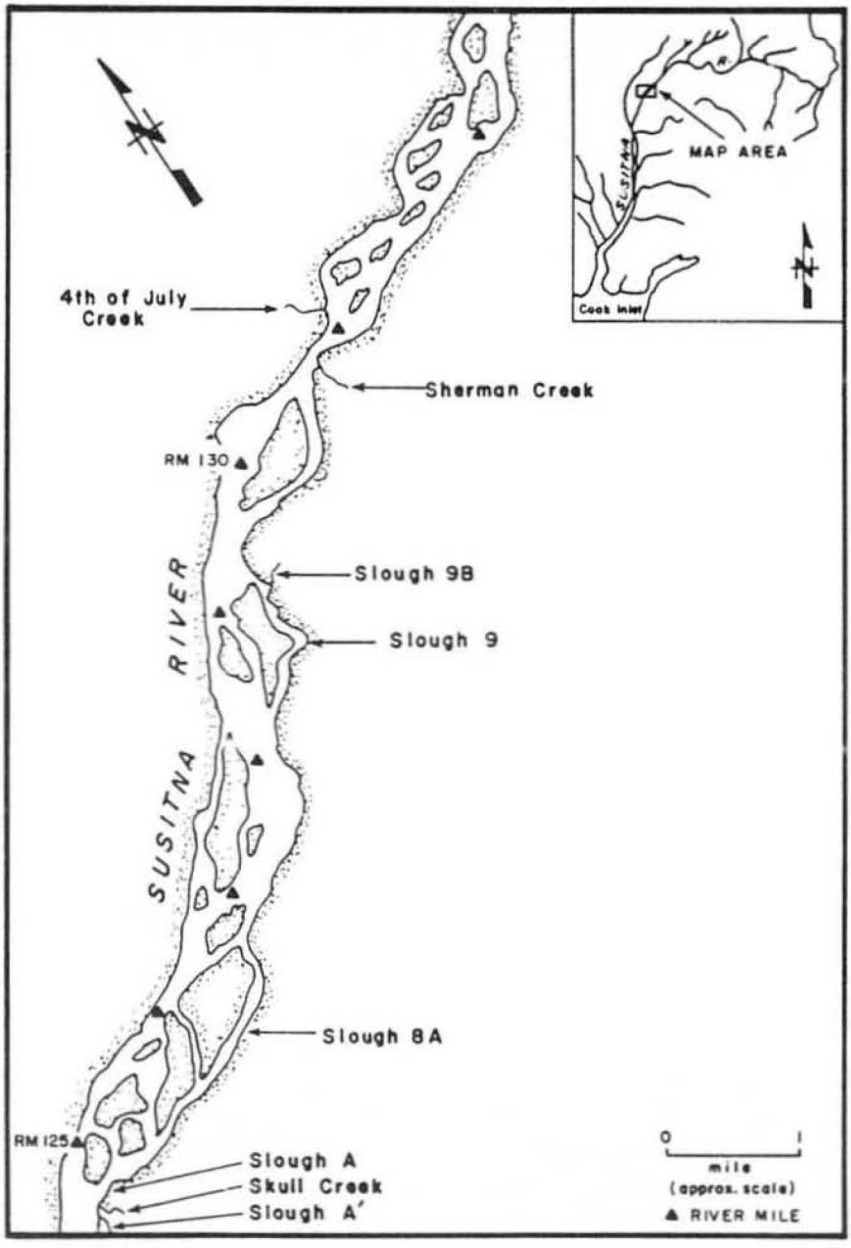

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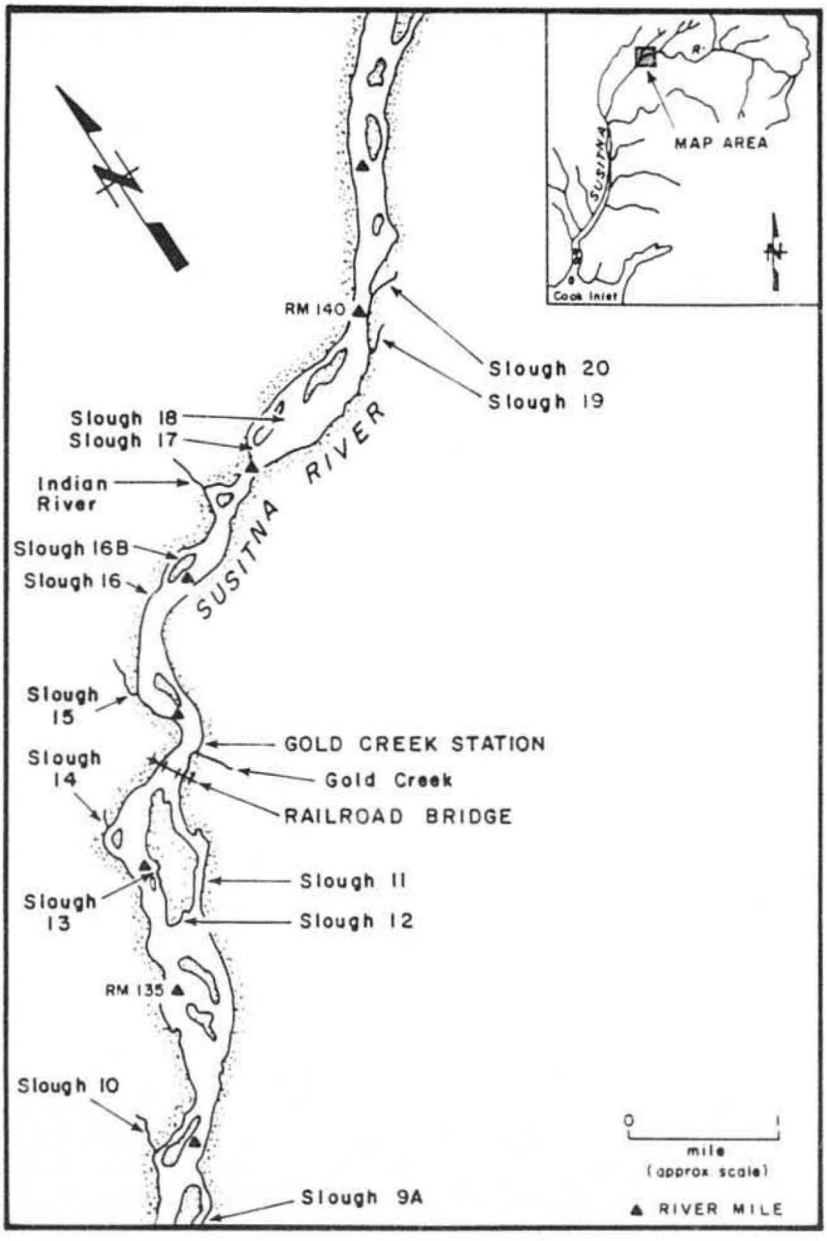

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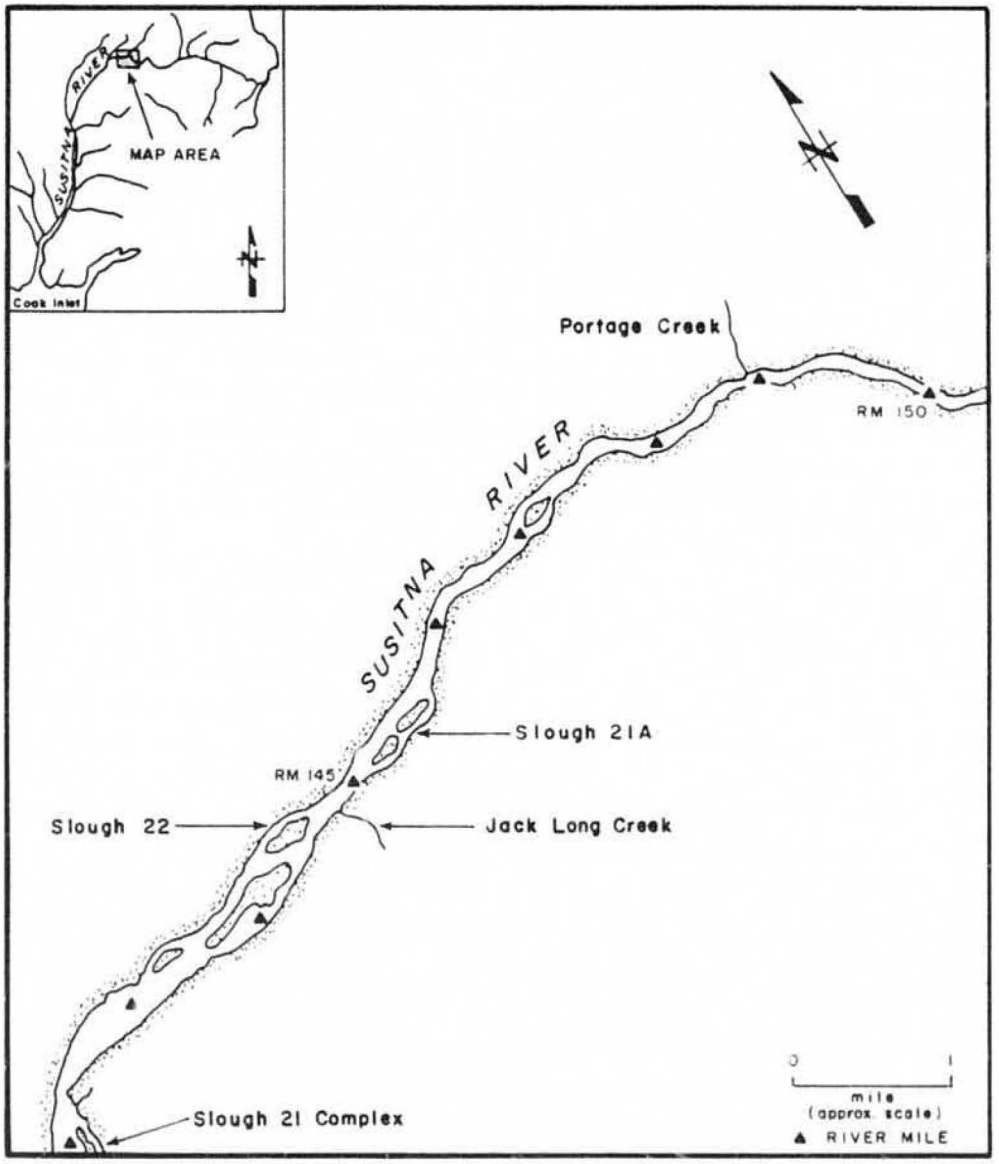

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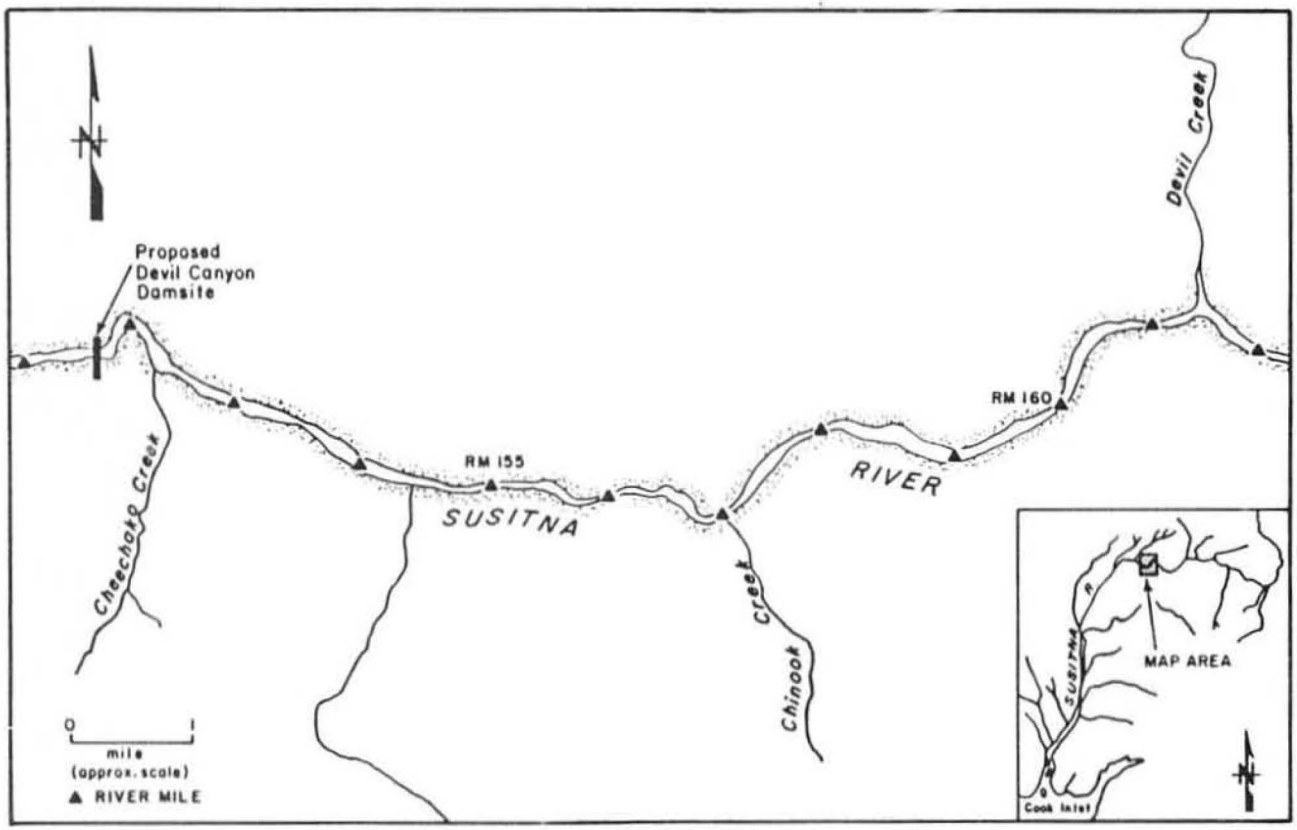

Appendix Figure C-2. (Continued).

Slough Habitat Characteristics

Habitat characteristics of 13 of these sloughs were evaluated during the open-water and ice-covered seasons. Whiskers Creek Slough, Slough 6A, Lane Creek Slough (Slough 8), and sloughs 8A, 9, 9B, 9A, 10, 11, 16B, 19, 20, 21* and 22** were sampled to represent a cross section of slough habitat in this reach of river. During the open-water season upwelling ground water, substrate composition, and salmon spawning activity were evaluated.

Upwelling was detected by observing the movement of small streambed particles as the ground water exited the substrate. Upwelling areas were easily visible in silt and sand substrates but were difficult to detect visually when larger streambed particle sizes predominated. Thus, the presence and extent of upwelling was difficult to quantify accurately in gravel, rubble or cobble substrates.

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* In this report the Slough 21 Complex has been defined to include the slough, as described in ADF&G (1981c, 1982, 1983b: Volume 4), and the adjoining access channel which parallels the mainstem Susitna River (Appendix Figure C-11). Surveys of spawning salmon included the entire Slough 21 Complex.

** Slough 22 was only surveyed for spawning fish on an infrequent basis.

Substrate categories were classified by visual observation. The area of various substrate sizes was indicated on field maps. Substrates were classified by one or a combination of two of the following codes, with the first of the two codes being the most predominant (i.e. 70% rubble - 30% cobble = RUCO).

Classification	Code	Size*
Silt	SI	--
Sand	SA	--
Gravel	GR	¼ - 3
Rubble	RU	3 - 5
Cobble	CO	5 - 10
Boulder	BO	>10

Salmon spawning locations within the sloughs were recorded by the stream survey crew during the distribution and abundance survey of the thirty four sloughs. Spawning locations at Slough 22 were recorded on an infrequent basis as part of other study program elements.

Open-water season observations were recorded and mapped on bluelines of aerial photographs** (scale 1"=50') during foot surveys in the sloughs. During the ice-covered months, the same sloughs were surveyed for open leads in the ice cover. Open leads were suspected indicators of upwelling ground water or other warm water sources. Helicopter observations of open leads were mapped on the same series of bluelines as the open-water season data from an altitude of 600 feet above the sloughs

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* Particle size range in inches.

** The aerial imagery was obtained on May 21, 1983, when the mainstem flow was 20,000 cfs at Gold Creek.

during two flights (November 18, 1982, and February 23, 1983). From the air it was difficult to determine differences between open leads and areas covered with clear ice unless a recent snow or wind left a layer of snow on the ice.

To complete the habitat evaluation, the relative density of open water season upwelling/seepage areas in sloughs was rated subjectively* on a scale of 0 to 3. A slough with no observed upwelling/seepage was assigned a rank of 0. A slough where upwelling/seepage was infrequently observed was assigned a rank of 1. A slough with a few localized areas of strong upwelling/seepage or numerous areas of weak upwelling/seepage was assigned a rank of 2. A slough with numerous areas of strong upwelling/seepage was assigned a rank of 3.

Surface areas of substrate types and open leads were computed indirectly from the scaled blueline maps using a digitizer. These areas were expressed as a proportion of total water surface area in the slough.

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* It is important to stress that this rating is based on visual detection of upwelling sources. Limitations such as substrate particle size may have biased some of these ratings. Additionally this method does not evaluate other important ground water sources which contribute to slough flow but are not readily detected by visual observation.

Spawning Distribution and Slough Habitat Analysis

The habitat and spawning distribution information for the 14 sloughs was tabulated and combined to permit a qualitative analysis of spawning habitat characteristics in sloughs.

RESULTS

Salmon Distribution and Abundance

The distribution and abundance of adult salmon differed between each slough and tributary location. Distribution and abundance also varied between years (1981 and 1982) at each location. Chinook salmon spawned exclusively in tributaries; whereas, sockeye salmon spawned predominantly in sloughs (Appendix Tables C-1 to C-4). Chum, pink and coho salmon spawned in both tributary and slough habitats.

Abundance of live salmon in tributaries is not comparable to abundance in the sloughs because entire tributaries were not surveyed. Relatively few sloughs contained large numbers of spawning salmon (Appendix Table C-5). Only sloughs 8A, 9, 9A, 11, 15 and 21 contained more than 100 salmon of a given species (ADF&G 1983b: Volume 2).

Spawning Distribution and Slough Habitat Characteristics

Maps of sampling sites, substrate types, upwelling ground water and open leads in ice cover for 14 sloughs are included in the ADF&G Basic Data

Appendix Table C-1 Number of observations of salmon in Susitna River sloughs in the Talkeetna to Devil Canyon reach during 1981 (adapted from ADF&G 1981a).

Slough	River Mile	Total # of visits	Number of visits live salmon were observed in sloughs					Sampling Period
			Chinook[a]	Sockeye	Pink	Chum	Coho	
1	99.6	6	-	0	0	1	0	8/21 - 10/2
2	100.2	7	-	0	0	3	0	8/2 - 10/2
3B	101.4	8	-	2	0	0	0	8/5 - 10/2
3A	101.9	8	-	4	1	0	0	8/4 - 10/2
4	105.2	8	-	0	0	0	0	8/4 - 10/2
5	107.2	5	-	0	0	0	0	8/7 - 9/22
6	108.2	5	-	0	0	0	0	8/2 - 9/22
6A	112.3	4	-	2	0	3	0	8/19 - 9/22
7	113.2	3	-	0	0	0	0	8/7 - 8/29
8	113.7	7	-	0	1	3	0	8/7 - 9/28
8D	121.8	4	-	0	0	0	0	8/1 - 8/27
8C	121.9	4	-	0	0	0	0	8/1 - 8/27
8B	122.2	4	-	0	0	1	0	8/1 - 8/27
Moose	123.5	5	-	0	0	5	0	8/27 - 9/27
A'	124.6	4	-	0	0	4	0	8/27 - 9/21
A	124.7	7	-	0	1	4	0	8/7 - 9/24
8A	125.1	7	-	4	0	4	0	8/7 - 9/27
9	128.3	8	-	3	0	4	0	8/7 - 9/27
9B	129.2	7	-	7	0	6	0	8/11 - 9/27
9A	133.3	8	-	3	0	5	0	7/31 - 9/27
10	133.8	5	-	0	0	0	0	7/31 - 9/20
11	135.3	10	-	8	0	7	0	7/31 - 9/26
12	135.4	7	-	8	0	0	0	7/31 - 9/26
13	135.7	8	-	0	0	2	0	7/31 - 9/26
14	135.9	7	-	0	0	0	0	7/31 - 9/26
15	137.2	7	-	0	0	1	0	7/31 - 9/19
16B	137.3	7	-	0	0	0	0	8/6 - 9/26
17	138.9	8	-	4	0	7	0	8/6 - 9/26
18	139.1	5	-	0	0	0	0	8/6 - 9/3
19	139.7	8	-	6	0	1	0	8/6 - 9/26
20	140.0	7	-	1	0	2	0	8/6 - 9/19
21	141.1	8	-	5	0	4	0	8/6 - 9/26
21A	144.3	3	-	0	0	3	0	8/26 - 9/11
TOTAL		209		49	3	70	0	

[a] Not included in the same survey - data not comparable.

Appendix Table C-2 Number of observations of salmon in Susitna River sloughs in the Talkeetna to Devil Canyon reach during 1982 (adapted from ADF&G 1983b: Volume 2).

Slough	River Mile	Total # of visits	Number of visits live salmon were observed in sloughs					Sampling Period
			Chinook	Sockeye	Pink	Chum	Coho	
1	99.6	6	0	0	0	0	0	8/8 - 9/29
2	100.2	6	0	0	0	0	0	8/8 - 9/29
3B	101.4	7	0	0	0	0	0	8/8 - 9/29
3A	101.9	6	0	0	0	0	0	8/8 - 9/21
4	105.2	7	0	0	0	0	0	8/13 - 9/29
5	107.2	7	0	0	0	1	0	8/7 - 9/21
6	108.2	6	0	0	0	0	0	8/13 - 9/21
6A	112.3	9	0	0	1	2	2	8/7 - 9/27
7	113.2	8	0	0	0	0	0	8/8 - 9/27
8	113.7	10	0	0	0	0	0	7/28 - 9/21
8D	121.8	8	0	0	0	1	0	8/6 - 9/25
8C	121.9	7	0	2	0	3	0	8/6 - 9/25
8B	122.2	10	0	4	0	6	0	8/6 - 9/25
Moose	123.5	8	1[a]	2	2	7	0	8/6 - 9/25
A'	124.6	9	0	0	0	0	0	7/29 - 9/19
A	124.7	9	0	0	0	0	0	7/29 - 9/19
8A	125.1	10	0	9	3	10	3	8/6 - 10/2
B	126.3	9	0	4	2	6	0	8/12 - 10/2
9	128.3	8	0	4	3	6	0	8/6 - 9/25
9B	129.2	3	0	1	0	1	0	8/6 - 9/25
9A	133.3	11	0	1	0	3	0	8/6 - 10/1
10	133.8	9	0	0	0	2	0	8/6 - 9/25
11	135.3	12	0	11	4	10	0	8/2 - 10/5
12	135.4	10	0	0	0	0	0	8/2 - 9/25
13	135.7	10	0	0	0	0	0	8/6 - 9/25
14	135.9	10	0	0	0	0	0	8/6 - 9/25
15	137.2	9	0	0	3	1	2	8/4 - 9/25
16B	137.3	9	0	0	0	0	0	8/4 - 9/25
17	138.9	10	0	0	0	3	0	8/4 - 9/30
18	139.1	10	0	0	0	0	0	8/4 - 9/30
19	139.7	10	0	0	1	0	0	8/4 - 9/30
20	140.0	10	0	0	4	4	0	8/4 - 9/30
21	141.1	10	0	7	3	8	0	8/4 - 9/30
21A	144.3	4	0	0	0	0	0	8/4 - 9/23
TOTAL		287	1	45	26	74	7	

[a]Single chinook salmon observed milling in slough.

Appendix Table C-3 Number of observations of salmon in Susitna River tributaries in the Talkeetna to Devil Canyon reach during 1981 (adapted from ADF&G 1981a).

Tributary	River Mile	Total # of visits	Number of visits live salmon were observed in tributaries: Chinook[a]	Sockeye	Pink	Chum	Coho	Sampling Period
Whiskers Creek	101.4	8	-	0	0	0	7	8/5 - 10/2
Chase Creek	106.9	9	-	0	2	1	7	8/4 - 10/2
Gash Creek	111.6	2	-	0	0	0	2	9/23 - 9/28
Lane Creek	113.6	7	-	0	3	6	2	8/19 - 9/28
Lower McKenzie Creek	116.2	6	-	1	0	2	4	8/23 - 9/28
McKenzie Creek	116.7	2	-	0	0	0	0	8/11 - 8/23
Deadhorse	120.9	2	-	0	0	0	0	8/11 - 9/25
5th of July	123.7	1	-	0	1	0	0	8/11
Skull Creek	124.7	3	-	0	2	1	0	8/20 - 9/19
Sherman Creek	130.8	6	-	0	3	4	0	7/31 - 9/25
4th of July Creek	131.0	6	-	0	4	4	2	7/31 - 9/25
Gold Creek	136.7	1	-	0	0	0	0	8/25
Indian River	138.6	8	-	0	1	5	3	8/6 - 9/26
Jack Long Creek	144.5	3	-	0	1	0	0	8/21 - 9/24
Portage Creek	148.9	3	-	0	0	0	1	8/21 - 9/24
TOTAL		67	-	1	17	23	28	

[a] Not included in same survey - data not comparable.

Appendix Table C-4 Number of observations of salmon in Susitna River tributaries in the Talkeetna to Devil Canyon reach during 1982 (adapted from ADF&G 1983b: Volume 2).

Tributary	River Mile	Total # of visits	Number of visits live salmon were observed in tributaries					Sampling Period
			Chinook	Sockeye	Pink	Chum	Coho	
Whiskers Creek	101.4	6	0	0	4	0	5	8/8 - 9/24
Chase Creek	106.9	8	1	0	4	0	3	8/8 - 9/27
Slash Creek	111.2	1	0	0	0	0	1	9/21
Gash Creek	111.6	7	0	0	0	0	3	8/7 - 10/2
Lane Creek	113.6	11	4	0	5	8	4	7/12 - 9/21
Lower Mckenzie Creek	116.2	10	0	0	2	0	4	8/7 - 10/2
Mckenzie Cr	116.7	10	0	0	1	0	0	8/7 - 10/2
Little Portage Cr	117.7	10	0	0	4	3	3	8/7 - 10/2
5th of July Creek	123.7	8	1	0	4	1	0	8/6 - 9/20
Skull Creek	124.7	8	0	0	3	1	0	8/6 - 9/19
Sherman Cr	130.8	8	1	0	3	0	0	8/6 - 10/1
4th of July Creek	131.0	11	3	0	4	9	3	8/28 - 10/1
Gold Creek	136.7	5	1	0	2	0	1	8/3 - 8/30
Indian River	138.6	13	6	0	6	9	7	7/21 - 9/30
Jack Long Creek	144.5	9	2	0	3	1	1	8/4 - 9/30
Portage Cr	148.9	12	4	1	4	6	3	7/21 - 9/30
Cheechako Creek	152.5	8	4	0	0	0	0	8/5 - 9/24
Chinook Cr	156.8	4	3	0	0	0	0	8/6 - 8/22
Devil Cr	161.4	4	0	0	0	0	0	8/6 - 8/22
TOTAL		153	30	1	49	38	38	

Appendix Table C-5 Abundance of adult salmon in Susitna River sloughs during peak observations in 1982. Relative abundance: High (H) 100, Medium (M) 50-100, Low (L) 50, None observed (-).

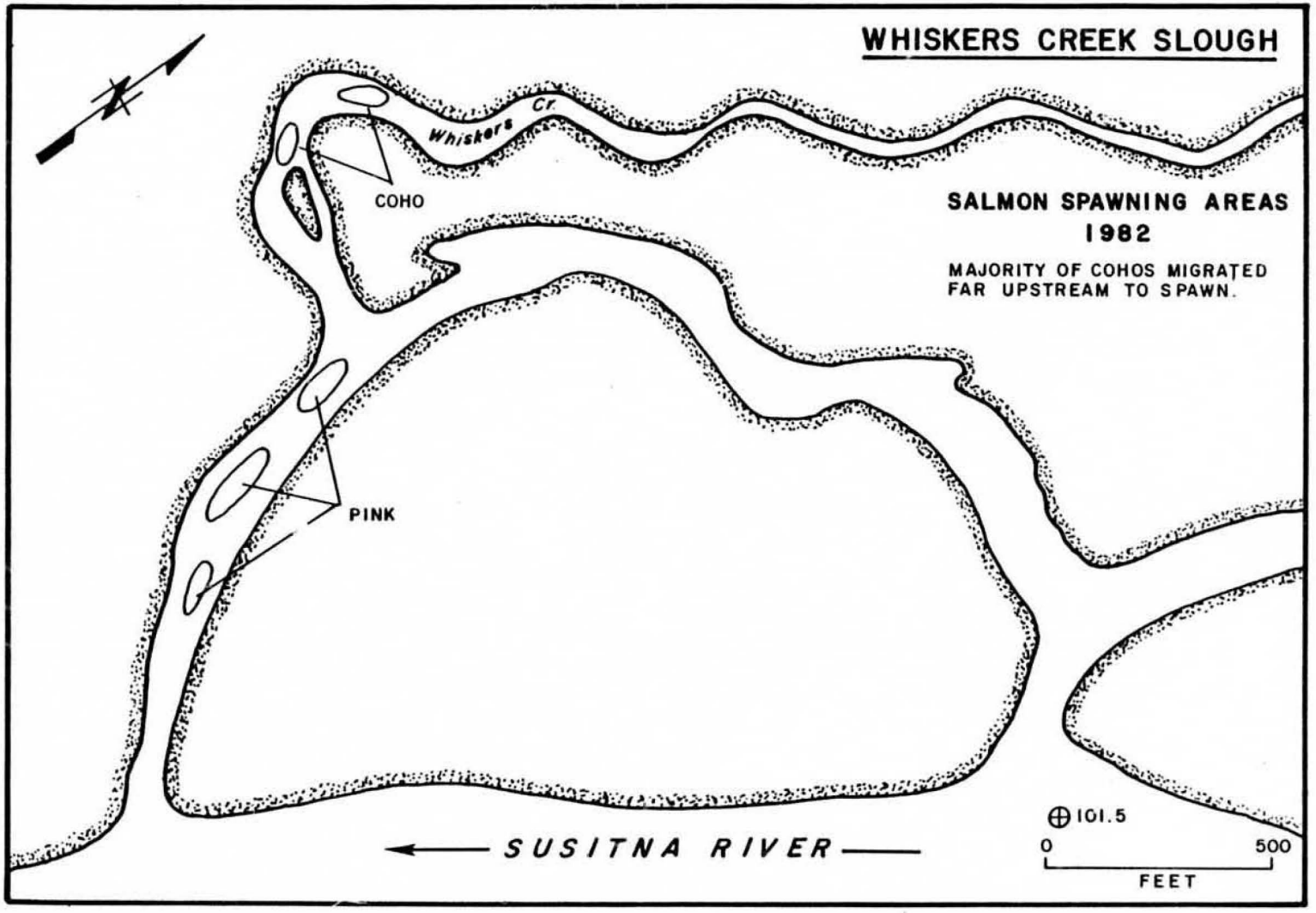
Slough	River Mile	Chinook	Sockeye	Pink	Chum	Coho
1-4	99.6-105.2	-	-	-	-	-
5	107.2	-	-	-	L	-
6	108.2	-	-	-	-	-
6A	112.3	-	-	L	L	L
7	113.2	-	-	-	-	-
8	113.7	-	-	-	-	-
8D	121.8	-	-	-	L	-
8C	121.9	-	L	-	L	-
8B	122.2	-	L	-	M	-
Moose	123.5	L[a]	L	L	L	-
A'	124.6	-	-	-	-	-
A	124.7	-	-	-	-	-
8A	125.1	-	M	L	H	L
B	126.3	-	L	L	L	-
9	128.3	-	L	L	H	-
9B	129.2	-	L	-	L	-
9A	133.3	-	L	-	H	-
10	133.8	-	-	-	L	-
11	135.3	-	H	H	H	-
12	135.4	-	-	-	-	-
13	135.7	-	-	-	-	-
14	135.9	-	-	-	-	-
15	137.2	-	-	H	L	L
16B	137.3	-	-	-	-	-
17	138.9	-	-	-	L	-
18	139.1	-	-	-	-	-
19	139.7	-	-	L	-	-
20	140.0	-	-	M	L	-
21	141.1	-	L	M	H	-
21A	144.3	-	-	-	-	-

[a]Single chinook salmon observed milling in slough.

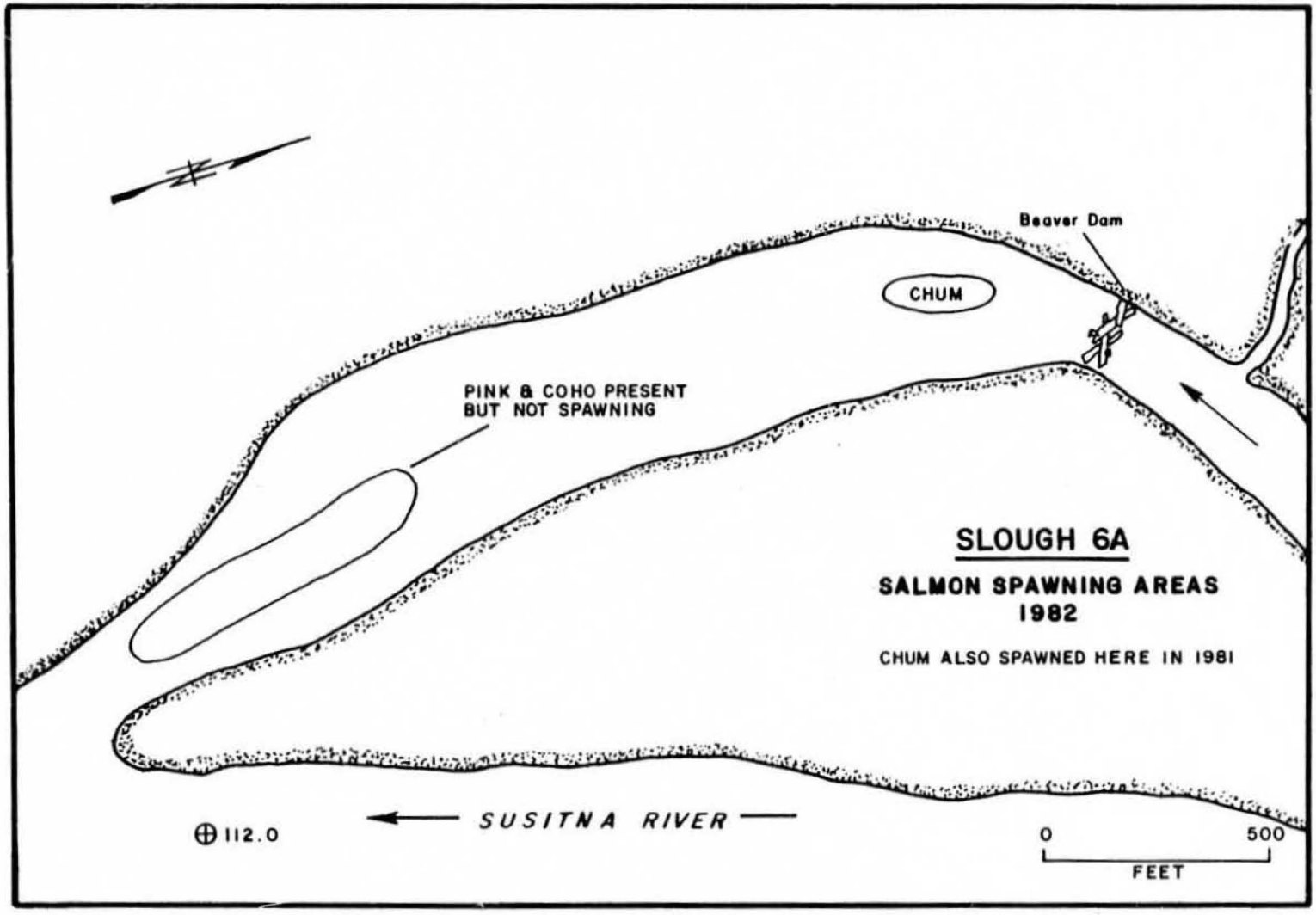
Report (ADF&G 1983b: Appendix Figures 4-F-15 to 4-F-69). Salmon spawning areas were observed in 10 of these sloughs during 1982 (Appendix Figures C-3 to C-11). In addition, locations of redds (ADF&G 1983b: Appendix 4-F) were mapped in more intensively studied sloughs (8A, 9, 11 and 21). A list of the maps produced and their locations is summarized in Appendix Table C-6. Information from all of these maps has been synthesized in Appendix Table C-7 and is discussed below.

Due to our dependence on visual observations to detect areas of upwelling, and our inability to observe upwelling if silts and sand substrates were absent, the relationship between open leads and areas of upwelling ground water was not always established. Field observations in which this relationship could be detected appeared to indicate that open leads occur immediately downstream from the point of upwelling. This trend was noted at Lane Creek Slough and sloughs 9, 9A, 11, 21 and 22. Other sloughs had many open leads yet little or no observed upwelling. In most of these instances, open leads were probably due to the presence of a nearby tributary or source of flowing water which was not observed. This occurred at Whiskers Creek Slough and sloughs 6A, 10 and 20. Slough 19 had a concentrated upwelling area yet very few open leads, none in the vicinity of the upwelling. Open leads were present in Slough 16B yet no upwelling was observed (perhaps because upwelling was so difficult to observe in rubble-cobble substrate).

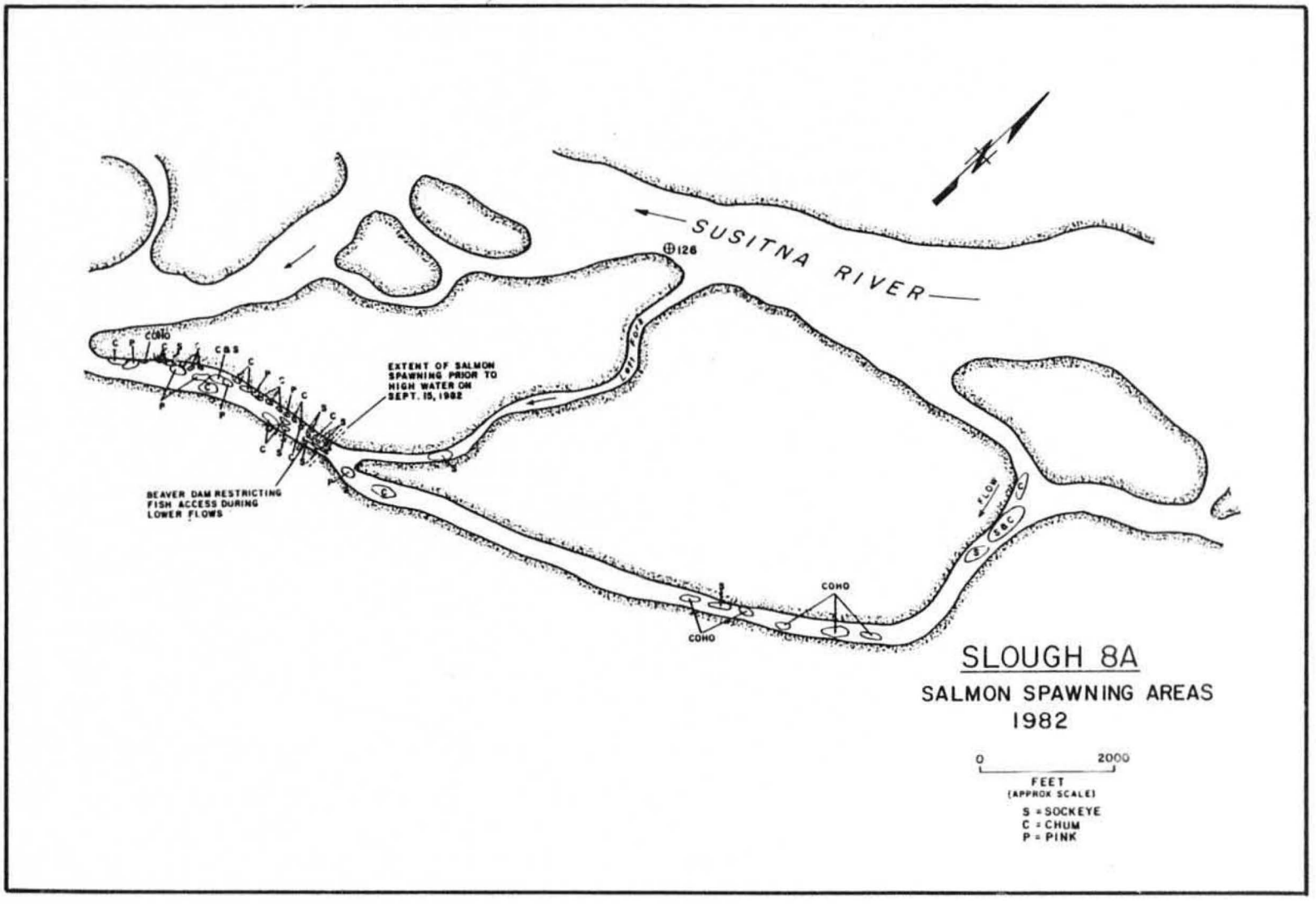
Substrate in sloughs varied from silt to cobble and boulders. The majority of salmon spawning in the sloughs were observed utilizing a



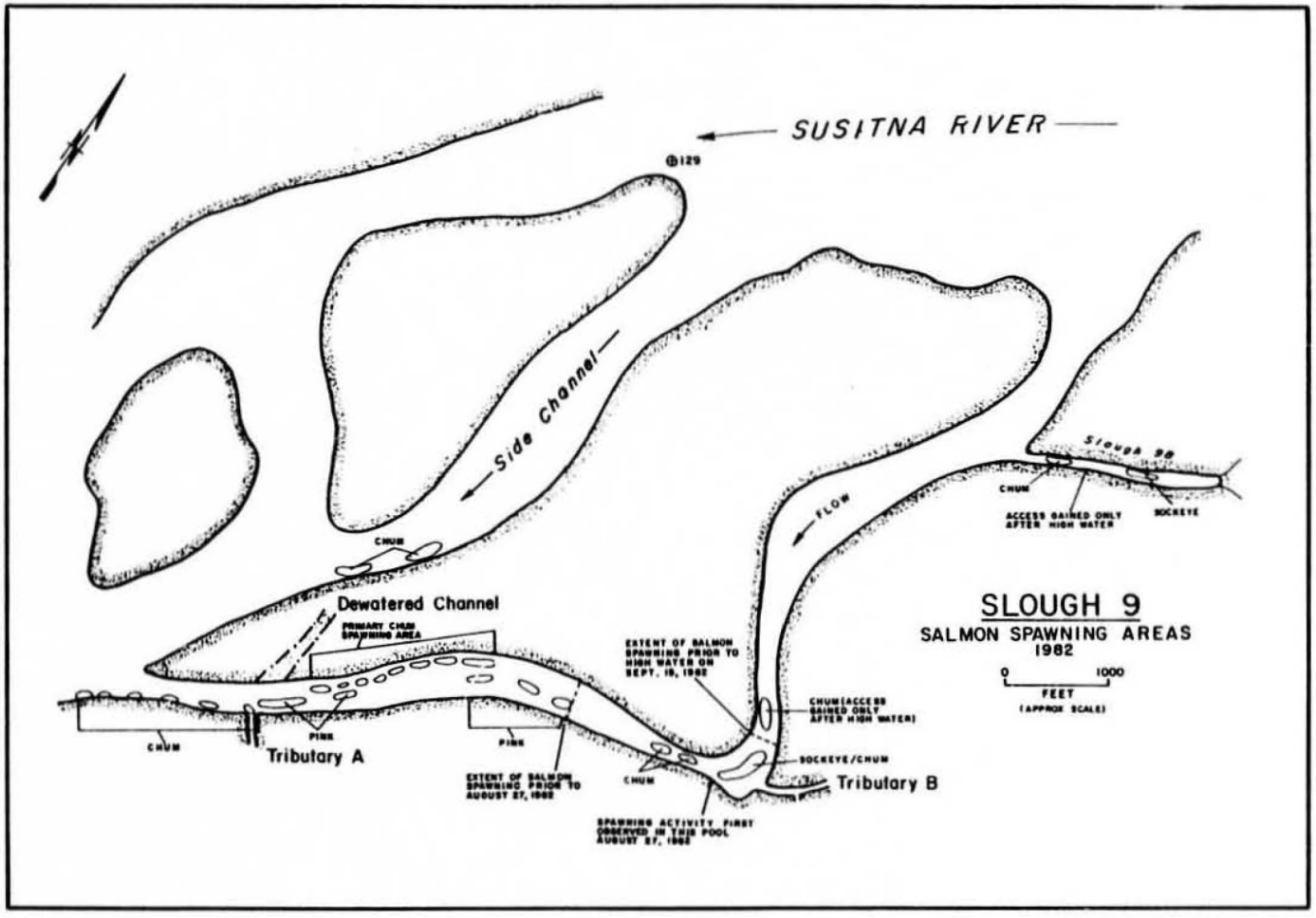
Appendix Figure C-3. Salmon spawning areas in Whiskers Creek Slough.



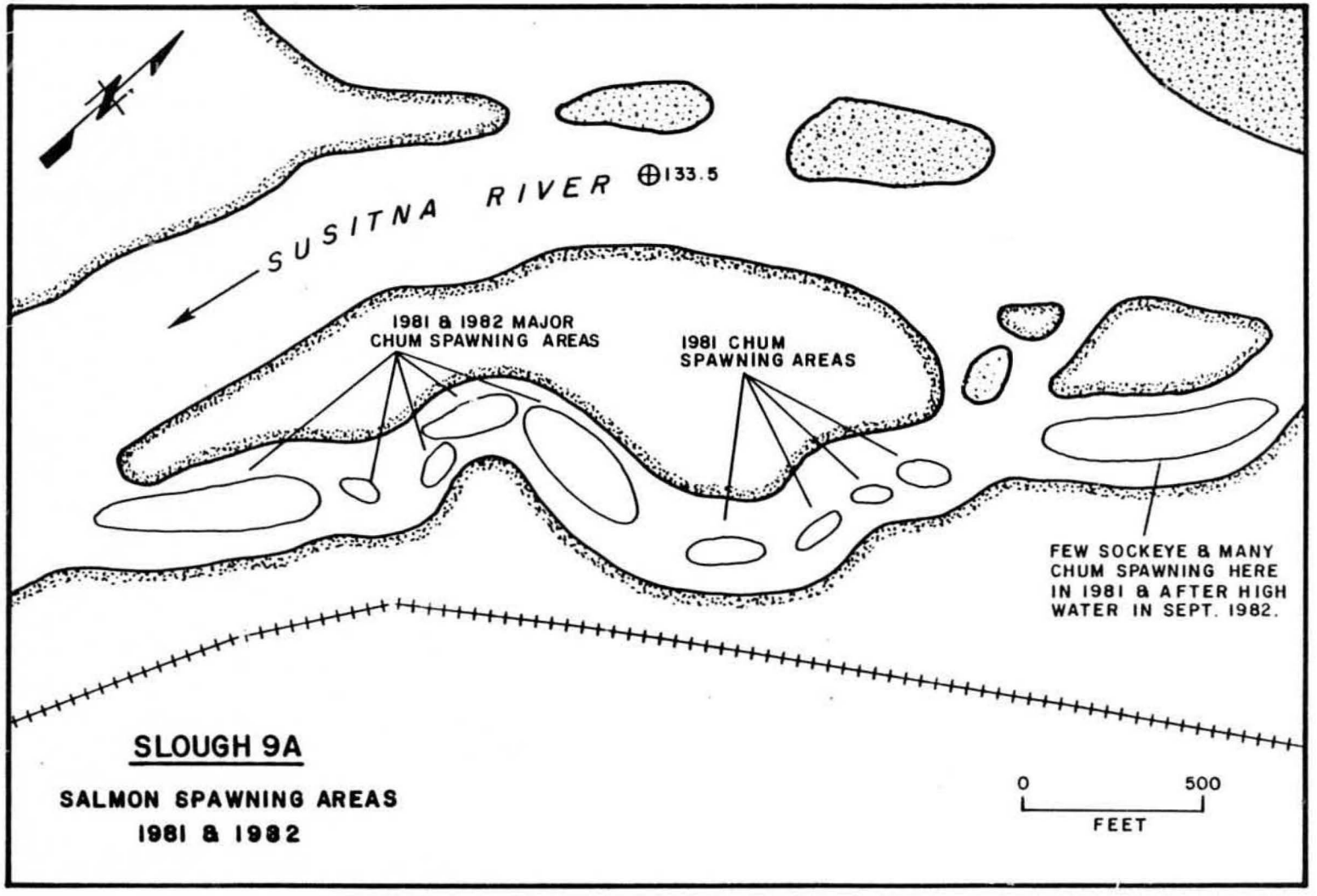
Appendix Figure C-4. Salmon spawning areas in Slough 6A.



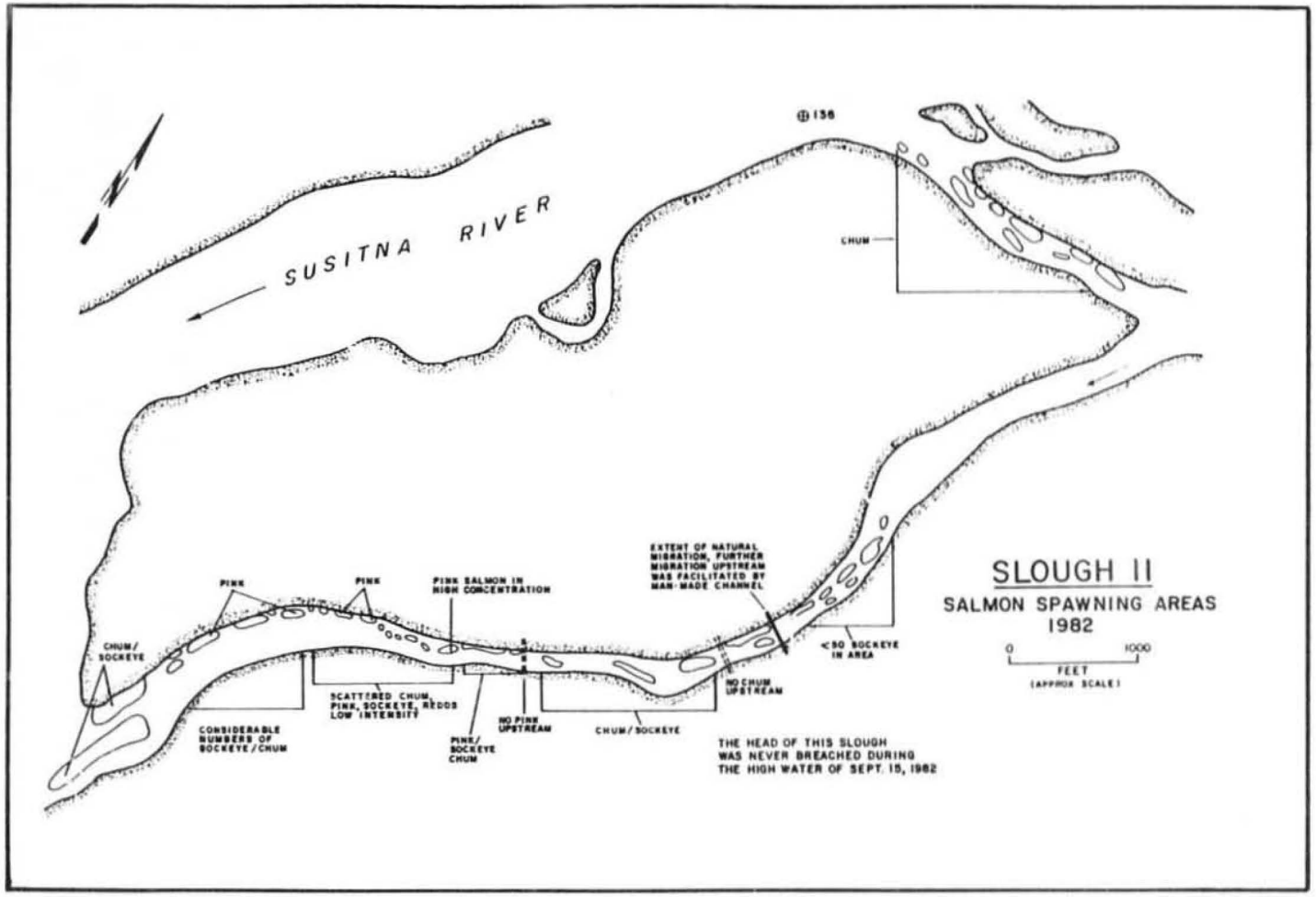
Appendix Figure C-5. Salmon spawning areas in Slough 8A.



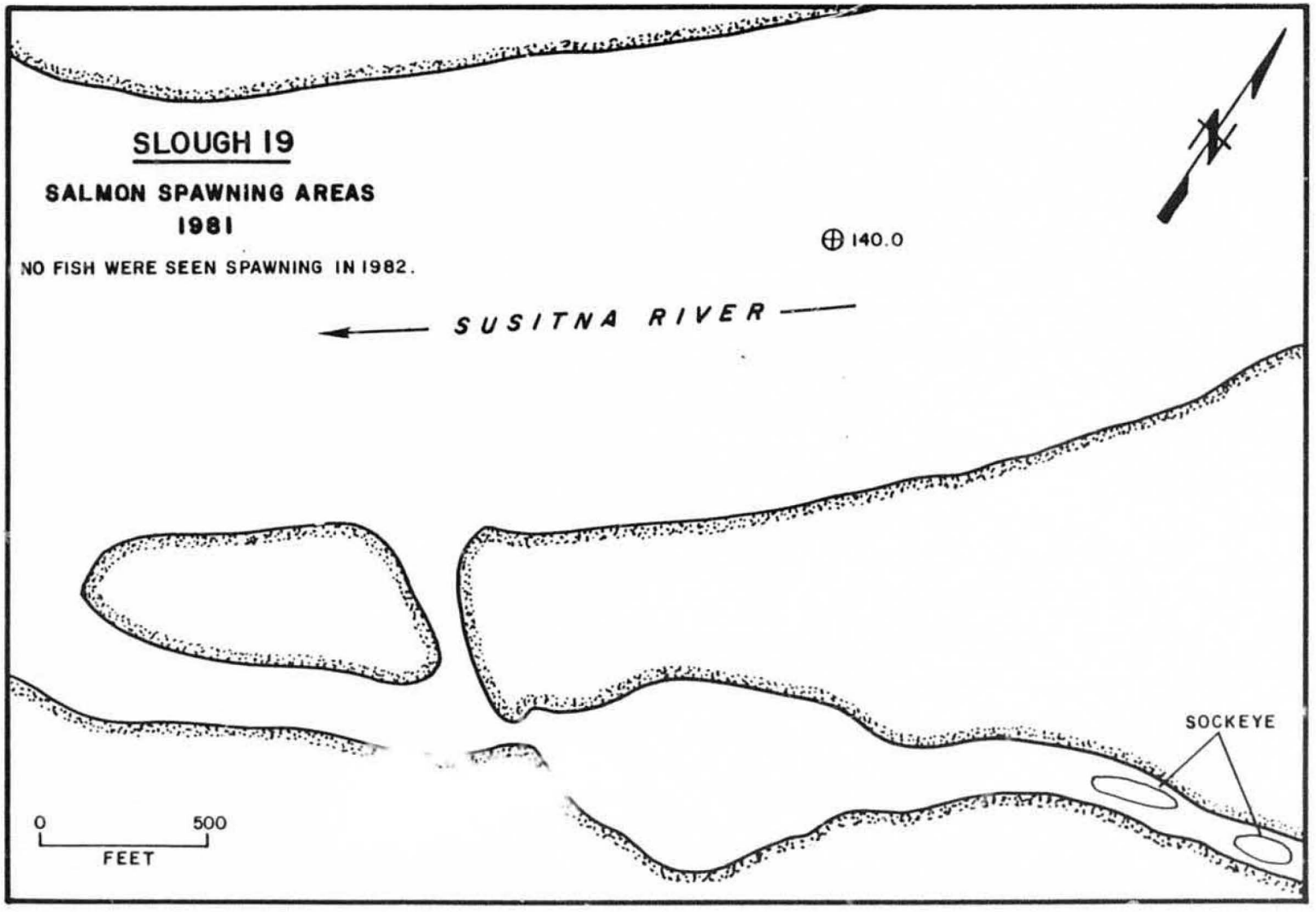
Appendix Figure C-6. Salmon spawning areas in sloughs 9 and 9B.



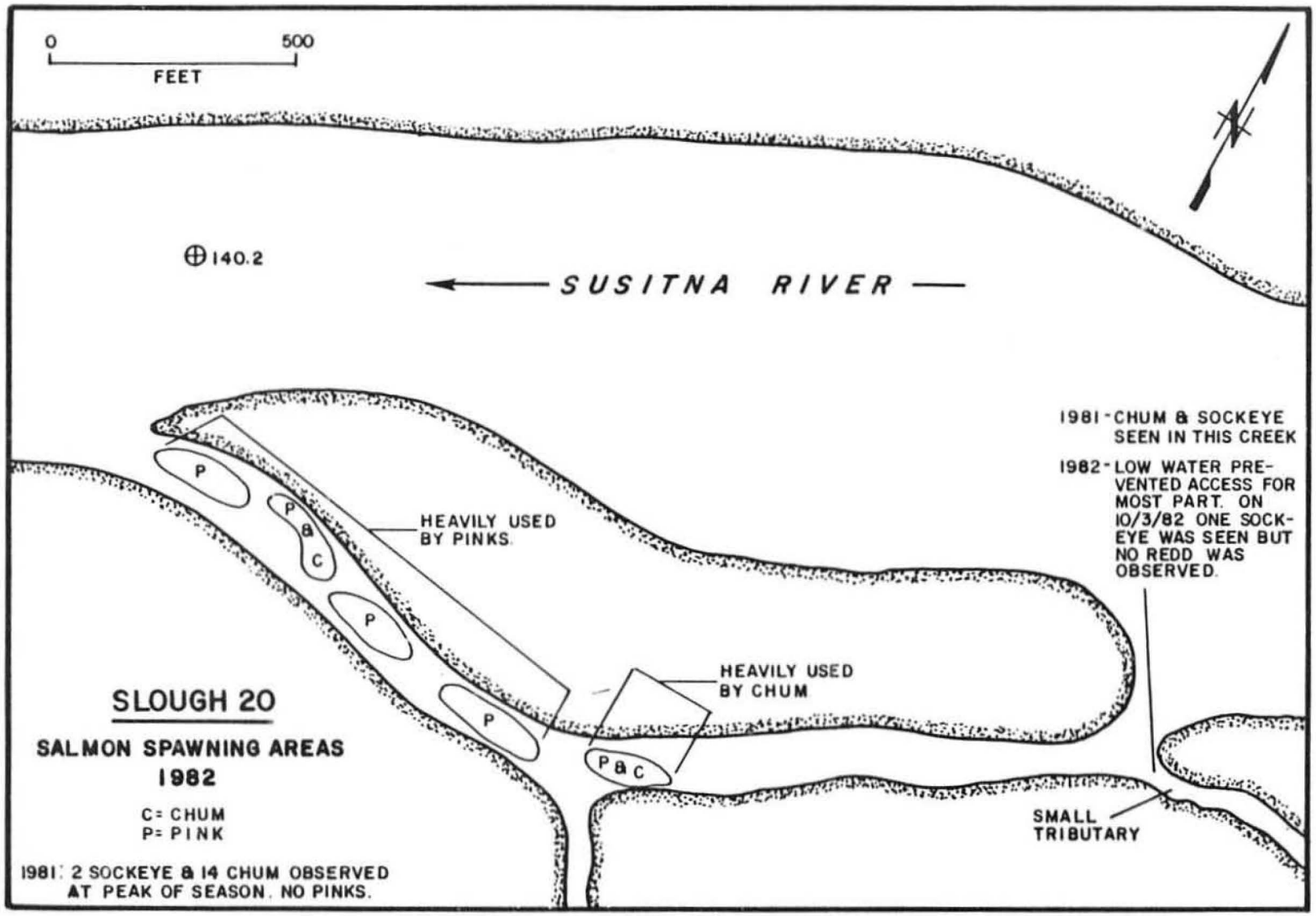
Appendix Figure C-7. Salmon spawning areas in Slough 9A.



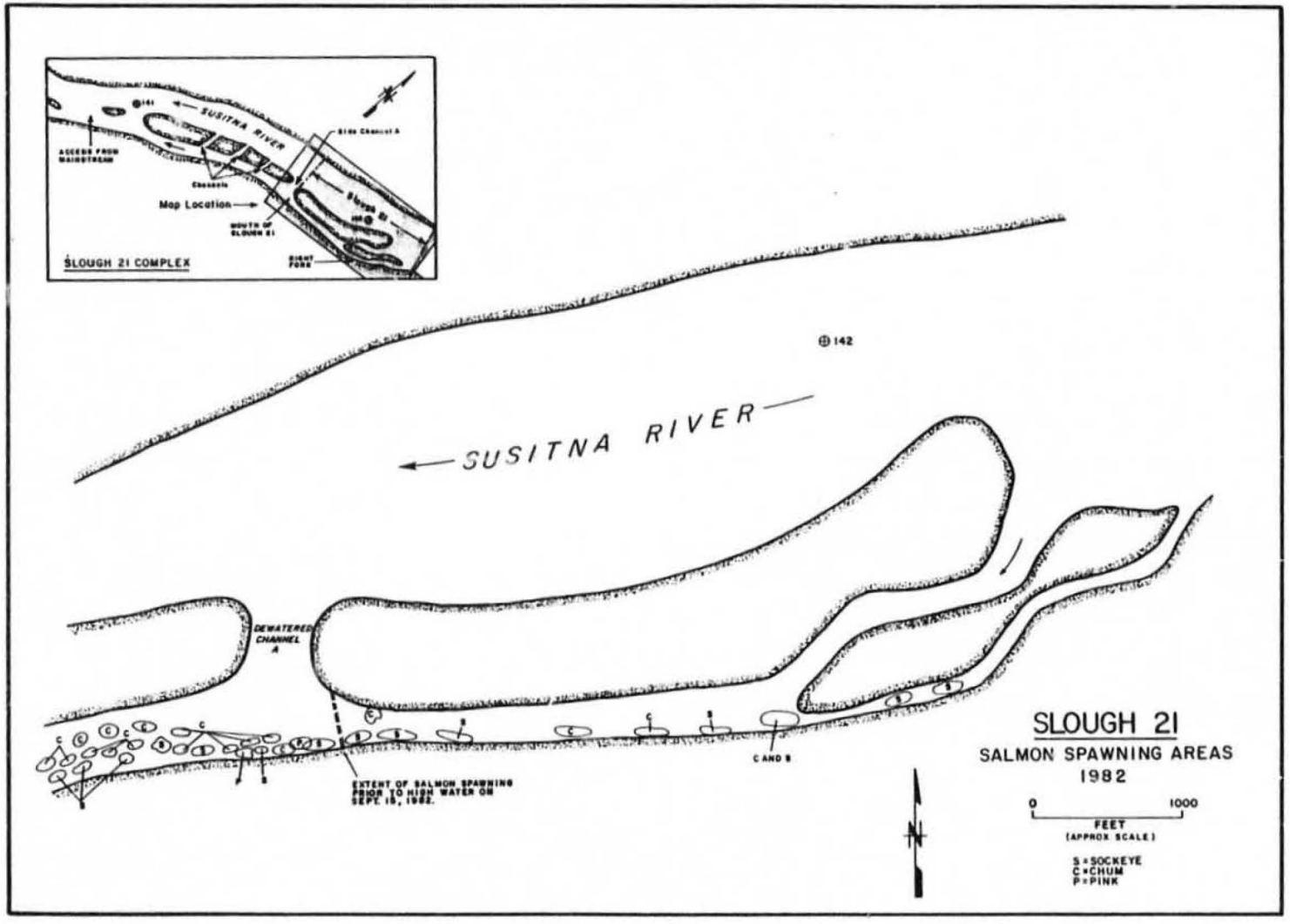
Appendix Figure C-8. Salmon spawning areas in Slough 11.



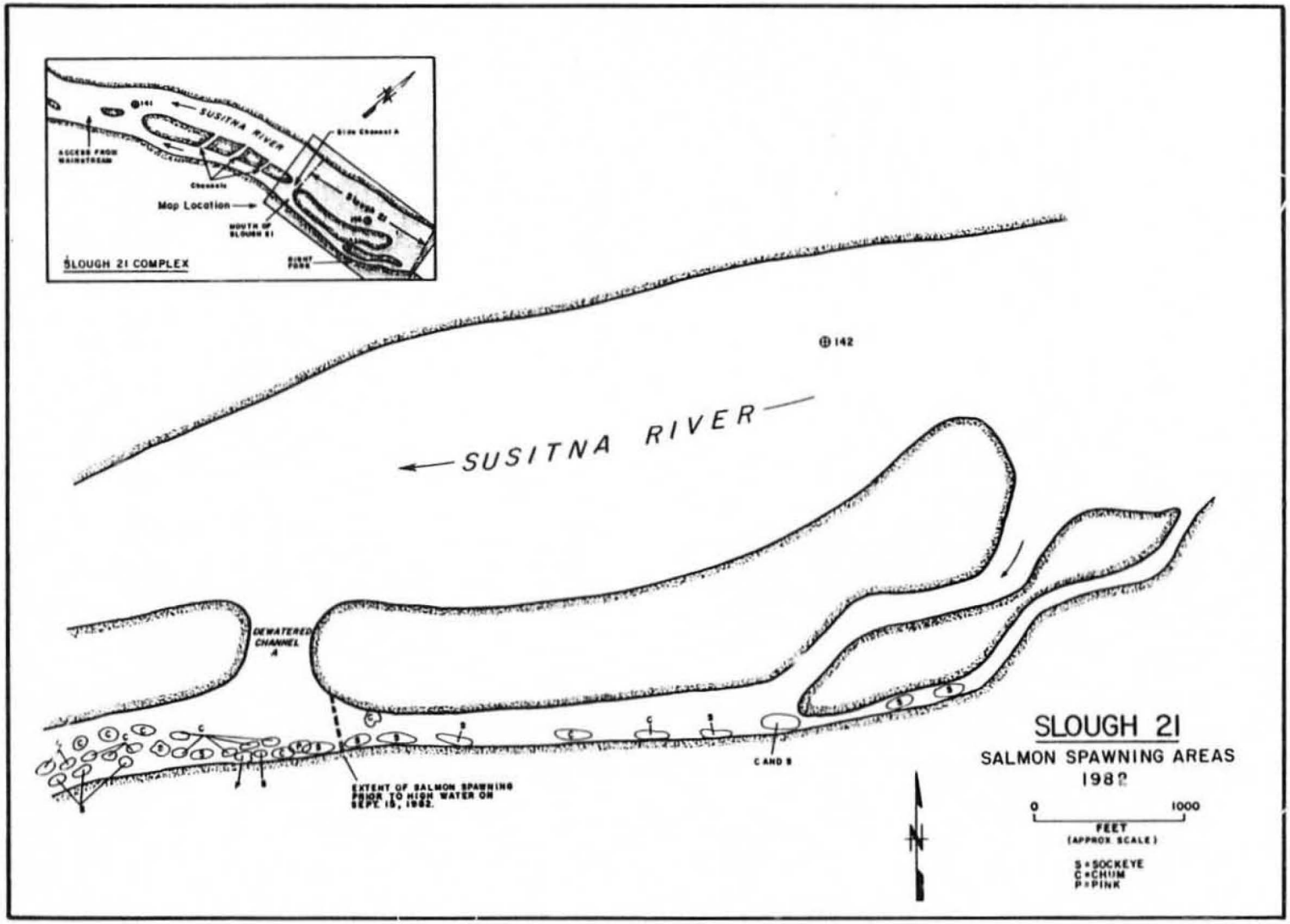
Appendix Figure C-9. Salmon spawning areas in Slough 19.



Appendix Figure C-10. Salmon spawning areas in Slough 20.



Appendix Figure C-11. Salmon spawning areas in Slough 21.



Appendix Figure C-11. Salmon spawning areas in Slough 21.

Appendix Table C-6 Summary of available maps of sampling sites, substrate types, ground water upwelling, open leads in ice cover and salmon spawning areas in 14 sloughs of the Susitna River, 1982.

Sloughs	Sampling Site[a]	Substrate[a]	Upwelling[a]	Ice Free Lead[a]	Spawning Area[a]
Whiskers Creek	X	X	0	X	X
Lane Creek	X	X	X	X	--
6A	X	X	0	X	X
8A	X	X	X	X	X
9, 9B	X	X	X	X	X
9A	X	X	X	X	X
10	X	X	0	X	0
11	X	X	X	X	X
16B	X	X	0	X	0
19	X	X	X	X	X
20	X	X	0	X	X
21	X	X	X	X	X
22	X	X	X	X	0

[a]ADF&G 1983b: Appendix Figures 4-F-15 to 4-F-69.

[b] X = Locations shown on map.
0 = No map, none observed.
-- = Salmon observed spawning but locations not mapped.

Appendix Table C-7 Summary of ground water upwelling, substrate composition and distribution of spawning salmon among some Susitna River sloughs, 1982.

Slough	Open leads in ice-cover (% total slough area)	Upwelling/ seepage[a]	Substrate Type[b]	Substrate Area(%)	Spawning[c] 1981	Spawning[c] 1982
Whiskers Creek Slough	52	1	GRRUCO SISA	98 2		P
Slough 6A	33	0	SICO SI	4 96	C,S	C,P, Coho
Lane Creek Slough	59	2	CORU SISA	44 56	C,P	
Slough 8A	10	3	GRRUCO SISA	91 9	C,S, Coho	C,P,S Coho
Slough 9	24	2	GRRUCO SISA	40 60	C,S	C,P,S
Slough 9B	8	2	CORU SISA	1 99	C,S	C,S
Slough 9A	52	2	RUCO SISA	95 5	C,S	C,S
Slough 10	19	2	RUCO SISA	58 42		C
Slough 11	48	3	GRRUCO GRSI	60 40	C,S	C,P,S
Slough 16B	8	0	GRRUCO SA	96 4		
Slough 19	11	2	RUCO SI	45 55	C,S	P
Slough 20	6	1	GRRUCO SI	67 33	C,S	C,P
Slough 21	70	3	RUCO SISA	64 36	C,S	C,P,S
Slough 22	15	2	RUCO SI	65 35	C	

[a] Upwelling/seepage observation rating scale (rating may be biased by limitation of visual observation method).

0 - none observed
1 - infrequently observed
2 - several localized areas of strong upwelling/seepage or numerous areas of weak upwelling/seepage
3 - numerous areas of strong upwelling/seepage

[b] SI - silt, SA - sand, GR - gravel, RU - rubble, CO - cobble, BO - boulder

[c] C - chum salmon, S - sockeye salmon, P - pink salmon, Coho - coho salmon

combination of gravel, rubble and/or cobble. In most sloughs the substrate was overlain with a thin layer of silt that could easily be fanned away by spawning fish. However, very few fish were observed spawning in areas where the overlying silt or sand deposits were more than 4-6 inches deep.

Access into sloughs can be a limiting factor regardless of the presence of upwelling ground water or good spawning substrate. Access difficulties may have prevented chum salmon spawning in Lane Creek Slough and sloughs 19 and 22 in 1982 (Appendix B).

DISCUSSION

Chum Salmon

Most chum salmon spawning appeared to occur in or near areas where upwelling ground water could be observed. Other investigators have also associated chum salmon spawning habitat with upwelling ground water (Kogl 1965, Francisco 1977, Wilson et al. 1981). In 1982, the sloughs with the most chum salmon (Appendix Table C-5) were observed to have intermediate or abundant levels of upwelling (Appendix Table C-7). The other salmon species were not abundant in these sloughs, except in Slough 11. In 1981, Lane Creek Slough (Slough 8) also had an intermediate level of upwelling and spawning chum salmon were abundant. Substrate composition differed among these sloughs, ranging from a high proportion of gravel, rubble and cobble, to a high proportion of sand and silt. Some sloughs with substantial upwelling ground water, such as

Lane Creek Slough and Slough 19 did not attract spawning chum salmon during 1982, perhaps due to limited access.

Because of its apparant importance to chum salmon spawning, it is recommended that specific studies to identify mainstem/slough ground water relationships be initiated and that existing studies be continued to further evaluate the relationship between this variable and spawning.

Pink Salmon

Pink salmon apparently select tributary-like areas for spawning within the sloughs. In sloughs 8A, 9, 11, 20 and 21 they were found spawning in shallow riffle zones containing gravel-rubble-cobble substrate. Because pink salmon return to spawn after two years in the ocean, interchange between alternate years is rare and one population is generally larger than the other. In the Susitna River basin the even years have the most abundant runs of pink salmon and this increase is evident in Appendix Table C-7.

Sockeye Salmon

Sockeye salmon apparently select the slower, deeper pools with a rubble-cobble substrate such as those in sloughs 8A, 9 (near the 90° bend), 11, 19 (1981 only) and 21.

Coho Salmon

Coho salmon are not nearly as abundant in the sloughs as chum, pink and sockeye salmon. Coho salmon seem to prefer to spawn in the tributaries but were observed in Whiskers Creek Slough in 1981 and observed spawning in the upper reaches of Slough 8A during both 1981 and 1982. Coho salmon were not observed in upper Slough 8A until after the water level rose in mid September 1982. However, coho salmon also arrived in Slough 8A in mid September 1981. Water levels were high throughout the summer of 1981 and turbid water may have obscured the arrival of the earliest coho salmon.

Chinook Salmon

Chinook salmon were observed to spawn exclusively in tributaries.

LITERATURE CITED

Alaska Department of Fish and Game (ADF&G). 1981a. Adult Anadromous Fisheries project. Phase I. Final report. Susitna Hydro Aquatic Studies Program. Anchorage, Alaska.

_____. 1981b. Aquatic Studies procedures manual. Phase I. Prepared for Acres American, Inc. Anchorage, Alaska.

_____. 1981c. Aquatic Habitat and Instream Flow project. Phase I. Final report. Susitna Hydro Aquatic Studies Program. Anchorage, Alaska.

_____. 1982. Aquatic Studies Program. Phase I. Final report. Susitna Hydro Aquatic Studies Program. Anchorage, Alaska.

_____. 1983a. Aquatic Studies procedures manual. Phase II. Prepared for Acres American, Inc. Anchorage, Alaska.

_____. 1983b. Susitna Hydro Aquatic Studies. Phase II. Basic data report. 5 Vols. Prepared for Acres American, Inc. Anchorage, Alaska.

Francisco, K. 1977. Second interim report of the Commercial Fish-Technical Evaluation Study. Joint State/Federal Fish and Wildlife Advisory Team. Special Report No. 9. Anchorage, Alaska. 46 pp.

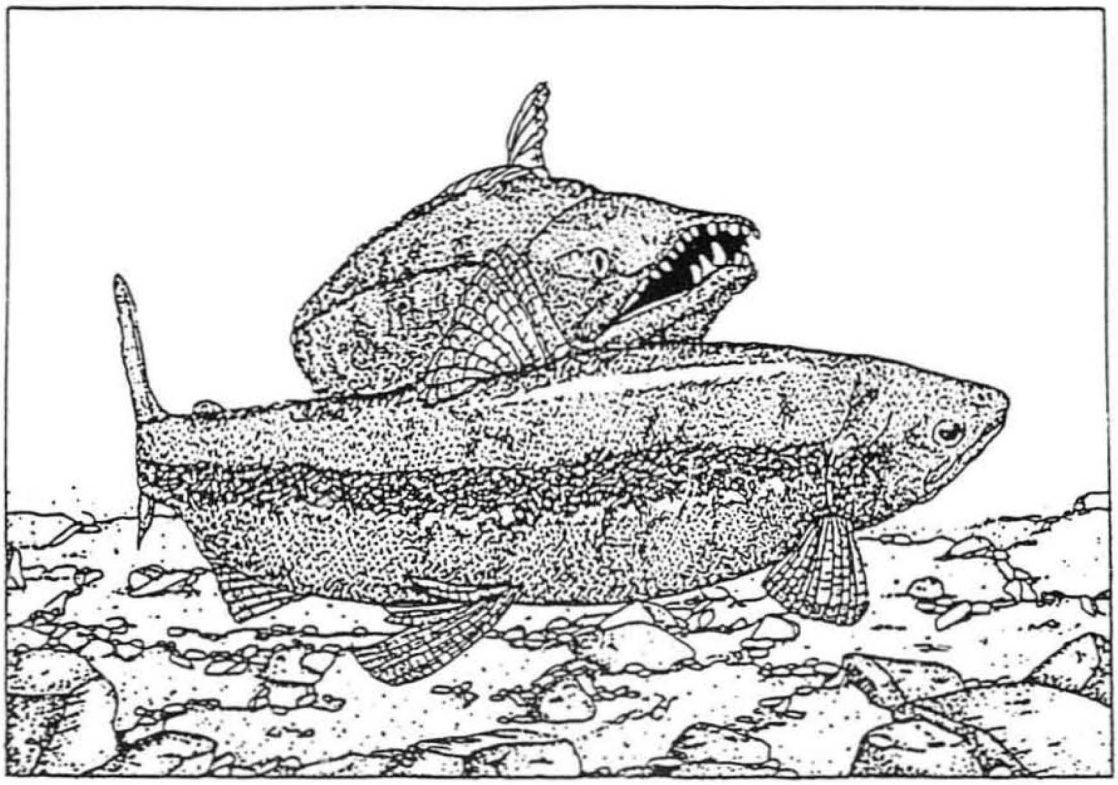
Gorman, O.T. and J.R. Karr. 1978. Habitat structure and stream fish communities. Ecology 59(3):507-515.

Hasler, A.D. 1966. Underwater guideposts: homing of salmon. Univ. Wisconsin Press, Madison. 155 pp.

Kogl, D.R. 1965. Springs and ground water as factors affecting survival of chum salmon spawn in a sub-arctic stream. M.S. thesis, Univ. of Alaska, Fairbanks. 59 pp.

Wilson, W.J., E.W. Trihey, J.E. Baldrige, C.D. Evans, J.G. Thiele, and D.E. Trudgen. 1981. An assessment of environmental effects of construction and operation of the proposed Terror Lake hydroelectric facility, Kodiak, Alaska. Instream flow studies final report. Arctic Environmental Information and Data Center, Univ. of Alaska. 419 pp.

Appendix C:
Qualitative Analysis of Salmon Spawning Habitat in Sloughs located Within the Talkeetna to Devil Canyon Reach of the Susitna River.



SUSITNA HYDRO AQUATIC STUDIES
PHASE II REPORT

Synopsis of the 1982 Aquatic Studies and Analysis of Fish and Habitat Relationships

— APPENDICES —

by

ALASKA DEPARTMENT OF FISH AND GAME
Susitna Hydro Aquatic Studies
2207 Spenard Road
Anchorage, Alaska 99503

1983