Sportfish Research and Technical Services Unit
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38a	1986	Sundet, R.L. 1986. Winter resident fish distribution and habitat studies conducted in the Susitna River below Devil Canyon, 1984-85. Part 1 of: ADF&G. Winter studies of resident and juvenile anadromous fish (October 1984-May 1985). Susitna Aquatic Studies Program. Report No. 11 (Volume 1). Alaska Department of Fish and Game, Anchorage, Alaska. APA Document #3062.	3062	
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39	1986	Hoffmann, A.G., and D.L. Crawford. 1986. Susitna River drainage salmon escapement data summary, 1951-1984. Appendix 1 Of: F.M. Thompson, S.N. Wick, and B.L. Stratton. 1986. Adult salmon investigations: May - October 1985. Susitna Aquatic Studies Program. Report No. 13 (Part 2 of 2: Appendices). Alaska Department of Fish and Game, Anchorage, Alaska.	3412	13
40	1986	Roth, K.J., D.C. Gray, J.W. Anderson, A.C. Blaney, and J.P. McDonell. 1986. The migration and growth of juvenile salmon in the Susitna River, 1985. Susitna Aquatic Studies Program. Report No. 14. Alaska Department of Fish and Game, Anchorage, Alaska. APA Document #3413.	3413	14
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36	1985	Seagren, D.R., and R.G. Wilkey. 1985b. Summary of water temperature and substrate data from selected salmon spawning and groundwater upwelling sites in the middle Susitna River. Susitna Aquatic Studies Program. Technical Data Report No. 12. Alaska Department of Fish and Game, Anchorage, Alaska. APA Document #2913.	2913	12
37	1985	Bigler, J., K. Levesque. 1985. Lower Susitna River preliminary chum salmon spawning habitat assessment. Susitna Aquatic Studies Program. Draft technical memorandum. Alaska Departmant of Fish and Game, Anchorage, Alaska. APA Document #3504.	3504	
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ALASKA DEPARTMENT OF FISH AND GAME
SUSITNA RIVER AQUATIC STUDIES
DIVISIONS OF SPORT AND COMMERCIAL FISHERIES

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2	1976	Alaska Department of Fish and Game (ADF&G). 1976. Fish and wildlife related to the Devil Canyon, Watana Reservoir Hydroelectric Project. Alaska Department of Fish and Game, Anchorage, Alaska. APA Document #549.	549	
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TITLES IN THIS SERIES*

ADF&G ' (Subset)

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Su Hydro Series Report Number	APA Report No.	RTS Number	Title	Publication Date
1	1450	19	Adult Anadromous Fish Investigations: May - October 1983	Apr 1984
2	1784	20	Resident and Juvenile Anadromous Fish Investigations: May - October 1983	Jul 1984
3	1930-1939	21a-j	Aquatic Habitat and Instream Flow Investigations: May - October 1983	Sep 1984
4	2049	22	Access and Transmission Corridor Aquatic Investigations: May - October 1983	Sep 1984
5	2658,2659	26a,b	Winter Aquatic Investigations: September 1983 to May 1984	Mar 1985
6	2748	29	Adult Salmon Investigations: May - October 1984	Jun 1985
7	2836,2837	30a,b	Resident and Juvenile Anadromous Fish Investigations: May - October 1984	Jul 1985
8	2846	31	Availability of Invertebrate Food Sources for Rearing Juvenile Chinook Salmon in Turbid Susitna River Habitats	Jul 1985
9	2749	32	Summary of Salmon Fishery Data for Selected Middle Susitna River Sites	Aug 1985
10	2908	35	Preliminary Evaluations of Potential Fish Mitigation Sites in the Middle Susitna River	Nov 1985
11	3062,3063	38a,b	Winter Studies of Resident and Juvenile Anadromous Fish: October 1984 - May 1985	Dec 1985
12	2913	36	Summary of Water Temperature and Substrate Data from Selected Salmon Spawning and Groundwater Upwelling Sites in the Middle Susitna River	Dec 1985
13	3412	39	Adult Salmon Investigations: May - October 1985	1986
14	3413	40	The Migration and Growth of Juvenile Salmon in the Susitna River, 1985	Jun 1986

* Publications that were technical memorandums, addendums, or procedures manuals during this time period were not usually included in this series.

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ALASKA DEPARTMENT OF FISH AND GAME

SUSITNA AQUATIC STUDIES

DIVISIONS OF SPORT AND COMMERCIAL FISHERIES PUBLICATIONS

ANNOTATED BIBLIOGRAPHY

RTS No.

1 Barrett, B.M. 1974. An assessment of the anadromous fish populations in the upper Susitna River watershed between Devil Canyon and the Chulitna River. Alaska Department of Fish and Game, Anchorage, Alaska. APA Document #1612.

Fishwheels operating in the lower portion of the middle Susitna River (RM 101.7 and RM 104.0) provided migrational timing, age-length-sex composition and abundances levels by salmon species. Chum (Oncorhynchus keta) and pink (O. gorbuscha) 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 predominantly four-year old fish.

Twenty-one sloughs were identified on the Susitna River between the Chulitna River confluence and Devil Canyon and surveyed for the first time: rearing coho (O. kisutch) fry were observed in twelve of these, and spawning chum salmon in nine of the sloughs. In four of the sloughs, sockeye (O. nerka) salmon co-spawned with chum salmon.

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

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

Spawning coho salmon were recorded in Indian River, Fourth of 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.

RTS No.

1 Cont. 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 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 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 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.

1a Barrett, B.M. 1975. December investigations on the upper Susitna River watershed between Devil Canyon and Chulitna River. Alaska Department of Fish and Game, Division of Commercial Fisheries, Anchorage, Alaska. APA Document #1609.

These investigations were intended to provide "information on fry distribution and abundance and winter conditions in the sloughs and in (the mainstem of) the Susitna River." Data collection field trips were conducted in December 1974, January 1975, and February 1975 that encompassed four, five, and seven days, respectively.

Age and length data is reported for coho *Oncorhynchus kisutch* fry. With the exception of one rainbow trout, *Salmo gairdneri*, no other fry were reported as being caught.

Dissolved oxygen, pH, relative water height, ice thickness and cover, snow depth, air and water temperature, and flow data were collected at Sloughs 8, 8A, 9, 9A, 11, 12, 13, 14, 15, Indian River, Lane Creek, Gold Creek, and at three mainstem Susitna River sites (at Gold Creek, Chase, and at the Anchorage-Fairbanks Highway). Settleable, non-filterable, and total suspended solids were reported for the mainstem sites. Flow data is limited to present or not, except for one measured flow at Lane Creek (7.21 CFS on 12/6/74).

RTS No.

1a Cont. The report is divided into three sections, by sample trip. Each trip report includes methods or procedures, discussion, results, and recommendations. The recommendations are limited to suggestions about further sampling.

2 Alaska Department of Fish and Game (ADF&G). 1976. Fish and Wildlife studies related to the Corp of Engineers Devil Canyon, Watana Reservoir Hydroelectric Project. Alaska Department of Fish and Game, Anchorage, Alaska. APA Document #549.

Friese, N.V. 1975. Preauthorization assessment of anadromous fish populations of the upper Susitna River watershed in the vicinity of the proposed Devil Canyon Hydroelectric Project. Commercial Fisheries Division Section in: ADF&G. Fish and wildlife studies related to the Corp of Engineers Devil Canyon, Watana Reservoir Hydroelectric Project. Alaska Department of Fish and Game, Anchorage, Alaska.

Gross indications of migrational timing, abundance by species and age-length-sex data was obtained from fishwheel operation in the lower study area. The total catch of salmon during the 1975 season was less than 1974. Chum (Oncorhynchus keta) and pink (O. gorbuscha) salmon dominated the fishwheel catches. Population estimates were determined by the Petersen mark and recapture method. The population estimates for 1974 and 1975 were:

	1974	1975
Chum	24,386 ± 2,602	11,850 ± 4,044
Pink	5,252 ± 998	6,257 ± 261
Sockeye	1,008 ± 224	1,835 ± 337

Comparative data is not available for chinook (O. tshawytscha) and coho (O. kisutch) salmon. Tag recoveries from chum, pink, sockeye, (O. nerka) and coho salmon below the fishwheel sites indicate a significant, but unknown, proportion of the salmon captured were possibly milling and not migrating to spawning grounds above the tagging project.

Twenty-one sloughs were identified and surveyed on the Susitna River during 1974. An additional seven sloughs were identified during winter and summer 1975. Rearing fry were observed in 22 of the slough areas. Adult salmon were found spawning in eight of the sloughs. Adult sockeye salmon were observed in four sloughs and adult chum salmon were observed in six slough areas. Pink, king, and coho salmon were found exclusively in clearwater tributaries. Chum salmon were observed spawning in Lane Creek and Indian River, and sockeye spawned in Fourth of July Creek, McKenzie Creek, and Indian River, clearwater tributaries of the Susitna River.

RTS No.

2 Cont. A minimum of 575 pink, 568 chum, 242 sockeye, and 62 king salmon spawned in the streams and sloughs of the Susitna River between the confluence of the Chulitna River and Portage Creek as determined from peak slough and stream index escapement counts.

Thirteen sloughs and two clearwater streams were identified and surveyed on the Talkeetna River between its confluence with the Susitna River and Clear Creek in 1975. Coho fry were rearing in eight sloughs and one clearwater stream. Rearing chum salmon fry were observed in three sloughs in June. Chum salmon were the only salmon species observed spawning in the slough areas of the Talkeetna River. Pink salmon were, however, observed in Clear Creek by the escapement survey crew. The presence of spawning sockeye, coho, and pink salmon was confirmed by sport fishermen's tag returns in Chunilna Creek, Clear Creek, and Stephan Lake.

Winter surveys of the slough and mainstem Susitna River established the presence of rearing coho (O. kisutch) fry in both areas. Suspended solid levels of the mainstem river were extremely low during fall and winter months resulting in clear water conditions. The combination of partial slough dewatering and clear water conditions were contributing factors of fry emigration into the mainstem river for rearing.

Artificial substrate sampling and fry foregut analysis was conducted to determine species composition of invertebrates within the study area and the importance of benthic invertebrates as food items to rearing fry. Insects comprised 100 percent of the benthic organisms found in the substrate samples. The number of species of benthic organisms identified was extremely low. The contributing factors are the time of year they were installed and the length of time they remained in the sampling locations. The Plecoptera (stonefiles) and Diptera ("no-see-ums") represented the dominant orders. Simuliidae (black flies), Ephemeroptera (mayflies), Tricoptera (caddis flies) were also present.

Riis, J.C. 1976. Preauthorization assessment of the Susitna River Hydroelectric Projects: preliminary investigations of water quality and aquatic species composition. Sport Fish Division Section in: ADF&G. Fish and wildlife studies related to the Corp of Engineers Devil Canyon, Watana Reservoir Hydroelectric Project. Alaska Department of Fish and Game, Anchorage, Alaska.

Biological investigations of the Susitna River and selected tributaries were conducted from February 10, 1975 to September 30, 1975 to obtain baseline data regarding indigenous fish populations, available aquatic habitat, and water quality

RTS No.

2 Cont. which will aid in the definition of biological areas of concern requiring additional study prior to authorization of hydroelectric development.

There is evidence that resident and rearing anadromous fish migrate out of the tributaries and into the mainstem in the fall and return to the tributaries in the spring. Coho (Oncorhynchus kisutch), chinook (O. tshawytscha), chum (O. keta), grayling (Thymallus arcticus, sculpin (Cottus cognatus), burbot (Lota lota), whitefish (Coregonus sp.), and sucker (Catostomus catostomus) were found overwintering in the mainstem Susitna River.

Five Dolly Varden (Salvelinus malma) ranging from 85 mm to 142 mm were trapped in early April in Willow Creek, and four chinook fry were trapped in Montana Creek. Minnow traps generally were not effective as under-ice sampling gear in tributaries because water depths were too shallow.

Electroshockers were the most effective sampling gear. During the summer salmon fry, rainbow trout (Salmo gairdneri), and grayling were scarce in the turbid mainstem Susitna River whereas whitefish, sculpin, and suckers were commonly captured. Occurring in most of the clearwater tributaries, Arctic grayling are the most common recreationally important resident fish species. Aquatic insects collected in both the mainstem and tributaries are typical of clear cold water streams in Alaska.

Water samples were collected on a bi-weekly basis at bridge crossings of each major east side tributary. Parameters measured included temperature, pH, turbidity, conductivity, total alkalinity, total hardness, and dissolved oxygen. Temperatures were also monitored using a Ryan thermograph in the Susitna River, Birch Creek, and Willow Creek. Similar trends in water temperature fluctuations were noted for the mainstem and tributaries with the exception of Birch Creek which is the outlet for Fish Lake. Temperatures there were considerably warmer and flows did not fluctuate as much as in other tributaries.

Specific conductance in the mainstem in substantially higher than in the tributaries. There was no consistent trend in turbidity among the tributaries. Fluctuations appear to be linked to precipitation.

3 Riis, J.C. 1977. Preauthorization assessment of the proposed Susitna River Hydroelectric Projects: preliminary investigations of water quality and aquatic species composition. Alaska Department of Fish and Game, Sport Fish Division, Anchorage, Alaska. APA Document #1610.

RTS No.

3 Cont. Biological, water quality, and water quantity investigations were conducted from July 1, 1976 through September 30, 1976 to obtain baseline data on indigenous fish populations and the existing aquatic habitat as part of an ongoing environmental study to assess the potential impacts of the proposed Watana/Devil Canyon hydroelectric project upon the aquatic ecosystem of the Susitna River drainage.

Long term ecological changes to this drainage may be significant. The level and flow patterns of the Susitna River will be altered and will affect the fish and wildlife resources.

Between May 12 and June 12, 1976, mainstem Susitna River discharge ranged from 11,900 cfs to 33,3000 cfs. Stage fluctuations within clearwater sloughs were directly related to mainstem discharge. Nine of the 12 sloughs monitored were isolated pools or completely dry when mainstem flows were 7,000 cfs, the proposed post-project flow.

Baseline water temperature data was collected with thermographs at the Parks Highway Bridge, upstream of Chase Creek, and between Devil Canyon and Portage Creek. Temperature trends were similar at the three sites. Water temperature was measured with a pocket thermometer at other study sites. Slough temperatures were generally more stable than those of the mainstem.

Total suspended solid levels and turbidity were directly related to Susitna River discharge. Oxygen concentrations were close to saturation throughout the study. The range of pH measured at each station remained relatively stable over the study period.

Seven artificial substrate baskets were installed in the mainstem Susitna River to collect baseline data on benthic invertebrates present. A total of 118 specimens from two baskets were collected and identified. Of these, 63 percent were classified as "sensitive" to changes in water quality.

Aerial and ground escapement surveys were conducted to estimate the relative abundance of fish. Chinook (Oncorhynchus tshawytscha) escapement was estimated to be 50,499. Other species of salmon were observed, but their numbers were not estimated.

4 Alaska Department of Fish and Game (ADF&G). 1978. Preliminary environmental assessment of hydroelectric development on the Susitna River. Alaska Department of Fish and Game, Anchorage, Alaska. APA Document #75.

Riis, J.C. and N.V. Friese. 1978. Fisheries and habitat investigations of the Susitna River: a preliminary study of potential impacts of the Devil Canyon and Watana Hydroelectric Projects. Section I in: ADF&G. Preliminary environmental assessment of hydroelectric development on the Susitna River. Alaska Department of Fish and Game, Anchorage, Alaska.

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4 Cont.

Biological and water quality and quantity investigations were conducted from May 1, 1977 through March 7, 1978 to obtain baseline data on indigenous fish populations and the existing aquatic habitat of the Susitna River drainage.

The relative abundance, distribution, and migrational timing of adult salmon (Oncorhynchus spp.) were determined within the Susitna River drainage through tag and recovery programs during 1977. The salmon escapement from June 29 through August 14 was estimated to be approximately 237,000 sockeye (O. nerka), 50,000 coho (O. kisutch), and 105,000 chum (O. keta) salmon. An escapement estimate in excess of 100,000 fish was determined for chinook salmon (O. tshawytscha) through aerial surveys. Population estimates of pink (O. gorbuscha) salmon utilizing the drainage in the area of the Susitna and Chulitna river confluences were determined as a part of this study.

Documentation of the outmigration of salmon fry from tributary rearing areas into the mainstem Susitna River was accomplished by intensive investigation of two clearwater tributaries. The objective of these studies was to determine utilization of the mainstem river for rearing during winter months. A total of 25,176 chinook salmon fry were marked in Montana Creek between July 19 and August 4. A gradual downstream movement of fry was noted from the latter part of August to February. A drastic reduction in population density was found in February and was attributed to lower flows which prevailed at the time. Chinook fry were documented overwintering in the Susitna River. No distinct movement of fry was observed in Rabideux Creek.

The relative abundance, distribution, age, length, and weight characteristics, and feeding habits of juvenile salmonids were monitored in sloughs and tributaries of the Susitna River from Portage Creek downstream to the Chulitna River confluence from July 1 through October 5, 1977. The predominant rearing species were chinook and coho salmon. Water quality and quantity determinations were made in conjunction with all juvenile salmon surveys.

The Susitna River was floated from its intersection with the Denali Highway to Devil Canyon during the first two weeks of July to inventory fish species present and survey the aquatic habitat in the areas to be inundated. Arctic grayling (Thymallus arcticus) were abundant in all of the clearwater tributaries within the proposed impoundment area. The headwaters of these tributaries and upland lakes were also surveyed by separate crews. It is apparent that the Watana reservoir, which is projected to have substantial seasonal fluctuations, will alter the fisheries habitat.

RTS No.

4 Cont.

Measurements of hydrological and limnological parameters associated with the Susitna River and selected tributaries and sloughs were obtained between the Denali Highway and Montana Creek. A cooperative agreement between the United States Geological Survey (USGS) and the ADF&G was initiated to determine discharge, sediment loads, and standard water quality analysis of the mainstem Susitna River.

Long term ecological changes to the drainage may be significant due to dam construction. The level and flow patterns of the Susitna River will be altered and will affect the fisheries resources.

The effects of impoundment and construction activities which alter natural flow regimes, water chemistry, mass transport of materials, and quantity of wetted habitat areas are of primary concern. These changes may disrupt the trophic structure and habitat composition and reduce or eliminate terrestrial and aquatic populations. These populations and vegetation in and around the free-flowing rivers have evolved to their current levels due to natural flow variations. Some species may be present only because this particular hydrologic regime exists.

5 Alaska Department of Fish and Game (ADF&G). 1979. Fish and wildlife studies proposed by the Alaska Department of Fish and Game. Preliminary final plan of study. Alaska Department of Fish and Game, Anchorage, Alaska. APA Document #3281.

Alaska Department of Fish and Game proposed a five-year study program to assess the potential impacts of hydroelectric development on the Susitna River. Phase I study proposals were designed to provide baseline information for accomplishing this. Six general objectives were outlined:

1) Determine the relative abundance and distribution of adult anadromous fish populations within the drainage.

2) Determine the distribution and abundance of selected resident and juvenile anadromous fish populations.

3) Determine the spatial and seasonal habitat requirements of anadromous and resident fish species during each stage of their life histories.

4) Determine the economic, recreational, social, and aesthetic values of the existing resident and anadromous fish stocks and habitat.

5) Determine the impact the Devil Canyon project on the aquatic ecosystems and any required mitigation prior to construction approval decision.

RTS No.

5 Cont. 6) Determine a long term study plan, if the project is authorized, to monitor the impacts during and after project completion.

6a Alaska Department of Fish and Game (ADF&G). 1981. Aquatic Studies Procedures Manual (1980-1981). (Volume 1 of 2). Susitna Hydro Aquatic Studies. Phase 1. Subtask 7.10. Alaska Department of Fish and Game, Anchorage, Alaska. APA Document # ?.

Technical procedures and data procedures used during Phase I of the Susitna Hydroelectric Aquatic Studies Program are detailed.

6b Alaska Department of Fish and Game (ADF&G). 1981. Aquatic Studies Procedures Manual (1980-1981). (Volume 2 of 2: Appendices). Susitna Hydro Aquatic Studies. Phase 1. Subtask 7.10. Alaska Department of Fish and Game, Anchorage, Alaska. APA Document # ?.

7 Alaska Department of Fish and Game (ADF&G). 1981. Adult anadromous fisheries project (June-September 1981). Susitna Hydro Aquatic Studies. Phase 1 final draft report. Subtask 7.10. Alaska Department of Fish and Game, Anchorage, Alaska. APA Document #324.

Salmon escapement was monitored at four stations on the Susitna River between Cook Inlet and Devil Canyon and one station on the Yentna River. These stations were operational from late June to mid-September 1981. Methods used included side scan sonar counters and fishwheels. Chinook (Oncorhynchus tshawytscha) salmon escapement surveys were conducted in late July and early August on tributary streams. A radio telemetry tagging program monitored the migrational movements of adult chinook, chum (O. keta), and coho (O. kisutch) salmon between late June and early September. The Susitna River mainstem was surveyed for spawning activity by three crews from late July through September using primarily drift gill nets, electroshocking equipment, and egg deposition pumps. Set netting was effected at river mile (RM) 150 in the Susitna River mainstem immediately below Devil Canyon (RM 151) from late July to mid-September. Susitna River tributary streams and sloughs between the Talkeetna River confluence (RM 99) and Devil Canyon were surveyed on foot for spawning salmon from late July through September.

Fishwheel catch and sonar enumeration data indicate the chinook salmon migration was underway before the fishwheels and sonar counters were placed. Peak migration timing was determined at Sunshine (RM 80), Talkeetna (RM 103), and Curry (RM 120) stations. Commencement of migration was recorded only at Curry Station. A correlation may exist between river discharge and upstream migration. The 1981 Susitna River chinook salmon escapement was dominated by four year old fish. Length measurements segregated by age and sex indicate that chinook salmon at Talkeetna and Curry stations were significantly larger than those intercepted at Sunshine Station. Early smolting is a possible cause based on a

RTS No.

7 Cont. higher percentage of Talkeetna and Curry station fish having spent less than one winter in freshwater before smolting. Radio telemetry investigations indicate that the confluence of the Talkeetna, Chulitna, and Susitna rivers (RM 99) is a probable chinook salmon milling area and also that some upper Susitna River chinook salmon stocks use lower Devil Canyon (RM 151) as a milling area.

The Susitna River basin chinook salmon escapement in 1985 was generally above average based on comparative recent year surveys.

Sockeye (*O. nerka*), pink (*O. gorbuscha*), chum, and coho salmon escapements and timing were documented at each mainstem sampling station. The data indicate that the majority of 1981 Susitna River sockeye, pink, chum, and coho salmon escapement originated in the Susitna River reach above (upstream of) the Yentna River confluence (RM 28). Escapement samples collected from fishwheel interceptions indicate average length differences in sockeye and pink salmon stocks between the Yentna River subdrainages and the Susitna River basin above the Yentna River confluence.

Scale samples collected at the mainstem sampling stations indicate Susitna River sockeye, chum, and coho salmon stocks were comprised predominantly of age 5_2, 4_1, and 4_3 fish, respectively.

Twelve Susitna River mainstem salmon spawning sites were located between RM 64.5 and RM 135.2. Chum salmon were found spawning in the same area as chum salmon at two sites.

Sockeye, chum, and coho salmon were gill netted in the Susitna River mainstem less than one mile below Devil Canyon (RM 151) indicating a milling area exists in the lower canyon.

Eight additional salmon spawning sloughs and streams were identified in the Susitna River reach between the Chulitna River (RM 99) and Devil Canyon (RM 151).

Radio telemetry investigations on chum and coho salmon indicate that both species display milling behavior in the Susitna River mainstem above Talkeetna (RM 99). Coho salmon displayed the greatest milling movement; radio tagged coho salmon were found in the Susitna River several miles upstream of their spawning area. Necropsies of radio tagged coho and chum salmon indicate successful spawning occurred.

8 Alaska Department of Fish and Game (ADF&G). 1981. Juvenile anadromous fish study on the Susitna River (November 1980-October 1981). Susitna Hydro Aquatic Studies. Phase 1 final draft report. Subtask 7.10. Alaska Department of Fish and Game, Anchorage, Alaska. APA Document #322.

This study was designed to gather information describing the presence, abundance, geographical and seasonal distribution, age class composition, length distribution, and smolt migration timing

RTS No.

8 Cont. of juvenile salmon in the Susitna River between Cook Inlet and Devil Canyon as part of a feasibility study regarding the proposed Susitna Hydroelectric project.

Field collection of data on juvenile salmon (Oncorhynchus spp.) species took place from November 1980 to October 1981. Sampling gear included variable mesh gillnets, minnow traps, beach seines, electrofishing units, and dip nets.

Juvenile chinook (O. tshawytscha) salmon were captured throughout the study area. The majority of juvenile chinook salmon captured during winter between Cook Inlet and Devil Canyon occurred at slough and mainstem Susitna River sites and in summer at tributary mouth sites. Two age classes (0+ and I+) were captured. Age I+ were not captured after July between Talkeetna and Devil Canyon and were not captured after August in the Cook Inlet to Talkeetna reach.

Juvenile coho (O. kisutch) salmon occurred throughout the study area. The majority of juvenile coho salmon captured between Cook Inlet and Talkeetna during winter and summer occurred at tributary mouth sites. Between Talkeetna and Devil Canyon occurrence was greater at slough sites in winter and at slough and tributary mouth sites in summer. Three age classes (0+, I+, and II+) were captured. Age II+ were not captured after May in the Talkeetna to Devil Canyon reach and were not captured after mid-June in the Cook Inlet to Talkeetna reach.

Relatively small numbers of juvenile pink (O. gorbuscha), chum (O. keta), and sockeye (O. nerka) salmon were collected in 1980-81. Sampling scheme bias imposed by gear types and by location of effort can account for the limited numbers of these juvenile salmon species encountered. Further seasonal distribution, relative abundance, and biological information on these three juvenile salmon species is needed to evaluate their life histories.

Further information is needed on the winter distribution and habits of all five species of juvenile salmon.

Further information is needed on the timing on the smolt outmigration and also on the incubation of embryos of all five juvenile salmon species.

9 Alaska Department of Fish and Game (ADF&G). 1981. Resident fish investigation on the Lower Susitna River (November 1980-October 1981). Susitna Hydro Aquatic Studies. Phase 1 final draft report. Subtask 7.10. Alaska Department of Fish and Game, Anchorage, Alaska. APA Document #318.

Rainbow trout (Salmo gairdneri) were captured throughout the Susitna River between Cook Inlet and Devil Canyon, with the mouths of tributary streams producing higher catches per unit effort than mainstem river locations. The mean fork length of the 395 rainbow

RTS No.

9 Cont. trout captured was 285 mm. Fork lengths of rainbow trout in the Cook Inlet to Talkeetna reach was consistently 20 to 40 mm longer in each age class than those recorded in the Talkeetna to Devil Canyon reach. The most prevalent age classes captured were Age III, Age IV, and Age V.

Peak catches of Arctic grayling (Thymallus arcticus) occurred in May and September. Cache Creek slough, Montana Creek, and Portage Creek had the largest catches per unit effort. The mean fork length of fish captured was 202 mm and the most prevalent age classes were Age V and Age VI.

Burbot (Lota lota) were captured at 43 of the 44 habitat locations between Alexander Creek and Portage Creek with peak catch rates recorded in late August and early September. The mean length of 457 burbot measured was 428 mm. The most prevalent age classes were Age III, Age V, and Age VIII.

Round whitefish (Prosopium cylindraceum) occurred throughout the study area but, the more productive sites tended to be upstream of Talkeetna. Age IV fish were the most common and had a mean length of 261 mm.

Humpback whitefish (Coregonus pidschian) were captured at approximately half the habitat locations throughout the study area but were generally more abundant at sites downstream of Talkeetna. The mean fork length of 344 fish measured was 284 mm. Age IV and Age VI were the most prevalent age classes.

Eight hundred, thirty-four Bering cisco (Coregonus laurettae) were captured at sites ranging from Kroto Slough to a site just upstream of Talkeetna in the late summer and early fall. This species was not know to occur in the Susitna River drainage prior to this study. The mean fork length of measured fish was 332 mm and Age IV was the most prevalent age class. Spawning was observed at three sites between river mile 74 and mile 79. Peak spawning occurred during the second week of October.

Longnose suckers (Catostomus catostomus) occurred throughout the study area. The mean fork length of 532 suckers measured was 259 mm and the most prevalent age class was Age VI.

Dolly Varden (Salvelinus malma) were captured at sites ranging from Alexander Creek to Portage Creek with the highest catch per unit effort recorded at the mouths of tributary streams. The mean fork length was 196 mm. Dolly Varden captured in minnow traps on upper Indian River and upper Portage Creek had a mean fork length of 94 mm.

Threespine stickleback (Gasterosteus aculeatus) were widespread and abundant in the Susitna River below Devil Canyon during the early summer. The catch in minnow traps at habitat locations generally

RTS No.

9 Cont. decline after late June. Threespine sticklebacks were caught at a site two miles below the confluence of Portage Creek, approximately 50 miles further upriver than previously reported. The mean total length of fish measured was 79 mm. Three age classes (0+, I+, II+) were present during the summer.

The slimy sculpin (Cottus cognatus) was present at almost all habitat locations between Cook Inlet and Devil Canyon. The mean total length of 476 fish measured was 70 mm.

Forty Arctic lamprey (Lampetra japonica) were captured at sites in the lower 100 miles of the Susitna River.

One Age IX female northern pike (Esox lucius) measuring 715 mm fork length was captured in Kroto Slough on September 11, 1981. Northern pike are expanding their range from the Bulchitna Lake area; this is the first record of one captured in the mainstem Susitna River.

Information obtained to date has described the geographic and seasonal distribution, relative abundance, length distribution, and age distribution of adult residents during the period June through September. The data on male/female ratios are less complete.

Relatively small numbers of juvenile resident fish were collected in 1980-81. Sampling scheme bias imposed by gear types and by location of effort can account for the limited numbers of juvenile residents encountered. Further seasonal distribution, relative abundance, and biological information on juvenile residents is needed to evaluate their life histories.

Spawning sites were located for the round whitefish and Bering cisco. More information is needed on location of mainstem and slough spawning sites and on spawning habits and timing for all species. More information is also needed on the incubation of embryos.

Further information is needed on the winter distribution and habits of all species.

Although many fish were tagged during this study, there have been few recaptures to date. As more recaptures are made, the migrations and movement of the various species can be better described.

10 Alaska Department of Fish and Game (ADF&G). 1981. Resident fish investigation on the upper Susitna River (May-October 1981). Susitna Hydro Aquatic Studies. Phase 1 final draft report. Subtask 7.10. Alaska Department of Fish and Game, Anchorage, Alaska. APA Document #316.

The seasonal distribution and relative abundance of resident fish species was evaluated in eight major tributaries of the Susitna River above Devil Canyon. Eight different species were captured:

RTS No.

10 Cont. Arctic grayling (Thymallus arcticus), burbot (Lota lota), slimy sculpin (Cottus cognatus), Dolly Varden (Salvelinus namaycush), Longnose sucker (Catostomus catostomus), humpback whitefish (Coregonus pidschian), and round whitefish (Prosopium cylindraceum). No juvenile or adult salmon (Oncorhynchus spp.) were captured or observed in the study area between Fog Creek (RM 173.9) and the Oshetna River (RM 226.9). Observations in May 1981 indicate that Arctic grayling (Thymallus arcticus) spawn during late April or early May under the ice or in flood waters immediately following ice out. Schnabel population estimates, based on tag and and recapture data, were generated for Arctic grayling in tributaries and in the study area. The estimate for the upper Susitna River was 10,279 fish.

11a Alaska Department of Fish and Game (ADF&G). 1981. Aquatic habitat and instream flow project (December 1980-October 1981). Susitna Hydro Aquatic Studies. Phase 1 final draft report. Volume 1. Subtask 7.10. Alaska Department of Fish and Game, Anchorage, Alaska. APA Document #1307.

This report is one of a series of reports on studies conducted during Phase 1 of the Susitna Aquatic Studies Program. Analysis of data is limited to first stage reduction.

Fishery habitat evaluation studies were performed during the 1981 winter and summer field seasons on the Susitna River between the mouth and the Oshetna River. Data was collected in conjunction with the resident and juvenile anadromous and adult anadromous fish investigations. Velocity, depth, and substrate were collected regularly at fish sampling gear placement sites and incidentally where fish were observed. General habitat evaluations provided the necessary data to describe and map the overall habitat characteristics of each site.

In addition, water quality, morphometric, and discharge data were collected at five selected sites to evaluate the relationships of mainstem hydraulic and water quality conditions to fisheries habitat in slough areas between Talkeetna and Devil Canyon. Water quality parameters included temperature, pH, dissolved oxygen, conductivity, and turbidity.

Analysis of data was limited to first stage reduction, and the discussion of results is limited to descriptions, rather than comparisons, of study sites.

11b Alaska Department of Fish and Game (ADF&G). 1981. Aquatic habitat and instream flow project. Susitna Hydro Aquatic Studies. Phase 1 final draft report. Volume 2 (Section 1 of 2: Appendices EA-EH). Subtask 7.10. Alaska Department of Fish and Game, Anchorage, Alaska. APA Document #311.

RTS No.

11b Cont. Volume 2 consists of maps and data tables summarizing data collected during 1981. Part 1 contains site maps, a methods supplement, and data tables (physiochemical, temperature, stage, cross section survey, discharge, and incidental data).

11c Alaska Department of Fish and Game (ADF&G). 1981. Aquatic habitat and instream flow project. Susitna Hydro Aquatic Studies. Phase 1 final draft report. Volume 2 (Section 2 of 2: Appendices EI-EJ). Subtask 7.10. Alaska Department of Fish and Game, Anchorage, Alaska. APA Document #312.

Volume 2 consists of maps and data tables summarizing data collected during 1981. Part 2 contains depth, velocity, and substrate data collected at fish sampling gear placement sites during 1981. Winter data collected in early 1981 is also presented.

Objectives, technical procedures, and data reduction procedures as used by each component of the Susitna Hydro Aquatic Studies Program during 1982-83 are described.

11d Alaska Department of Fish and Game. 1982. Aquatic Studies Procedures manual, Phase I. Alaska Department of Fish and Game, Division of Commercial Fisheries, Anchorage, Alaska. APA Document #*?*.

This document details the objectives, technical procedures, data procedures, quality control, schedule, and personnel qualifications (as of May 1981) of the Su-Hydro Aquatic Studies. The technical and data procedures are divided into those used by the adult anadromous fisheries, resident and juvenile anadromous fisheries, and the aquatic habitat and instream flow study groups.

Appendices included describe sonar installation and operation, oscilloscope operation, fishwheel operation, fish tagging, electroshocking instructions, habitat site locations, resident and juvenile sampling, techniques, and aquatic habitat instruction manuals.

12 Alaska Department of Fish and Game (ADF&G). 1982. Aquatic studies program (November 1980-October 1981). Susitna Hydro Aquatic Studies. Phase 1 final draft report. Subtask 7.10. Alaska Department of Fish and Game, Anchorage, Alaska. APA Document #517.

This report represents a partial synthesis of the 1981 fishery and habitat data collected by the ADF&G Susitna Aquatic Studies Program. Fishery/habitat relationships are discussed to the extent possible. The relationships between individual aquatic habitat parameters and discharge are described. Various predictive models developed by other research groups involved with the project are discussed.

When compared to discharge data, daily sonar counts indicate that salmon (Oncorhynchus spp.) movement decreased during periods of high flow and increased as flows subsided after major flood events.

RTS No.

12 Cont. Burbot (Lota lota) catches during low flow conditions were primarily restricted to the mainstem and deeper sloughs and side channel habitats. During high flows, burbot were captured at a greater number of habitats, including shallow side channels, sloughs, and tributary mouths. Percent incidence of rainbow trout (Salmo gairdneri) caught is related to mainstem discharge and their seasonal migration patterns, whereas that of chinook (O. tshawytscha) fry is apparently a function of fish growth and independent of discharge. The availability of suitable substrate and adequate flows to permit access into sloughs from the mainstem are two of the factors determining the suitability of salmon spawning habitat. Tributary and ground water flow which contribute to slough flow may be critical during periods of low mainstem discharge. At sites above Devil Canyon, Arctic grayling (Thymallus arcticus) were generally more abundant in channels with large deep pools and/or cutbanks and streamflows less than 2.0 feet/second. Availability of suitable substrate within the study area was not a limiting factor in the distribution and abundance of grayling.

Mainstem turbidity generally increases with discharge. Slough turbidity remains low as mainstem discharge increases until a certain threshold level at which point the turbidity/discharge relationship in sloughs resembles that of the mainstem.

Temperature was found to be related to mainstem discharge, intragravel flow, and tributary discharge. The HEC-2 hydraulic model was used to predict water surface elevation (WSEL) at approximately 70 mainstem cross sections for a range of mainstem discharges. The model generally predicted a smaller than observed change in mainstem WSEL when the discharge values are below 20,000 cfs.

13 Alaska Department of Fish and Game (ADF&G). 1982. Adult anadromous fisheries project. Stock separation feasibility report. Susitna Hydro Aquatic Studies. Phase 1 final draft report. Subtask 7.10. Alaska Department of Fish and Game, Anchorage, Alaska. APA Document #403.

Past efforts to estimate the Susitna River's contribution to the upper Cook Inlet commercial salmon harvest has been limited almost exclusively to sockeye (Oncorhynchus nerka) salmon, the most economically valuable of the five species. The Susitna River appears to be a major producer of coho (O. kisutch), pink (O. gorbuscha), and chum (O. keta) salmon; however, contributions of river systems on the west side of Cook Inlet are unknown and need to be assessed before implementing a stock identification program. Chinook (O. tshawytscha) migration begins well before the commercial fishing season opens. Thus, Susitna River stocks are not significantly exploited in the upper Cook Inlet fishery and a stock separation program is not necessary at this time.

RTS No.

14 Alaska Department of Fish and Game (ADF&G). 1983. Aquatic Studies Procedures Manual (1982-1983). Susitna Hydro Aquatic Studies. Phase 2. Subtask 7.10. Alaska Department of Fish and Game, Anchorage, Alaska. APA Document #938.

15a Alaska Department of Fish and Game (ADF&G). 1983. Summarization of Volumes 2, 3, 4, Part I and II, and 5. Susitna Hydro Aquatic Studies. Phase 2 basic data report (October 1981-October 1982). Volume 1. Alaska Department of Fish and Game, Anchorage, Alaska. APA Document #96.

This report presents a synopsis of the information contained in Volumes 2 through 4 of the Phase II reports.

15b Alaska Department of Fish and Game (ADF&G). 1983. Adult anadromous fish studies, 1982. Susitna Hydro Aquatic Studies. Phase 2 final report. Volume 2 (Section 1 of 2). Alaska Department of Fish and Game, Anchorage, Alaska. APA Document #588.

Tag recapture techniques and sonar counters were used to estimate escapement and determine the timing and nature of the migration of Pacific salmon into the Susitna River. Stream surveys were conducted to identify salmon spawning sites in the mainstem and peripheral habitats and to evaluate their relative importance. Radio tags were implanted in chinook (Oncorhynchus tshawytscha), chum (O. keta), and coho (O. kisutch) salmon to monitor and characterize their migration upriver.

Two runs of eulachon in May/June were documented and characterized. Bering cisco (Coregonus laurettae) were intercepted by fishwheels at Susitna Station (RM 26), Yentna Station (TRM 04), and Sunshine Station (RM 80).

15c Alaska Department of Fish and Game (ADF&G). 1983. Adult anadromous fish studies, 1982. Susitna Hydro Aquatic Studies. Phase 2 final report. Volume 2 (Section 2 of 2: Appendices A-H). Alaska Department of Fish and Game, Anchorage, Alaska. APA Document #589.

Bernard, D.R., G. Oliver, W. Goshert, and B. Cross. 1983. Comparison of scale patterns from sockeye salmon sampled from different stocks in the Susitna River in 1982. Appendix H in: ADF&G. Adult anadromous fish studies, 1982. Susitna Hydro Aquatic Studies. Phase 2 final report. Volume 2 (Section 2 of 2: Appendices A-H). Alaska Department of Fish and Game, Anchorage, Alaska.

Scale pattern analysis with linear discriminant functions was used to examine the probable fate of sockeye salmon fry spawned upstream of Curry Station on the Susitna River. Scale samples were taken from sockeye salmon collected at Talkeetna Station, at Curry Station, from the Tokositna River, and from the confluence of the outlet from Larson Lake and the Talkeetna

RTS No.

15c Cont. River. Fish aged 1.3 dominate the samples and are used in the analysis. Growth during the first season of life (1977) is the most discriminating scale pattern variable. Scale patterns from fish sampled at Tokositna River and at Larson Lake are most different. Fish from Larson Lake grew slower for a longer period of time than did fish from the Tokositna River. Fish from Talkeetna Station on the Susitna River are more like fish sampled at Larson Lake on the Talkeetna River. Fish from Curry Station are misclassified as being from Tokositna River or from Larson Lake more often than from upstream of Curry Station. Sockeye salmon passing Curry Station are probably not a separate stock, but are strays from Talkeetna and Chulitna rivers. Fry hatched upstream of Curry Station most probably die or move to the lower Susitna to rear.

15d Alaska Department of Fish and Game (ADF&G). 1983. Resident and juvenile anadromous fish studies on the Susitna River below Devil Canyon, 1982. Susitna Hydro Aquatic Studies. Phase 2 basic data report. Volume 3 (Section 1 of 2). Alaska Department of Fish and Game, Anchorage, Alaska. APA Document #486.

Studies were conducted to assess the potential impact that hydroelectric development on the Susitna River would have on resident and juvenile anadromous fish species. Data were collected concerning the seasonal distribution and relative abundance of the various fish species utilizing the mainstem and peripheral habitats. Emergence, outmigration, and food habits of juvenile salmon (*Oncorhynchus* spp.) were also studied.

15e Alaska Department of Fish and Game (ADF&G). 1983. Resident and juvenile anadromous fish studies on the Susitna River below Devil Canyon, 1982. Susitna Hydro Aquatic Studies. Phase 2 basic data report. Volume 3 (Section 2 of 2: Appendices). Alaska Department of Fish and Game, Anchorage, Alaska. APA Document #487.

15f Alaska Department of Fish and Game (ADF&G). 1983. Aquatic habitat and instream flow studies, 1982. Susitna Hydro Aquatic Studies. Phase 2 basic data report. Volume 4 (Section 1 of 3: Part I and II). Alaska Department of Fish and Game, Anchorage, Alaska. APA Document #585.

Studies were conducted to evaluate existing aquatic habitat conditions and define their relationship to mainstem Susitna River discharge. Available and usable habitat areas at various discharges were evaluated using computer modelling. The influence of the mainstem Susitna River discharge on hydrological and water quality characteristics in selected slough, tributary, and mainstem habitats was investigated.

Changes in mainstem water surface elevation generally ranged from 3 to 5 feet for mainstem discharges between 8,000 and 32,000 cfs. The stage/discharge relationship for that range of flows is well

RTS No.

15f Cont. defined. Backwater effects at slough, tributary, and side channel mouths was dependent on mainstem discharge and the morphology of the specific site. Most side sloughs between Talkeetna and Devil Canyon were found to breach as mainstem discharge at Gold Creek passed from 20,000 cfs to 26,000 cfs (±15%).

Surface water temperature was monitored at twelve sites in the mainstem Susitna River between Talkeetna and Devil Canyon. Intragravel and surface water temperatures were monitored at six side sloughs. Surface water temperature fluctuated more than intragravel temperature did. Specific conductance, pH, dissolved oxygen, water temperature and turbidity were collected at study sites between River Mile (RM) 5.0 and RM 258.0. Values measured in the mainstem Susitna River appeared to be relatively homogenous and independent of mainstem discharge, location, or date of collection. In some sloughs, water quality was very similar during both breached and unbreached flows.

Preliminary salmon spawning habitat investigations in the mainstem indicate that the majority of the habitat available is unsuitable because the substrate is cemented. Chum salmon (Oncorhynchus keta) were found spawning in the mainstem, however, the majority were observed spawning in clear backwater habitats situated in side channels which were cut off from mainstem water influence at their heads. All species of salmon except chinook (O. tshawytscha) were observed spawning in slough habitats. Chum salmon appeared to prefer areas with upwelling present.

Access to spawning areas in sloughs and side channels is the most critical factor in determining the suitability of the site. Because access is mostly a function of water depth, reduced discharge can make otherwise suitable habitat unavailable to spawning fish.

15g Alaska Department of Fish and Game (ADF&G). 1983. Aquatic habitat and instream flow studies, 1982. Susitna Hydro Aquatic Studies. Phase 2 basic data report. Volume 4 (Section 2 of 3: Appendices A-C). Alaska Department of Fish and Game, Anchorage, Alaska. APA Document #587.

15h Alaska Department of Fish and Game (ADF&G). 1983. Aquatic habitat and instream flow studies, 1982. Susitna Hydro Aquatic Studies. Phase 2 basic data report. Volume 4 (Section 3 of 3: Appendices D-J). Alaska Department of Fish and Game, Anchorage, Alaska. APA Document #587.

15i Alaska Department of Fish and Game (ADF&G). 1983. Upper Susitna River impoundment studies, 1982. Susitna Hydro Aquatic Studies. Phase 2 basic data report. Volume 5. Alaska Department of Fish and Game, Anchorage, Alaska. APA Document #590.

Water quality, fish habitat evaluation, and resident fish species distribution and abundance were investigated in the upper Susitna River between RM 152.0 to RM 239.0 above the proposed Devil Canyon

RTS No.

15i Cont. impoundment. Water quality of tributaries, mainstem, sloughs, and Sally Lake was evaluated by dissolved oxygen, pH, turbidity, conductivity and temperature measurements. Mainstem turbidity may influence the distribution of Arctic grayling (*Thymallus arcticus*) which prefer clearwater tributaries. Arctic grayling distribution, abundance, age, length, sex, and migration in tributary and mainstem habitats were investigated. Other resident fish species noted were burbot (*Lota lota*), longnose sucker (*Catostomus catostomus*), round whitefish (*Prosopium cylindraceum*), and humpback whitefish (*Coregonus pidschian*). Morphometric data, water quality data, and a contour map were collected at Sally Lake. Lake trout (*Salvelinus namaycush*) and Arctic grayling (*Thymallus arcticus*) were present in the lake.

Chinook and Cheechako creeks, located within lower Devil Canyon are the only two tributaries within the proposed impoundment areas that are presently known to be utilized by spawning salmon (*Oncorhynchus* spp.).

16a Alaska Department of Fish and Game (ADF&G). 1983. Synopsis of the 1982 aquatic studies and analysis of fish and habitat relationships (Section 1 of 2). Susitna Hydro Aquatic Studies. Phase 2 report. Alaska Department of Fish and Game, Anchorage, Alaska. APA Document #40.

This report provides a synopsis of the findings on each of the target species of resident and anadromous fish, and an analysis of fish and habitat data contained in the 1982 ADF&G Phase II Basic Data Reports. Specific analytical components are presented in 11 appendices to complement the major findings of this report.

16b Alaska Department of Fish and Game (ADF&G). 1983. Synopsis of the 1982 aquatic studies and analysis of fish and habitat relationships (Section 2 of 2: Appendices A-K). Susitna Hydro Aquatic Studies. Phase 2 report. Alaska Department of Fish and Game, Anchorage, Alaska. APA Document #40.

Thompson, F.M., and B.M. Barrett. 1983. Analysis of the species selectivity of fishwheels for the capture of adult salmon in the Susitna River. Appendix A in: ADF&G. Synopsis of the 1982 aquatic studies and analysis of fish and habitat relationships (Section 2 of 2: Appendices). Susitna Hydro Aquatic Studies. Phase 2 report. Alaska Department of Fish and Game, Anchorage, Alaska.

A statistical Chi-square test showed that fishwheels were significantly species selective (P 0.001) at two of five sites on the Susitna River. These over or under catch rates should be considered when estimating species escapements.

Trihey, E.W., L.J. Vining, and C.C. Estes. 1983. Timing and passage of adult salmon in the mainstem Susitna River and access into selected sloughs upstream of the Chulitna River

RTS No.

16b Cont.

confluence. Appendix B in: ADF&G. Synopsis of the 1982 aquatic studies and analysis of fish and habitat relationships (Section 2 of 2: Appendices). Susitna Hydro Aquatic Studies. Phase 2 report. Alaska Department of Fish and Game, Anchorage, Alaska.

Timing and passage of five salmon species (Oncorhynchus nerka, O. keta, O. gorbuscha, O. kisutch, and O. tshawytscha) to spawning habitat in the Susitna River were monitored by fishwheel catches, spawning habitat surveys and passage surveys in 9 sloughs between Talkeetna (RM 103.0) and Devil Canyon (RM 157.0). Comparisons were made between a low water year (1982) and a high water year (1981).

Salasky, S., R. Sinnott, and A. Hoffmann. 1983. Qualitative analysis of salmon spawning habitat in sloughs located within the Talkeetna to Devil Canyon reach of the Susitna River. Appendix C in: ADF&G. Synopsis of the 1982 aquatic studies and analysis of fish and habitat relationships (Section 2 of 2: Appendices). Susitna Hydro Aquatic Studies. Phase 2 report. Alaska Department of Fish and Game, Anchorage, Alaska.

Sinnott, R., K. Sylvester, A. Hoffmann, and C.C. Estes. 1983. Modelling of hydraulic conditions and chum salmon spawning habitat in selected Susitna River sloughs. Appendix D in: ADF&G. Synopsis of the 1982 aquatic studies and analysis of fish and habitat relationships (Section 2 of 2: Appendices). Susitna Hydro Aquatic Studies. Phase 2 report. Alaska Department of Fish and Game, Anchorage, Alaska.

Available hydraulic conditions in four sloughs (8A, 9, 21, and Chum Channel) were modelled as a function of slough discharge. Water depth and velocity were evaluated over a wide range of predicted slough discharge.

The influence of slough hydraulic conditions on the selection of redd sites by chum salmon (Oncorhynchus keta) was modelled by analyzing the frequency distribution of chum redds among available water depths, velocities, and substrate types at low flows in sloughs 8A, 9, and 21. Available water depths, velocities, and substrate types at a predicted slough flow of 5 cfs and the frequency distributions of chum salmon redds were evaluated using a habitat suitability model developed for sloughs 8A, 9, and 21.

Marshall, B. 1983. Effects on mainstem Susitna discharge on total wetted backwater surface area at selected study sites. Appendix E in: ADF&G. Synopsis of the 1982 aquatic studies and analysis of fish and habitat relationships (Section 2 of 2: Appendices). Susitna Hydro Aquatic Studies. Phase 2 report. Alaska Department of Fish and Game, Anchorage, Alaska.

RTS No.

16b Cont.

Additional information beyond that discussed in previous reports concerning the response of backwater surface areas to changes in mainstem discharge is presented. The relationship between backwater and wetted surface areas, and data on the abundance of pools formed by berms in free flowing stream areas at study sites is also discussed.

Fourteen sites were sampled: Sloughs 6A, 8A, 9, 11, 19, 20, and 21; Whiskers Creek and Slough, Birch Creek and Slough, Sunshine Creek and Side Channel, Lane Creek, Whitefish Slough, Goose Creek and Side Channel, Rabideux Creek and Slough.

Hale, S.S. 1983. Influence of habitat parameters on distribution and relative abundance of juvenile salmon and resident species. Appendix F in: ADF&G. Synopsis of the 1982 aquatic studies and analysis of fish and habitat relationship (Section 2 of 2: Appendices). Susitna Hydro Aquatic Studies. Phase 2 report. Alaska Department of Fish and Game, Anchorage, Alaska.

The proposed hydroelectric project could create physical-chemical conditions which are outside the limits of natural variation with regard to timing, magnitude, or both. This appendix presents an analysis of the cause-effect relationships observed between natural variations in physical and chemical conditions and the distribution and abundance of fish (primarily juvenile salmon) during the 1982 open water season. A habitat classification system was developed for dividing the study sites into nine possible zones so that changes in physical habitat with changing discharge could be monitored without an intensive data collection effort. An estimate of how juvenile salmon habitat changes with variations in mainstem discharge was developed by combining the catch variations between zones with the changes in the surface area of the zones.

Suchanek, P.M., and S.S. Hale. 1983. Use of major habitat types by juvenile salmon and resident species. Appendix G in: ADF&G. Synopsis of the 1982 aquatic studies and analysis of fish and habitat relationships (Section 2 of 2: Appendices). Susitna Hydro Aquatic Studies. Phase 2 report. Alaska Department of Fish and Game, Anchorage, Alaska.

An analysis of habitat preferences of resident fish and juvenile salmon during the open water season is presented. Six major habitat types occurring on the Susitna River between Cook Inlet and Devil Canyon were identified: tributary mouths, side channels with large tributary mouths, side sloughs with large tributary mouths, or ground water input, upland sloughs, and mainstem channels or side channels.

RTS No.

16b Cont. Chi-square and graphic analysis were used. Data were extracted from Volume 3 of the Basic Data Report ( ). Juvenile salmon species considered were: chinook (Oncorhynchus tshawytscha), coho (O. kisutch), chum (O. keta), and red (O. nerka) salmon. Pink (O. gorbuscha) salmon were not included due to low numbers captured. Resident species included: round whitefish (Prosopium cylindraceum), Arctic grayling (Thymallus arcticus), longnose sucker (Catostomus catostomus), slimy sculpin (Cottus cognatus), burbot (Lota lota), humpback whitefish (Coregonus pidschian), rainbow trout (Salmo gairdneri), and Dolly Varden (Salvelinus malma).

Hale, S.S. 1983. Habitat relationships of juvenile salmon outmigration. Appendix H in: ADF&G. Synopsis of the 1982 aquatic studies and analysis of fish and habitat relationships (Section 2 of 2: Appendices). Susitna Hydro Aquatic Studies. Phase 2 report. Alaska Department of Fish and Game, Anchorage, Alaska.

The relationship between the outmigration timing of juvenile salmon and the environmental variables for the Susitna River between the Chulitna River confluence and Devil Canyon were analyzed in order to evaluate the influence environmental factors have on the outmigration of juvenile salmon (Oncorhynchus gorbuscha, O. tshawytscha, O. keta, O. kisutch, and O. nerka). Parameters examined included were mainstem discharge, water temperature, turbidity, and photoperiod. Other related factors were time of season and variation in size (mean length) of juvenile salmon.

Schmidt, D.C. 1983. A model of the effects of incremental increases in sport fishing on population structure of Arctic grayling above Devil Canyon. Appendix I in: ADF&G. Synopsis of the 1982 aquatic studies and analysis of fish and habitat relationships (Section 2 of 2: Appendices). Susitna Hydro Aquatic Studies. Phase 2 report. Alaska Department of Fish and Game, Anchorage, Alaska.

The opening of access roads into the impoundment area of the proposed Susitna Hydroelectric project, can be expected to create a substantial Arctic grayling sport fishery in this previously seldom-fished drainage. This study was initiated to examine the effect of increased mortality rates due to fishing pressure on the age structure and abundance of the Arctic grayling (Thymallus arcticus) populations in the clearwater tributaries studied to date. Fish were sampled using hook and line and then tagged. Mark and recapture, and age-length data were collected over two open water seasons at eight major clearwater tributaries in the proposed impoundment area.

Suchanek, P.M., and S.S. Hale. 1983. Age-length curves and growth of Arctic grayling and rainbow trout. Appendix J in: ADF&G.

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16b Cont. Synopsis of the 1982 aquatic studies and analysis of fish and habitat relationships (Section 2 of 2: Appendices). Susitna Hydro Aquatic Studies. Phase 2 report. Alaska Department of Fish and Game, Anchorage, Alaska.

Age-length curves and regressions were examined for Arctic grayling (Thymallus arcticus) to determine if the growth of the population in the proposed impoundment area above Devil Canyon was significantly different from that of the population below Devil Canyon. Age-length curves for rainbow trout (Salmo gairdneri) were also analyzed.

Sandone, G., and J. Sautner. 1983. Evaluation of Arctic grayling spawning and rearing habitat and notes on salmon spawning in the impoundment study area of the Susitna River . Appendix K in: ADF&G. Synopsis of the 1982 aquatic studies and analysis of fish and habitat relationships (Section 2 of 2: Appendices). Susitna Hydro Aquatic Studies. Phase 2 report. Alaska Department of Fish and Game, Anchorage, Alaska.

Arctic grayling (Thymallus arcticus) spawning and rearing habitats were surveyed and documented above and below the proposed impoundment elevation (PIE) along eleven major tributaries which would be partially inundated by the proposed impoundment. Inundation would result in loss of existing habitat in the lower reaches; therefore, continued spawning and rearing of Arctic grayling in these streams depends upon the quantity, quality, and availability of habitat above the PIE.

Chinook and Cheechako creeks, located within lower Devil Canyon are the only tributaries within the proposed impoundment areas at which salmon are known to spawn. ADF&G documented chinook (Oncorhynchus tshawytscha) salmon spawning in the glacial/clearwater mixing zones of these creeks. A semi-dewatered redd was observed at the water's edge approximately 150 feet downstream from the mouth of Cheechako Creek, indicating that spawning had occurred during a higher discharge period.

17 Alaska Department of Fish and Game (ADF&G). 1983. Winter aquatic studies (October 1982-May 1983). Susitna Hydro Aquatic Studies. Phase 2 report. Alaska Department of Fish and Game, Anchorage, Alaska. APA Document #309. Incorrect: 309 is draft, 397 is final

A. 1983 Winter Aquatic Studies, October 1982-May 1983, Continuous Surface and Intragravel Water Temperature Study. Andrew Hoffmann.

Water surface and intragravel water temperatures were continuously monitored with Omnidata datapod recorders at 13 slough and mainstem sites in the Susitna River from August 1982

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17 Cont.

to June 1983. This study provided baseline data and allowed comparisons of temperatures of sites known to be used or not used by spawning salmon (Oncorhynchus spp.). Intragravel temperatures in sloughs were generally warmer and more stable than surface water temperatures. However, slough water temperatures were affected by upwelling ground water.

B. 1983 Winter Aquatic Studies, October 1982-May 1983, Salmon Incubation and Emergence Studies. L. Vining and J. Quinn.

Physical and chemical conditions of surface and intragravel water were related to development of sockeye (Oncorhynchus nerka) and chum salmon (O. keta) embryos and alevins in the Susitna River. Datapods and standpipes were used to measure temperature, dissolved oxygen, pH and conductance in slough and side channel spawning sites. Temperature units and time required for development were similar to those recorded for these species elsewhere in Alaska.

C. 1983 Winter Aquatic Studies, October 1982-May 1983, Burbot Spawning in the Susitna River below Devil Canyon. R. Sundet.

The timing and habitat characteristics of burbot (Lota lota) spawning were studied in the Deshka River, a tributary of the Susitna River. Physical and chemical characteristics of two sites on the Deshka River (Susitna RM 40.6) were measured: ice thickness, water depth, under ice water velocity, dissolved oxygen, specific conductance, pH, and water temperature. Timing of spawning was determined from monthly necropsies of samples (n = 69) to determine gonad maturity. Otoliths were collected to determine age and fish length was measured. Monthly examinations of sexually ripe gonads showed that the size increased from early December to mid-January, then progressively decreased in size through March.

D. 1983 Winter Aquatic Studies, October 1982-May 1983, Winter Radio Telemetry Investigations of Selected Resident Fish. M. Wenger, R. Sundet, and M. Stratton.

Three species of resident fish in the Susitna River were radio tagged to determine winter movements, overwintering locations, or spawning habitat and timing. Radio transmitters were implanted in live fish in September-October 1982 and monitored by air, boat, and snowmobile until May 1983. Ten rainbow trout (Salmo gairdneri) migrated 14-76.6 miles downstream to overwintering locations. Fifteen Arctic grayling (Thymallus arcticus) migrated 2.1 to 50.8 miles from tributaries down the mainstem, in September to early October, to two main areas on concentration. Six burbot (Lota lota) migrated 1 to 113.6 miles to winter spawning grounds in September to mid-January. They spawned mid-January to early February and migrated again

RTS No.

17 Cont. early February to mid-March. Burbot showed some preference for areas with upwelling.

18a Alaska Department of Fish and Game (ADF&G). 1984. Susitna Hydro Aquatic Studies Procedures Manual (May 1983 - June 1984) (Volume 1 of 2). Susitna Hydro Aquatic Studies. Alaska Department of Fish and Game, Anchorage, Alaska. APA Document #885.

Objectives, technical procedures, and data reduction procedures are described for each component of the Susitna Hydroelectric Aquatic Studies Program during the period of May 1983 - June 1984.

18b Alaska Department of Fish and Game (ADF&G). 1984. Susitna Hydro Aquatic Studies Procedures Manual (May 1983 - June 1984) (Volume 2 of 2: Appendices). Susitna Hydro Aquatic Studies. Alaska Department of Fish and Game, Anchorage, Alaska. APA Document #886.

19 Barrett, B.M., F.M. Thompson, and S.N. Wick, editors. 1984. Adult anadromous fish investigations: May-October 1983. Susitna Hydro Aquatic Studies. Report No. 1. Alaska Department of Fish and Game, Anchorage, Alaska. APA Document #1450.

Eulachon (Thaleichthys pacificus) migrated into the Susitna River in two runs during late May-early June 1983. Pre-spawning males were more numerous than females in the first, smaller run, while pre-spawning females outnumbered males in the second, larger run. This suggests that individual male eulachon ripen earlier and spawn over a longer period than females following ice-out at water temperatures between 6.0°C and 9.0°C. About 70 percent of the fish spawned within the first 29 miles from the mouth. No fish were observed spawning in clearwater sloughs or tributaries. Age data indicated that three year olds accounted for 92-97 percent of spawning fish in both runs. Weight/length data showed that three year old males were significantly larger in the first run than in the second. Spawning habitat was described in terms of water depth, velocity, temperature, and substrate. The first run included several hundred thousand fish, while the second escapement reached several million eulachon. Escapement of chum (Oncorhynchus keta), chinook (O. tshawytscha), coho (O. kisutch), pink (O. gorbuscha), and red (O. nerka) salmon occurring in the Susitna River was monitored at three points on the Susitna River using fishwheels, Petersen tag-recapture techniques and side scan sonar. Age, length, weight, and fecundity data were collected. Streams and sloughs were surveyed for salmon spawning activity. Results are presented by species and river location.

Bering cisco (Coregonus laurettae) were incidentally sampled at Yentna (TRM 04), Sunshine (RM 80), Talkeetna (RM 103), and Curry (RM 120) stations in 1983. Relative abundance, distribution, and migrational timing were determined, and age, length, and sex data were collected. The documented distribution of Bering cisco was extended from Talkeetna Station (RM 103) to Fourth of July Creek (RM 131.1).

RTS No.

20 Schmidt, D.C., S.S. Hale, D.L. Crawford, and P. Suchanek, editors. 1984. Resident and juvenile anadromous fish investigations (May-October 1983). Susitna Hydro Aquatic Studies. Report No. 2. Alaska Department of Fish and Game, Anchorage, Alaska. APA Document #1784.

Report No. 2 includes juvenile salmon and resident species studies conducted during the period May to October 1983. The majority of these studies took place in the Susitna River between the Chulitna River confluence and Devil Canyon. Very limited sampling (primarily for resident species) was conducted downstream of the Chulitna River confluence.

The report is divided into seven separate papers addressing topics from four general subject areas: distribution and relative abundance, movement and migration, population dynamics, and habitat/species relationships.

Roth, K.J., D.C. Gray, and D.C. Schmidt. 1984. The outmigration of juvenile salmon from the Susitna River above the Chulitna River confluence. Part 1 in: D.C. Schmidt, S.S. Hale, D.L. Crawford, and P.M. Suchanek, editors. Resident and juvenile anadromous fish investigations (May-October 1983). Susitna Hydro Aquatic Studies. Report No. 2. Alaska Department of Fish and Game, Anchorage, Alaska.

Population estimates of juvenile chum (Oncorhynchus keta) and sockeye (O. nerka) salmon were obtained by mark-recapture using a unique application of half-length coded wire tags. Fry were tagged at four sloughs and one tributary of the Susitna River between the Chulitna River confluence and Devil Canyon. Downstream migrant traps were used to recapture tagged fry during June, July, and August 1983. Chinook (O. tshawytscha), coho (O. kisutch), and pink (O. gorbuscha) salmon were also collected during the sampling season.

Dugan, L.J., D.A. Sterritt, and M.E. Stratton. 1984. The distribution and relative abundance of juvenile salmon in the Susitna River drainage above the Chulitna River confluence. Part 2 in: D.C. Schmidt, S.S. Hale, D.L. Crawford, and P.M. Suchanek, editors. Resident and juvenile anadromous fish investigations (May-October 1983). Susitna Hydro Aquatic Studies. Report No. 2. Alaska Department of Fish and Game, Anchorage, Alaska.

Thirty-five sites, representing four macrohabitat types within the Susitna River drainage, were sampled from May through September 1983 to determine the seasonal distribution and abundance of juvenile salmon (Oncorhynchus spp.). Limited sampling was also conducted during October and November. Distribution of all species was found to be significantly related to macrohabitat type and time of year.

RTS No.

20 Cont. Suchanek, P.M., R.P. Marshall, S.S. Hale, and D.C. Schmidt. 1984. Juvenile salmon rearing suitability criteria. Part 3 in: D.C. Schmidt, S.S. Hale, D.L. Crawford, and P.M. Suchanek, editors. Resident and juvenile anadromous fish investigations (May-October 1983). Susitna Hydro Aquatic Studies. Report No. 2. Alaska Department of Fish and Game, Anchorage, Alaska.

Habitat attributes were measured and juvenile salmon (Oncorhynchus spp.) were sampled at representative sites on the Susitna River between the Chulitna River confluence and Devil Canyon. Suitability criteria for percent cover, cover type, velocity, and depth were developed for juvenile (O. tshawytscha), coho (O. kisutch), sockeye (O. nerka), and chum (O. keta) salmon. Composite weighting factors were formulated and correlated with observed fish catch.

Marshall, R.P., P.M. Suchanek, and D.C. Schmidt. 1984. Juvenile salmon rearing habitats models. Part 4 in: D.C. Schmidt, S.S. Hale, D.L. Crawford, and P.M. Suchanek, editors. Resident and juvenile anadromous fish investigations (May-October 1983). Susitna Hydro Aquatic Studies. Report No. 2. Alaska Department of Fish and Game, Anchorage, Alaska.

Using habitat models, the effects of mainstem discharge on rearing habitat of juvenile salmon (Oncorhynchus spp.) in the Susitna River between the Chulitna River confluence and Devil Canyon were quantified. Data collected include hydraulic characteristics, cover, water quality, water surface area, and fish density. Weighted usable areas were calculated for selected species at each site. A habitat index was calculated for site comparisons.

Sundet, R.L., and M.N. Wenger. 1984. Resident fish distribution and population dynamics in the Susitna River below Devil Canyon. Part 5 in: D.C. Schmidt, S.S. Hale, D.L. Crawford, and P.M. Suchanek, editors. Resident and juvenile anadromous fish investigations (May-October 1983). Susitna Hydro Aquatic Studies. Report No. 2. Alaska Department of Fish and Game, Anchorage, Alaska.

Using radio telemetry and mark and recapture methods, the seasonal distribution of rainbow trout (Salmo gairdneri) and estimates of local abundance for other resident species were obtained for the Susitna River between the Chulitna River confluence and Devil Canyon. Seasonal distribution of round whitefish (Prosopium cylindraceum), burbot (Lota lota), Arctic grayling (Thymallus arcticus), and Dolly Varden (Salvelinus malma) are described. Selected sites were established to monitor catch per unit effort for resident fish species and their response to flow regulation of the proposed hydroelectric project.

RTS No.

20 Cont. Suchanek, P.M., R.L. Sundet, and M.N. Wenger. 1984. Resident and fish habitat studies. Part 6 in: D.C. Schmidt, S.S. Hale, D.L. Crawford, and P.M. Suchanek, editors. Resident and juvenile anadromous fish investigations (May-October 1983). Susitna Hydro Aquatic Studies. Report No. 2. Alaska Department of Fish and Game, Anchorage, Alaska.

Habitat distribution and suitability were evaluated for rainbow trout (Salmo gairdneri), Arctic grayling (Thymallus arcticus), round whitefish (Prosopium cylindraceum), and longnose suckers (Catostomus catostomus) in the Susitna River drainage between the Chulitna River confluence and Devil Canyon. Electrofishing, beach seine, and hook-and-line catch data and habitat data were collected at radio telemetry relocation sites for rainbow trout and burbot (Lota lota) and at spawning sites (round whitefish). Suitability criteria for velocity, depth, and object cover were fit to the distribution of resident fish.

Hale, S.S., P.M. Suchanek, and D.C. Schmidt. 1984. Modelling of juvenile salmon and resident fish habitat. Part 7 in: D.C. Schmidt, S.S. Hale, D.L. Crawford, and P.M. Suchanek, editors. Resident and juvenile anadromous fish investigations (May-October 1983). Susitna Hydro Aquatic Studies. Report No. 2. Alaska Department of Fish and Game, Anchorage, Alaska.

Instream Flow Group (IFG) hydraulic models were used to evaluate the effect of mainstem discharge on rearing habitat for juvenile salmon and resident species at seven sites on the Susitna River between the Chulitna River confluence and Devil Canyon. Overtopping of side slough heads by mainstem discharge causes abrupt changes in rearing habitat which are positive benefit to some species/life stages and negative for others.

21a-j Estes, C.C., and D.S. Vincent-Lang, editors. 1984. Aquatic habitat and instream flow investigations, May-October 1983 (10 volumes: Chapters 1-10). Susitna Hydro Aquatic Studies. Report No. 3. Alaska Department of Fish and Game, Anchorage, Alaska. APA Document #1930-1939.

Report No. 3 is divided into two parts: Part I (Chapters 1-4), Hydrological and Water Quality Investigations, is a compilation of the physical and chemical data collected by the ADF&G Susitna Hydroelectric Aquatic Studies team during 1983. Part II (Chapters 5-10), Adult Anadromous Fish Habitat Investigations, describes the subset of available habitat between Cook Inlet and Devil Canyon that is utilized by adult anadromous fish. Primary emphasis is upon slough and side channel habitats.

21a Quane, T., P. Morrow, and T. Withrow. 1984. Stage and discharge investigations. Chapter 1 in: C.C. Estes, and D.S. Vincent-Lang, editors. Aquatic habitat and instream flow investigations, May-October 1983. Susitna Hydro Aquatic Studies. Report No. 3. Alaska Department of Fish and Game, Anchorage, Alaska. APA Document #1930.

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21a Cont. Baseline hydrological data have been collected within the Susitna River basin since 1981 in conjunction with the baseline fisheries studies being conducted by the Alaska Department of Fish and Game Susitna Hydroelectric Aquatic Studies Feasibility Team. The primary objective of the data collection program has been to collect baseline hydrological data (stage/water surface, elevation, stream flow, and discharge) within the variety of fish habitats that are present in the Susitna River basin and to determine the influences of mainstem discharge conditions on the hydrological characteristics of these habitats. Although these investigations have been conducted throughout this large glacially-fed river system, effort has been concentrated in the reach of river extending from Talkeetna (RM 97) to Devil Canyon (RM 150) as impacts from the construction and operation of the proposed hydroelectric development are expected to be greatest in this river reach.

Six major fishery habitat types are located in the reach of river from Talkeetna to Devil Canyon; mainstem, side channel, side slough, upland slough, tributary mouth, and tributary. Sufficient data was collected to describe the relationship of mainstem discharge on the water surface elevation of the mainstem at 46 sites. Based on these data, this relationship is fairly well defined for the range of discharges from 5,000 to 30,000 cfs (as referenced to the USGS Gold Creek mainstem discharge gaging station). Mainstem discharge was also found to influence, to varying degrees, the hydraulic characteristics of side channels and side slough habitats by creating backwater areas and by overtopping the heads of these habitats. Prior to overtopping events, flow in these habitats was found to be generally clear and low, originating from ground water upwelling and surface water runoff. Subsequent to overtopping, flow in these habitats was found to increase dramatically and become directly governed by mainstem discharge. The heads of upland slough habitats are never found to breach, with the only influence of mainstem discharge on these habitats being backwater effects. The stream flow regimes of the major clearwater tributaries in this reach were also evaluated to determine the relative contribution of the tributaries to the overall discharge of the Susitna River watershed.

Information from these studies will be used by other project biologists and engineers to evaluate the impact of hydroelectric development on the Susitna River.

21b Quane, T., I. Queral, T. Keklak, and D. Seagren. 1984. Channel geometry investigations of the Susitna River basin. Chapter 2 in: C.C. Estes, and D.S. Vincent-Lang, editors. Aquatic habitat and instream flow investigations, May-October 1983. Susitna Hydro Aquatic Studies. Report No. 3. Alaska Department of Fish and Game, Anchorage, Alaska. APA Document #1931.

Channel geometry data have been collected by the Alaska Department of Fish and Game Susitna Hydro Aquatic Studies Feasibility Study

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21b Cont. Team since 1982 at twenty-one side channel, upland and side slough and tributary habitats located in the Talkeetna to Devil Canyon reach of the Susitna River. These data have been used to describe the channel characteristics of these study sites. Thalweg profiles, depicting the overall gradient, extent of backwater, and substrate composition of the site, were constructed from the data for four side channels and thirteen upland and side sloughs. Cross section profiles, illustrating the cross sectional channel characteristics and wetted surface area as a response to stage changes, were also developed for selected stage/discharge monitoring stations within these study sites. These data are used by other project biologists and engineers to evaluate the impact of hydroelectric development on the Susitna River.

21c Keklak, T., and T. Quane. 1984. Continuous water temperature investigations. Chapter 3 in: C.C. Estes, and D.S. Vincent-Lang, editors. Aquatic habitat and instream flow investigations, May-October 1983. Susitna Hydro Aquatic Studies. Report No. 3. Alaska Department of Fish and Game, Anchorage, Alaska. APA Document #1932.

Surface and intragravel water temperature data have been recorded on a continuous basis at selected locations throughout the Susitna River Basin since 1981 by the Alaska Department of Fish and Game Susitna Hydro Aquatic Studies Feasibility Team to characterize the water temperature regimes of the mainstem Susitna River and its peripheral habitats. During the 1983 open water season (May-October 1983) baseline surface and intragravel water temperature data were recorded in the mainstem Susitna River and its peripheral side channel, side slough, upland slough, and tributary habitats. Although data were collected from the estuary (RM 0.0) to above the Oshetna River (RM 235.7), the study concentrated on the reach of the river from the Parks Highway Bridge (RM 83.9) to the Oshetna River (RM 233.4). During the 1983 open water season surface water temperatures in the mainstem Susitna River generally increased downstream from RM 235.7 to RM 103.0. Surface water temperatures recorded at RM 83.9 were colder reflecting the influences of the Talkeetna and Chulitna rivers. Intragravel temperatures were recorded at sites form RM 103.3 to RM 142.3. Warmest intragravel temperatures were recorded at the most upstream site. The influence of mainstem temperatures on surface water temperatures in side sloughs or side channels resulting from mainstem breaching discharges was observed in side channels 10, upper 11, and 21, and in side slough 9 and 21. Intragravel temperatures recorded in side channels and side sloughs were influenced by ground water upwelling or mainstem temperatures. Variability in intragravel temperatures recorded within a side channel or side slough was observed in upper side channel 11 and slough 8A.

Results of these investigations will be used to evaluate the influences that seasonal water temperatures have on fish and fish habitats and to calibrate or validate various temperature models.

RTS No.

21d Sandone, G., and T. Quane. 1984. Water quality investigations. Chapter 4 in: C.C. Estes, and D.S. Vincent-Lang, editors. Aquatic habitat and instream flow investigations, May-October 1983. Susitna Hydro Aquatic Studies. Report No. 3. Alaska Department of Fish and Game, Anchorage, Alaska. APA Document #1933.

Baseline water quality data have been collected within the Susitna River basin since 1981 in conjunction with the baseline fisheries studies being conducted by the Alaska Department of Fish and Game Susitna Hydroelectric Aquatic Studies Feasibility Team. The primary objective of the data collection program has been to collect baseline water quality data (dissolved oxygen, pH, conductivity, temperature, and turbidity) within the habitats selected for fishery studies that are present in the Susitna River basin and to determine the influences of mainstem discharge conditions on the water quality characteristics of these habitats. Although these investigation have been conducted throughout this large glacially-fed river system, effort has been concentrated in the reach of river extending from Talkeetna (RM 97) to Devil Canyon (RM 150) as impacts from the construction and operation of the proposed hydroelectric development are expected to be greatest in this river reach.

The 1983 investigations (summarized in this report), concentrated on mainstem, side channel, side slough and tributary habitats. Water quality measurements of dissolved oxygen, pH, conductivity and turbidity were obtained in the mainstem Susitna River and Talkeetna and Chulitna rivers twice a month on an instantaneous basis except for the Talkeetna fishwheel and Gold Creek camp stations, which were monitored daily. Turbidity measurements were obtained from several side channels and side sloughs in the Talkeetna to Devil Canyon reach twice a month.

Results of these investigations indicate that water quality in the mainstem Susitna River is relatively similar among sampling locations but that specific water quality variables at sampling stations change in relation to mainstem discharge. Increased levels of turbidity in the mainstem were found to correlate to mainstem discharge, but are assumed to result from suspended sediment contributed by the Susitna and MacClaren glaciers. Turbidity levels remain low when glacial melt ceases. Turbidity levels in side channels and side sloughs were found to be independent of mainstem discharge prior to breaching of the heads by the mainstem, however, subsequent to breaching those sites were found to resemble the turbidity of the mainstem with the controlling factor being the relative flow contribution of the mainstem to that of the site flow. Tributary water quality was found to be independent of mainstem Susitna River discharge and was determined to influence to varying degrees the water quality conditions of the mainstem depending on the relative size of the tributary.

Information from these studies will be used by other project biologists and engineers to evaluate the impact of hydroelectric development on the Susitna River.

RTS No.

21e Vincent-Lang, D.S., and I. Queral. 1984. Eulachon spawning in the lower Susitna River. Chapter 5 in: C.C. Estes, and D.S. Vincent-Lang, editors. Aquatic habitat and instream flow investigations, May-October 1983. Susitna Hydro Aquatic Studies. Report No. 3. Alaska Department of Fish and Game, Anchorage, Alaska. APA Document #1934.

Eulachon (Thaleichthys pacificus [Richardson]) are an anadromous member of the smelt family. Studies to determine naturally occurring hydraulic and temperature relationships to eulachon immigration and spawning were initiated by the Alaska Department of Fish and Game (ADF&G) in 1982 and continued into 1983. These surveys indicated that eulachon are probably the most abundant species of fish in the Susitna River. Based on 1981 and 1983 catch data, eulachon begin their upstream spawning migration during early to mid-May. Two distinct spawning runs of eulachon enter the Susitna River with no apparent correlation with either mainstem discharge or temperature. Spawning was found to occur over a broad range of hydraulic and substrate conditions along the margins of mainstem habitats from the mouth of the Susitna River (RM 0) upstream to RM 50.3. Based on a representative number of spawning sites selected for further evaluation, it appears that similar physical habitat condition will be present under both decreased and increased mainstem discharge conditions.

21f Sautner, J., L.J. Vining, and L.A. Rundquist. 1984. An evaluation of passage conditions for adult salmon in sloughs and side channels of the middle Susitna River. Chapter 6 in: C.C. Estes, and D.S. Vincent-Lang, editors. Aquatic habitat and instream flow investigations, May-October 1983. Susitna Hydro Aquatic Studies. Report No. 3. Alaska Department of Fish and Game, Anchorage, Alaska. APA Document #1935.

An interim evaluation of passage conditions for adult Pacific salmon (Oncorhynchus spp.) into and within twelve slough and side channel sites in the middle reach of the Susitna River is presented to determine the effects of mainstem discharge on passage conditions into these habitat types. These habitats were selected for evaluation as they are affected by mainstem Susitna River discharges. A final evaluation will be completed in FY 85. The sites account for the majority of chum, sockeye, and pink salmon which spawn in sloughs and side channels in this reach. The evaluation of salmon passage conditions at each site included the effect of mainstem breaching discharge and backwater staging, and slough flows (local flows) derived from local water sources (e.g., upwelling, tributaries, precipitation). Timing and distribution patterns of salmon were also evaluated as they relate to passage conditions and flow patterns in the Susitna River system.

Daily salmon catch data at three fishwheel sites on the mainstem river were compared to mean daily discharge levels. These discharge data and survey counts of peak numbers of live and dead salmon in

RTS No.

21f Cont. sloughs and side channels indicate that the period from August 20 to September 20 is a critical period for providing passage into and within slough and side channel sites from the mainstem Susitna River. All analyses of passage were therefore restricted to this time period.

Reaches within the study sites which were restrictive to salmon passage (passage reaches) were identified at each site on the basis of water depth requirements for passage by salmon. Depth requirements for successful passage increased with and increase in the length of a passage. The analyses of breaching and backwater discharges and local flow effects on passage reaches were conducted independently and their relative importance is reported on a site by site basis. In general, breaching discharges affect all passage reaches within a site simultaneously; whereas, backwater staging usually affects only one or two passage reaches in the lower portion of a site. Local flow requirements may affect all passage reaches, but vary among sites and among passage reaches. These variations in local flow requirements are due to spatial variations in sources of local flow.

21g Vincent-Lang, D.S., A. Hoffmann, A.E. Bingham, C.C. Estes, D. Hillard, C. Steward, E.W. Trihey, and S. Crumley. 1984. An evaluation of chum and sockeye salmon spawning habitat in sloughs and side channels of the middle Susitna River. Chapter 7 in: C.C. Estes, and D.S. Vincent-Lang, editors. Aquatic habitat and instream flow investigations, May-October 1983. Susitna Hydro Aquatic Studies. Report No. 3. Alaska Department of Fish and Game, Anchorage, Alaska. APA Document #1936.

Three sloughs (8A, 9, and 21) and four side channels (10, lower 11, upper 11 and 21) in the middle reach of the Susitna River were evaluated using an Instream Flow Incremental Methodology (IFIM) physical habitat simulation (PHABSIM) modelling approach to evaluate the effects that site flow and mainstem discharge have on chum (Oncorhynchus keta) and sockeye (O. nerka) salmon spawning habitat conditions on these sloughs and side channels are thought to represent the range of spawning habitat conditions that are present in the sloughs and side channels of the middle Susitna River which currently support a majority of chum and sockeye salmon spawning in these habitat types.

Ten hydraulic simulation models were calibrated to simulate depths and velocities associated with a range of site specific flows at these seven modelling study sites. Comparisons between corresponding sets of simulated and measured depths and velocities indicate that the calibrated models provide reliable estimates of depths and velocities within their recommended calibration ranges.

Habitat suitability criteria for chum and sockeye salmon spawning for the habitat variables of depth, velocity, substrate, and upwelling were developed for input into a habitat simulation model.

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21g Cont. The suitability criteria developed for chum salmon spawning were based on an analysis of utilization data as modified using limited preference data, literature information, and the opinion of project biologists familiar with middle Susitna River chum salmon stocks. The spawning suitability criteria constructed for sockeye salmon were developed using the same analytical approach used in the chum salmon analysis with the exception that no analysis of preference could be made.

Using a habitat simulation model (HABTAT), the output of hydraulic simulation models and the spawning habitat suitability criteria were linked to project usable area of chum and sockeye salmon spawning habitat (WUA) as a function of flow for each of the seven modelled study sites. Using these relationships and relationships between site flows and mainstem discharge presented in Chapter 1 of this report, the relationships between chum and sockeye salmon spawning habitat as a function of mainstem discharge for the period of controlled site flows were also determined for each modelled study site. These projections of chum and sockeye spawning WUA made at study sites indicate that spawning habitat usability in sloughs and side channels exhibits certain species-specific and site-specific trends. Generally, projections of WUA at study sites peak in the range mainstem discharges from 20,000 to 35,000 cfs, with the controlling factor appearing to be the overtopping of the site by mainstem discharge and the subsequent control of the site flow by mainstem discharge. Assuming that the modelled sloughs and side channels are representative of other non-modelled sloughs and side channels in the middle reach which currently support spawning, the theoretical maximum WUA for slough and side channel habitats in the middle river reach would occur slightly after the mainstem discharge overtops and controls the hydraulics at a maximum number of these habitats. Based on a review of time series plots of WUA over time of each study site, however, flows at study sites which currently support chum and sockeye spawning are only infrequently controlled by mainstem discharge. For this reason, the WUA at study sites remains relatively low and stable during the period of peak spawning activity (August through September), except during flood events. There appears to be a general positive correlation between projected WUA and habitat use at study sites.

21h Sandone, G., D.S. Vincent-Lang, and A. Hoffmann. 1984. Evaluation of chum salmon spawning habitat in selected tributary mouth habitats on the middle Susitna River. Chapter 8 in: C.C. Estes, and D.S. Vincent-Lang, editors. Aquatic habitat and instream flow investigations, May-October 1983. Susitna Hydro Aquatic Studies. Report No. 3. Alaska Department of Fish and Game, Anchorage, Alaska. APA Document #1937.

Two tributary mouths (Lane Creek and Fourth of July Creek) located in the middle reach of the Susitna River were evaluated to determine the influence that mainstem discharge has on the quantity and quality of chum (*Oncorhynchus keta*) salmon spawning habitat. During

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21h Cont. the 1983 field season, chum salmon were observed spawning in the clearwater plume of Fourth of July Creek, but not within the Lane Creek mouth area. At each study site, the location and surface area of available and usable chum salmon spawning habitat was determined. Available habitat surface area was positively correlated to changes in mainstem discharge at both tributary mouth study sites, whereas usable chum salmon spawning habitat increased with increasing mainstem discharge only at the Fourth of July Creek mouth area. The surface area of usable chum salmon spawning habitat within the Lane Creek mouth decreased as mainstem discharge increased. This difference in usable surface area responses is likely related to the different type of confluence area of each site. Lane Creek flows directly into the mainstem while Fourth of July Creek empties into a side channel. Spawning activity could not be observed beyond the clearwater plume at the Fourth of July mouth area due to high mainstem turbidities. Because of this, the importance of the clearwater plume in determining the area of usable chum salmon spawning habitat at tributary mouth habitats could not be ascertained. If it is subsequently determined that chum salmon spawning does take place outside of the clearwater plume area of tributary mouths, the frequency distribution of spawning depths and velocities reported herein is likely biased towards shallower and slower waters.

21i Vincent-Lang, D.S., A. Hoffmann, A.E. Bingham, and C.C. Estes. 1984. Habitat suitability criteria for chinook, coho, and pink salmon spawning in tributaries of the middle Susitna River. Chapter 9 in: C.C. Estes, and D.S. Vincent-Lang, editors. Aquatic habitat and instream flow investigations, May-October 1983. Susitna Hydro Aquatic Studies. Report No. 3. Alaska Department of Fish and Game, Anchorage, Alaska. APA Document #1938.

Utilization data for the habitat variables of depth, velocity, and substrate composition were collected at chinook (Oncorhynchus tshawytscha) salmon spawning sites in selected tributaries of the middle reach of the Susitna River. These data were modified using statistical methods and the professional judgements of project biologists familiar with Susitna River chinook salmon stocks to develop suitability criteria for chinook salmon spawning in tributaries of the middle Susitna River. These criteria show that depths ranging from 0.5 to 4.0 feet; mean water column velocities ranging from 0.3 to 4.5 feet/second; and, substrates ranging from small gravels to cobbles are suitable for chinook salmon spawning in these habitats. Suitability criteria were also developed for coho (O. kisutch) and pink (O. gorbuscha) salmon spawning in tributaries of the middle Susitna River based on literature information as modified using the professional judgements of project biologists familiar with Susitna River coho and pink salmon stocks. These criteria show that depths ranging from 0.3 to 4.0 feet; mean water

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21i Cont. column velocities ranging from 0.1 to 4.0 feet/second; and, substrates ranging from sand intermixed with small gravels to large rubbles are suitable for pink salmon spawning in these habitats. The criteria developed for coho salmon spawning in these habitats show the range of depths from 0.3 to 4.0 feet; mean water column velocities from 0.1 to 4.0 feet/second; and, substrates from sand intermixed with small gravel to large rubbles are suitable for spawning in tributaries of the middle Susitna River. Suggested applications and limitations of these suitability criteria are discussed.

21j Sandone, G., and C.C. Estes. 1984. Evaluations of the effectiveness of applying infrared imagery techniques to detect upwelling ground water. Chapter 10 in: C.C. Estes, and D.S. Vincent-Lang, editors. Aquatic habitat and instream flow investigations, May-October 1983. Susitna Hydro Aquatic Studies. Report No. 3. Alaska Department of Fish and Game, Anchorage, Alaska. APA Document #1939.

Studies by the Alaska Department of Fish and Game Susitna Hydroelectric Aquatic Studies Team suggest that upwelling ground water is one of the principal variables influencing the suitability of habitat for chum (Oncorhynchus keta) salmon spawning in the middle reach of the Susitna River (ADF&G 1983). Three infrared heat sensing devices (Hughes Probeye, Xedar Pyroscan, and AGA Thermovision) were tested to evaluate the feasibility of using infrared thermal imagery as a remote sensing technique for detecting and quantifying the amount of upwelling ground water in slough habitats of the Susitna River. Results of these investigations indicate that the application of infrared heat sensing devices for locating upwelling is contingent on a host of environmental conditions and the level of detail desired. Areas of upwelling ground water and their relative magnitude were identified using these techniques; however, some areas known to have upwelling based on ground truthing surveys were not detected. This inconsistency is due to the wide variety of environmental conditions that occur within the Susitna River combined with the physical limitations of the technology. For these reasons, it is doubtful whether this technique can be applied on a large scale for the detection and quantification of upwelling areas.

22 Schmidt, D.C., C.C. Estes, D.L. Crawford, and D.S. Vincent-Lang, editors. 1984. Access and transmission corridor aquatic investigations (May-October 1983). Susitna Hydro Aquatic Studies. Report No. 4 Alaska Department of Fish and Game, Anchorage, Alaska. APA Document #2049.

This report consists of two parts. Part 1 provides information collected during the open water field season on the aquatic habitat and fish resources within the proposed access and transmission corridors for the Susitna Hydroelectric Project. Part 2 analyzes the potential effect of an expended sport fishery on Arctic grayling (Thymallus arcticus) in tributaries of the upper Susitna basin.

RTS No.

22 Cont. Sautner, J.S., and M.E. Stratton. 1984. Access and transmission corridor studies. Part I in: D.C. Schmidt, C.C. Estes, D.L. Crawford, and D.S. Vincent-Lang, editors. Access and transmission corridor aquatic investigations (July-October 1983). Susitna Hydro Aquatic Studies, Anchorage, Alaska.

Construction of the proposed access and transmission corridors (ATC) associated with the development of the Susitna Hydroelectric Project may affect the aquatic habitat and fish resources along these routes. Studies were conducted by the Alaska Department of Fish and Game during a portion of the 1983 open water field season to provide information on the aquatic habitat and fish resources within the proposed corridors to enable project participants to assess potential impacts on these resources from construction activities. Forty-two proposed stream crossing sites and ten lake habitats were sampled within the ATC study area. Three study reaches of Deadman Creek, which closely parallels the ATC, were also sampled. A total of 13 fish species were found to inhabit the streams and lakes within the ATC study area. Arctic grayling (Thymallus arcticus), Dolly Varden (Salvelinus malma), and lake trout (Salvelinus namaycush) were the major sport fish species identified within these habitats. General water quality (dissolved oxygen, pH, conductivity, and water temperature), discharge, and substrate data were collected at stream crossing study sites. Selected physical and chemical data were collected in Deadman Lake. Population estimates were generated for Arctic grayling within the three study reaches of Deadman Creek. Among the impacts which could result from development of the ATC, the increase in sport fishing pressure, due to the increased access to the area, may have the greatest effect on various sport fish species within the study area. The increase in sport fishing pressure may result in reduced number and sizes of fish species such as Arctic grayling, Dolly Varden, and lake trout. Other impacts which may occur at proposed stream crossing sites include alterations of stream hydraulics, deterioration of water quality, and removal or shifting of substrates.

Schmidt, D.C., and M.E. Stratton. 1984. Population dynamics of Arctic grayling in the upper Susitna Basin. Part 2 in: D.C. Schmidt, C.C. Estes, D.L. Crawford, and D.S. Vincent-Lang, editors. Access and transmission corridor aquatic investigations (July-October 1983). Susitna Hydro Aquatic Studies, Anchorage, Alaska.

The effects of an anticipated sport fishery for Arctic grayling (Thymallus arcticus) on the tributary streams of the upper Susitna basin are examined by modelling the effects of hypothetical harvest. The increased levels of mortality created by a sport fishery cause a rapid shift in the age structure and consequently the size of the fish caught. To

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22 Cont. maintain a "trophy" fishery on a sustained yield basis, a catch and release fishery appears to be warranted. Under the assumptions of the model, the total number of all fish caught is not substantially reduced with comparatively high levels of fishing. Possible explanations of the differences in population structures of the Deadman Creek drainage and the impoundment tributaries are discussed.

23 Alaska Department of Fish and Game (ADF&G). 1985. Adult Anadromous Studies Procedures Manual (June 1984 - June 1985). Draft. Susitna Hydro Aquatic Studies Program. Alaska Department of Fish and Game, Anchorage, Alaska (Unpublished report). APA Document #*?*.

Technical procedures and data procedures used by Adult Anadromous Studies personnel during the period June 1984 - June 1985 of the Susitna Hydro Aquatic Studies Program are detailed.

An Adult Anadromous Studies procedures manual was not actually produced. Instead objectives and procedures for the period June 1984 - June 1985 were extracted from Barrett, et al, 1985, ADF&G Susitna Hydro Aquatic Studies Report No. 6; APA Document #2748, RTS #29.

24 Alaska Department of Fish and Game (ADF&G). 1985. Resident and Juvenile Anadromous Studies Procedures Manual (May 1984 - April 1985). Draft. Susitna Hydro Aquatic Studies Program. Alaska Department of Fish and Game, Anchorage, Alaska (Unpublished report). APA Document #3014.

Technical procedures and data procedures used by the Resident and Juvenile Anadromous Studies personnel during the period May 1984 - April 1985 of the Susitna Hydro Aquatic Studies Program are detailed here.

24a Alaska Department of Fish and Game (ADF&G). 1985. Aquatic Habitat and Instream Flow Studies Procedures Manual (May 1984 - April 1985). Draft. Susitna Hydro Aquatic Studies Program. Alaska Department of Fish and Game, Anchorage, Alaska (Unpublished report). APA Document #*?*.

Technical procedures and data procedures used by the Aquatic Habitat and Instream Flow Studies personnel during the period May 1984 - April 1985 of the Susitna Hydro Aquatic Studies Program are detailed here.

25 Keklak, T., and T. Quane. 1985. Continuous water temperature investigations. Susitna Aquatic Studies Program. Task 32 Support Technical Report. Alaska Department of Fish and Game, Anchorage, Alaska. APA Document # ?.

Surface water temperatures were collected at 15 mainstem and 8 tributary sites on the Susitna River during the 1984 open water season. Continuous recordings were made with either Peabody-Ryan

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25 Cont. model J-90 temperature recorders, or Omnidata two channel datapod recorders. Data is presented in tables and plots. The data will be used by the Arctic Environmental and Information Data Center (AEIDC) in a temperature modelling study.

26 Estes, C.C., J. Sautner, and D.S. Vincent-Lang, editors. 1985. Winter aquatic investigations, September 1983-May 1984 (2 volumes). Susitna Aquatic Studies Program. Report No. 5. Alaska Department of Fish and Game, Anchorage, Alaska. APA Document #2658 and 2659.

Report No. 5 provides results of the 1983-84 winter studies conducted by the Alaska Department of Fish and Game to evaluate and compare existing chum (Oncorhynchus keta) salmon incubation conditions in selected slough, side channel, tributary, and mainstem habitats of the Susitna River between Talkeetna and Devil Canyon (RM 98-152). The types of data presented include development and survival data for chum salmon embryos, surface and intragravel water quality data (pH, conductivity, temperature, and dissolved oxygen), and substrate composition data. The report is bound in two volumes. Volume 1 presents an evaluation of the incubation life phase of chum salmon in the middle Susitna River. Volume 2 presents an independent evaluation of the surface and intragravel water temperature conditions at incubation study sites as well as other monitoring sites.

26a Vining, L.J., J.S. Blakely, and G.M. Freeman. 1985. An evaluation of the incubation life-phase of chum salmon in the middle Susitna River. Volume 1 in: C.C. Estes, J. Sautner, D.S. Vincent-Lang, editors. Winter aquatic investigations (September 1983-May 1984). Susitna Aquatic Studies Program. Report No. 5. Alaska Department of Fish and Game, Anchorage, Alaska. APA Document #2658.

An evaluation of the pattern of survival and development and chum (Oncorhynchus keta) salmon embryos incubated in artificial redds in slough, side channel, tributary, and mainstem habitats of the middle Susitna River was conducted in conjunction with an assessment of the currently available chum salmon incubation habitat conditions within these habitat types. Chum salmon eggs obtained from local stocks were artificially fertilized, placed within modified Whitlock-Vibert Boxes (WVB's) and then implanted in artificial redds in the streambed at selected study sites. At each of these sites, a polyvinyl chloride standpipe was also installed to obtain instantaneous intragravel water quality measurements of temperature, dissolved oxygen, pH, and conductivity which were later correlated to the percent survival of embryos (100 percent hatched) at each site. In addition, representative substrate samples were obtained at selected study sites using a modified McNeil substrate sampler to characterize the substrate conditions present at incubation study sites.

The survival rates of embryos in slough, side channel and tributary habitats were 17, 9, and 11 percent, respectively. Survival of

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26a Cont.

embryos in mainstem habitat was 19 percent but did not reflect the effects of dewatering and freezing due to a difference in the method of site location. Thus, estimates of percent survival for this habitat type are probably higher than would be expected for natural conditions.

The largest demonstrated cause of embryo mortality at study sites was due to dewatering and subsequent freezing of the streambed. Greater than 47 percent of the total number of WVB's used to estimate survival became frozen. This effect was greatest in side channels and least in sloughs, and was observed to be directly related to the presence and quantity of upwelling water. Areas particularly vulnerable to the effects of dewatering and freezing include large portions of side channel habitats as well as the mouth areas of slough and tributary habitats which may lack sources of upwelling water.

A quantitative analysis of the effect of each variable on survival was hampered by the high embryo mortality due to dewatering and subsequent freezing of substrate. When frozen embryos were removed from the survival data base, no significant correlations were obtained between measured water quality variables and percent survival of embryos (p 0.5). However, the correlation between dissolved oxygen (mg/l) and percent survival of embryos decreased to zero at dissolved oxygen concentrations below 3.0 mg/l. The percent survival of embryos was also correlated to the percent of fine substrate particles (0.08 in. diameter) contained within WVB's. Although there was no significant correlation, the percent survival of embryos decreased to zero when the percent of fines exceeded 18 percent.

The rate of embryonic development at study sites was found to be strongly influenced by the degree of upwelling present. Chum salmon embryos which were fertilized on August 26, 1983, and incubated in an upwelling area in a side channel, reached the 100 percent hatch in late December, whereas those incubated in a non-upwelling area in the mainstem Susitna River experienced delayed development and did not reach 100 percent hatch until mid-April. Therefore, the presence of upwelling water in middle Susitna River habitats appears to be a key component which maintains the integrity of chum salmon incubation habitats by preventing substrate from dewatering and freezing and by maintaining suitable incubation temperatures which allow embryos to develop properly.

A comparison of the rates of in situ embryo development observed in this study to those observed in the laboratory study of Wangaard and Burger (1983) was hampered by problems encountered with temperature recorders installed at each site. Incomplete temperatures records were obtained at study sites used to compare thermal unit requirements for development. However, based on a quantitative assessment of development data collected in these study sites and a previous ADF&G study (ADF&G 1983), it is the opinion of the authors

RTS No.

26a Cont. that the predictive equation of Wangaard and Burger are an adequate model to use in predicting rates of chum salmon development of the middle Susitna River.

26b Keklak, T., and T. Quane. 1985. Appendix F: Winter temperature data. Volume 2 in: C.C. Estes, J. Sautner, D.S. Vincent-Lang, editors. Winter aquatic investigations (September 1983-May 1984). Susitna Aquatic Studies Program. Report No. 5. Alaska Department of Fish and Game, Anchorage, Alaska. APA Document #2659.

Surface and/or intragravel water temperature was monitored on a continuous basis at 20 selected sites along the Susitna River between Talkeetna and Devil Canyon during the 1983-84 winter field season.

Sites were located at: LRX 9, LRX 29, LRX 57, slough 8A, 9, 10, 11, and 21, side channel 10, 11, and 21, Fourth of July Creek, Deadhorse Creek, Indian River, and mainstem Susitna at RM 136.1.

Similar surface water temperature patterns were exhibited at all mainstem locations except LRX 9, site 3 where beginning in April, temperatures were warmer and more variable than those at LRX 29 and 57. This was probably due to ground water upwelling.

Surface water temperatures generally decreased to approximately 0°C by October and remained near 0°C through May when they began to increase. Intragravel water temperatures at mainstem sites remained stable through the winter until mid-May.

Temperatures were recorded at one mainstem site in support of the chum salmon (Oncorhynchus keta) incubation study. Intragravel temperatures averaged near 0°C until mid-April when they began to increase. Ground water upwelling was not evident. Surface temperatures during the period March 2-May 3 ranged from -0.1°C to 2.0°C. Temperatures recorded within side channel sites were often dissimilar, reflecting the influences of various ground water sources.

Surface water temperatures generally followed similar trends at all slough sites except lower slough 8A. At that site, temperatures were similar to those recorded in the mainstem. surface water temperatures at other sites were generally warmer, ranging from approximately 1°C to 2°C. Intragravel temperature trends varied, reflecting different ground water sources.

Surface and intragravel temperatures measured at Fourth of July Creek and Indian River followed a trend similar to the mainstem. Temperatures were recorded at Deadhorse Creek in support of the mitigation evaluation study. They remained near 0°C through March and then began to increase and daily fluctuations of up to 3.5°C were observed.

RTS No.

27 Quane, T., P. Morrow, and I. Queral. 1985. Hydrological investigations at selected lower Susitna River study sites. Susitna Aquatic Studies Program. Task 36 Support Technical Report. Alaska Department of Fish and Game, Anchorage, Alaska. APA Document #2704.

This technical memorandum provides hydraulic data for May-October 1984 to be used in the Task 36 Lower River Instream Flow Incremental Methodology (IFIM) rearing habitat modelling study. The relationship of mainstem Susitna River discharge to side channel and slough stage, stream flow, breaching and backwater conditions was monitored. The data will be used to model changes in salmon rearing habitat as a function of mainstem discharge.

28 Quane, T., P. Morrow, and I. Queral. 1985. Hydrological investigations at selected lower Susitna River study sites. Susitna Aquatic Studies Program. Task 14 Support Technical Report. Alaska Department of Fish and Game, Anchorage, Alaska. APA Document #2736.

This report provides hydraulic data to support the Task 14 Lower River Resident and Juvenile Habitat modelling study. In May-October 1984, 19 side channel and slough sites were evaluated for the relationship of mainstem discharge to stream flow, stage, and backwater. Rating curves were developed for six side channel sites. Thalweg and cross section profiles were surveyed to describe channel geometry at all sites. Mainstem discharge at USGS Sunshine Station ranged from 6,000-104,000 cfs. Initial and controlling breaching discharges were estimated for the study sites.

29 Barrett, B.M., F.M. Thompson, and S.N. Wick, editors. 1985. Adult salmon investigations: May-October 1984. Susitna Aquatic Studies Program. Report No. 6. Alaska Department of Fish and Game, Anchorage, Alaska. APA Document #2748.

This report presents escapement estimates for the Susitna River for chum (Oncorhynchus keta), chinook (O. tshawytscha), sockeye (O. nerka), pink (O. gorbuscha), and coho (O. kisutch) salmon. Fishwheels were operated at four locations between the confluence of the Chulitna River (RM 0.0) and Devil Canyon (RM 161.0). Fish were tagged with Petersen discs or Floy FT-4 spaghetti tags to monitor migration upstream. Samples from each location monitored age, sex, fork length, and length of fish. A fishwheel and side scan sonar were also operated at one location on the Yentna River. An escapement of 5.4 million salmon into the Susitna was estimated using the Petersen index.

Spawning surveys were performed by visual identification of spawning pairs, redds, or incubating eggs. Spawning sites were mapped and described by channel morphology, substrate, and ground water. Escapement and spawning results and described by location and species.

RTS No.

30a,b Schmidt, D.C., S.S. Hale, and D.L. Crawford, editors. 1985. Resident and juvenile anadromous fish investigations (May-October 1984). Susitna Aquatic Studies Program. Report No. 7 (2 Volumes: Parts 1-2 and Part 3). Alaska Department of Fish and Game, Anchorage, Alaska. APA Document #2836 and 2837.

This report covers studies of juvenile salmon and resident species of the Susitna River during the period May through October 1984. In addition, some information is included on overwintering of resident fish radio-tagged in 1983. The majority of the effort during the 1984 open water season was on the lower river (from the mouth to the Chulitna River confluence). No studies were conducted above Devil Canyon.

30a Roth, K.J., and M.E. Stratton. 1985. The migration and growth of juvenile salmon in the Susitna River. Part 1 in: D.C. Schmidt, S.S. Hale, and D.L. Crawford, editors. Resident and juvenile anadromous fish investigations (May-October 1984). Susitna Aquatic Studies Program. Report No. 7 (Volume 1). Alaska Department of Fish and Game, Anchorage, Alaska. APA Document #2836.

Studies of salmon spawning, embryo incubation, and juvenile rearing are all critical in understanding the current life history and habitat dynamics of salmon in the Susitna River. However, the final measure of the value of a reach of river to the freshwater life stages of salmon is the number and condition of the fry which outmigrate from the reach to the ocean. Baseline data on salmon outmigration have been collected at Talkeetna Station (RM 103.0) for the past three years. The data from 1982 and 1983 have shown that a substantial number of chinook (Oncorhynchus tshawytscha), coho (O. kisutch), and sockeye (O. nerka) fry outmigrate from the middle river during their first summer. Because the majority of returning adults have spent at least one winter rearing in freshwater, an important question was whether these age 0+ fish overwintered in the lower river or had a low survival rate. To help answer this question, outmigrant traps were also operated near the mouth of the Susitna River (RM 22.4) during 1984. Mark and recapture studies gave population estimates for chum and sockeye fry (marked by coded wire tags) in the Susitna River above Talkeetna Station (middle river) and for chinook fry (marked by cold branding) in Indian River and other rearing sites. The cold branding study also monitored outmigration timing from Indian River and obtained estimates of juvenile chinook residence time in mainstem rearing areas. The Talkeetna River and Deshka River were intermittently sampled to help explain the mainstem outmigrant trap data. A portion of the age 0+ chinook fry apparently outmigrate from the middle river upon reaching a critical size but a large number remain to overwinter and then outmigrate during their second summer. Coho fry outmigrate at a wider range of lengths than chinook fry so the cumulative biomass of coho fry lags behind the cumulative numbers of individuals by one or two weeks. Age 0+

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30a Cont. chinook and coho fry grow about 30 mm in length during the open water season. Juvenile sockeye salmon appear to seek out lake-like rearing areas at a size of about 50 mm. The limited amount of this habitat type in the middle river is the major influence on their redistribution to the lower river. The estimated 1984 middle river population size was about 300,000 for age 0+ sockeye and 2,040,000 for chum fry. Chum fry rearing in the middle river demonstrated by their growth and by analysis of stomach contents.

30a Hale, S.S. 1985. Time series analysis of discharge, turbidity, and juvenile salmon outmigrationing the Susitna River, Alaska. Appendix C of Part 1 in: D.C. Schmidt, S.S. Hale, and D.L. Crawford, editors. Resident and juvenile anadromous fish investigations (May-October 1984). Susitna Aquatic Studies Program. Report No. 7 (Volume 1). Alaska Department of Fish and Game, Anchorage, Alaska. APA Document #2836.

30a Suchanek, P.M., K.J. Kuntz, and J.P. McDonnell. 1985. The relative abundance, distribution, and instream flow relationships of juvenile salmon in the lower Susitna River. Part 2 in: D.C. Schmidt, S.S. Hale, and D.L. Crawford, editors. Resident and juvenile anadromous fish investigations (May-October 1984). Susitna Aquatic Studies Program. Report No. 7 (Volume 1). Alaska Department of Fish and Game, Anchorage, Alaska. APA Document #2836.

Juvenile salmon abundance and distribution were studied in the lower Susitna River (below the Chulitna River confluence) and juvenile salmon rearing habitat was modelled at 20 sites within the reach. Chinook (Oncorhynchus tshawytscha), chum (O. keta), and sockeye (O. nerka) salmon juveniles made use of side channels; however, high turbidity limited use of side channels located in the Chulitna River plume. Coho salmon juveniles were found primarily in tributary mouths; sockeye, chinook and chum salmon also were present in these areas. Sloughs, which were limited in occurrence, were not used heavily by any of the salmon species.

Both tributary mouths and side channel/slough sites were modelled using one of two habitat models. At tributary mouths, an increase in weighted usable area with a rise in mainstem discharge resulted from the formation of backwater areas which led to lower velocities and an expansion of the area and amount of cover inundated. At side channels, chinook weighted usable area increased after overtopping due to a gain in cover suitability (turbidity), velocity, and area. The weighted usable area response to a rise in mainstem discharge for sockeye and chum salmon juveniles at side channels was also usually positive. Habitat indices at side channels for chinook, chum, and sockeye juveniles at mainstem discharges and side channel flows above the overtopping discharge declined as velocities became unsuitably high. Weighted usable area for

RTS No.

30a Cont. these species did not always decline at high discharges, however, because of the compensating effect of a larger surface area.

30a Anderson, J., J. Bigler, and A.G. Hoffmann. 1985. Hydraulic models for use in assessing the rearing habitat of juvenile salmon in six side channels of the lower Susitna River. Appendix D of Part 2 in: D.C. Schmidt, S.S. Hale, and D.L. Crawford, editors. Resident and juvenile anadromous fish investigations (May-October 1984). Susitna Aquatic Studies Program. Report No. 7 (Volume 1). Alaska Department of Fish and Game, Anchorage, Alaska. APA Document #2836.

Six side channels (Island, Mainstem West Bank, Circular, Sauna, Sunset, and Trapper Creek) in the lower reach of the Susitna River were evaluated using an Instream Flow Incremental Methodology (IFIM) physical habitat simulation (PHABSIM) modelling approach to describe the effects that site flow and mainstem discharge have on rearing juvenile salmon habitat. These sites were thought to contain potential habitat for rearing juvenile salmon and were chosen to range greatly in size, shape, and overtopping discharge.

Six hydraulic simulation models (either IFG-2 or IFG-4) were calibrated to simulate depths and velocities associated with a range of site-specific flows at the six modelling study sites. Comparisons between corresponding sites of simulated and measured depths and velocities indicated that the models provide reliable estimates of depths and velocities within their recommended calibration ranges.

The recommended of ranges of mainstem Susitna River discharge over which these models can hydraulically simulate the habitat of rearing juvenile salmon are: Island Side Channel from 35,000 to 70,000cfs mainstem discharge; Mainstem West Bank Side Channel from 18,000 to 48,000 cfs; Circular Side Channel from 36,000 to 63,000 cfs; Sauna Side Channel from 44,000 to 63,000 cfs; Sunset Side Channel from 32,000 to 67,000 cfs; and Trapper Creek Side Channel from 20,000 to 66,000 cfs.

30b Sundet, R.L., and S.D. Pechek. 1985. Resident fish distribution and life history in the Susitna River below Devil Canyon. Part 3 in: D.C. Schmidt, S.S. Hale, and D.L. Crawford, editors. Resident and juvenile anadromous fish investigations (May-October 1984). Susitna Aquatic Studies Program. Report No. 7 (Volume 2). Alaska Department of Fish and Game, Anchorage, Alaska. APA Document #2837.

Studies of resident fish were conducted in both the lower (below Chulitna River confluence) and middle (Chulitna River confluence to Devil Canyon) Susitna River in 1984. The primary objectives in the middle river were to determine the seasonal distribution, timing of spawning, and spawning areas of rainbow

RTS No.

30b Cont. trout (Salmo gairdneri), and to monitor 13 index sites as part of the long term monitoring effort. Most of the rainbow trout data was collected by use of radio telemetry. Results showed that rainbow trout are relatively few in numbers and that spawning occurs at selected areas which are influenced by lakes. Much of the rainbow trout population in the middle river probably originates in lakes which drain into middle river tributaries. Rainbow trout were abundant in lakes located at the headwaters of Fourth of July Creek and in the upper reaches of Portage Creek. Rainbow trout were also found to use Portage Creek more extensively than previously thought. Spawning occurred during the first week of June. All rainbow trout moved out of tributaries by early October (probably triggered by low fall discharges), and most overwintered in the mainstem Susitna River slightly downstream (0.1-4.0 miles) of the tributary where they were captured. Other middle river studies suggest Arctic grayling (Thymallus arcticus) overwinter in the mainstem Susitna then ascend and spawn in tributaries in late May. Arctic grayling also outmigrated from tributaries at the same time as rainbow trout. Catch data at middle river index sites in 1984 were similar to 1982 and 1983 findings. Studies in the lower river reinforced the belief that some humpback whitefish (Coregonus pidschian) are anadromous, and that rainbow trout and Arctic grayling outmigrate from most east side tributaries in September. Lower river studies also found that burbot (Lota lota) move into the Deshka River in mid-September.

31 Hansen, T.F., and J.C. Richards. 1985. Availability of invertebrate food sources for rearing juvenile chinook salmon in turbid Susitna River habitats. Susitna Aquatic Studies Program. Report No. 8. Alaska Department of Fish and Game, Anchorage, Alaska. APA Document #2846.

Benthic and drifting invertebrates were sampled from May through October 1984 to evaluate available fish food resources and the gain and loss of benthic invertebrate habitat resulting from changes in flow. Four side channel and side slough sites were sampled at head and mid-section locations using drift nets and modified Hess type samplers. Juvenile chinook (Oncorhynchus tshawytscha) salmon were also sampled using electrofishing techniques to correlate the available food sources being utilized.

A total of 52 invertebrate taxa were identified in drift and benthic samples, with Chironomidae being the dominant taxa. The proportions of numbers of invertebrates found in the stomachs of juvenile chinook salmon were closely correlated with the proportions of invertebrates available in the drift. Drift samples collected under breached conditions indicated that invertebrates were being transported from the mainstem into the side channels and side sloughs. The quantity of

RTS No.

31 Cont. drifting invertebrates in side channels and side sloughs under unbreached conditions was negligible compared to the drift under breached conditions when total drift was considered.

Habitat suitability criteria were developed and weighted usable area was estimated for invertebrates which were common to drift, benthos, and the diet of juvenile chinook salmon by behavioral type (i.e., burrower, swimmer, clinger, and sprawler). The densities of each of the behavioral types generally correlated with water velocity and substrate type. Depth of water did not appear to be an important factor influencing and density of organisms. Water velocities less than 0.4 feet/second and substrates comprised of silts and sands generally supported the highest mean densities of burrowers which were made up primarily of Chironomidae. Rubble substrates with components of large gravel or cobble and water velocities between 1.6 feet/second and 2.6 feet/second generally supported the highest mean densities of swimmers and clingers. Sprawlers did not appear to preferentially utilize any particular substrate or water velocity.

Projected weighted usable area for each of the behavioral types was clearly a function of mainstem discharge. The minimum controlling mainstem discharge for each of the study sites generally produced the greatest amount of burrower habitat weighted usable area. The maximum amount of weighted usable area for swimmer, clinger, and sprawler habitat at all study sites was reached at a mainstem discharge above 25,000 cfs.

In conclusion, naturally fluctuating mainstem flows which occasionally inundated sampling sites appeared to maintain a diverse benthic fauna and appeared to provide drifting food organisms within sampling sites, thereby contributing to the overall rearing potential of these sites for juvenile chinook salmon.

32 Hoffmann, A.G. 1985. Summary of salmon fishery data for selected middle Susitna River sites (1981-84). Susitna Aquatic Studies Program. Report No. 9. Alaska Department of Fish and Game, Anchorage, Alaska. APA Document #2749.

The fishery data collected by the Alaska Department of Fish and Game on the Susitna River is a necessary component for use in evaluating effects of variations in natural flow regimes on the life history cycles of the various species present. These data, used in conjunction with the hydraulic data now available for the river, provide the basis for recommending various flow regimes, mitigation options, etc. for the proposed hydroelectric development with respect to the fishery. This report indexes the fishery data collected by a variety of ADF&G studies under one cover in order to better facilitate this process.

RTS No.

33 Blakely, J.S., J.S. Sautner, L.A. Rundquist, and N.E. Bradley. 1985. Salmon passage validation studies (August-October 1984). Susitna Aquatic Studies Program. Addendum to Report No. 3, Chapter 6. Alaska Department of Fish and Game, Anchorage, Alaska. APA Document #2854.

An interim evaluation of the effects that mainstem discharge and local flow have on passage conditions for adult salmon at selected slough and side channel habitats of the middle reach of the Susitna River was previously presented in Sautner et al. (1984). Due to the limited data available for this interim evaluation, the Passage Validation Studies (PVS) were initiated during the 1984 open water field season to collect additional physical and biological data to re-evaluate the passage criteria and the local flow and mainstem discharge values required for successful and unsuccessful salmon passage within these habitats. In addition, the methodologies used for the backwater and local flow analyses were revised to reflect the additional data which were collected. Physical data collected included channel cross section and thalweg profiles, substrate assessments, and local flow measurements. Biological data consisted of salmon passage criteria based on visual observations of adult chum salmon (Oncorhynchus keta) movement in selected slough and side channel habitats.

The salmon passage criteria previously presented in Sautner et al. (1984) were re-evaluated and revised based on these data using a modified analytical approach. The revised analysis resulted in the development of a single set of salmon passage criteria thresholds for defining successful and unsuccessful passage conditions at study sites. A total of 85 passage reaches were identified at slough and side channel sites during the 1984 PVS compared to 74 passage reaches identified in Sautner et al. (1984). Using the revised criteria thresholds as guidelines, a re-evaluation of the breaching, backwater, and local flow analyses for these passage reaches indicates that mainstem discharge and local flow requirements for successful and unsuccessful passage are similar to values previously established. The most significant differences occurred in the backwater analysis for some sites, where required mainstem discharges decreased over 1,000 cfs. Water depth was determined to be the primary physical variable affecting passage conditions at passage reaches; passage conditions were not greatly affected by changes in passage reach length. Variations in channel configuration and substrate size were assumed to have a negligible influence on the salmon passage criteria. The revised passage criteria thresholds are based on an upper thalweg depth of 0.5 feet thereby voiding all previous analyses that utilized 0.67 feet as the upper limit of thalweg depth.

34 Keklak, Theresa, and Tommy Withrow. 1985. Tasks 29 and 37 support technical report: continuous water temperature investigations. Alaska Department of Fish and Game, Susitna Aquatic Studies, Anchorage, Alaska. APA Document #2867.

RTS No.

34 Cont. Surface and intragravel water temperatures were recorded on a continuous basis at 18 selected tributary, slough, side channel, and mainstem locations in support of Tasks 29 and 37. This technical report presents a summary of the data collection methods and the findings of these temperature investigations from October 1984 through April 1985. The 18 temperature sites were selected by task 29 and 37 personnel to meet specific task objectives.

The tributary data collection included sites at Lane Creek, Fourth of July Creek, and Indian River. The slough sites include Bushrod Slough (RM 139.0), Curry Slough (RM 119.7), and Slough 10 (RM 115.0). Side channel sites included Mainstem 2 (RM 115.0), Upper Side Channel 11 (RM 136.0), and Upper Side Channel 21 (RM 141.6). The mainstem sites were located at river miles 117.9, 118.9, 127.1, 129.8, 131.3, 132.9, 137.5, and 139.0.

Refer to the Task 28 and 37 summary reports for the criteria used to select these study sites. No conclusions were drawn in this report. The data is summarized in the narrative, tables, and graphs.

35 Seagren, D.R., and R.G. Wilkey. 1985. Preliminary evaluations of potential fish mitigation sites in the middle Susitna River. Susitna Aquatic Studies Program. Report No. 10. Alaska Department of Fish and Game, Anchorage, Alaska. APA Document 2908.

This report is one of a series of reports prepared for the Alaska Power Authority (APA) by the Alaska Department of Fish and Game (ADF&G) to provide information to be used in evaluating the feasibility of the proposed Susitna Hydroelectric Project. The ADF&G Susitna River Aquatic Studies Program was initiated in November 1980.

The studies described in this report were conducted in support of mitigation planning being done by ENTRIX, Inc., the primary mitigation contractor. This report includes studies conducted from July 1984 through April 1985 in the middle reach of the Susitna River from Talkeetna (RM 98.0) to the mouth of Devil Canyon (RM 150.0). The study examined general habitat characteristics during the open-water season and site specific incubation conditions during the ice-covered season.

The open-water study examined general habitat characteristics (surface water quality, substrate, upwelling, passage, temperature, salmon spawning, etc.) of 44 slough and side channel sites in order to evaluate their potential to mitigate for adverse effects to salmon spawning and incubation habitats as a result of the proposed hydroelectric project. The ice-covered study examined incubation conditions (surface and intragravel water quality and temperature, and substrate composition) in these sites to further determine their suitability as potential mitigation sites. Each site studies exhibited general conditions (passage, substrate, etc.) that were similar to those found in other sites that proved to be limiting to salmon spawning.

RTS No.

35 Cont. The combined data from these open-water and ice-covered studies will be used by ENTRIX, Inc. to help determine the suitability of habitat types (side slough, upland slough, side channel) and habitat modification methods for mitigation of adverse impacts to salmon spawning and incubation environments as a result of the proposed hydroelectric development.

36 Seagren, D.R., and R.G. Wilkey. 1985b. Summary of water temperature and substrate data from selected salmon spawning and groundwater upwelling sites in the middle Susitna River. Susitna Aquatic Studies Program. Technical Data Report No. 12. Alaska Department of Fish and Game, Anchorage, Alaska. APA Document #2913.

This report is one of a series of reports prepared for the Alaska Power Authority (APA) by the Alaska Department of Fish and Game (ADF&G) to provide information to be used in evaluating the feasibility of the proposed Susitna Hydroelectric Project. The ADF&G Susitna River Aquatic Studies Program was initiated in November 1980.

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The combined data from these open-water and ice-covered studies will be used by ENTRIX, Inc. to assist in determining the suitability of side channel and mainstem sites as replacement salmon spawning habitats to mitigate for adverse impacts to present salmon spawning and incubation habitats as a result of the proposed hydroelectric development.

37 Bigler, Jeff, and Kim Levesque. 1985. Lower Susitna River preliminary Chum Salmon spawning habitat assessment. Draft technical memorandum. Alaska Department of Fish and Game, Susitna Hydro Aquatic Studies, Anchorage, Alaska. APA Document #*?*.3504

This draft technical memorandum describes methods and presents habitat and biological data collected at six side channels of the lower Susitna River (from the Talkeetna River to the Kashwitna River) during the 1984 open water field season. IFG modeling techniques were used to evaluate rearing habitat for juvenile salmon. It is noted that unexpectedly high numbers of mainstem and side channel spawning chum salmon were found. A preliminary baseline evaluation of the newly discovered spawning habitat was conducted. "The objective of this preliminary assessment is to

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37 Cont. evaluate selected baseline habitat conditions and their relationship to mainstem discharge to determine if further studies are required to assess the impacts of with-project flows in these habitats."

The report concludes that "several of the physical variables evaluated may be critical to availability of spawning habitat and to the viability of incubating chum salmon embryos deposited in these habitats." The report states that the study sites with the higher mainstem discharges provided more WUA (weighted useable area) for chum salmon spawning than those with lower mainstem controlling discharges. Groundwater is noted to be a critical factor in embryo overwintering success. The amount of groundwater varied with mainstem stage. Upwelling is noted as important for embryo survival. "Water temperature did not seem to pose a threat to incubating embryos at any of the study sites as long as sufficient groundwater upwelling was present." The conclusion section notes that significant numbers of chum, chinook, coho, and sockeye salmon utilize mainstem and side channel habitats for overwintering.

37a Alaska Department of Fish and Game (ADF&G). 1985. FY 87 Plan of Study. Proposal with recommendations for Spring 1988. Alaska Department of Fish and Game. Anchorage, Alaska. APA Document #*?*.

Includes presentations made during a three day project review to a review team composed of ADF&G regional supervisors and biometricians. This is essentially the proposed FY 87 plan of study for the Susitna Aquatic Studies.

Presentations were made for the following projects: lower river salmon escapement; middle river salmon escapement (Susitna River adult salmon investigations); middle river outmigrant evaluation (Susitna River juvenile salmon outmigration monitoring); lower river spawning habitat evaluation (chum salmon spawning and passage habitat assessment in lower river mainstem and side channel habitats); middle river resident fish study; aquatic habitat monitoring (aquatic habitat and instream flow investigations); and long term monitoring strategies (for water quality and dissolved gas, sonar evaluation, resident fish populations, and adult and juvenile salmon).

37b Alaska Department of Fish and Game (ADF&G). 1985. An overview of the Susitna Aquatic Studies Program: Its history and future direction. Susitna Aquatic Studies staff. Division of Commercial Fisheries. Region II. Anchorage, Alaska. APA Document #3502.

Commissioner Collinsworth has requested that a briefing paper, which provides a concise overview of the Susitna Aquatic Studies Program, its history and future direction, be prepared to assist the Department in its review and policy development regarding the proposed Susitna hydroelectric development. In accordance with this request, the following discussion of the Susitna Aquatic Studies Program is presented. This discussion describes the recent history

RTS No.

37b Cont. of the project, its relationship to the Federal Energy Regulatory Commission (FERC) licensing process, its accomplishments, and the projected future direction of the program.

It must be emphasized, however, that this paper outlines only one aspect of the Department's overall association with the Susitna hydroelectric development evaluation. Integral to a more complete understanding of the Department's involvement and responsibility for a project with the magnitude and complexity of the Susitna Hydro Project are the significant roles played by the Division of Game which has been responsible for a major portion of the terrestrial studies program and the Habitat Division which has the regulatory review responsibility for the project. A listing of significant correspondence from which this document has been synthesized is included as Attachment 3.

38a Sundet, R.L. 1986. Winter resident fish distribution and habitat studies conducted in the Susitna River below Devil Canyon, 1984-85. Part 1 of: ADF&G. Winter studies of resident and juvenile anadromous fish (October 1984-May 1985). Susitna Aquatic Studies Program. Report No. 11 (Volume 1). Alaska Department of Fish and Game, Anchorage, Alaska. APA Document #3062.

This report is one of a series of reports prepared for the Alaska Power Authority (APA) by the Alaska Department of Fish and Game (ADF&G) to provide information to be used in evaluating the feasibility of the proposed Susitna Hydroelectric Project. The ADF&G Susitna River Aquatic Studies Program was initiated in November 1980.

38a Cont. This report covers winter studies (RSA Task 34) conducted from October 15, 1984 through May 15, 1985 on juvenile salmon and resident fish species of the Susitna River. In addition, some radio telemetry monitoring data is also included for resident fish that were radio tagged in September and early October 1984. This volume is divided into two parts.

Part 1 presents the results of winter resident fish studies in both the lower and middle river. Monitoring of selected resident fish movements through the use of radio tags was continued. Efforts were also made to describe the overwintering habitat associated with rainbow trout, burbot, and Arctic grayling, and to identify the timing and locations of burbot spawning in the lower river.

Part 2 discusses the juvenile chinook and coho salmon studies during the winter of 1984-85 in the middle river. Findings from this study using cold branding/mark-recapture techniques further define the distribution and relative abundance of overwintering juvenile salmon and generate site specific population estimates and an estimate of the number of juvenile chinook which overwinter in the middle reach.

38b Stratton, M.E. 1986. Summary of juvenile chinook and coho salmon winter studies in the middle Susitna River, 1984-85. Part 2 of: ADF&G.

RTS No.

38b Cont. Winter studies of resident and juvenile anadromous fish (October 1984-May Cont. 1985). Susitna Aquatic Studies Program. Report No. 11 (Volume 2). Alaska Department of Fish and Game, Anchorage, Alaska. APA Document #3063.

This report is one of a series of reports prepared for the Alaska Power Authority (APA) by the Alaska Department of Fish and Game (ADF&G) to provide information to be used in evaluating the feasibility of the proposed Susitna Hydroelectric Project. The ADF&G Susitna River Aquatic Studies Program was initiated in November 1980.

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Part 2 discusses the winter studies of juvenile chinook and coho salmon that were conducted in the middle river. Findings from this study define the distribution and relative abundance of fish within specific overwintering sites, document limited movements of marked fish between overwintering sites, and present information on fish lengths over the course of the winter. This report also presents mark-recapture data which can be used to generate site specific population estimates of juvenile chinook salmon that overwinter in the middle reach of the Susitna River.

39 Thompson, F.M., S.N. Wick, and B.L. Stratton. 1986. Adult salmon investigations: May-October 1985. Susitna Hydro Aquatic Studies. Report No. 13. Alaska Department of Fish and Game, Anchorage, Alaska. APA Document #3412.

This report concludes five years of data collection on adult salmon in the Susitna River, Southcentral Alaska, by the Susitna Aquatic Studies Team of the Alaska Department of Fish and Game. These data were collected to provide baseline information in preparation for proposed hydroelectric development on the Susitna River at Watana and Devil Canyons. This year's report is similar to the previous years' reports in format and content. Population estimates, escapement timing, length, age and sex ratio, and spawning distribution information is reported for all five species of Pacific salmon utilizing the river. The fecundity of chinook and coho salmon and egg retention of sockeye and chum salmon is also reported to aid associated studies on juvenile salmon.

RTS No.

39 Cont. A different population estimate methodology was affected this season. In previous years a Petersen model for closed systems was utilized. This year, a stratified open model was used where the design allowed.

As might have been expected, the specific goals of the program have changed from year to year depending on the amount of funding available and the data needed to meet within year objectives. To meet 1985 objectives, Flathorn, Sunshine and Curry stations were operated by Susitna Aquatic Studies staff. Yentna Station, a Susitna Aquatic Studies camp from 1981 until 1984, was operated by the Alaska Department of Fish and Game, Commercial Fisheries Division, Soldotna staff in 1985. Readers interested in the data collected from Yentna Station should contact the Soldotna office of the Alaska Department of Fish and Game.

The primary objectives of the 1985 Adult Salmon Studies were:

1. Estimate the escapements of chinook (Oncorhynchus tshawytscha), sockeye (O. nerka), pink (O. gorbuscha), chum (O. keta), and coho (O. kisutch) salmon at Flathorn, Sunshine and Curry stations.

2. Evaluate the adult salmon migrational timing and travel rates between sampling stations.

3. Using fishwheel catches, monitor the age, length and sex composition of the adult salmon escapements at Flathorn, Sunshine, and Curry stations.

4. Determine the relative importance of middle-river [River Mile (RM) 98.6-161.0] main channel, slough and tributary habitats as salmon spawning areas.

Secondary objectives included:

1. Determine the fecundity of chinook and coho salmon at Sunshine Station. Fecundities of sockeye, pink and chum salmon were evaluated in previous years' studies.

2. Provide estimates of egg retention for sockeye and chum salmon which spawn in middle river slough habitats.

All objectives were met.

40 Roth, K.J., D.C. Gray, J.W. Anderson, A.C. Blaney and J.P. McDonnell. 1986. The migration and growth of juvenile salmon in the Susitna River, 1985. Susitna Aquatic Studies Program. Report No. 14. Alaska Department of Fish and Game, Anchorage, Alaska. APA Document #3413.

RTS No.

40 Cont. This report presents the results of the juvenile salmon outmigration studies conducted on the Susitna River between Cook Inlet and Devil Canyon during the 1985 open-water season. Five Pacific salmon species were studied: chinook (*Oncorhynchus tshawytscha*), coho (*O. kisutch*), sockeye (*O. nerka*), chum (*O. keta*), and pink (*O. gorbuscha*).

The methods, results, and a discussion of the use of a stationary inclined plane outmigrant trap to define juvenile salmon size, migration timing, and their response to changing habitat conditions in the Susitna River from Cook Inlet to Devil Canyon is presented. Use of stationary traps, mobile traps, coded wire tagging, and cold branding is reported. Appendices A-E, respectively, report discharge, temperature, and turbidity; cold brand symbols, etc.; a cold branding experiment; juvenile salmon catch data; and juvenile salmon length and weight data.

Data pertaining to catch per unit effort, size, mark-and-recapture, and population estimates are reported for chinook, coho, sockeye, chum, and pink salmon by age class. A "Results and Discussion" section is presented for each species. No separate conclusion section is presented.

41 Cannon, R. 1986. Susitna River Aquatic Studies Review: Findings and recommendations of the Susitna program review team. Division of Commercial Fisheries. Susitna Aquatic Studies Program. Alaska Department of Fish and Game. Anchorage, Alaska. APA Document #3501.

This report provides a discussion of the background and findings of the 1985 Susitna Aquatic Studies program review which was held on October 2 and 3 in Anchorage by the Alaska Department of Fish and Game.

Commissioner Collinsworth in his June 18, 1985 memorandum (Reorganization of the Susitna Aquatic Studies), assigned the project coordinator of the Susitna Aquatic Studies program under the direction of the Commercial Fisheries Division regional supervisor, Central Region, with the responsibility for planning and coordinating all departmental salmon escapement activities on the Susitna River. In addition, the coordinator was to administer the contract between the Alaska Power Authority (APA) and the Division of Commercial Fisheries. The coordinator was also instructed to prepare a technical data report which summarized all salmon escapement data collected to date for the Susitna River by the combined efforts of the Divisions of Sport Fisheries and Commercial Fisheries and was to coordinate a cooperative effort among the fisheries divisions to ensure proper planning for future Susitna River escapement studies.

In order to accomplish these tasks, the Division of Commercial Fisheries has initiated the following: 1) staff orientation and

RTS No.	
41 Cont.	coordination activities for staff assigned to Susitna River projects, 2) the preparation of the Susitna salmon escapement summary, and 3) a Susitna program review.

This bibliography is stored on IBM Displaywriter diskette at:

Alaska Department of Fish and Game
Division of Sport Fisheries/RTS
Anchorage, Alaska 99518-1599

EsESV

SuHydroKey Word List Oct 85

used by staff to develop Keyword Abstracts

Key words: Preliminary draft 8/2.

Key Words for Abstracts etc

(might be another version too)

abundance
access
access corridor
aerial photograph
age
age and growth
age-length relationship
Alaska
anadromous fish
anesthesia
angling
arcane
Arctic grayling
Arctic lamprey
artifact
available habitat
backwater
Bering cisco
biased
binary criteria
biology
biomass
breaching
breaching discharge
Burbot
calibration
catch per unit effort
Catostomus catostomus
cell
Cheechako Creek
Chinook Creek
Chinook salmon
Chum salmon
clearwater plume
coded wire tagging
Coho salmon
cold branding (freeze branding)
commercial fishery
conductivity
controlling breaching discharge
Coregonus laurettae
Coregonus pidschian
Cottus cognatus
cover
CPUE
creel census
critical reach
cross section
datapod
Deadman Creek
Deadman Lake

CEV

Dist to staff 10-01-85

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Denali Highway
depth
Devil Canyon
Devil Creek
diel activity
diet
DIHAB
discharge
dissolved gas study
distribution
DO
Dolly Varden
drift net
duration curve
egg retention
eggs
electroshocking (electrofishing)
elevation of zero flow
Entosphenus tridentatus
Esox lucius
Eulachon
extrapolation limits
flow duration curve
fecundity
feeding
first run
fishing gear
fishery
fishery management
fishwheel
flooding
flow
floy anchor tagging
Fog Creek
food study
fortuitous
freeze branding (cold branding)
fry
FT-4 spaghetti tags
gaging station
Gasterosteus aculeatus
Gilbert-Rich aging
gill net
Goose Creek
gradient
gross surface area
growth
habitat
habitat curve
habitat index
habitat modeling
habitat suitability
habitat use
habitat variable

Key words

CEV

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HABTAT
harvest
hatching
head
Humpback whitefish
hydraulic control
hydraulic model
hydraulic simulation modeling
hydrolab
ice covered season
identification
IFG-2
IFG-4
IFIM
impoundment
inclined plane
incremental
incubation
initial breaching discharge
instantaneous survival rates
instream flow
Instream Flow Incremental Methodology
interpolate
intragravel
invertebrate
Jay Creek
Joint Preference Factor
juvenile salmon
Kosina Creek
Lake trout
Lampetra japonica
length
length-age relations
length frequency composition
life history data
Longnose sucker
Lota lota
lower reach Susitna
macrohabitat
mainstem
Manning's N
mark-recovery
marking (tagging)
Maximum Grouped Value
microcomputer data entry programs
microhabitat
middle reach Susitna
migration
Minimal Irregular Fluctuations
Minimal Peakedness
Minimal Sample Varience
modeling
models
mortality

Key Words

CEV

(3.7.6)

movements (migration)
MS-222
netting
Ninespine stickleback
Northern pike
Oncorhynchus gorbuscha
Oncorhynchus keta
Oncorhynchus kisutch
Oncorhynchus nerka
Oncorhynchus tshawytscha
open water season
Oshetna River
otoliths
outmigration
overflow channel
Pacific lamprey
passage
passage depth
passage reach
Peakedness Index
Petersen disc
Petersen estimates-model
pH
PHABSIM
photoperiod
Pink salmon
Platichthys stellatus
population estimate
post-spawners
predation
preference
pre-spawning
project datum
Prosopium cylindraceum
Pungitius pungitius
radio tag
radio telemetry
Rainbow trout
rating curve
recaptures
recruitment
redds
relative abundance
representative reach
reproduction
resident fish
Round whitefish
Sally Lake
Salmo gairdneri
salmon escapement
Salvelinus malma
sampling method
scale analysis
scaled frequency

Key words

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Schnabel population estimate
Sculpin
seasonal effect (variation)
second run
serendipity
set net
sex determination
sex ratios
sexual development
side channel
side scan sonar
side slough
Slimy sculpin
sloughs
smolt
smolt (outmigrant) trap
smoltification
Sockeye salmon
spawners
spawning
spawning habitat
spawning habitat curve
species composition
sport fishery
staff gage
stage
stage-discharge relationship
stage of zero flow
Starry flounder
stocks
stream crossing
streambed elevation
streamflow
streams
subsistence fishery
substrate
substrate classification
suitability criteria
suitability index
supersaturation
survival estimate
Susitna River
synthetic data
tag loss
Talkeetna
temperature
Thaleichthys pacificus
thalweg
thalweg profile
thermal infrared imagery
thermograph
Threespine stickleback
Thymallus arcticus
time series

Key Words

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CER

time series analysis
timing
transect
traps
transmission corridor
tributary
tributary mouths
Tsusena Creek
turbidity
Tyone River
upland slough
upper reach Susitna
upwelling
USGS water year
utilized
utilization curve
utilization data
velocity
velocity adjustment factor
verification
vertical
vertical distribution
Watana Creek
water quality
water surface elevation ~~(levels)~~ (levels)
water surface profile model
water year
weighted usable area
wetted surface area
winter aquatic studies
WSEL
WSP
WUA
year class

Key words

(6 of 6)

CEV

ESTES

COE
pre 86's

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

COE
PHASE

by Bruce M. Barrett

(1065)

Alaska Department of Fish and Game
Division of Commercial Fisheries
Anchorage, Alaska

#1.

November 1974

APA DOC #1612

Estes ✓

Barrett (#1)

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COE

#1 BARRETT (#1)

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.

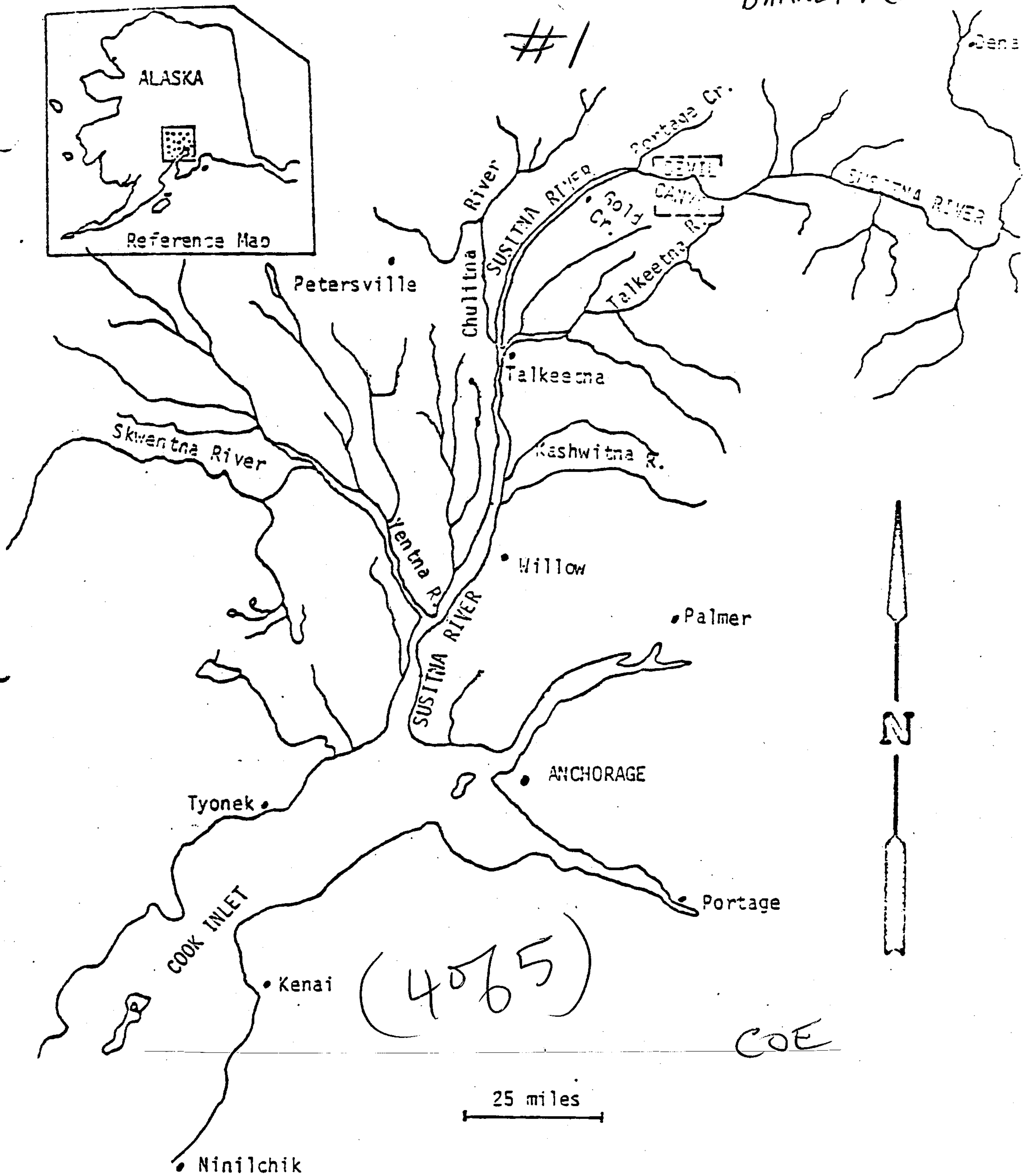
Recent information is not available on the extent of salmon utilizing the Susitna River and its tributaries between Devil Canyon and its confluence with the Chulitna River. Field investigations conducted by the Fish and Wildlife Service in 1956 document the presence of salmon in the Susitna River and 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.

COE (3878) E3-K3

BARRETT (1)

#1



(4065)

COE

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

Estes

COE (#1) BARRETT (1)

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

(5 of 5)

Estes

ADF+G winter studies - de Hydro
(Dec. - Feb 1974-75)

Barrett, Bruce M. 1975
APA Doc #1609
ADFG #1A

Estes

#1A

December Investigations on the Upper Susitna River Watershed Between Devil Canyon and Chulitna River

ADF+G
1975

COE

(1061)

INTRODUCTION

In December of 1974 the Division of Commercial Fisheries, contracted by the National Marine Fisheries Service, commenced a series of monthly winter investigations on the Upper Susitna River below Devil Canyon. Previous investigations denoted 21 relativly major and minor salmon spawning and rearing sloughs adjoining the Susitna River between Devil Canyon and the Chulitna River (Figure 1). Chum salmon were the primary spawning species and coho fry the dominate rearing species.

The presence of age 0.0 coho fry and the absence of adult coho spawners in the sloughs suggests that fry immigrate, in early spring, from the spawning streams to the Susitna River and enter the sloughs for rearing. Some emigration into the Susitna River was observed in the late fall of 1974 corresponding with partial slough dewatering. Rearing fry may inhabit both the Susitna River and the sloughs during winter months. Sloughs void of adult spawning populations may be due to their incapability to buffer winter conditions. The winter investigations are intended to provide qualative information on fry distribution and abundance and winter conditions in the sloughs and in the Susitna River.

PROCEDURES

The first survey was conducted during the period of December 3 through 6 from a field station established at Gold Creek. Travel to the sloughs was achieved primarily through the use of two twin track snow vehicles. Sloughs that were accessible were sampled for D.O., pH, relative water height, ice thickness and cover, snow depth, temperature and flow. Minnow traps baited with salmon roe were fished in sloughs having sufficient water depth.

#1A

ESTES

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
ANCHORAGE, ALASKA

SOUTH CENTRAL RAILBELT AREA - SUSITNA RIVER BASIN

FISH AND WILDLIFE STUDIES RELATED TO THE CORPS OF ENGINEERS DEVIL CANYON, WATANA RESERVOIR HYDROELECTRIC PROJECT

DEPARTMENT OF THE INTERIOR
U.S. FISH AND WILDLIFE SERVICE

COE

Cover Sheets
(1 of 2)

STUDIES WERE CONDUCTED BY THE ALASKA DEPARTMENT OF FISH AND GAME UNDER A CONTRACT AGREEMENT WITH THE U. S. FISH AND WILDLIFE SERVICE

ALASKA
Fish & Game

2.

FEBRUARY 1976

APA Doc #549

ESTES✓

STATE OF ALASKA

JAY S. HAMMOND, GOVERNOR

DEPARTMENT OF FISH AND GAME

333 RASPBERRY ROAD
ANCHORAGE 99502

January 19, 1976

(#2)

Mr. Gordon Watson
Fish and Wildlife Service
U.S. Department of the Interior
813 D Street
Anchorage, Alaska 99501

COE
cover sheets
(2 of 2)

Dear Mr. Watson:

Contained herein are reports submitted by the Alaska Department of Fish and Game to fulfill contract obligations to the U. S. Fish and Wildlife Service for studies of the proposed Susitna River hydroelectric project.

(FISH #2A & #2B)

The biological studies attached were conducted by three separate divisions of this agency, resulting in a segmented report. The Game Division conducted studies of moose and caribou within and adjacent to the impoundment area. The Commercial Fish Division studied primarily the anadromous fish populations and aquatic habitat downstream of the proposed impoundment site, and the Sport Fish Division conducted a limnological study supplemented with fishery information for both resident and anadromous fish species.

(wildlife #2C)

The full impacts of hydroelectric development of the Susitna River are as yet undetermined. The potential impacts depicted in each of the fish division report segments are not necessarily impacts this project will have, but illustrate areas of biological concern. As stated previously, inadequate funding and time have been limiting factors in carrying out more extensive studies.

We think the collective findings of these reports will be valuable as preliminary baseline data and as an aid in planning future investigations.

If I may be of assistance in interpreting or clarifying any of the attached study findings feel free to contact me.

Yours truly,

Larry J. Heckart

Larry J. Heckart
Mgt-Research Coordinator
Division of Sport Fish

Attachments:

FISH (~~#2A, B~~)

Wildlife (~~#2C~~)

ESTES ✓

PREAUTHORIZATION ASSESSMENT OF ANADROMOUS FISH POPULATIONS
OF THE UPPER SUSITNA RIVER WATERSHED IN THE VICINITY
OF THE PROPOSED DEVIL CANYON HYDROELECTRIC PROJECT

COE

by:
Nancy V. Friese
Fisheries Research Biologist

(163)

Alaska Department of Fish and Game
Division of Commercial Fisheries
Anchorage, Alaska

November, 1975

(#2A)

Friese

Estes ✓

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(#2A)

FRIESE

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PRE-AUTHORIZATION ASSESSMENT

OF THE

SUSITNA RIVER HYDROELECTRIC PROJECTS:

PRELIMINARY INVESTIGATIONS OF WATER QUALITY AND AQUATIC SPECIES COMPOSITION

SPORT FISH SECTION

BY

JAMES C. RIIS

FISHERIES BIOLOGIST

(1 of 2)

(#2B)

ALASKA DEPARTMENT OF FISH AND GAME

SPORT FISH DIVISION

ANCHORAGE

COE

Riis

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2B

ESTES ✓

(#2C)

PRE-AUTHORIZATION ASSESSMENT

OF THE

SUSITNA RIVER HYDROELECTRIC PROJECTS:

A LIMITED WILDLIFE STUDY

GAME DIVISION SECTION

COE

BY

CARL MCILROY

GAME BIOLOGIST

AND

TED SPRAKER

GAME BIOLOGIST

(1 of 2)

ALASKA DEPARTMENT OF FISH AND GAME

GAME DIVISION

ANCHORAGE

(#2C)

Estes ✓

GAME

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Cote

(#20)

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PRE-AUTHORIZATION ASSESSMENT
OF THE
PROPOSED SUSITNA RIVER HYDROELECTRIC PROJECTS:
PRELIMINARY INVESTIGATIONS OF WATER QUALITY
AND AQUATIC SPECIES COMPOSITION

by

JAMES C. RIIS

Fisheries Biologist

COE (1 of 3)

#3.

Alaska Department of Fish and Game
Sport Fish Division
Anchorage
May 1977

APA Doc #1610

CoE

Riis

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(#3)

(2 of 3)

COE

R115

ABSTRACT

Biological, water quality, and water quantity investigations were conducted from July 1, 1976 through September 30, 1976 to obtain baseline data on indigenous fish populations and the existing aquatic habitat as part of an ongoing environmental study to assess the potential impacts of the proposed Watana/Devils Canyon hydroelectric project upon the aquatic ecosystem of the Susitna River drainage.

Long term ecological changes to this drainage may be significant. The level and flow patterns of the Susitna River will be altered and will affect the fish and wildlife resources.

INTRODUCTION

The U.S. Army Corps of Engineers has been considering several sites within the Susitna River drainage for construction of a hydroelectric complex. The current plan includes construction of dams and power plants on the Susitna River at Devils Canyon and Watana Creek with transmission lines to the southcentral railbelt. A timetable suggested by the dams' chief advocate, U.S. Senator Mike Gravel, calls for construction authorization in 1981 and Watana Dam completion in 1986. Devils Canyon Dam will be completed in 1990.

(3 of 3)

(#3)

ESTES

PRELIMINARY ENVIRONMENTAL ASSESSMENT OF HYDROELECTRIC DEVELOPMENT ON THE SUSITNA RIVER

(1 of 2)

Prepared for the
United States Fish and Wildlife Service

by the
Alaska Department of Fish and Game
333 Raspberry Road
Anchorage, Alaska

COE

MASTER
#4 cover pages
#4A FISH
#4B FISH
#4C wildlife
#4d wildlife

1978

(#4.)

APA Doc# 75

(#4)

COE

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(#4 TOC)

OE

Fisheries and Habitat Investigations of the Susitna River—A Preliminary Study of Potential Impacts of the Devils Canyon and Watana Hydroelectric Projects

by
James C. Riis
and
Nancy V. Friese

Alaska Department of Fish and Game
Divisions of Sport and Commercial Fish

(#4/a)

March 1978

COE (ToC 1of3)

(#4a) Riis
Friese

COE

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Estes

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Riis Friese (#4a)

DOE

3+/3 (TOC)

Estes

Riis / Friese (#4a)

SUMMARY

Summary pp I-7 to p9 (1 of 3)

Biological and water quality and quantity investigations were conducted from May 1, 1977 through March 7, 1978 to obtain baseline data on indigenous fish populations and the existing aquatic habitat of the Susitna River drainage. These investigations conclude a four year series of environmental baseline inventories. They were designed to generate sufficient biological information to enable the Alaska Department of Fish and Game (ADF&G) to prepare a comprehensive biological study plan in the event a final environmental impact study is initiated to determine the feasibility of constructing the proposed Watana and Devils Canyon hydroelectric dams on the Susitna River.

The relative abundance, distribution and migrational timing of adult salmon (Oncorhynchus sp.) were determined within the Susitna River drainage through tag and recovery programs during 1977. The salmon escapement from June 29 through August 14 was estimated to be approximately 237,000 sockeye (O. nerka), 50,000 coho (O. kisutch), and 105,000 chum salmon (O. keta) (Friese, in prep.). An escapement estimate in excess of 100,000 fish was determined for chinook salmon (O. tshawytscha) through aerial surveys (Kubik, 1977; Watsjold, 1977). Population estimates of pink salmon utilizing the drainage in the area of the Susitna and Chulitna river confluence were determined as a part of this study.

Documentation of the outmigration of salmon fry from tributary rearing areas into the mainstem Susitna River was accomplished by intensive investigation of two clearwater tributaries. The objective of these studies was to determine utilization of the mainstem river for rearing during winter months. A total of 25,176 chinook salmon fry were marked

Estes

Riis (Friese CoE #(46)

in Montana Creek between July 19 and August 4. A gradual downstream movement of fry was noted from the latter part of August to February. A drastic reduction in population density was found in February and was attributed to low flows which prevailed at the time. Chinook fry were documented overwintering in the Susitna River. No distinct movement of fry was observed in Rabideux Creek.

(Summary 2of3)

The relative abundance, distribution, age, length, and weight characteristics, and feeding habits of juvenile salmonids were monitored in sloughs and tributaries of the Susitna River from Portage Creek downstream to the Chulitna River confluence from July 1 through October 5, 1977. The predominant rearing species were chinook and coho salmon. Water quality and quantity determinations were made in conjunction with all juvenile salmon surveys.

The Susitna River was floated from its intersection with the Denali Highway to Devils Canyon during the first two weeks of July to inventory fish species present and survey the aquatic habitat in the areas to be inundated. Arctic grayling (Thymallus arcticus) were abundant in all of the clearwater tributaries within the proposed impoundment area. The headwaters of these tributaries and upland lakes were also surveyed by separate crews. It is apparent that the Watana reservoir, which is projected to have substantial seasonal fluctuations, will alter the fisheries habitat.

Measurements of hydrological and limnological parameters associated with the Susitna River and selected tributaries and sloughs were obtained between the Denali Highway and Montana Creek. A cooperative agreement between the United States Geological Survey (USGS) and the ADF&G was initiated to determine discharge, sediment loads, and standard water

Estes

COE RILS/Friese (#4b)

quality analysis of the mainstem Susitna River. This data, along with the water quality and quantity data collected in conjunction with the fisheries studies, will be extremely valuable for future comparisons.

Long term ecological changes to the drainage may be significant due to dam construction. The level and flow patterns of the Susitna River will be altered and will affect the fisheries resources. Extensive research is necessary both upstream and downstream of the proposed dams to adequately assess the potential effects of these impacts on fisheries resources. (Summary 3063)

The effects of impoundments and construction activities which alter natural flow regimes, water chemistry, mass transport of materials, and quantity of wetted habitat areas are of primary concern. These changes may disrupt the trophic structure and habitat composition and reduce or eliminate terrestrial and aquatic populations. These populations and vegetation in and around the free-flowing rivers have evolved to their current levels due to natural flow variations. Some species may be present only because this particular hydrologic regime exists.

BACKGROUND

Background knowledge of the Susitna River basin is limited. The proposed hydroelectric development necessitates gaining a thorough knowledge of its natural characteristics and populations prior to final dam design approval and construction authorization to enable protection of the aquatic and terrestrial populations from unnecessary losses.

The Susitna River basin has long been recognized as an area of high recreational and aesthetic appeal. It is also important habitat to a wide variety of fish species, both resident and anadromous. Five species of Pacific salmon (chinook, coho, chum, pink, and sockeye) utilize the

Estes

Taylor/Ballard (#4c)

COE

(II-1 TOC 1 of 2)

Moose Movements and Habitat Use
Along the Upper Susitna River--A Preliminary Study of
Potential Impacts of the Devils
Canyon Hydroelectric Project

by
Kenton P. Taylor
and
Warren B. Ballard

Alaska Department of Fish and Game
Division of Game

Robert A. Rausch, Director

March 1978

Estes

CUE Taylor/Ballard (#4c)

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(TOC 2 of 2)

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COE

Taylor/Ballard (#4d)

SUMMARY

II-3

During October 1976 and March 1977, 18 radio and 21 visual collars were placed on moose along the Susitna River from the mouth of the Maclaren River downstream to Devil Creek. Radio tracking flights over 13 months yielded 270 observations of radio-collared moose. Visual collars were located 43 times. Movements were slight for radio-collared moose between Jay Creek and Devil Mountain, generally within 48 km^2. One visual collar from Devil Creek was seen near Lone Butte, 84 km east of her tagging location. Movements of moose collared east of Jay Creek were substantially longer, and migrations up to 103 km were observed. Radio-collared moose were found most often (70 percent) in spruce dominated habitats during all seasons. Seven of the eight cows that had calves gave birth in spruce vegetation. The bend of the Susitna River from Goose Creek to the mouth of Tyone River was identified as important winter habitat for moose from many areas of the Susitna River drainage. Lower elevations along the Susitna River were found to be important as both wintering and calving areas for resident populations, particularly on the south side, east of Stephan Lake. Collared moose crossed the Susitna a minimum of 26 times during this study, 15 of which were across that portion which would be inundated by dam construction.

Movement data gathered over a period of only 13 months are insufficient to accurately delineate separate moose populations. Evidence to date suggests that moose from many portions of the Susitna River drainage utilize habitats adjacent to or portions of the area which will be flooded by dam construction. Intensive vegetative studies and research

(Summary 1 of 2)

Este 3

Taylor / Ballard (#4d)

on movements both upstream and downstream are needed to adequately assess the impacts of the proposed construction (Appendix II).

BACKGROUND

Feasibility studies on providing hydroelectric power from the Susitna River to the railbelt area of southcentral Alaska have been conducted since 1948. Potential dam sites were identified by the U.S. Bureau of Reclamation, the Alaska Power Administration and the Henry J. Kaiser Company. Proposed hydroelectric projects have included from 2 to 12 dams within the Susitna River basin, along with associated maintenance facilities and transmission lines to Anchorage and Fairbanks (Dept. of Army 1975).

The Devils Canyon-Watana dam system has been selected by the Army Corps of Engineers as the most viable of several alternatives (Fig. 1). This system would theoretically provide 6.1 billion kilowatt-hours of electrical power annually from a dependable capacity of 1,568 megawatts (Army Corps of Engineers 1975). The Devils Canyon dam would be a concrete structure 193 m high, and the Watana dam would be a rock fill impoundment rising 247 m above the river bottom. A 103 km road from Chulitna to the Watana site including a 198 m bridge across the Sustina would be constructed for transporting materials and personnel to the dam sites. Five hundred eighty-six km of transmission line corridors, 57-64 m wide, would be cut across the mountains between Anchorage and Fairbanks. Warehouses, vehicle storage buildings and permanent living quarters would be erected at the dam sites. The total projected cost of completing this project

COE (Summary 2of2) Estes

ESTES ✓

POST COE

80's Studies POS for APA / post COE

SUSITNA HYDROELECTRIC PROJECT

Preliminary Final Plan of Study

Fish and Wildlife Studies

proposed by the

Alaska Department of Fish and Game

November 1979

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#5.

APA Doc # 3281

ADF&G 79

80's APA

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POST COE

ALASKA POWER AUTHORITY

SUSITNA HYRDROELECTRIC PROJECT

(1 of 2)

Subtask 7.10

AQUATIC STUDIES PROCEDURES MANUAL

PHASE I - Final Draft

(Vol. 1)

-by-
Alaska Department of Fish and Game
Susitna Hydro Aquatic Studies
2207 Spenard Road
Anchorage, Alaska 99503

(#6a.)

-for-
Acres American Incorporated
Liberty Bank Building, Main at Court
Buffalo, New York 14202

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for ADA (1 of 1)

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SUSITNA HYDROELECTRIC PROJECT

APA
80's

Subtask 7.10
Phase 1 Final Draft Report
Adult Anadromous Fisheries Project
ADF & G / Su Hydro 1981

by

Alaska Department of Fish and Game
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2207 Spenard Road
Anchorage, Alaska 99503

#7.

for

APA Doc # 324

(1 of 3)

Acres American Incorporated
Liberty Bank Building, Main at Court
Buffalo, New York, 14202

Estes

ABA

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ALASKA POWER AUTHORITY

APA 80's

SUSITNA HYDROELECTRIC PROJECT

(1 of 5)

Subtask 7.10
Phase 1 Final Draft Report
Juvenile Anadromous Fish Study on the Lower Susitna River
ADF&G / Su Hydro 1981

#8.

by
Alaska Department of Fish and Game
Susitna Hydro Aquatic Studies
2207 Spenard Road
Anchorage, Alaska 99503

APA Doc # 322

for

Acres American Incorporated
Liberty Bank Building, Main at Court
Buffalo, New York 14202

(2665)

Estes

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Estes✓

(4 of 5) (#8)

1. SUMMARY

(1) This study was designed to gather information describing the presence, abundance, geographical and seasonal distribution, age class composition, length distribution, and smolt migration timing of juvenile salmon in the Susitna River between Cook Inlet and Devil Canyon as part of a feasibility study regarding the proposed Susitna Hydroelectric project.

(2) Field collection of data on juvenile salmon fish species took place from November, 1980 to October, 1981. Sampling gear used included variable mesh gillnets, minnow traps, beach seines, electrofishing units, and dip nets.

(3) Five juvenile salmon species were captured during the course of this study.

(4) Juvenile chinook salmon were captured throughout the study area. The majority of juvenile chinook salmon captured during winter between Cook Inlet and Devil Canyon occurred at slough and mainstem Susitna River sites and in summer at tributary mouth sites. Two age classes (0+ and I+) were captured. Age I+ were not captured after July between Talkeetna and Devil Canyon and were not captured after August in the Cook Inlet to Talkeetna reach.

(5) Juvenile coho salmon occurred throughout the study area. The majority of juvenile coho salmon captured between Cook Inlet and Talkeetna during winter and summer occurred at tributary mouth sites. Between Talkeetna

(5 of 5) Estes

and Devil Canyon occurrence was greater at slough sites in winter and at slough and tributary mouth sites in summer. Three age classes (0+, I+ and II+) were captured. Age II+ were not captured after May in the Talkeetna to Devil Canyon reach and were not captured after mid June in the Cook Inlet to Talkeetna reach.

(6) Relatively small numbers of juvenile pink, chum and sockeye salmon were collected in 1980-1981. Sampling scheme bias imposed by gear types and by location of effort can account for the limited numbers of these juvenile salmon species encountered. Further seasonal distribution, relative abundance, and biological information on these three juvenile salmon species is needed to evaluate their life histories.

(7) Further information is needed on the winter distribution and habits of all five species of juvenile salmon.

(8) Further information is needed on the timing of the smolt outmigration and also on the incubation of embryos of all five juvenile salmon species.

(#8)

Estes ✓

ALASKA POWER AUTHORITY

SUSITNA HYDROELECTRIC PROJECT

(1685)

Subtask 7.10
Phase 1 Final Draft Report
Resident Fish Investigation on the Lower Susitna River
ADF&G / Su Hydro 1981

#9.

by
Alaska Department of Fish and Game
Susitna Hydro Aquatic Studies
2207 Spenard Road
Anchorage, Alaska 99503

APA Doc #318

for

Acres American Incorporated
Liberty Bank Building, Main at Court
Buffalo, New York 14202

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ALASKA POWER AUTHORITY

SUSITNA HYDROELECTRIC PROJECT

(1 of 3)

Subtask 7.10
Phase 1 Final Draft Report
Resident Fish Investigation
on the Upper Susitna River
ADF&G / 1981

#10.

by

Alaska Department of Fish and Game
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APA Doc #316

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SUSITNA HYDROELECTRIC PROJECT

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Subtask 7.10

Phase 1 Final Draft Report Vol. 1

Aquatic Habitat & Instream Flow Project

ADF & G / Su Hydro 1981

11a.

by

Alaska Department of Fish and Game
Susitna Hydro Aquatic Studies
2207 Spenard Road
Anchorage, Alaska 99503

APA Doc# 1307

for

Acres American Incorporated
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SUSITNA HYDROELECTRIC PROJECT

(1 of 2)

Subtask 7.10

Phase 1 Final Draft Report Vol. 2 Pt. 1

Aquatic Habitat & Instream Flow Project

ADF & G / Su Hydro 1981

#11b.

by

Alaska Department of Fish and Game
Susitna Hydro Aquatic Studies
2207 Spenard Road
Anchorage, Alaska 99503

APA Doc#311

for

Acres American Incorporated
Liberty Bank Building, Main at Court
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Estes

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ALASKA POWER AUTHORITY

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Estes

(1 of 2)

Subtask 7.10

Phase 1 Final Draft Report Vol. 2 Pt. 2

Aquatic Habitat & Instream Flow Project

ADF & G / Su Hydro 1981

#11c.

by

Alaska Department of Fish and Game
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2207 Spenard Road
Anchorage, Alaska 99503

APA Doc #312

for

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Liberty Bank Building, Main at Court
Buffalo, New York 14202

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Estes✓

DRAFT

AQUATIC STUDIES PROCEDURES MANUAL

PHASE I

(108)

Alaska Department of Fish and Game
Su-Hydro Aquatic Studies
2207 Spenard Road
Anchorage, Alaska
99503

May 1981

(#11d)

DRAFT

(#11d) (2018)

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CEV

I. INTRODUCTION

(#11d)

The Susitna River, Southcentral Alaska's major river system, drains into Cook Inlet near the City of Anchorage (Figure 1). The drainage encompasses an area of 19,400 square miles and extends north to Mt. Denali and east almost to the town of Glenallen. The mainstem river and its major tributaries are of glacial origin and carry a heavy silt load during ice-free months. Many of the smaller tributaries are perennially silt-free.

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Construction of hydroelectric dams will affect portions of the fish and wildlife resources of the Susitna River Basin. The two dam system proposed would inundate in excess of 50,500 acres of an aquatic and terrestrial habitat upstream of Devil Canyon. Historically, the long and short term environmental impacts of hydroelectric dams have adversely altered the sport and commercial fisheries of affected drainages (Keller, 1980; Hagen et al., 1973). Regulation of the mainstem river will substantially alter the natural flow regime downstream. The transmission line corridor, substations, road corridor, and construction pad sites will also impact aquatic and terrestrial communities and their habitat.

The proposed hydroelectric development necessitates gaining a thorough knowledge of its chemical, physical and biological parameters prior to final dam design approval and construction authorization. Preliminary environmental assessments of the project noted deficiencies in the state of knowledge of the Susitna drainage fisheries (FWS-ADF&G, 1978).

To insure adequate information is available to determine the impacts of the proposed hydroelectric project and to design proper mitigative strategies, a two-phase data collection program has been developed. This manual addresses Phase I (July 1, 1980-December 31, 1981) procedures to be conducted within those study areas outlined in Figure 2.

The following objectives are to be addressed in the Phase I field fisheries studies.

<u>OBJECTIVE 1.</u> Determine the seasonal distribution and relative abundance of adult anadromous fish populations produced within the study area.

- Task 1.1 Enumerate and characterize the runs of the adult anadromous fish.
- Task 1.2 Determine the timing and nature of migration, milling and spawning activities.
- Task 1.3 Identify spawning locations within the study area (i.e., subreaches of the mainstem sloughs and side channels, tributary confluences, lakes and ponds, etc.) and estimate their comparative importance.

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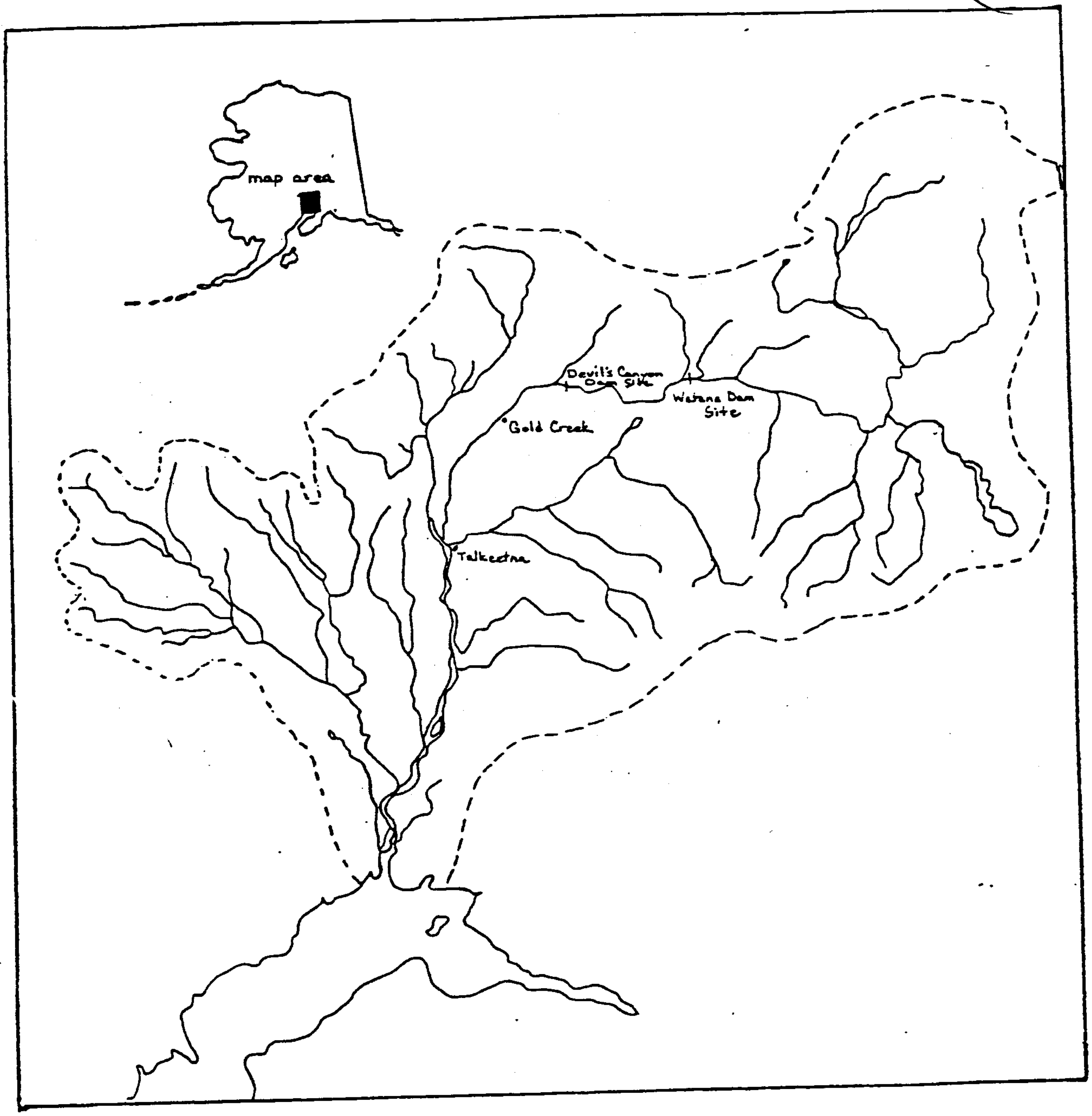

Figure 1. Susitna River Basin (approximate scale 1:2,200,000)

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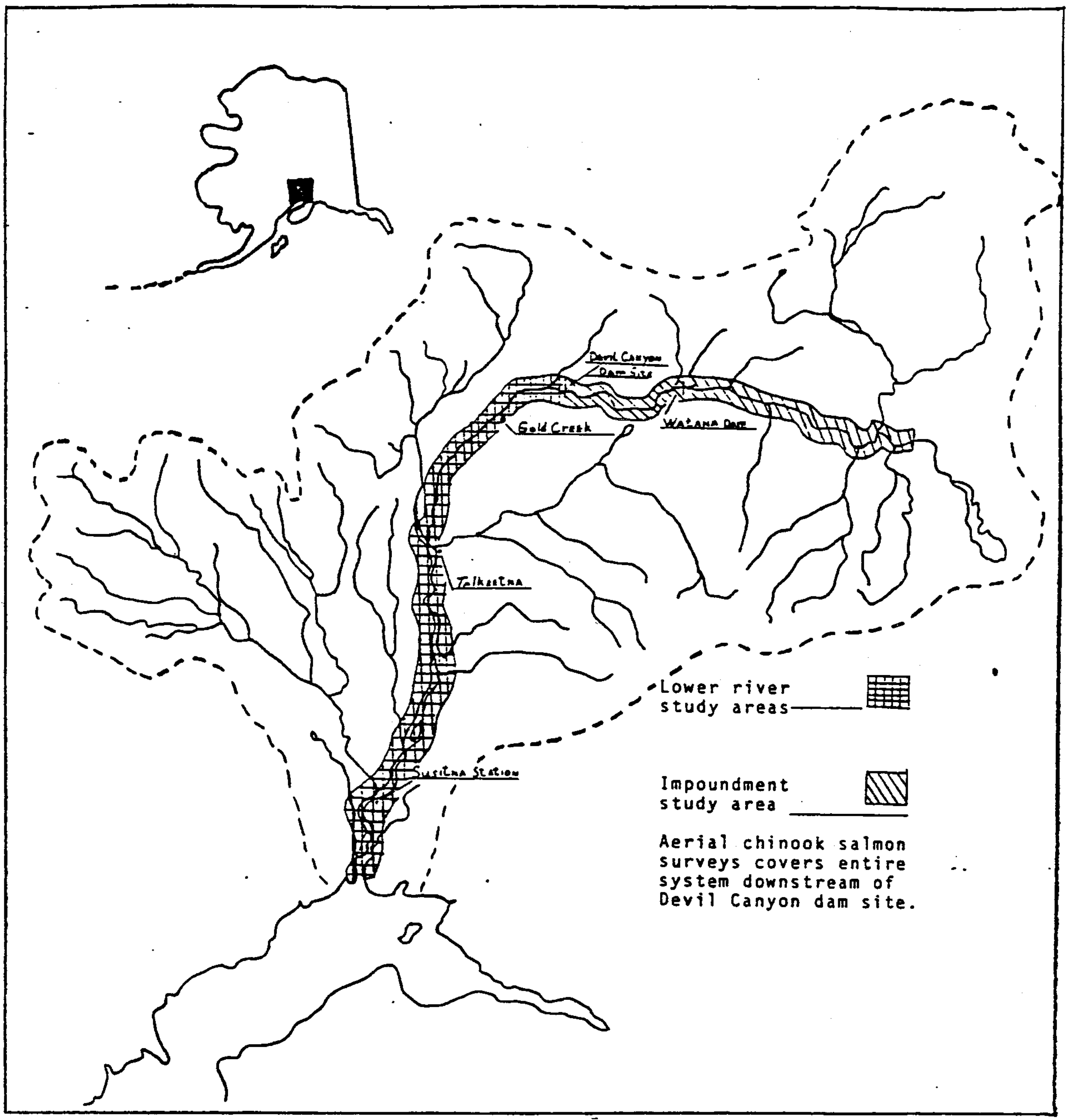

Figure 2. Phase I study areas, Susitna River basin.

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Task 1.4 Identify and determine methods, means and the feasibility of estimating the Susitna Rivers contribution to the Cook Inlet commercial fishery.

OBJECTIVE 2. Determine the seasonal distribution and relative abundance of selected resident and juvenile anadromous fish populations within the study area.

Task 2.1 Identify spawning and rearing locations of the resident species and the rearing locations of juvenile anadromous species to estimate their comparative importance.

Task 2.2 Record descriptive information on captured fish (species, location of capture site, age class), and discuss seasonal migration patterns of selected adult resident species.

OBJECTIVE 3. Characterize the seasonal habitat requirements of selected anadromous and resident species within the study area.

Task 3.1 Through direct field observations and measurements identify the physical and chemical conditions which appear to be influencing the suitability of various habitat types for the species and life history stages of interest.

Task 3.2 Through direct field observations and measurements characterize the physical and chemical parameters of the various habitat types found in the study area.

To meet the above objectives, the study program is separated into three sections; Adult Anadromous Fisheries, Resident and Juvenile Anadromous Fisheries, and Aquatic Habitat and Instream Flow Studies. The operations of the Anadromous Adult and Resident and Juvenile Anadromous field investigations will be interrelated to and conducted in cooperation with the Aquatic Habitat and Instream Flow studies. The specific procedures for completion of each section of the program are described in this manual.

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Subtask 7.10

Phase 1 Final Draft Report

Aquatic Studies Program

ADF & G / Su Hydro 1982

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ALASKA DEPARTMENT OF FISH AND GAME

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ALASKA POWER AUTHORITY

SUSITNA HYDROELECTRIC PROJECT

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Subtask 7.10
Phase 1 Final Draft
Stock Separation
Feasibility Report
Adult Anadromous Fisheries Project
ADF&G / Su Hydro 1982

#13.

by
Alaska Department of Fish and Game
Susitna Hydro Aquatic Studies
2207 Spenard Road
Anchorage, Alaska 99503

APA Doc #403

for

Acres American Incorporated
Liberty Bank Building, Main at Court
Buffalo, New York, 14202

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1. SUMMARY

Five species of Pacific salmon return to freshwater systems, including the Susitna River, in Upper Cook Inlet. The Upper Cook Inlet commercial fishery harvests mixed stocks and species migrating north of Anchor Point, with a long term average catch of 2.8 million fish, worth approximately 17.9 million dollars.

The commercial sockeye salmon harvest has averaged 1.2 million fish the past ten years. This species is economically the most valuable species, receiving greatest emphasis in management and research. A stock identification program using scale pattern analysis has been developed to estimate stock contribution of major river systems to the commercial harvest. Estimates for the 1979 and 1980 fisheries show stock contribution by the Susitna River was 22.7% and 19.2% respectively.

The Upper Cook Inlet chum salmon catch has averaged 707,000 fish the past ten years. Though available escapement data identify the Susitna River as the major producer, river systems on the west side of Cook Inlet are known to support chum salmon populations. Evaluation of west side production is necessary to determine the need for a stock separation program. Electrophoresis and scale pattern analysis are two options for stock identification, should a program prove necessary.

The Upper Cook Inlet coho catch has averaged 204,000 fish the past ten years. Though the Susitna River appears to be the single largest producing system in

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Upper Cook Inlet, contribution of west side river systems must be addressed. Previous stock identification has been attempted with positive results using fish weight and scale pattern analysis. However, prior to implementing a stock identification program, major Upper Cook Inlet systems must be confirmed to estimate Susitna River contribution.

The ten year average catch for Upper Cook Inlet pink salmon is 146,000 and 1.7 million fish for odd and even years respectively. Two leading pink salmon producers are the Kenai and Susitna river drainages. However, production of west shore systems is unknown. When major producing river systems have been defined, electrophoresis and length-weight data should be examined as stock identification techniques.

Because migration timing relative to 25 June commercial season opening, Susitna River chinook salmon currently are not significantly exploited in the Upper Cook Inlet fishery; a stock separation program is not necessary at this time.

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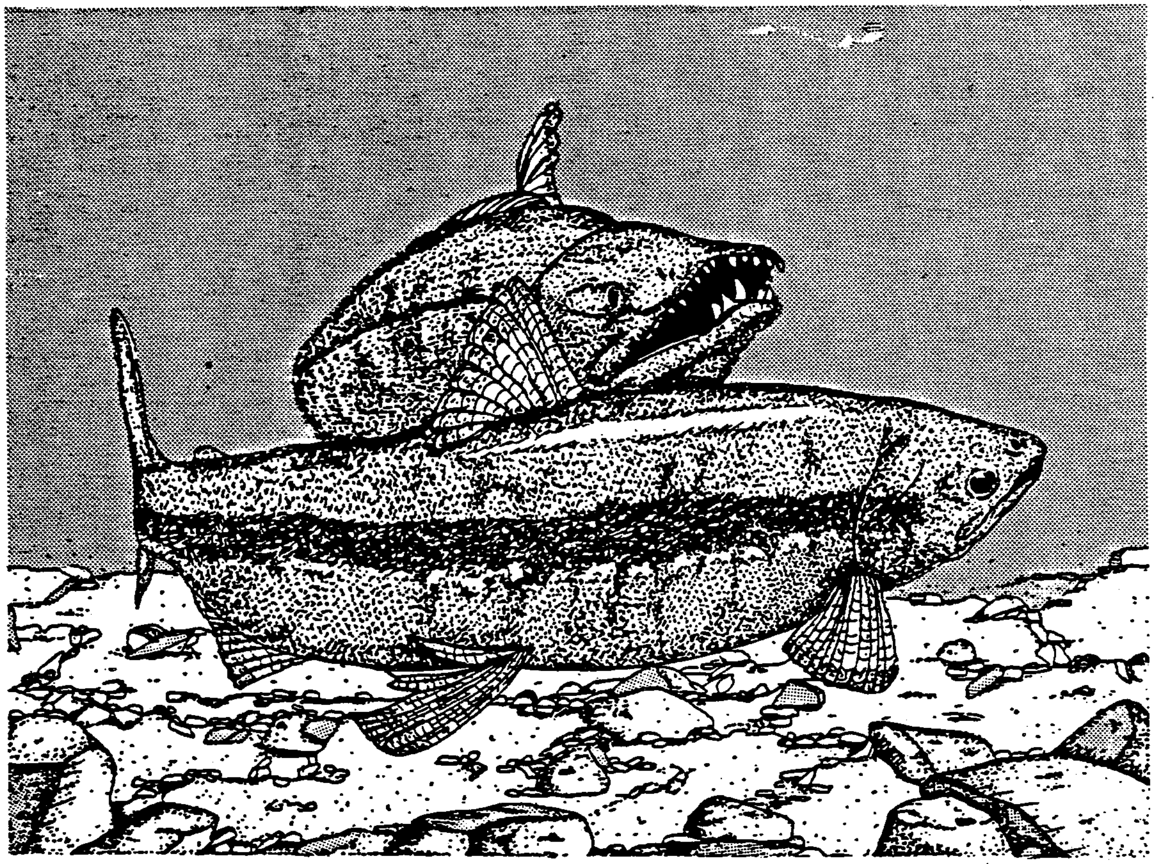

Subtask 7.10

AQUATIC STUDIES PROCEDURES MANUAL

PHASE II - Final Draft (2nd ed.)

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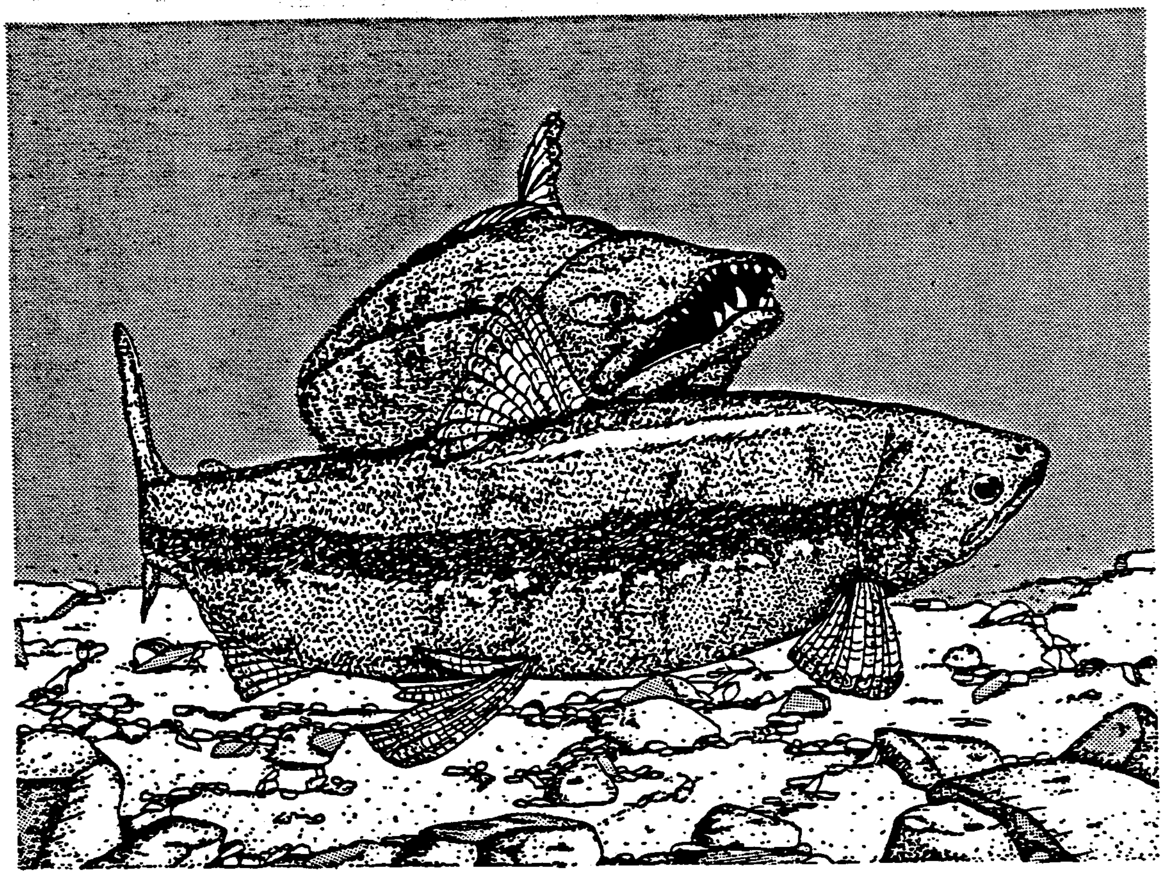

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Volume I: Summarization of Volumes 2, 3, 4; Parts I and II, and 5. Alaska Department Of Fish and Game Su Hydro Basic Data Reports, 1982.

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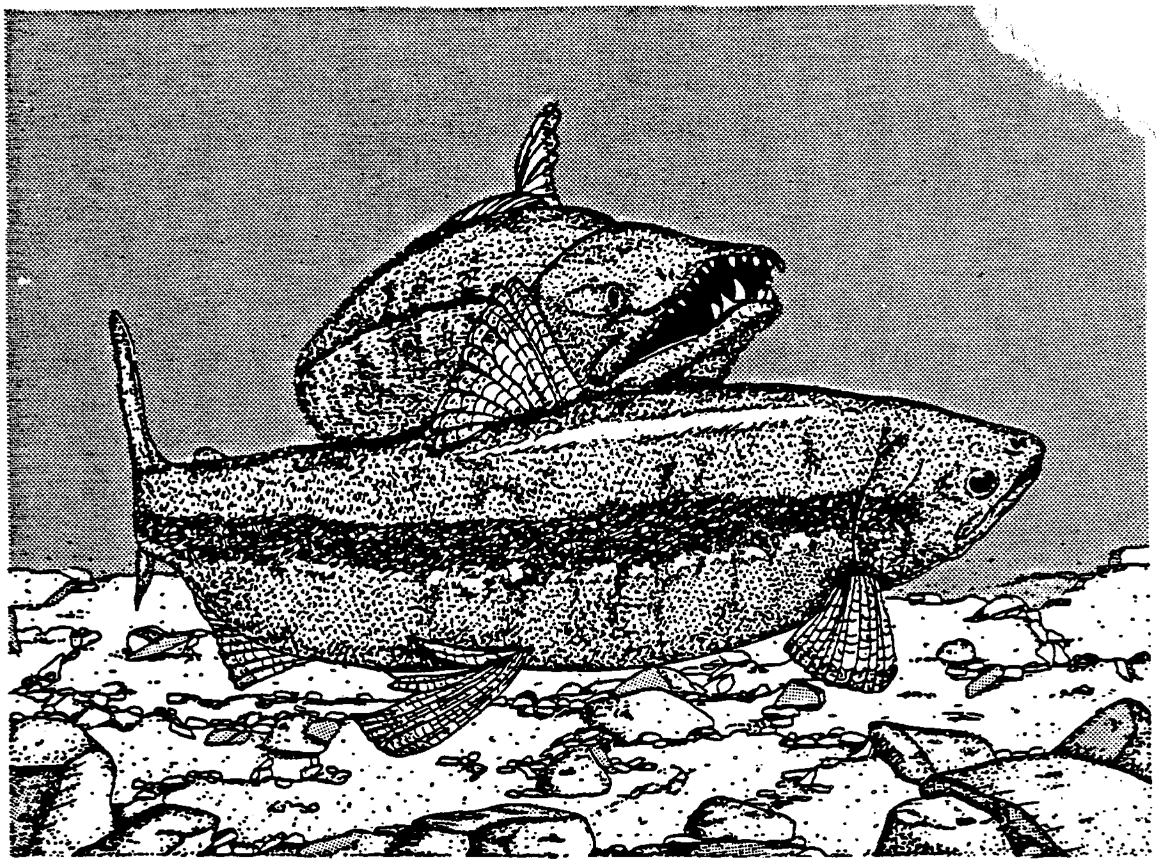

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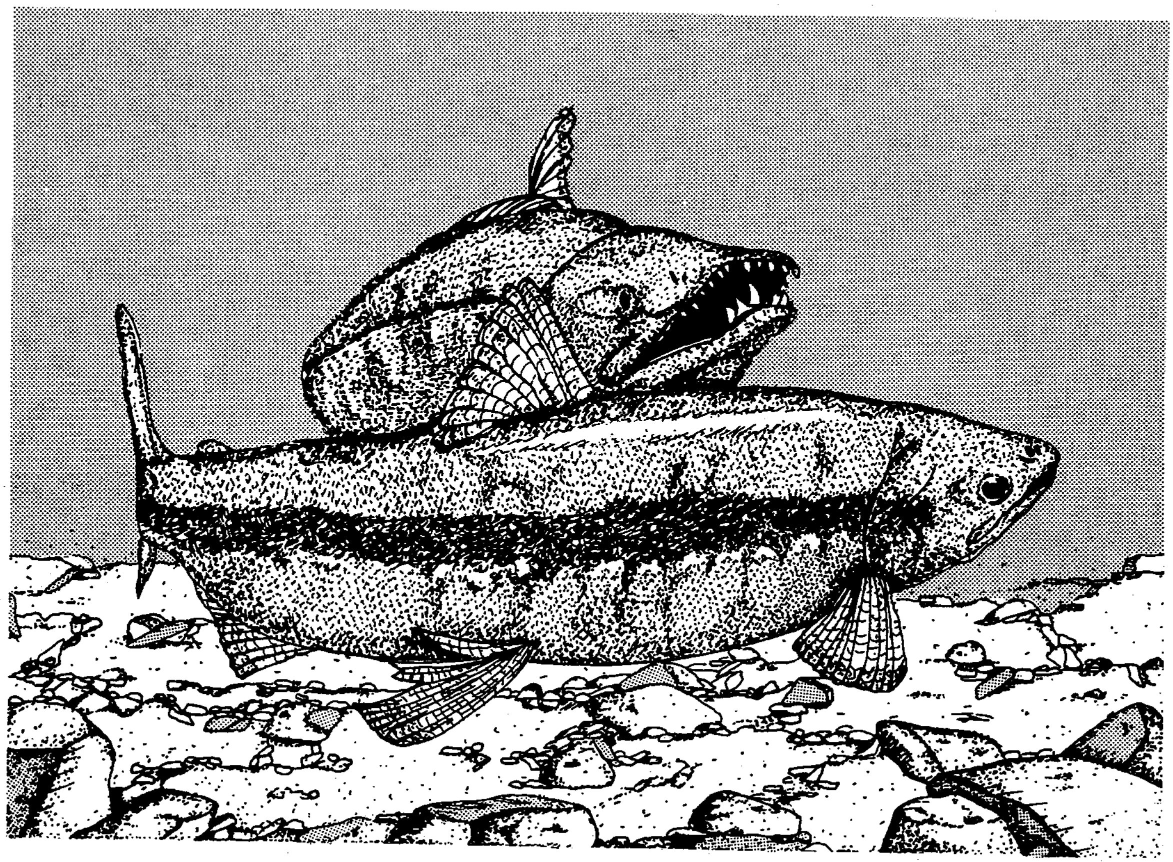

SUSITNA HYDRO AQUATIC STUDIES
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Volume 2. Adult Anadromous Fish Studies, 1982.

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APPENDIX 2-A

SUSITNA AND YENTNA RIVERS

SAMPLING STATIONS

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APPENDIX 2-B

SONAR

1. FIGURES OF DAILY SIDE SCAN SONAR COUNTS BY SPECIES
2. FIGURE OF CUMULATIVE PERCENT OF SONAR COUNTS BY SPECIES
3. DAILY SONAR COUNTS BY STATION
4. SECTOR DISTRIBUTION OF SONAR COUNTS
5. BOTTOM PROFILES OF 1982 SONAR SITES

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APPENDIX 2-C

DAILY FISHWHEEL CATCH DATA

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APPENDIX 2-D

LENGTH FREQUENCIES OF

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APPENDIX 2-E

RADIO TELEMETRY TRACKING REPORTS

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APPENDIX 2-F

MAINSTEM SPAWNING SURVEYS

1. ELECTROSHOCKING SUMMARY

2. VISUAL AND GILL NET SUMMARY

3. EVALUATION OF TAG LOSS

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APPENDIX 2-G

1. SLOUGH AND STREAM LOCATIONS FROM RM 98.6 TO 161.2
2. LOCATION OF CHEECHAKO AND CHINOOK CREEKS
3. MAP OF SLOUGH B
4. MAINSTEM SUSITNA RIVER SPAWNING SITE MAPS
5. ESCAPEMENT SURVEYS OF SLOUGHS AND STREAMS
6. TAGGED/UNTAGGED RATIOS FROM SPAWNING GROUND SURVEYS

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COMPARISON OF SCALE PATTERNS FROM SOCKEYE SALMON SAMPLED FROM DIFFERENT STOCKS IN THE SUSITNA RIVER IN 1982

This report also produced individually & as part of doc. 15C

Note:

By
David R. Bernard
Glen Oliver
William Goshert
and
Bev Cross

Alaska Department of Fish and Game
Division of Commercial Fisheries
Statewide Stock Biology Group

January, 1983

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ABSTRACT

Scale pattern analysis with linear discriminant functions was used to examine the probable fate of sockeye salmon fry spawned upstream of Curry Station on the Susitna River. Scale samples were taken from sockeye salmon collected at Talkeetna Station, at Curry Station, from the Tokositna River, and from the confluence of the outlet from Larson Lake and the Talkeetna River. Fish aged 1.3 dominate the samples and are used in the analysis. Growth during the first season of life (1977) is the most discriminating scale pattern variable. Scale patterns from fish sampled at Tokositna River and at Larson Lake are most different. Fish from Larson Lake grew slower for a longer period of time than did fish from the Tokositna River. Fish from Talkeetna Station on the Susitna River are more like fish sampled at Larson Lake on the Talkeetna River. Fish from Curry Station are misclassified as being from Tokositna River or from Larson Lake more often than from upstream of Curry Station. Sockeye salmon passing Curry Station are probably not a separate stock, but are strays from Talkeetna and Chulitna Rivers. Fry hatched upstream of Curry Station most probably die or move to the lower Susitna to rear.

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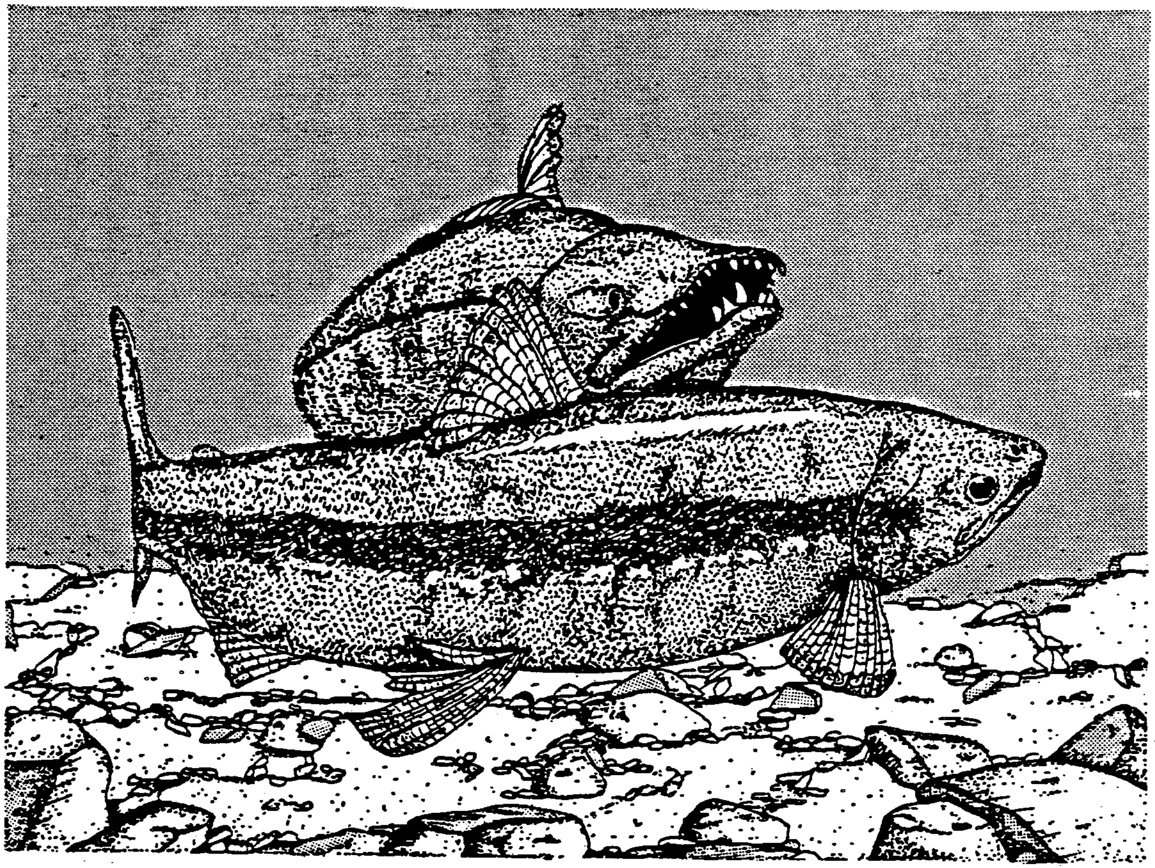

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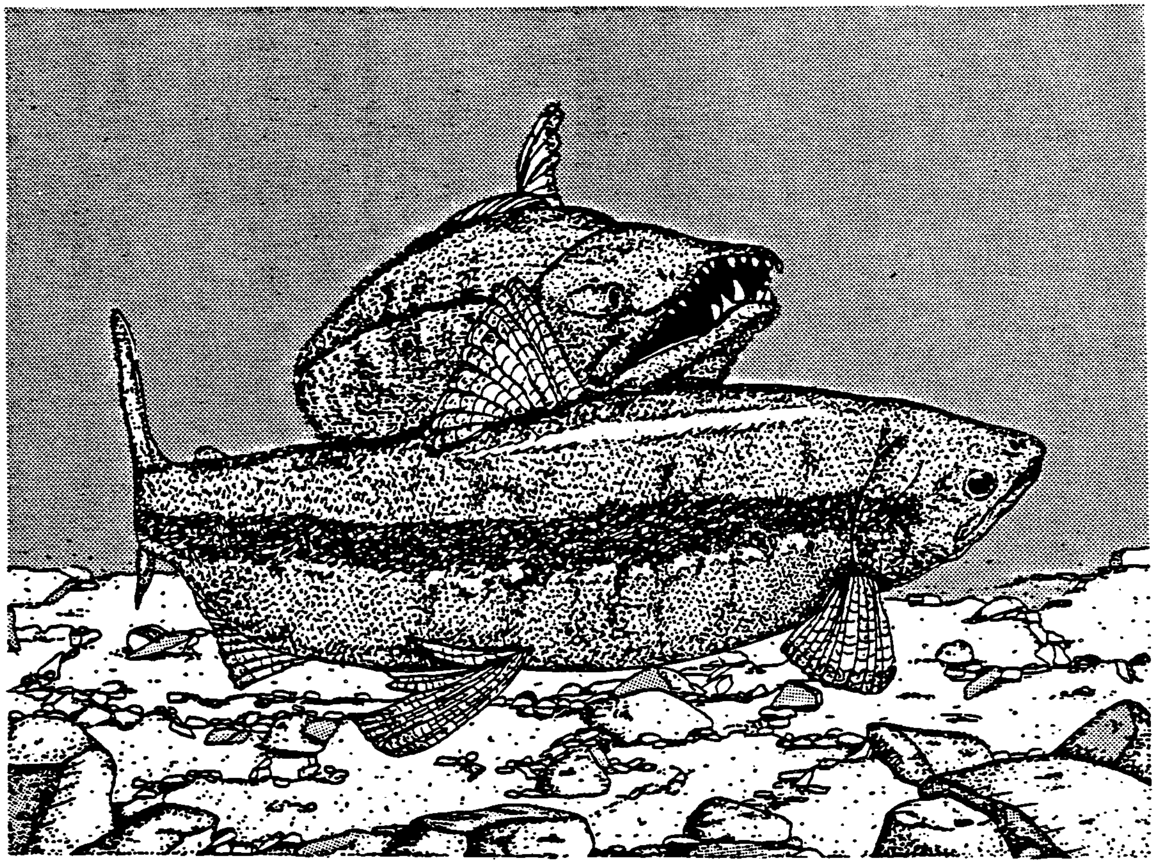

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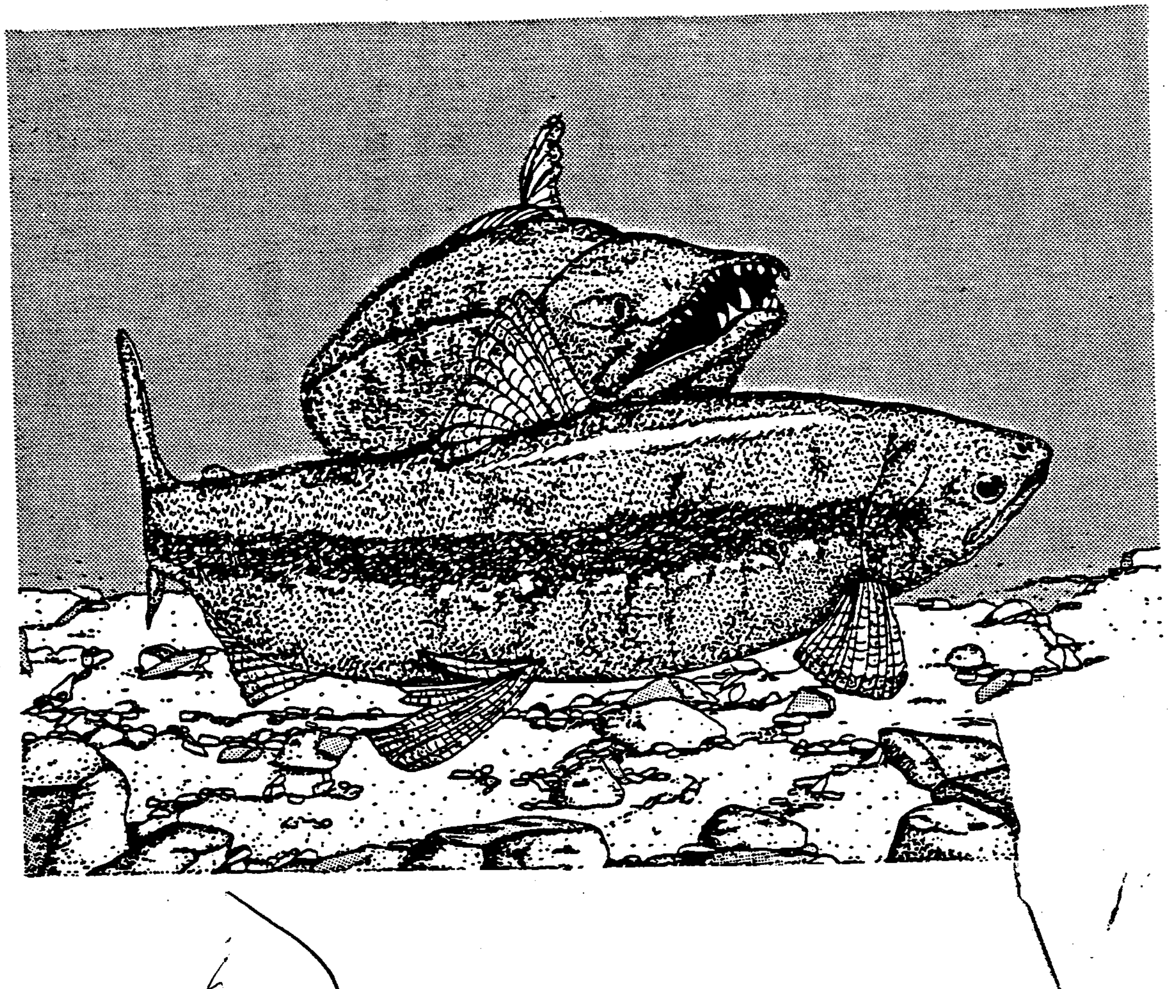

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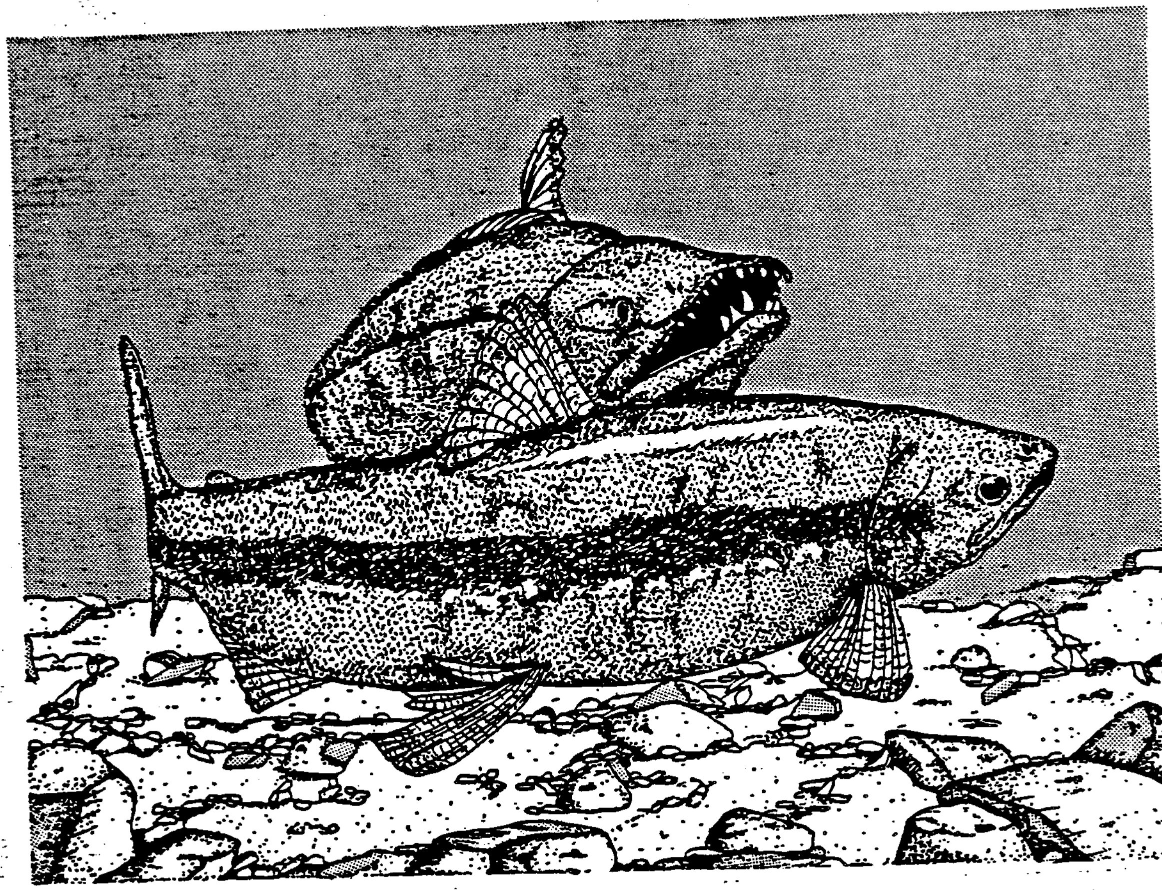

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Volume 4: Aquatic Habitat and Instream Flow Studies, 1982.

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APPENDIX A

STAGE/DISCHARGE DATA

This appendix includes mainstem discharges versus mainstem and slough water surface elevations (pp. 4-A-2 to 4-A-32); cross sectional profiles of sloughs (pp. 4-A-33 to 4-A-51); mainstem, slough, and tributary discharge data (pp. 4-A-52 to 4-A-61), periodic water surface elevations for sloughs (pp. 4-A-62 to 4-A-79); continuous hourly streamflow and surface water temperature records for Indian River and Portage Creek (pp. 4-A-80 to 4-A-177); periodic water surface elevations and measured flow at sloughs and tributaries (pp. 4-A-178 to 4-A-183); and surface areas of aggregate type II hydraulic zones at DFH sites compared with mainstem discharges (pp. 4-A-184 to 4-A-187). These data were collected during the open water season in the study area located within the Cook Inlet to Talkeetna reach of the Susitna River.

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APPENDIX B

SLOUGH AVAILABILITY AND UTILIZATION DATA

This appendix includes depths, velocities, and substrate types for Chum Channel, Rabideux Slough and sloughs 8A, 9 and 21 that were available to (pp. 4-B-2 to 4-B-89) and utilized by (pp. 4-B-90 to 4-B-100) chum, pink and sockeye salmon for spawning at various slough discharges. It also contains a complete summary of instantaneous intragravel and surface water temperature data at redds in sloughs 8A, 9, 11 and 21 (pp. 4-B-92 to 4-B-100). Other temperature data for these sloughs, not included in this appendix, are presented in Appendices C and D. Appendix C includes a complete summary of continuous surface and intragravel water temperatures collected with thermographs and datapods in these and other locations. It also includes the instantaneous temperature data included in this Appendix. Instantaneous surface and intragravel water temperature data collected along transects in Sloughs 8A, 9, 9B, 11 and 21, and at specified locations in sloughs 8A, 9 and 21 are in Appendix D. Mainstem depth and velocity utilization data for eulachon, Bering cisco and chum salmon spawning sites are presented in Appendix F. All of the above data were collected during the open-water season in the study area located within the Cook Inlet to Devil Canyon reach of the Susitna River.

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APPENDIX C

TEMPERATURE DATA (5 of 5)

This appendix includes an index of continuous temperature data collected in the Susitna River basin, 1981-1982, (pp 4-C-2 to 4-C-6); a complete summary of continuous surface water temperatures collected during the open water season in mainstem, sloughs, and tributaries (pp. 4-C-7 to 4-C-94); weekly water temperatures calculated from the mainstem, slough and tributary data (4-C-95 to 4-C-118); continuous intragravel and surface water temperatures collected during the open water season in sloughs (pp. 4-C-119 to 4-C-221); summaries of continuous surface and intragravel water temperatures collected during the ice-covered season in sloughs (pp. 4-C-222 to 4-C-260); weekly water temperatures calculated from the surface and intragravel data (4-C-261 to 4-C-271); and instantaneous intragravel and surface water temperatures in sloughs collected during the open water season at salmon redds (pp. 4-C-272 to 4-C-276). These data were collected during the open water and ice-covered seasons in the study area located within the Cook Inlet to Oshetna reach of the Susitna River. Instantaneous surface water temperature data collected during the ice-covered season, not included in this summary, are located in Appendix J.

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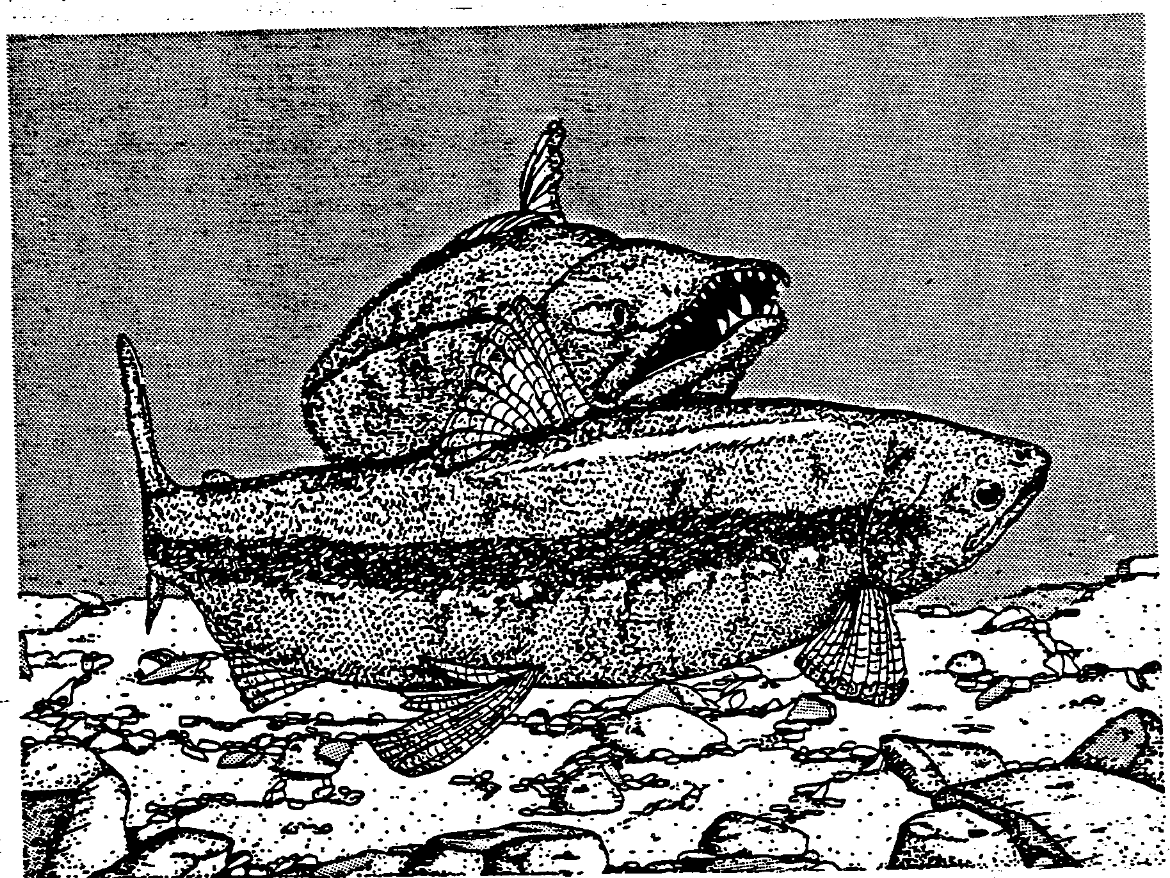

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APPENDIX D

WATER QUALITY DATA

This appendix is a complete summary of the dissolved gas data (pp. 4-D-2 to 4-D-43); mainstem and designated fish habitat site water quality data (pp. 4-D-44 to 4-D-68); mainstem and slough provisional water quality data (pp. 4-D-69 to 4-D-84); and instantaneous surface and intragravel water temperature and specific conductance data from sloughs 8A, 9, 9B, 11 and 21 (pp. 4-D-85 to 4-D-96). These data were collected during the open-water season in the study area located within the Cook Inlet to Oshetna River reach of the Susitna River. Ice-covered season water quality data are located in Appendix J. A partial listing of the water quality data collected at Designated Fish Habitat sites, included in this appendix, is presented in Appendix I.

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APPENDIX E

SURVEY DATA

This appendix includes a complete summary of the headpin and cross sectional elevations obtained at study transects (reported in feet) from five sites during 1982: Chum Channel, Rabideaux Slough, and sloughs 8A, 9, and 21. Cross sections and water surface elevations for these and other locations are illustrated in Appendix A. Thalweg profile data are also presented for sloughs 8A, 9, 11, and 21. Thalweg profiles are illustrated in Volume 4, Part I. These data were collected during the open-water season in the study area located within the Cook Inlet to Devil Canyon reach of the Susitna River.

Tables are ordered by slough with individual tables including: head pin data for each slough, cross sectional data for each transect within each slough (number of transects differed between sloughs), and thalweg elevations. Transects in each slough were oriented perpendicular to the direction of water flow and had limits defined by two head pins located on left and right banks of the slough channel (looking upstream).

Definitions of Terms Used in This Appendix

Table headings for head pin and cross sectional tables are defined as follows:

1) Bench Mark is that point in the immediate vicinity of the study site (i.e., head pin, nail in tree base, or ground)

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APPENDIX F

HABITAT LOCATION DESCRIPTION AND PHOTOS

This appendix includes descriptions, maps, and/or photos of all mainstem, side channel, slough, and tributary study areas. There are two parts: the first describes study areas investigated with regard to spawning adult anadromous fish (pp. 4-F-2 to 4-F-92) and the second describes study areas investigated with regard to juvenile anadromous and resident fish (4-F-93 to 4-F-214). Other descriptions, maps and photographs of these study areas are included in Volume 4, Parts I and II. These data were collected during the open-water season in the study area located within the Cook Inlet to Devil Canyon reach of the Susitna River.

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APPENDIX G

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CATCH DATA

All juvenile anadromous and resident fish catch data (i.e., minnow trap, trotline, beach seine, dip net, backpack electrofishing), except boat electrofishing data, for the 17 Designated Fish Habitat sites by 2-week periods from early June to the end of September 1982 are included in this appendix. Additionally, catch data are included for two sites (Slough 20 and Portage Creek mouth) sampled in early October. These data were collected in the study area located within the Cook Inlet to Devil Canyon reach of the Susitna River.

The catch data are presented by zone and by gear type. Zone codes are defined in Part II, Section 2.2 and gear codes and species codes are defined in the following table.

APPENDIX H

CATCH PER UNIT EFFORT DATA

All juvenile anadromous and resident fish catch per unit effort (CPUE) data (i.e., minnow trap, trotline, beach seine, dip net, backpack electrofishing), except boat electrofishing data, for the 17 Designated Fish Habitat sites by 2-week periods from early June to the end of September 1982 are included in this appendix. Additionally, CPUE data are included for two sites (Slough 20 and Portage Creek mouth) sampled in early October. These data were collected in the study area located within the Cook Inlet to Devil Canyon reach of the Susitna River.

The CPUE data are presented by zone and by gear type. Zone codes are defined in Part II, Section 2.2 and gear codes and species codes are defined in the following tables.

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APPENDIX I

HABITAT DATA

Water quality and velocity data for the 17 Designated Fish Habitat sites which were collected twice a month on a regularly scheduled basis are included in this appendix. These data are repeated in Appendix D and supplemented with similar data collected on an irregular basis at these sites. The methods describing how these data were obtained and an explanation of the Zone Code are in Part II, Section 2.2 of this volume. These data were collected during the open-water season in the study area located within the Cook Inlet to Devil Canyon reach of the Susitna River.

The data obtained from mixing zones, where tributary, slough or mainstem water mix (zone 3, zone 5, and zone 7), can vary widely, depending on exactly where in the zone the sample was taken.

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APPENDIX J

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ICE-COVERED SEASON (1981-82) HABITAT DATA

This appendix includes physical and chemical data that were measured instantaneously during the ice-covered season to describe general habitat conditions. Continuous surface and intragravel water temperatures in sloughs are located in Appendix C. These data were collected in the study area located within the Cook Inlet to Oshetna River reach of the Susitna River.

Data were collected at sites previously sampled during the 1981 open-water season and at selected sites in conjunction with radio telemetry studies. Open-water season habitat data are located in Appendices C, D and I.

Variables measured include air temperature, water temperature, pH, dissolved oxygen, specific conductance, turbidity, water depth, and ice thickness. Air temperature was measured with calibrated Brooklyn mercury thermometers. Water temperature, pH, dissolved oxygen, and specific conductance were measured with a Hydrolab Model 4041. Meters were calibrated before and after each field sampling period. Turbidity samples were collected in 250ml polyethylene bottles and stored in a cool, dark location until analyzed.

Analysis was done using a Hach laboratory Model 2100A turbidimeter. Water depth was measured from the bottom of the ice to the substrate. Ice thickness was measured from the top of the ice to the bottom. Surface and intragravel water temperature were monitored continuously at selected sites using Peabody-Ryan thermographs.

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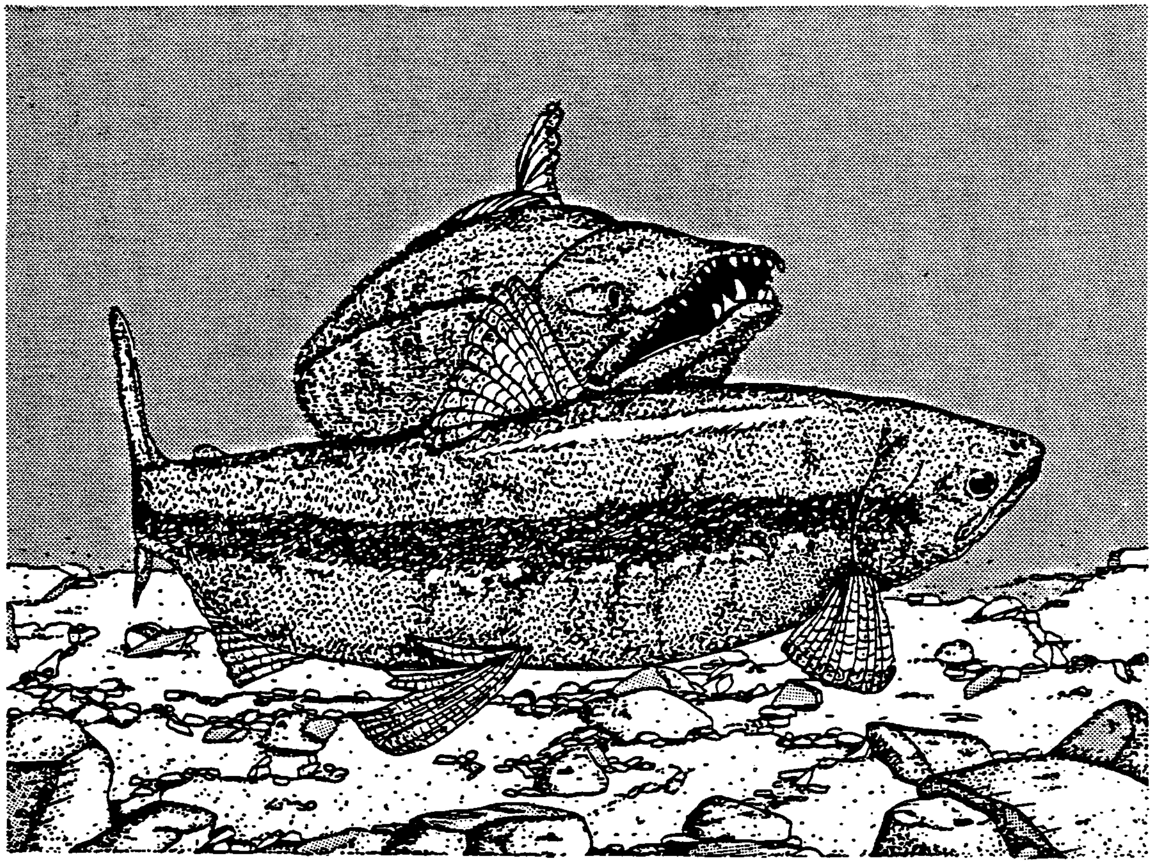

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PHASE II BASIC DATA REPORT

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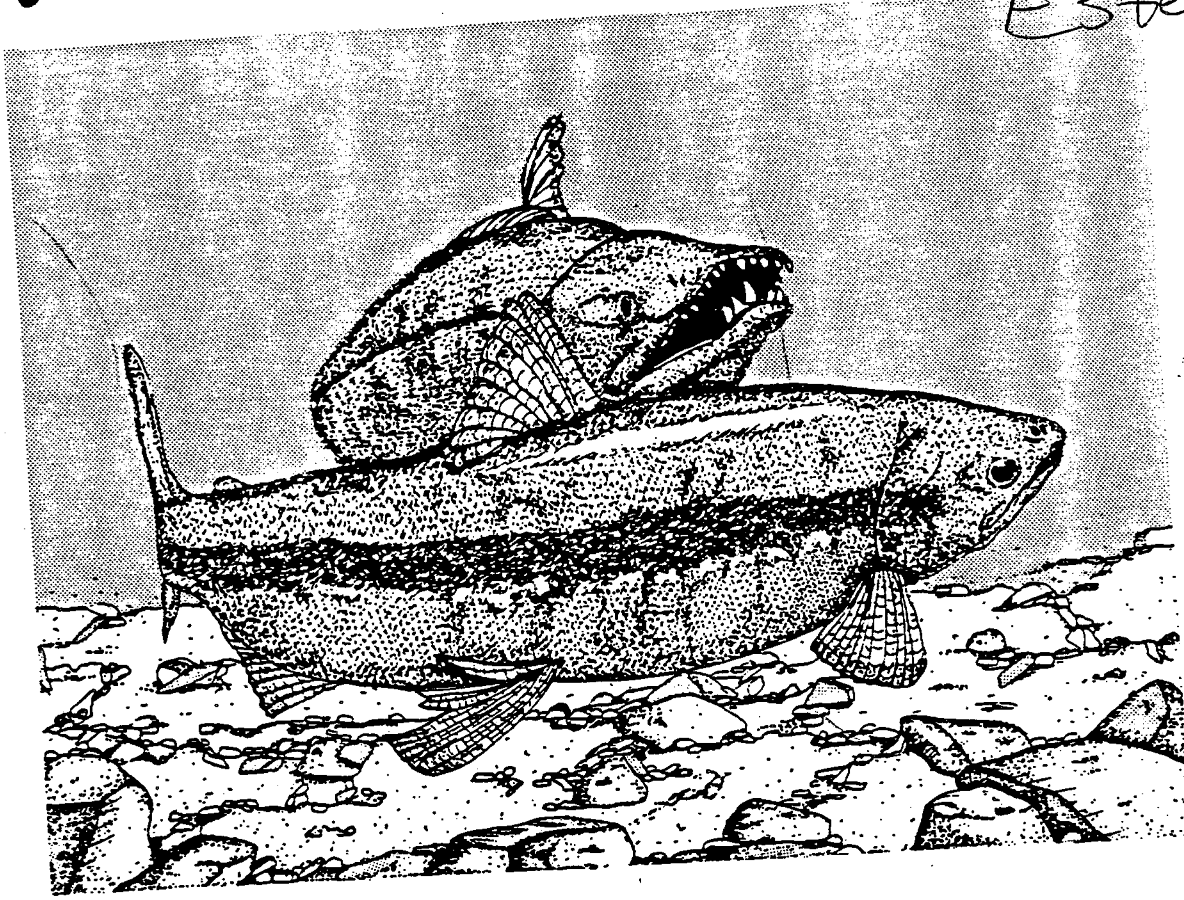

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PHASE II REPORT

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

ALASKA DEPARTMENT OF FISH AND GAME

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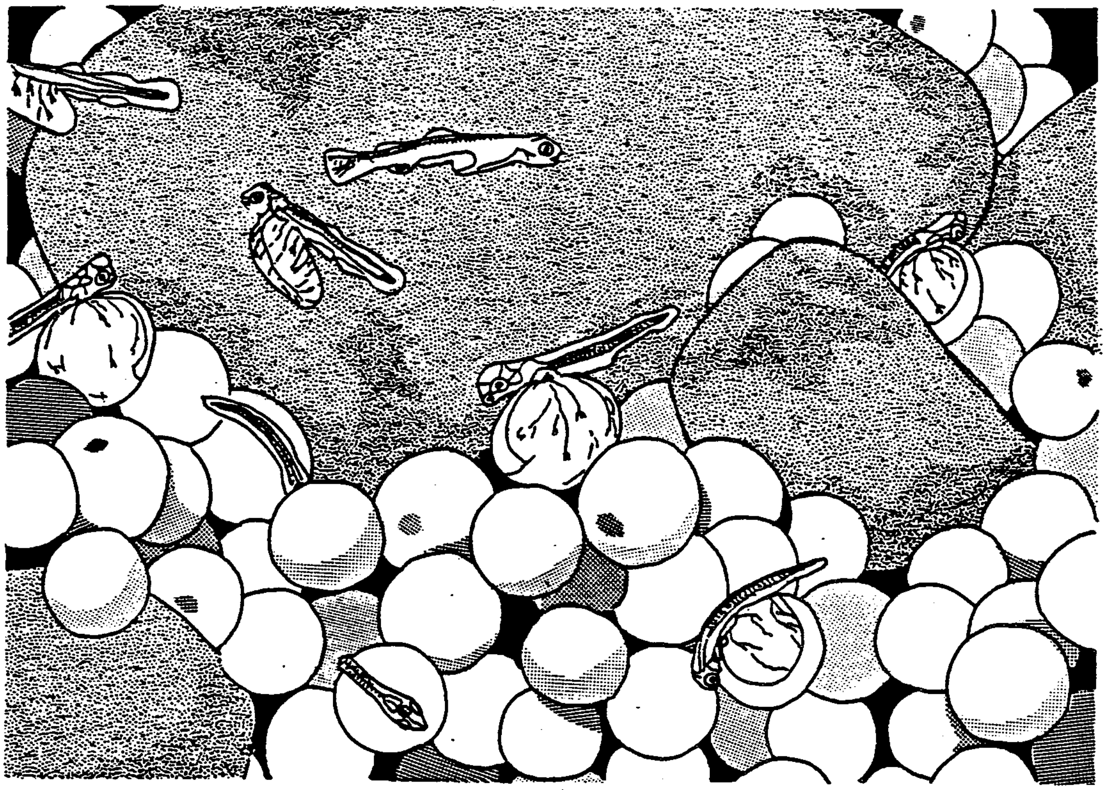

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SUSITNA HYDRO AQUATIC STUDIES
PHASE II DATA REPORT

Winter Aquatic Studies
(October, 1982 - May, 1983)

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ALASKA
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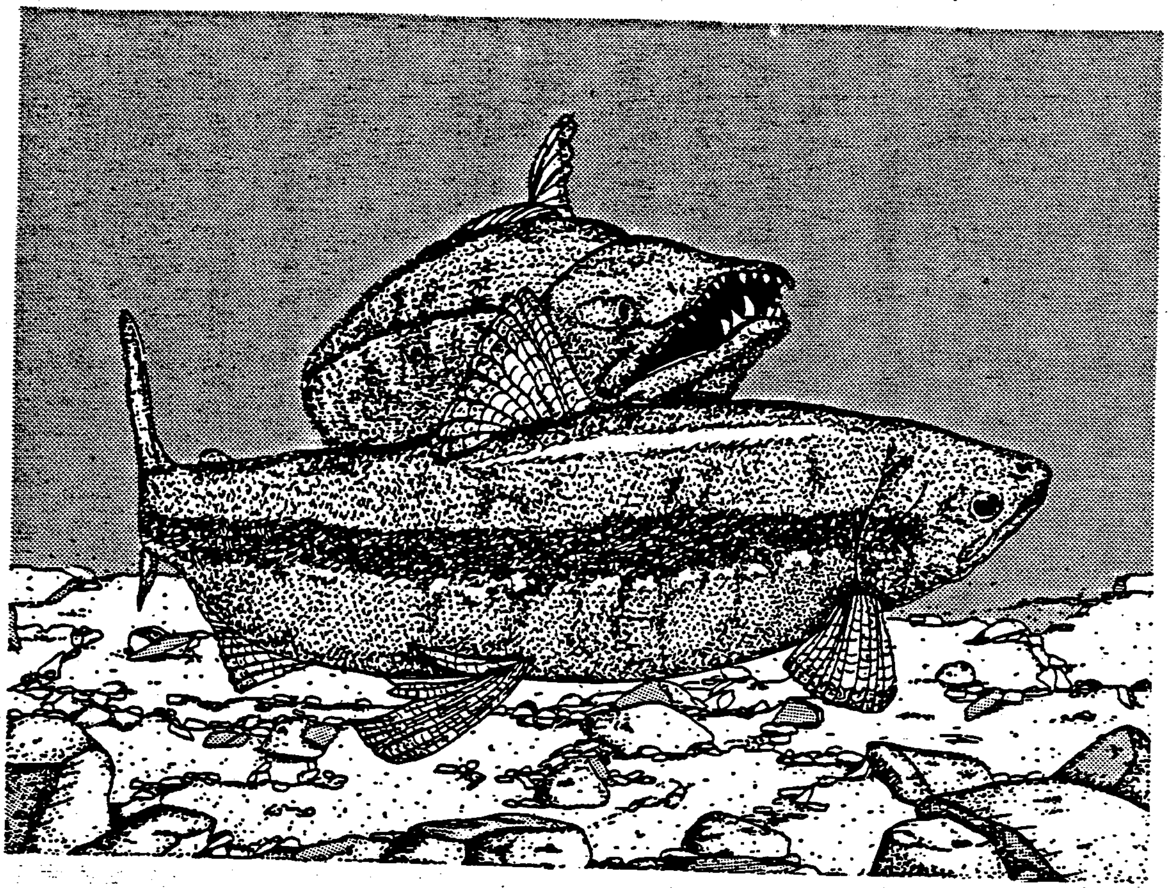

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May 1983 - June 1984

Procedures Manual
Final Draft

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2. Oscilloscope Operation
3. Fishwheel Operation
4. Fish Tagging
5. Geographic Location Code and General Maps
6. General Equipment, Camp Maintenance and Camp Police
7. Electroshocking Boat Operations

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1. Instructions for completing Juvenile Anadromous Habitat Study (JAHS) sampling forms and field data notes.

2. Operational procedures for the Epson HX-20 microcomputer data form program.

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1. Outline describing flow chart for salmon spawning habitat evaluation.

2. Revisions to the operation and maintenance instructions, Hydrolab Digital 4041.

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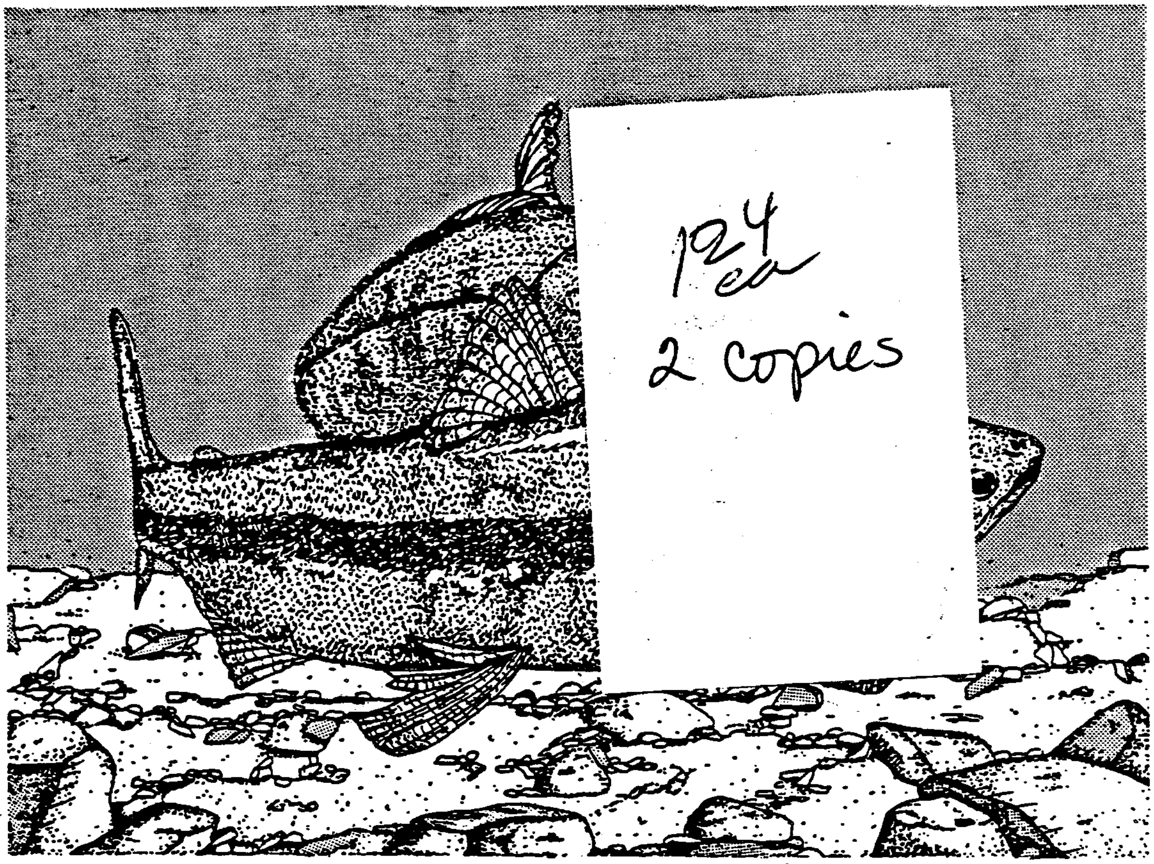

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ADF&G Su Hydro Aquatic Studies
May 1983 - June 1984

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ADULT ANADROMOUS FISHERIES STUDIES

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RESIDENT AND JUVENILE ANADROMOUS FISHERIES PROJECT

Instructions for completing Juvenile Anadromous Habitat Studies (JAHS) sampling forms and field data notes.

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RESIDENT AND JUVENILE ANADROMOUS FISHERIES PROJECT

Operational procedures for the Epson HX-20 microcomputer data form program.

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AQUATIC HABITAT AND INSTREAM FLOW PROJECT

Outline describing flow chart for salmon spawning habitat evaluation.

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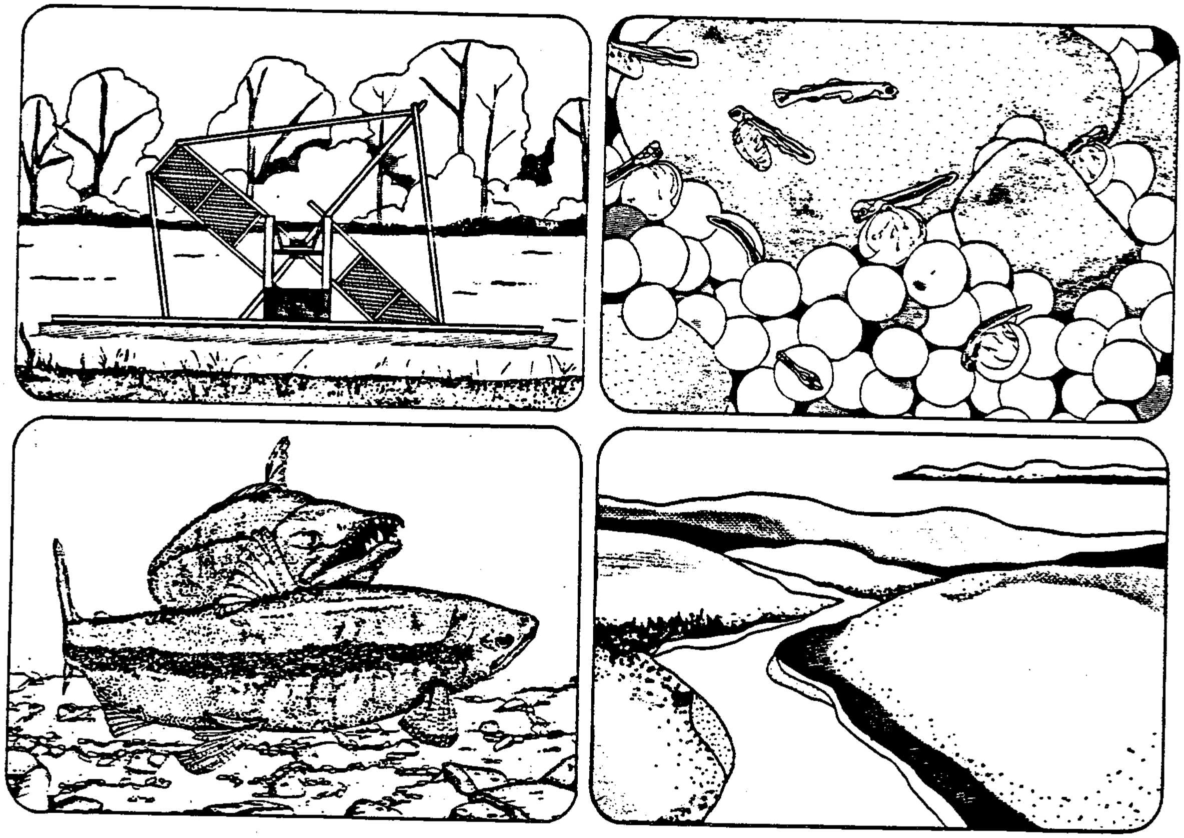

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ALASKA DEPARTMENT OF FISH AND GAME

SUSITNA HYDRO AQUATIC STUDIES

REPORT NO. 1

2207 Spenard Road

Anchorage, Alaska 99503

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ALASKA DEPARTMENT OF FISH AND GAME

SUSITNA HYDRO AQUATIC STUDIES REPORT SERIES

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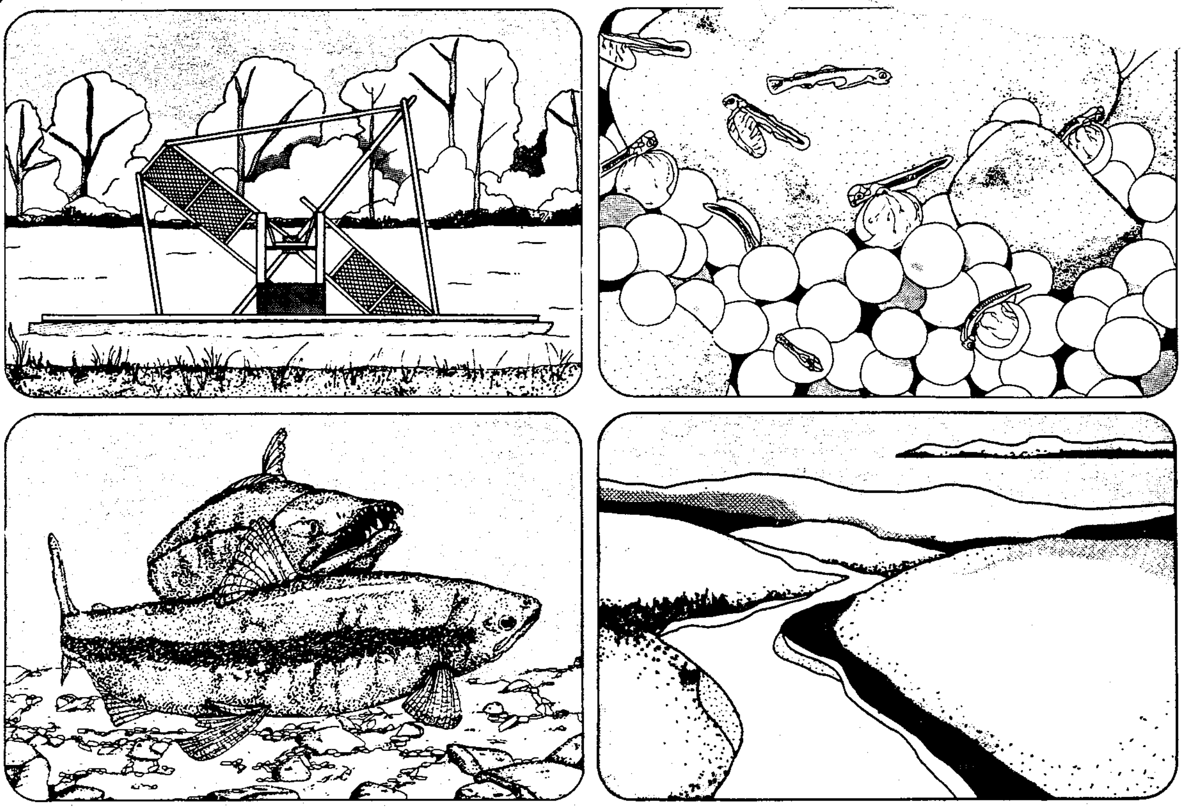

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RESIDENT AND JUVENILE ANADROMOUS FISH INVESTIGATIONS (MAY - OCTOBER 1983)

#20.

APA Doc #1784

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SUSITNA HYDRO AQUATIC STUDIES REPORT SERIES

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THE OUTMIGRATION OF JUVENILE SALMON FROM THE SUSITNA RIVER ABOVE THE CHULITNA RIVER CONFLUENCE

1984 Report No. 2, Part 1

by Kent J. Roth, Daniel C. Gray, and Dana C. Schmidt

Alaska Department of Fish and Game
Susitna Hydro Aquatic Studies
2207 Spenard Road
Anchorage, Alaska 99503

ABSTRACT

Population estimates of juvenile salmon were obtained by mark-recapture using a unique application of the coded wire tagging technique during 1983. One-half length coded wire tags were used to mark 24,287 post-emergent chum and 17,963 post-emergent sockeye salmon fry at four sloughs and one tributary of the Susitna River between the Chulitna River confluence and Devil Canyon. Tag retention rates averaged 96% and total mortalities caused by the capture and tagging procedure were 1%. Sixty-two coded wire tagged chum salmon fry and 394 tagged sockeye salmon fry were recovered in two downstream migrant traps located in the Susitna River five miles above the Chulitna River confluence. The mark-recapture estimates indicated that 3,322,000 chum salmon fry and 560,000 sockeye salmon fry migrated downstream past the outmigrant traps during 1983. Estimated survival rates between potential egg deposition and outmigration for chum and sockeye salmon fry were 14% and 41%, respectively. The downstream migrant traps collected all five species of Pacific salmon during the open water period. Pink salmon trap catches were highest in early June, and peak outmigration of chum salmon occurred in mid June. Chinook, coho, and sockeye salmon juveniles were collected at the traps throughout the sampling season, with peaks occurring during high mainstem discharge levels in early June, early July, and mid August. The rate of outmigration of chum salmon showed a higher correlation with discharge than that of other species.

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THE DISTRIBUTION AND RELATIVE ABUNDANCE OF JUVENILE SALMON IN THE SUSITNA RIVER DRAINAGE ABOVE THE CHULITNA RIVER CONFLUENCE

1984 Report No. 2, Part 2

by Lawrence J. Dugan, David A. Sterritt, and Michael E. Stratton

Alaska Department of Fish and Game
Susitna Hydro Aquatic Studies
2207 Spenard Road
Anchorage, Alaska 99503

ABSTRACT

The Juvenile Anadromous Habitat Study was undertaken to determine the seasonal distribution and abundance of juvenile salmon by macrohabitat type in the Susitna River drainage between the Chulitna River confluence and Devil Canyon. Thirty-five sites representing four macrohabitat types were sampled from May through September, 1983; limited sampling was conducted in October and November. Side channels and tributaries were found to be important rearing areas for juvenile chinook salmon with tributaries important early in the summer and side channels of the mainstem Susitna increasing in importance as the summer progressed. Coho salmon were most abundant in tributaries and upland sloughs. Natal side sloughs and backwater areas provided rearing areas for chum and sockeye salmon fry. Upland sloughs, the most lake-like environment, had concentrations of sockeye and coho salmon juveniles. Macrohabitat type and time of year were found to be significantly ($p < 0.10$) related to the distribution of all species.

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JUVENILE SALMON REARING SUITABILITY CRITERIA

1984 Report No. 2, Part 3

by Paul M. Suchanek, Robert P. Marshall, Stephen S. Hale, and Dana C. Schmidt

Alaska Department of Fish and Game
Susitna Hydro Aquatic Studies
2207 Spenard Road
Anchorage, Alaska 99503

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ABSTRACT

Changes in flow regimes in the Susitna River may affect the habitat used by rearing juvenile salmon. In order to model changes in habitat usability, data were collected for development of suitability criteria for the habitat attributes of cover, velocity, and depth used by juvenile chinook, coho, sockeye, and chum salmon. Representative sites between the Chulitna River confluence and Devil Canyon were sampled for juvenile salmon and habitat attributes were measured. Analysis was primarily univariate and data were pooled over site and season. Turbidity was apparently used by chinook salmon as cover prompting development of suitability criteria for clear (<30 NTU) and turbid (>30 NTU) conditions. Catches were insufficient for analysis of the other species by turbidity level. Suitability criteria for percent cover, cover type, velocity, and depth were developed for all four species of salmon. Composite weighting factors were formulated and correlated or compared with observed fish catch. Limitations of the suitability criteria and possible uses in habitat analysis are discussed.

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JUVENILE SALMON REARING HABITAT MODELS

1984 Report No. 2, Part 4

by Robert P. Marshall, Paul M. Suchanek, and Dana C. Schmidt

Alaska Department of Fish and Game
Susitna Hydro Aquatic Studies
2207 Spenard Road
Anchorage, Alaska 99503

ABSTRACT

The effects of mainstem discharge on rearing habitat of juvenile salmon in the Susitna River reach between the Chulitna River confluence and Devil Canyon were quantified by use of habitat models. Six slough and side channel sites were sampled at four to seven different levels of mainstem discharge during the 1983 open water season. Data were collected on hydraulic characteristics, cover, water quality, water surface area, and fish density. Suitability criteria were integrated with the habitat data to calculate weighting factors for cover and velocity for selected species at each site. These weighting factors, which were calculated for both shoreline and mid-channel areas, were then combined with area to produce weighted usable areas for the site. A habitat index was then calculated for site comparisons. Peaks in habitat indices for chinook salmon occurred when slough or side channel heads were overtopped. Upland slough habitat indices steadily increased with mainstem discharge. Lack of cover may limit juvenile salmon use of many of the sites.

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JUVENILE SALMON REARING HABITAT MODELS

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RESIDENT FISH DISTRIBUTION AND POPULATION DYNAMICS IN THE SUSITNA RIVER BELOW DEVIL CANYON

1984 Report No. 2, Part 5

by Richard L. Sundet and Mark N. Wenger

Alaska Department of Fish and Game
Susitna Hydro Aquatic Studies
2207 Spenard Road
Anchorage, Alaska 99503

ABSTRACT

Studies of resident fish during 1983 were concentrated on the reach of the Susitna River between the Chulitna River confluence and Devil Canyon. With the use of radio telemetry and mark and recapture methods, the seasonal distribution of rainbow trout and estimates of local abundance were obtained. Examination of recapture data over the past several years suggests that the rainbow trout population in this reach is probably less than 4,000 fish. Most of the concentrations are in the smaller tributaries, particularly Fourth of July Creek, which also has the only significant amount of successful spawning documented so far in this portion of the Susitna basin. The large tributaries, Portage Creek and Indian River, had comparatively small numbers of rearing rainbow trout. This species spends much of its annual life cycle in the mainstem Susitna near tributary mouth areas or mixing zone confluences of sloughs. Much of the migratory movements during the summer appear to be in response to the influx of adult salmon spawners, whose eggs apparently provide a major source of food. Radio tagged rainbow trout movement data suggests that the mainstem is important for overwintering. Limited data from tagged rainbow trout below the Chulitna River confluence suggests the reach of river between RM 78.0 and Talkeetna may also be an important overwintering area for Talkeetna River stocks as well. Spawning of round whitefish in October and probably burbot in January is directly influenced by mainstem flows. Young age class Arctic grayling and round whitefish appear to reside in the mainstem Susitna, usually near tributary or slough mouths. Nearly all of the spawning and most of the rearing of older age class Arctic grayling occurs in tributaries. Arctic grayling overwinter in the mainstem Susitna. Dolly Varden are rare in this reach of the Susitna. Selected sites have been established that can be used to monitor catch per unit effort of the resident species, and consequently their response to flow regulation of the proposed hydroelectric project.

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RESIDENT FISH HABITAT STUDIES

1984 Report No. 2, Part 6

by Paul M. Suchanek, Richard L. Sundet and Mark N. Wenger

Alaska Department of Fish and Game
Susitna Hydro Aquatic Studies
2207 Spenard Road
Anchorage, Alaska 99503

ABSTRACT

The macrohabitat distribution and microhabitat suitability for rainbow trout, Arctic grayling, round whitefish, and longnose suckers in the Susitna River drainage between the Chulitna River confluence and Devil Canyon were evaluated using electrofishing, beach seine, and hook and line catch data and habitat data collected at radio telemetry relocation sites (rainbow trout and burbot) and spawning sites (round whitefish).

Turbidity had important effects on distribution of both adult and juvenile resident fish. Longnose suckers and juvenile round whitefish were found in highest numbers in turbid water. Adult rainbow trout, Arctic grayling, and round whitefish found clear water more suitable, but used turbidity for cover. Suitability criteria for velocity, depth, and object cover were fit to the distribution of resident fish. The location of radio tagged rainbow trout among macrohabitat types varied greatly by season.

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MODELLING OF JUVENILE SALMON AND RESIDENT FISH HABITAT

Report Series No. 2, Part 7

by Stephen S. Hale, Paul M. Suchanek, and Dana C. Schmidt

Alaska Department of Fish and Game
Susitna Hydro Aquatic Studies
2207 Spenard Road
Anchorage, Alaska 99503

ABSTRACT

Output from the Instream Flow Group hydraulic models of rearing habitat for juvenile salmon and resident species at seven sites in the Chulitna River confluence to Devil Canyon reach of the Susitna River leads to similar conclusions as those drawn from a habitat model developed by the Susitna Hydro Aquatic Studies group for six additional sites. Overtopping of side slough heads by mainstem discharge causes abrupt changes in rearing habitat which are of positive benefit for some species/life stages and negative for others. Rearing habitat for chinook salmon at the study sites is greatest when the head of the site is slightly overtopped, thus providing turbid water for cover and moderate water velocities. The portions of this reach which are directly influenced by the mainstem provide only limited rearing habitat for coho and sockeye salmon during the open water season, but are likely to be of major importance for all overwintering species. Resident species are associated with levels of turbidity, velocity, and food supply and in general are not abundant in side sloughs when the head is closed unless a tributary is present.

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Questions concerning this and prior reports should be directed to:

Alaska Power Authority
334 W. 5th Avenue
Anchorage, Alaska 99501
Telephone (907) 276-0001

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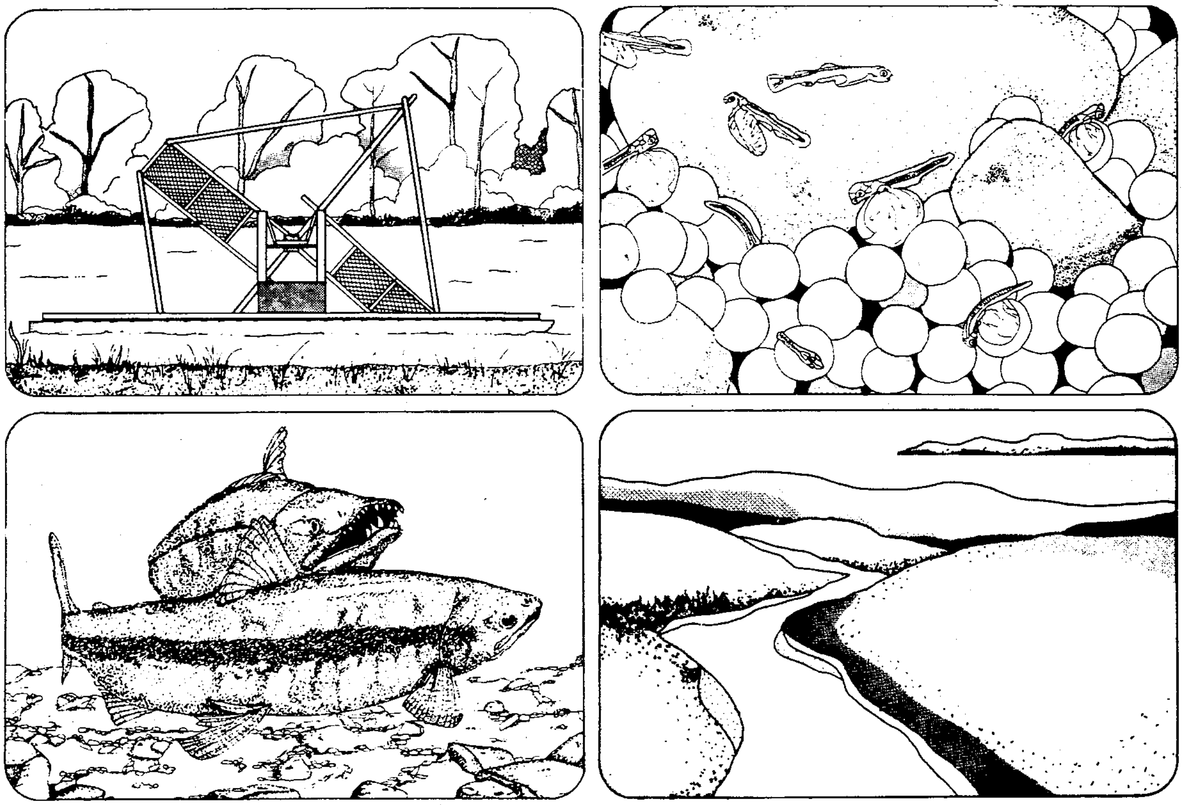

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REPORT NO. 3

AQUATIC HABITAT AND INSTREAM FLOW INVESTIGATIONS (MAY-OCTOBER 1983)

Chapter 1: Stage and Discharge Investigations

21a.

APA Doc# 1930

ALASKA DEPARTMENT OF FISH AND GAME
SUSITNA HYDRO AQUATIC STUDIES REPORT SERIES

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STAGE AND DISCHARGE INVESTIGATIONS

1984 Report No. 3, Chapter 1

#212

by Tim Quane, Pat Morrow, and Tommy Withrow

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Alaska Department of Fish and Game
Susitna Hydro Aquatic Studies
2207 Spenard Road
Anchorage, Alaska 99503

ABSTRACT

Baseline hydrological data have been collected within the Susitna River basin since 1981 in conjunction with the baseline fisheries studies being conducted by the Alaska Department of Fish and Game Susitna Hydroelectric Aquatic Studies Feasibility Team. The primary objective of the data collection program has been to collect baseline hydrological data (stage/water surface elevation, streamflow, and discharge) within the variety of fish habitats that are present in the Susitna River basin and to determine the influences of mainstem discharge conditions on the hydrological characteristics of these habitats. Although these investigations have been conducted throughout this large glacially-fed river system, effort has been concentrated in the reach of river extending from Talkeetna (RM 97) to Devil Canyon (RM 150) as impacts from the construction and operation of the proposed hydroelectric development are expected to be greatest in this river reach.

Six major fishery habitat types are located in the reach of river from Talkeetna to Devil Canyon; mainstem, side channel, side slough, upland slough, tributary mouth, and tributary. Sufficient data was collected to describe the relationship of mainstem discharge on the water surface elevation of the mainstem at 46 sites. Based on these data, this relationship is fairly well defined for the range of discharges from 5,000 to 30,000 cfs (as referenced to the USGS Gold Creek mainstem discharge gaging station). Mainstem discharge was also found to influence, to varying degrees, the hydraulic characteristics of side channels and side slough habitats by creating backwater areas and by overtopping the heads of these habitats. Prior to overtopping events, flow in these habitats was found to be generally clear and low, originating from groundwater upwelling and surface water runoff. Subsequent to overtopping, flow in these habitats was found to increase dramatically and become directly governed by mainstem discharge. The heads of upland slough habitats are never found to breach, with the only influence of mainstem discharge on these habitats being backwater effects. The streamflow regimes of the major clearwater tributaries in this reach were also evaluated to determine the relative contribution of the tributaries to the overall discharge of the Susitna River watershed.

Information from these studies will be used by other project biologists and engineers to evaluate the impact of hydroelectric development on the Susitna River.

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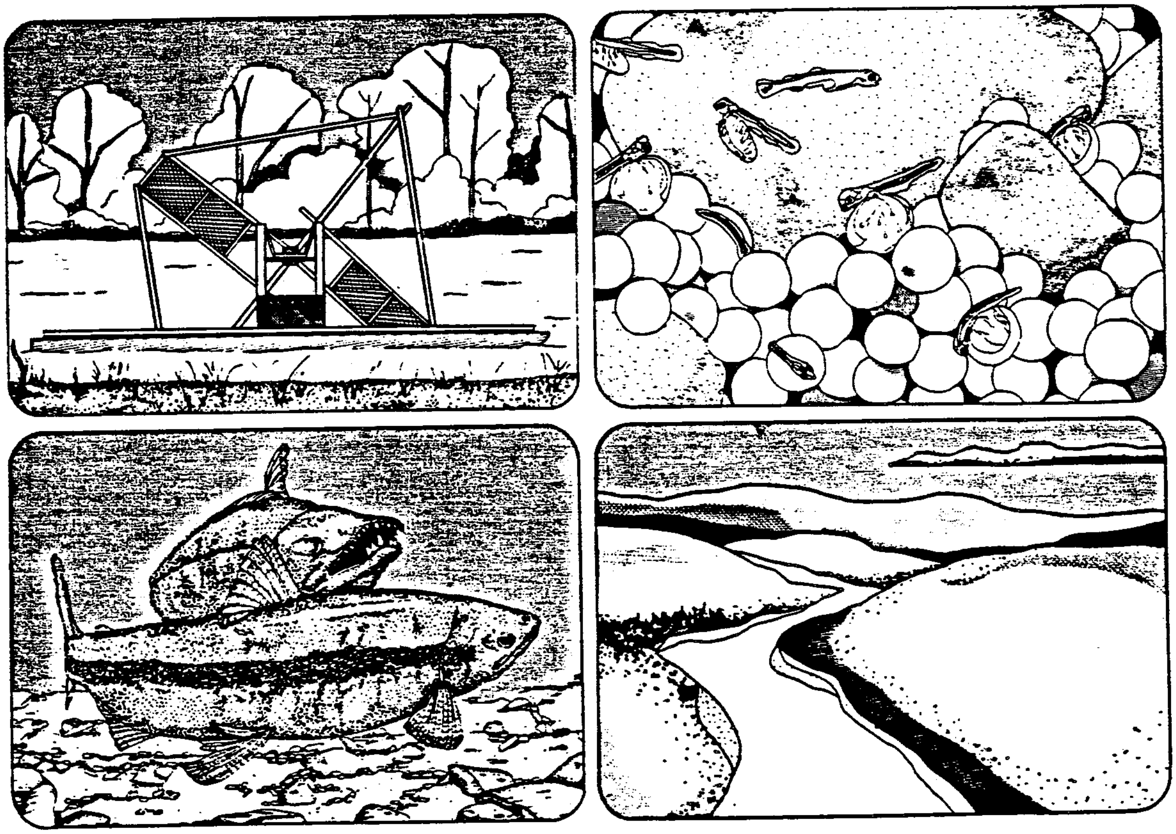

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AQUATIC HABITAT AND INSTREAM FLOW INVESTIGATIONS (MAY-OCTOBER 1983)

Chapter 2: Channel Geometry Investigations

21b.

APA Doc #1931

ALASKA DEPARTMENT OF FISH AND GAME
SUSITNA HYDRO AQUATIC STUDIES REPORT SERIES

Channel Geometry Investigations of the Susitna River Basin

(#21b)

1984 Report No. 3, Chapter 2

by: Tim Quane, Isaac Queral, Theresa Keklak, and Don Seagren,

Alaska Department of Fish and Game
Susitna Hydro Aquatic Studies
2207 Spenard Rd.
Anchorage, Alaska 99503

ABSTRACT

Channel geometry data have been collected by the Alaska Department of Fish and Game Susitna Hydro Aquatic Studies Feasibility Study Team since 1982 at twenty-one side channel, upland and side slough and tributary habitats located in the Talkeetna to Devil Canyon reach of the Susitna River. These data have been used to describe the channel characteristics of these study sites. Thalweg profiles, depicting the overall gradient, extent of backwater, and substrate composition of the site, were constructed from the data for four side channel and thirteen upland and side sloughs. Cross section profiles, illustrating the cross sectional channel characteristics and wetted surface area as a response to stage changes, were also developed for selected stage/discharge monitoring stations within these study sites. These data are used by other project biologists and engineers to evaluate the impact of hydroelectric development on the Susitna River.

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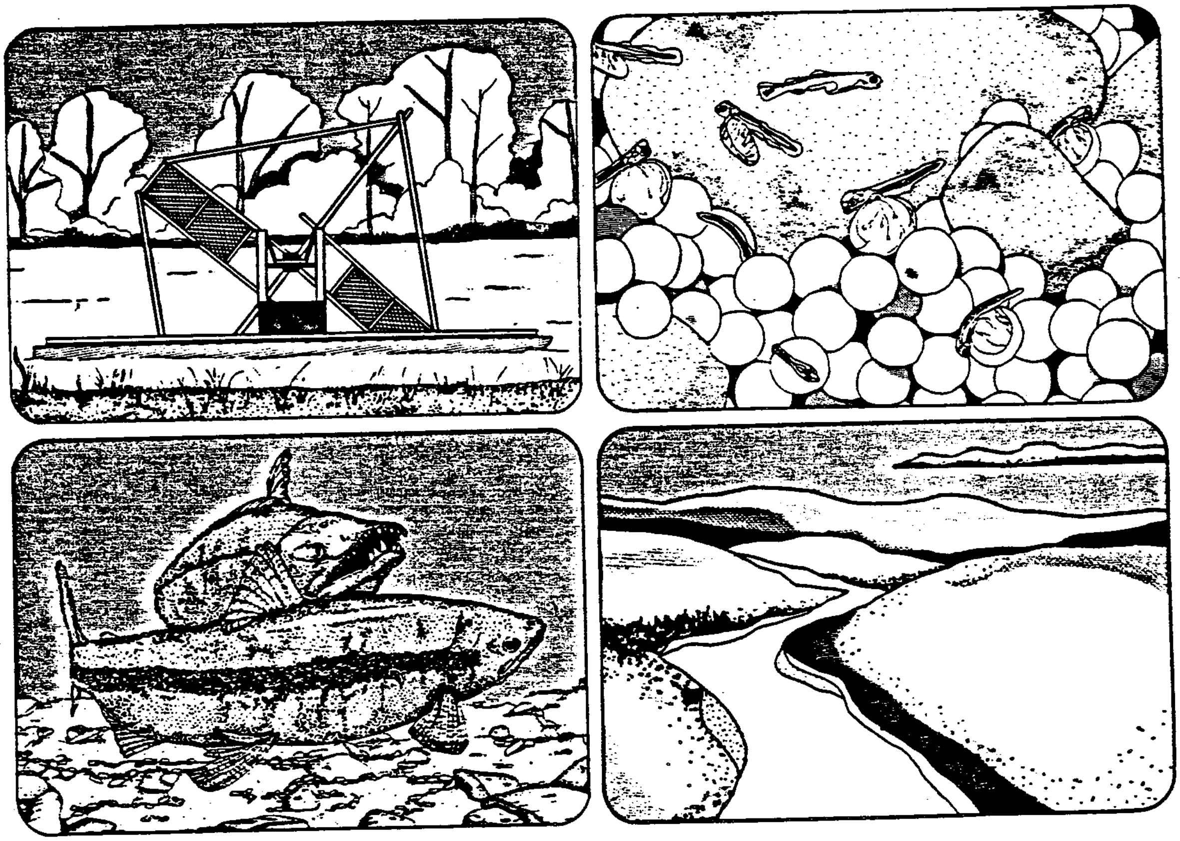

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AQUATIC HABITAT AND INSTREAM FLOW INVESTIGATIONS (MAY-OCTOBER 1983)

Chapter 3: Continuous Water Temperature Investigations

21c.

APA Doc# 1932

ALASKA DEPARTMENT OF FISH AND GAME

SUSITNA HYDRO AQUATIC STUDIES REPORT SERIES

(#21c)

Continuous Water Temperature Investigations

1984 Report No. 3, Chapter 3

by: Theresa Keklak and Tim Quane

Alaska Department of Fish and Game
Susitna Hydro Aquatic Studies
2207 Spenard Rd.
Anchorage, Alaska 99503

ABSTRACT

Surface and intragravel water temperature data have been recorded on a continuous basis at selected locations throughout the Susitna River Basin since 1981 by the Alaska Department of Fish and Game Su Hydro Aquatic Studies Feasibility Team to characterize the water temperature regimes of the mainstem Susitna River and its peripheral habitats. During the 1983 open water season (May-October, 1983) baseline surface and intragravel water temperature data were recorded in the mainstem Susitna River and its peripheral side channel, side slough, upland slough and tributary habitats. Although data was collected from the estuary (RM 0.0) to above the Oshetna River (RM 235.7), the study concentrated on the reach of the river from the Parks Highway Bridge (RM 83.9) to the Oshetna River (RM 233.4). During the 1983 open water season surface water temperatures in the mainstem Susitna River generally increased downstream from RM 235.7 to RM 103.0. Surface water temperatures recorded at RM 83.9 were colder reflecting the influences of the Talkeetna and Chulitna Rivers. Intragravel temperatures were recorded at sites from RM 103.3 to RM 142.3. Warmest intragravel temperatures were recorded at the most upstream site. The influence of mainstem temperatures on surface water temperatures in side sloughs or side channels resulting from mainstem breaching discharges was observed in Side Channels 10, Upper 11, and 21, and in Side Sloughs 9 and 21. Intragravel temperatures recorded in side channels and side sloughs were influenced by groundwater upwelling or mainstem temperatures. Variability in intragravel temperatures recorded within a side channel or side slough was observed in Upper Side Channel 11 and Slough 8A.

Results of these investigations will be used to evaluate the influences that seasonal water temperatures have a fish and fish habitats and to calibrate or validate various temperature models.

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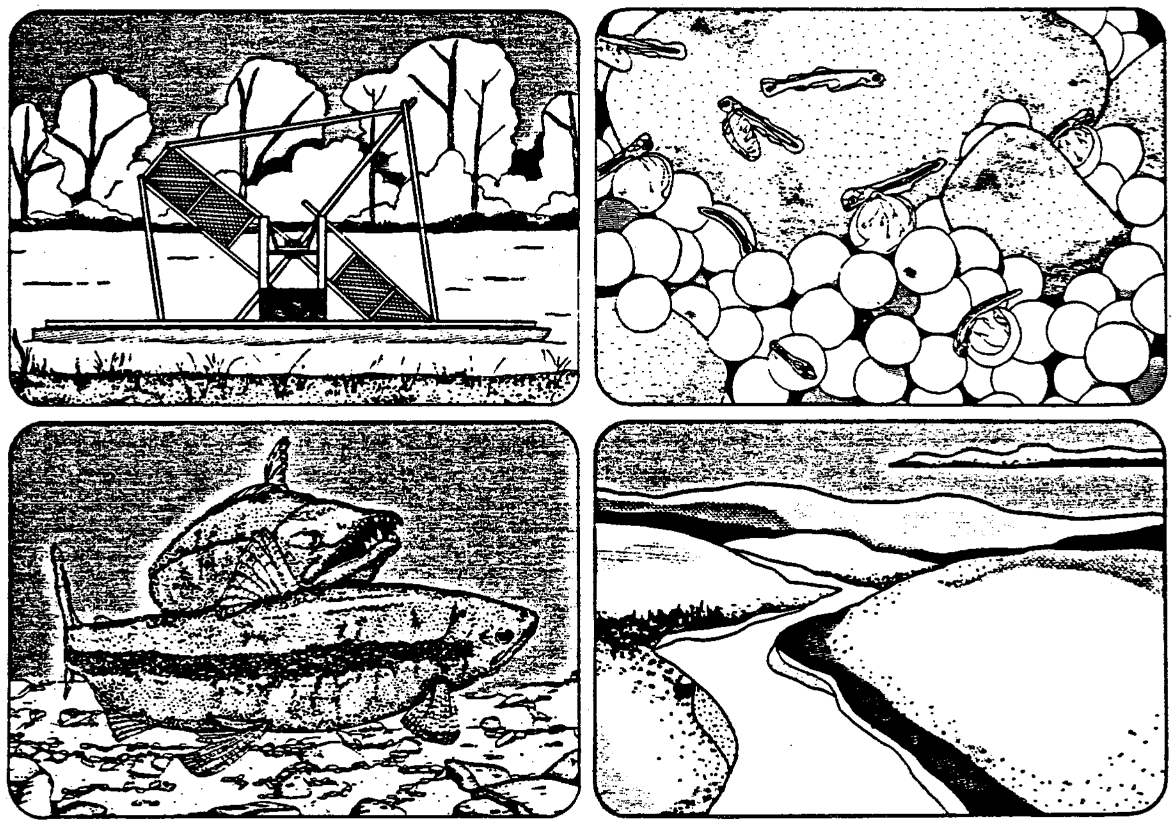

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REPORT NO. 3

AQUATIC HABITAT AND INSTREAM FLOW INVESTIGATIONS (MAY–OCTOBER 1983)

Chapter 4: Water Quality Investigations

21d.

APA Doc# 1933

ALASKA DEPARTMENT OF FISH AND GAME

SUSITNA HYDRO AQUATIC STUDIES REPORT SERIES

Water Quality Investigations

1984 Report No. 3, Chapter 4

(#21d)

by: Gene Sandone and Tim Quane

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Alaska Department of Fish and Game
Susitna Hydro Aquatic Studies
2207 Spenard Road
Anchorage, Alaska 99503

ABSTRACT

Baseline water quality data have been collected within the Susitna River basin since 1981 in conjunction with the baseline fisheries studies being conducted by the Alaska Department of Fish and Game Susitna Hydroelectric Aquatic Studies Feasibility Team. The primary objective of the data collection program has been to collect baseline water quality data (dissolved oxygen, pH, conductivity, temperature, and turbidity) within the habitats selected for fishery studies that are present in the Susitna River basin and to determine the influences of mainstem discharge conditions on the water quality characteristics of these habitats. Although these investigations have been conducted throughout this large glacially-fed river system, effort has been concentrated in the reach of river extending from Talkeetna (RM 97) to Devil Canyon (RM 150) as impacts from the construction and operation of the proposed hydroelectric development are expected to be greatest in this river reach.

The 1983 investigations (summarized in this report), concentrated on mainstem, side channel, side slough and tributary habitats. Water quality measurements of dissolved oxygen, pH, conductivity and turbidity were obtained in the mainstem Susitna River and the Talkeetna and Chulitna rivers twice a month on an instantaneous basis except for the Talkeetna fishwheel and Gold Creek camp stations, which were monitored daily. Turbidity measurements were obtained from several side channel and side sloughs in the Talkeetna to Devil Canyon reach twice a month.

Results of these investigations indicate that water quality in the mainstem Susitna River is relatively similar among sampling locations but that specific water quality variables at sampling stations change in relation to mainstem discharge. Increased levels of turbidity in the mainstem were found to correlate to mainstem discharge, but are assumed to result from suspended sediment contributed by the Susitna and Maclaren glaciers. Turbidity levels remain low when glacial melt ceases. Turbidity levels in side channels and side sloughs were found to be independent of mainstem discharge prior to breaching of the heads by the mainstem, however subsequent to breaching those sites were found to resemble the turbidity of the mainstem with the controlling factor being the relative flow contribution of the mainstem to that of the site

ccr

flow. Tributary water quality was found to be independent of mainstem Susitna River discharge and was determined to influence to varying degrees the water quality conditions of the mainstem depending on the relative size of the tributary.

Information from these studies will be used by other project biologists and engineers to evaluate the impact of hydroelectric development on the Susitna River.

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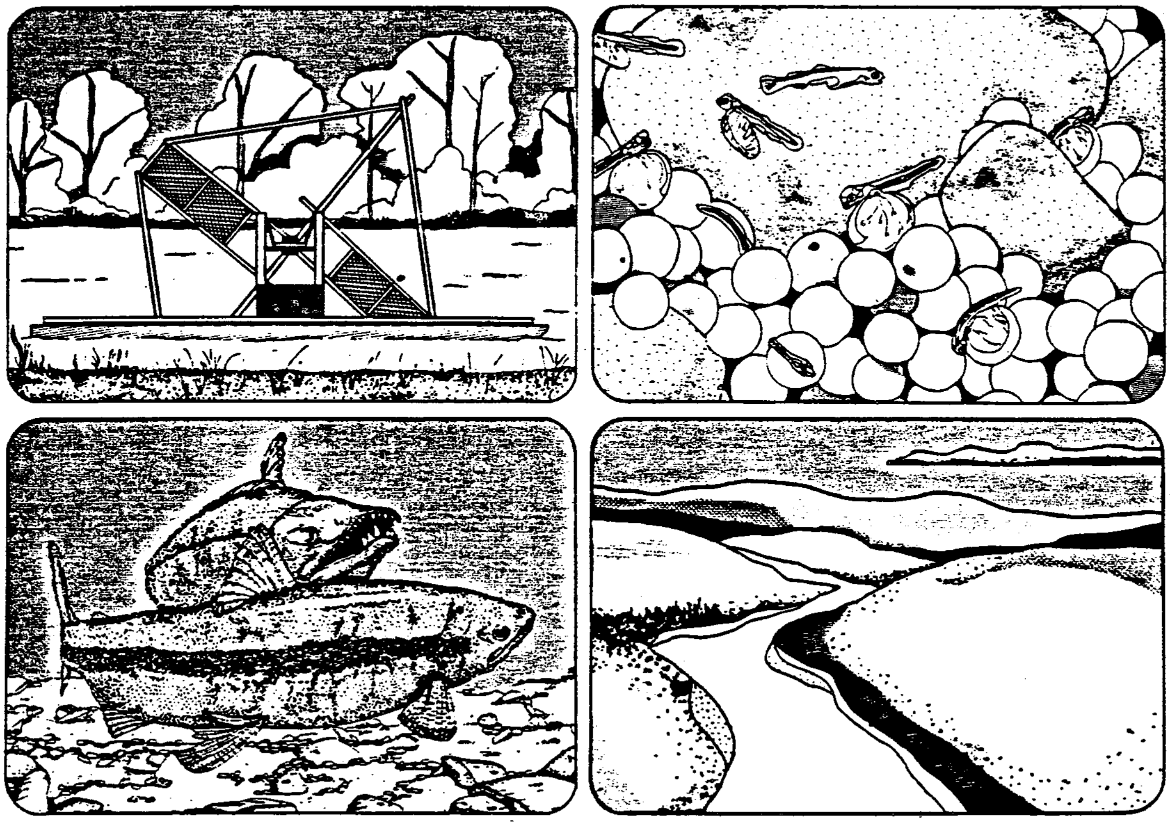

REPORT NO. 3

AQUATIC HABITAT AND INSTREAM FLOW INVESTIGATIONS (MAY-OCTOBER 1983)

(1983)

Chapter 5: Eulachon Spawning Habitat in the Lower Susitna River

21e.

APA Doc #1934

ALASKA DEPARTMENT OF FISH AND GAME

SUSITNA HYDRO AQUATIC STUDIES REPORT SERIES

(#21e)

EULACHON SPAWNING HABITAT IN THE LOWER SUSITNA RIVER.

1984 Report No. 3, Chapter 5

By: Douglas Vincent-Lang
and
Isaac Queral

Alaska Department of Fish and Game
Susitna Hydro Aquatic Studies
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Anchorage, Alaska 99503

ABSTRACT

Eulachon [Thaleichthys pacificus (Richardson)] are an anadromous member of the smelt family. Studies to determine naturally occurring hydraulic and temperature relationships to eulachon immigration and spawning were initiated by the Alaska Department of Fish and Game (ADF&G) in 1982 and continued into 1983. These surveys indicated that eulachon are probably the most abundant species of fish in the Susitna River. Based on 1982 and 1983 catch data, eulachon being their upstream spawning migration during early to mid-May. Two distinct spawning runs of eulachon enter the Susitna River with no apparent definite correlation with either mainstem discharge or temperature. Spawning was found to occur over a broad range of hydraulic and substrate conditions along the margins of mainstem habitats from the mouth of the Susitna River (RM 0) upstream to RM 50.3. Based on a representative number of spawning sites selected for further evaluation, it appears that similar physical habitat condition will be present under both decreased and increased mainstem discharge conditions.

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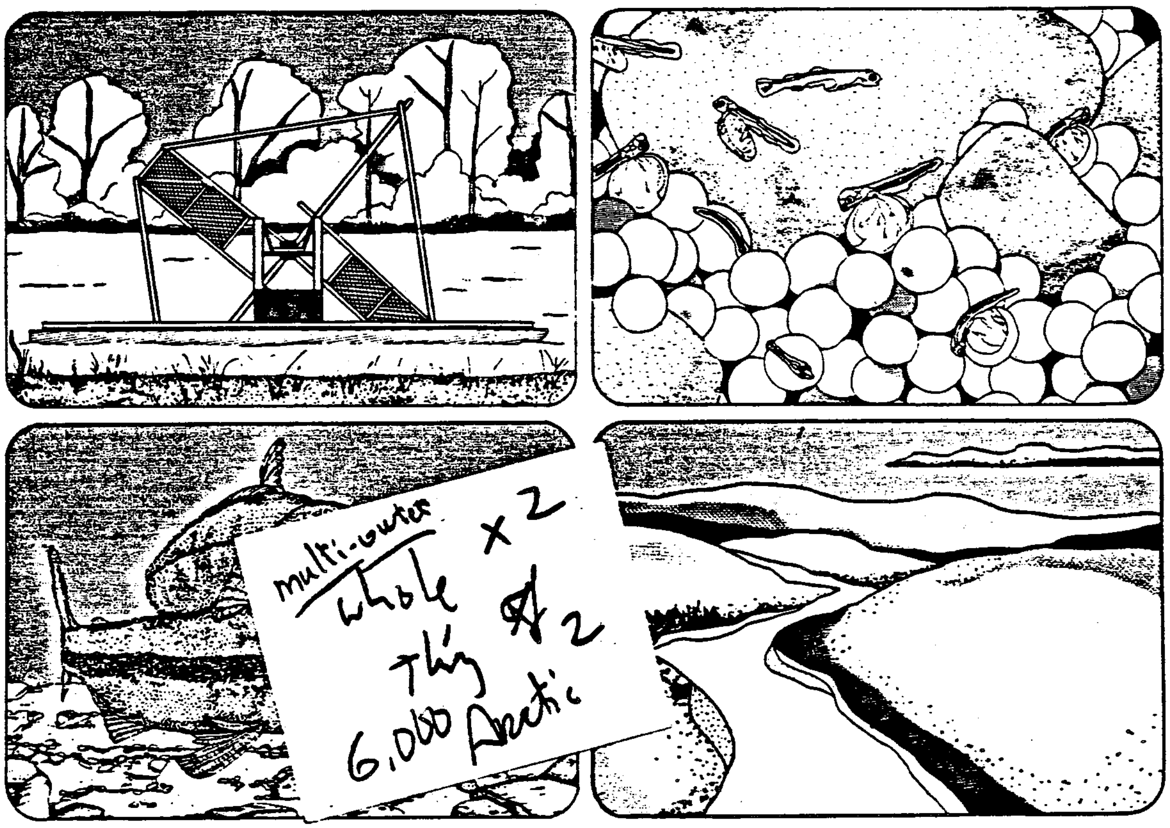

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REPORT NO. 3

AQUATIC HABITAT AND INSTREAM FLOW INVESTIGATIONS (MAY-OCTOBER 1983)

Chapter 6: An Evaluation of Passage Conditions for Adult Salmon in Sloughs and Side Channels of the Middle Susitna River

21f.

APA Doc #1935

ALASKA DEPARTMENT OF FISH AND GAME
SUSITNA HYDRO AQUATIC STUDIES REPORT SERIES

(#21-f)

AN EVALUATION OF PASSAGE CONDITIONS FOR ADULT SALMON IN SLOUGHS AND SIDE CHANNELS OF THE MIDDLE SUSITNA RIVER

1984 Report, Chapter 6

By:

Joseph S. Sautner
and
Leonard J. Vining

Alaska Department of Fish and Game
Susitna Hydro Aquatic Studies
2207 Spenard Road
Anchorage, Alaska 99503

and

Larry A. Rundquist

Woodward-Clyde Consultants

ABSTRACT

An interim evaluation of passage conditions for adult Pacific salmon into and within twelve slough and side channel sites in the middle reach of the Susitna River is presented to determine the effects of mainstem discharge on passage conditions into these habitat types. These habitats were selected for evaluation as they are affected by mainstem Susitna River discharges. A final evaluation will be completed in FY85. The sites account for the majority of chum, sockeye and pink salmon which spawn in sloughs and side channels in this reach. The evaluation of salmon passage conditions at each site included the effects of mainstem breaching discharge and backwater staging, and slough flows (local flows) derived from local water sources (e.g., upwelling, tributaries, precipitation). Timing and distribution patterns of salmon were also evaluated as they relate to passage conditions and flow patterns in the Susitna River system.

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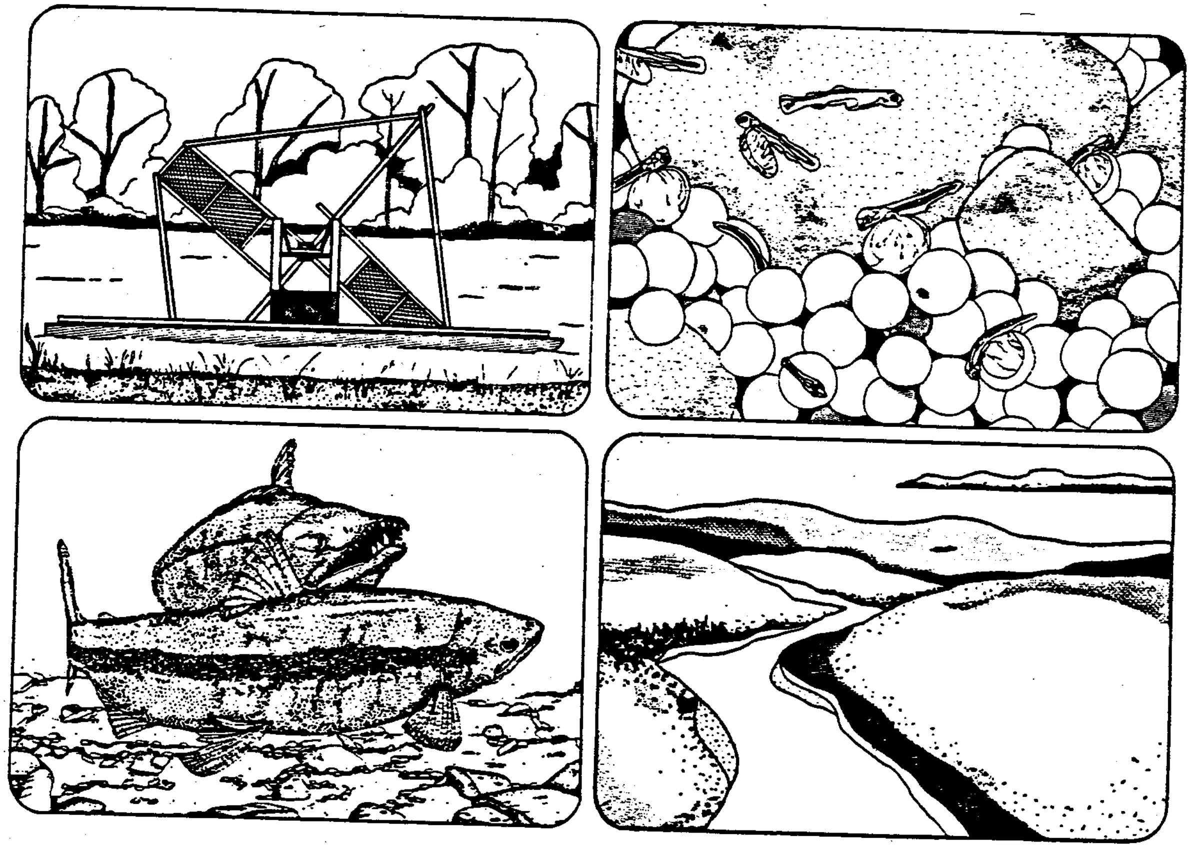

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REPORT NO. 3

AQUATIC HABITAT AND INSTREAM FLOW INVESTIGATIONS (MAY-OCTOBER 1983)

Chapter 7: An Evaluation of Chum and Sockeye Salmon Spawning Habitat in Sloughs and Side Channels of the Middle Susitna River

ALASKA DEPARTMENT OF FISH AND GAME

21g.

APA Doc #1936

ALASKA DEPARTMENT OF FISH AND GAME
SUSITNA HYDRO AQUATIC STUDIES REPORT SERIES

(#219)

AN EVALUATION OF CHUM AND SOCKEYE SALMON SPAWNING HABITAT IN SLOUGHS AND SIDE CHANNELS OF THE MIDDLE SUSITNA RIVER

1984 Report No. 3, Chapter 7

By:

Doug Vincent-Lang,
Andrew Hoffmann,
Allen E. Bingham, and
Christopher Estes
of
Alaska Department Fish and Game
Susitna Hydro Aquatic Studies
2207 Spenard Road
Anchorage, Alaska 99503

And

Diane Hilliard, Cleveland Stewart, and
E. Woody Trihey
of
E. Woody Trihey and Associates

And

Steve Crumley
of
Woodward Clyde Consultants

(2 of 7)

ABSTRACT

Three sloughs (8A, 9, and 21) and four side channels (10, Lower 11, Upper 11, and 21) in the middle reach of the Susitna River were evaluated using an Instream Flow Incremental Methodology (IFIM) physical habitat simulation (PHABSIM) modelling approach to evaluate the effects that site flow and mainstem discharge have on chum and sockeye salmon spawning habitat usability. Based in available field data, spawning habitat conditions on these sloughs and side channels are thought to represent the range of spawning habitat conditions that are present in the sloughs and side channels of the middle Susitna River which currently support a majority of chum and sockeye salmon spawning in these habitat types.

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Ten hydraulic simulation models were calibrated to simulate depths and velocities associated with a range of site-specific flows at these seven modelling study sites. Comparisons between corresponding sets of simulated and measured depths and velocities indicate that the calibrated models provide reliable estimates of depths and velocities within their recommended calibration ranges.

Habitat suitability criteria for chum and sockeye salmon spawning for the habitat variables of depth, velocity, substrate, and upwelling were developed for input into a habitat simulation model. The suitability criteria developed for chum salmon spawning were based on an analysis of utilization data as modified using limited preference data, literature information, and the opinion of project biologists familiar with middle Susitna River chum salmon stocks. The spawning suitability criteria constructed for sockeye salmon were developed using the same analytical approach used in the chum salmon analysis with the exception that no analysis of preference could be made.

Using a habitat simulation model (HABTAT), the output of hydraulic simulation models and the spawning habitat suitability criteria were linked to project usable area of chum and sockeye salmon spawning habitat (WUA) as a function of flow for each of the seven modelled study sites. Using these relationships and relationships between site flows and mainstem discharge presented in Chapter 1 of this report, the relationships between chum and sockeye salmon spawning habitat as a function of mainstem discharge for the period of controlled site flows were also determined for each modelled study site. These projections of chum and sockeye spawning WUA made at study sites indicate that spawning habitat usability in sloughs and side channels exhibits certain species-specific and site-specific trends. Generally, projections of WUA at study sites peak in the range mainstem discharges from 20,000 to 35,000 cfs, with the controlling factor appearing to be the overtopping of the site by mainstem discharge and the subsequent control of the site flow by mainstem discharge. Assuming that the modelled sloughs and side channels are representative of other non-modelled sloughs and side channels in the middle reach which currently support spawning, the theoretical maximum WUA for slough and side channel habitats in the middle river reach would occur slightly after the mainstem discharge overtops and controls the hydraulics at a maximum number of these habitats. Based on a review of time series plots of WUA overtime of each study site, however, flows at study sites which currently support chum and sockeye spawning are only infrequently controlled by mainstem discharge. For this reason, the WUA at study sites remains relatively low and stable during the period of peak spawning activity (August through September), except during flood events. There appears to be a general positive correlation between projected WUA and habitat use at study sites.

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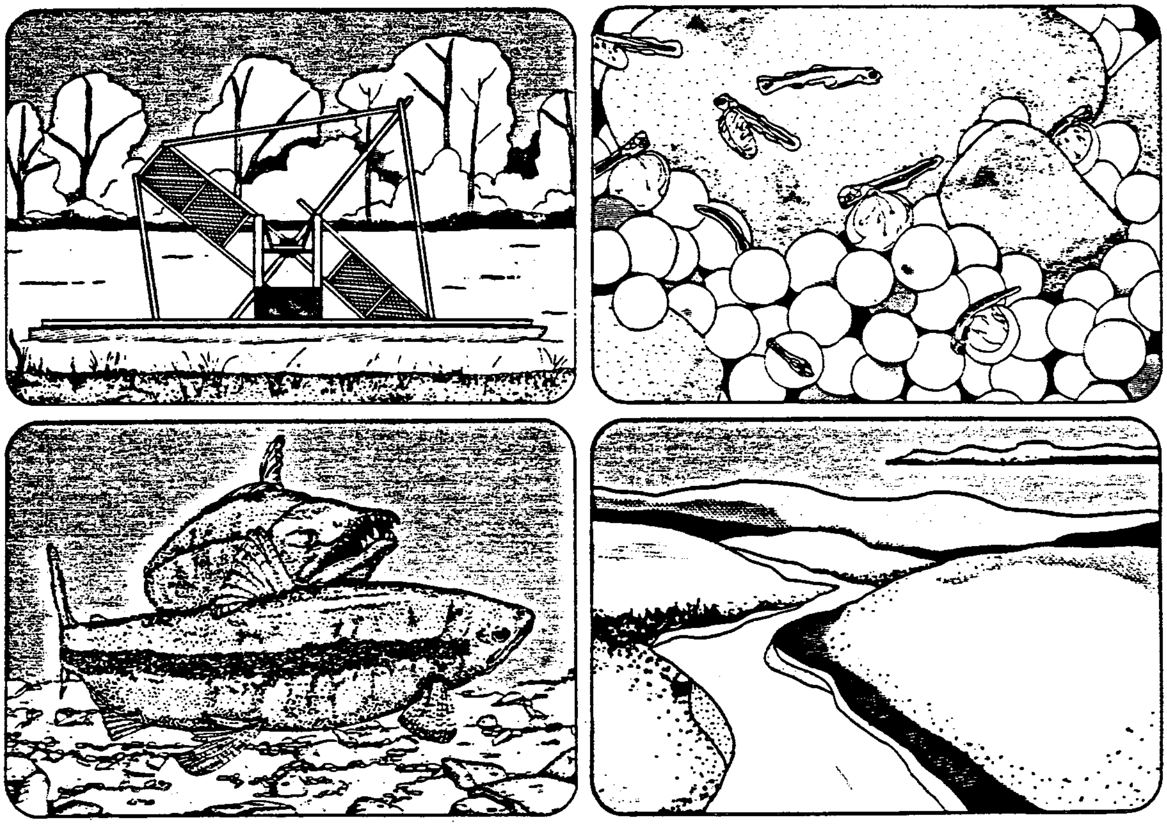

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REPORT NO. 3

AQUATIC HABITAT AND INSTREAM FLOW INVESTIGATIONS (MAY–OCTOBER 1983)

Chapter 8: Evaluations of Chum Salmon Spawning Habitat in Selected Tributary Mouth Habitats of the Middle Susitna River

21h.

ALASKA DEPARTMENT OF FISH AND GAME

APA Doc #1937

ALASKA DEPARTMENT OF FISH AND GAME
SUSITNA HYDRO AQUATIC STUDIES REPORT SERIES

(#21h)

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EVALUATIONS OF CHUM SALMON-SPAWNING HABITAT IN SELECTED TRIBUTARY-MOUTH HABITATS OF THE MIDDLE SUSITNA RIVER

1984 Report No. 3, Chapter 8

By: Gene Sandone, Doug Vincent-Lang, and Andrew Hoffmann

Alaska Department of Fish & Game
Susitna Hydro Aquatic Studies
2207 Spenard Road
Anchorage, Alaska 99503

ABSTRACT

Two tributary mouths (Lane Creek and Fourth of July Creek) located in the middle reach of the Susitna River were evaluated to determine the influence that mainstem discharge has on the quantity and quality of chum salmon spawning habitat. During the 1983 field season, chum salmon were observed spawning in the clearwater plume of Fourth of July Creek, but not within the Lane Creek mouth area. At each study site, the location and surface area of available and usable chum salmon spawning habitat was determined. Available habitat surface area was positively correlated to changes in mainstem discharge at both tributary mouth study sites, whereas usable chum salmon spawning habitat increased with increasing mainstem discharge only at the Fourth of July Creek mouth area. The surface area of usable chum salmon spawning habitat within the Lane Creek mouth decreased as mainstem discharge increased. This difference in usable surface area responses is likely related to the different type of confluence area of each site. Lane Creek flows directly into the mainstem while Fourth of July Creek empties into a side channel. Spawning activity could not be observed beyond the clearwater plume at the Fourth of July mouth area due to high mainstem turbidities. Because of this, the importance of the clearwater plume in determining the area of usable chum salmon spawning habitat at tributary mouth habitats could not be ascertained. If it is subsequently determined that chum salmon spawning does take place in the clearwater plume area of tributary mouths, the frequency distribution of spawning depths and velocities reported herein is likely biased towards shallower and slower waters.

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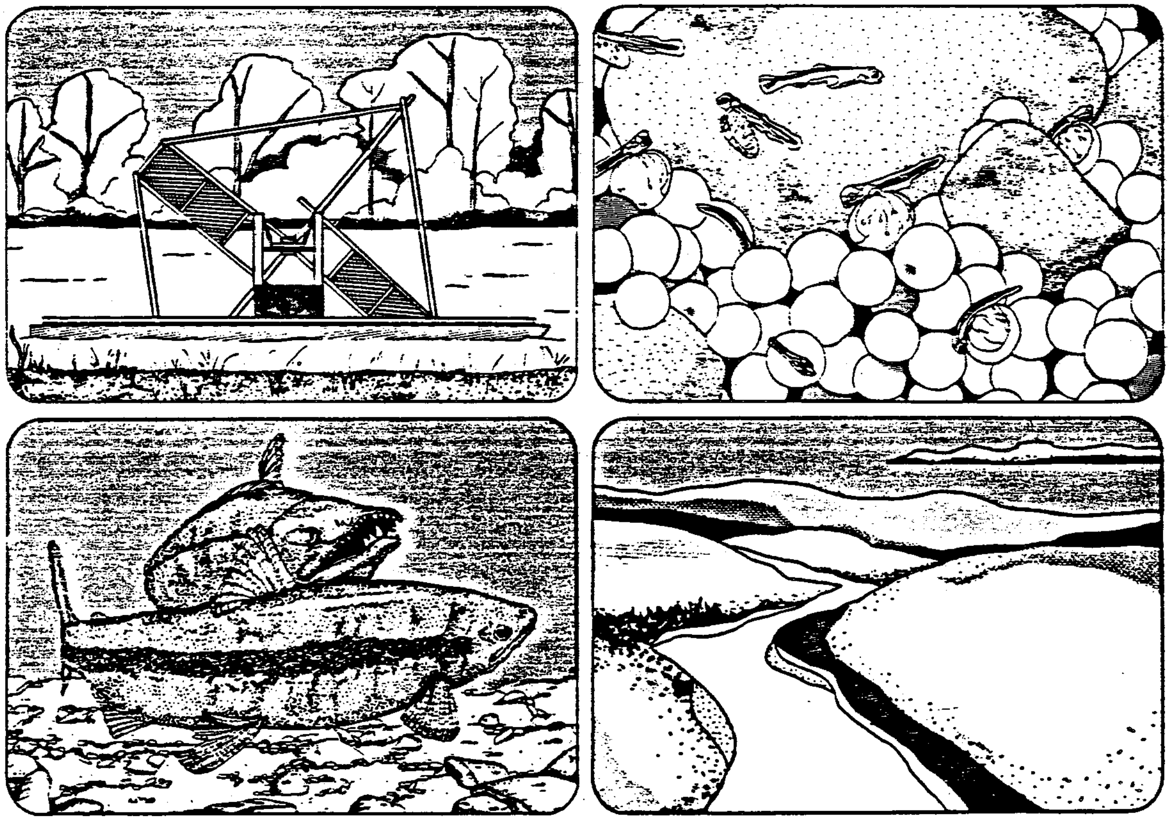

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REPORT NO. 3

AQUATIC HABITAT AND INSTREAM FLOW INVESTIGATIONS (MAY-OCTOBER 1983)

Chapter 9: Habitat Suitability Criteria for Chinook, Coho, and Pink Salmon Spawning in Tributaries of the Middle Susitna River

#21i.

APA Doc # 1938

ALASKA DEPARTMENT OF FISH AND GAME

SUSITNA HYDRO AQUATIC STUDIES REPORT SERIES

(#21 i)
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HABITAT SUITABILITY CRITERIA FOR CHINOOK, COHO, AND PINK SALMON SPAWNING IN TRIBUTARIES OF THE MIDDLE SUSITNA RIVER

1984 Report No. 3, Chapter 9

By

Doug Vincent-Lang,
Andrew Hoffmann,
Allen Bingham, and
Christopher Estes

Alaska Department of Fish and Game
Susitna Hydro Aquatic Studies
2207 Spenard Road
Anchorage, Alaska 99503

ABSTRACT

Utilization data for the habitat variables of depth, velocity, and substrate composition were collected at chinook salmon spawning sites in selected tributaries of the middle reach of the Susitna River. These data were modified using statistical methods and the professional judgments of project biologists familiar with Susitna River chinook salmon stocks to develop suitability criteria for chinook salmon spawning in tributaries of the middle Susitna River. These criteria show that depths ranging from 0.5 to 4.0 ft; mean water column velocities ranging from 0.3 to 4.5 ft/sec; and, substrates ranging from small gravels to cobbles are suitable for chinook salmon spawning in these habitats. Suitability criteria were also developed for coho and pink salmon spawning in tributaries of the middle Susitna River based on literature information as modified using the professional judgments of project biologists familiar with Susitna River coho and pink salmon stocks. These criteria show that depths ranging from 0.3 to 4.0 ft; mean water column velocities ranging from 0.1 to 5.0 ft/sec; and, substrates ranging from sand intermixed with small gravels to large rubbles are suitable for pink salmon spawning in these habitats. The criteria developed for coho salmon spawning in these habitats show the range of depths from 0.3 to 4.0 ft; mean water column velocities from 0.1 to 4.0 ft/sec; and, substrates from sand intermixed with small gravel to large rubbles are suitable for spawning in tributaries of the middle Susitna River. Suggested applications and limitations of these suitability criteria are discussed.

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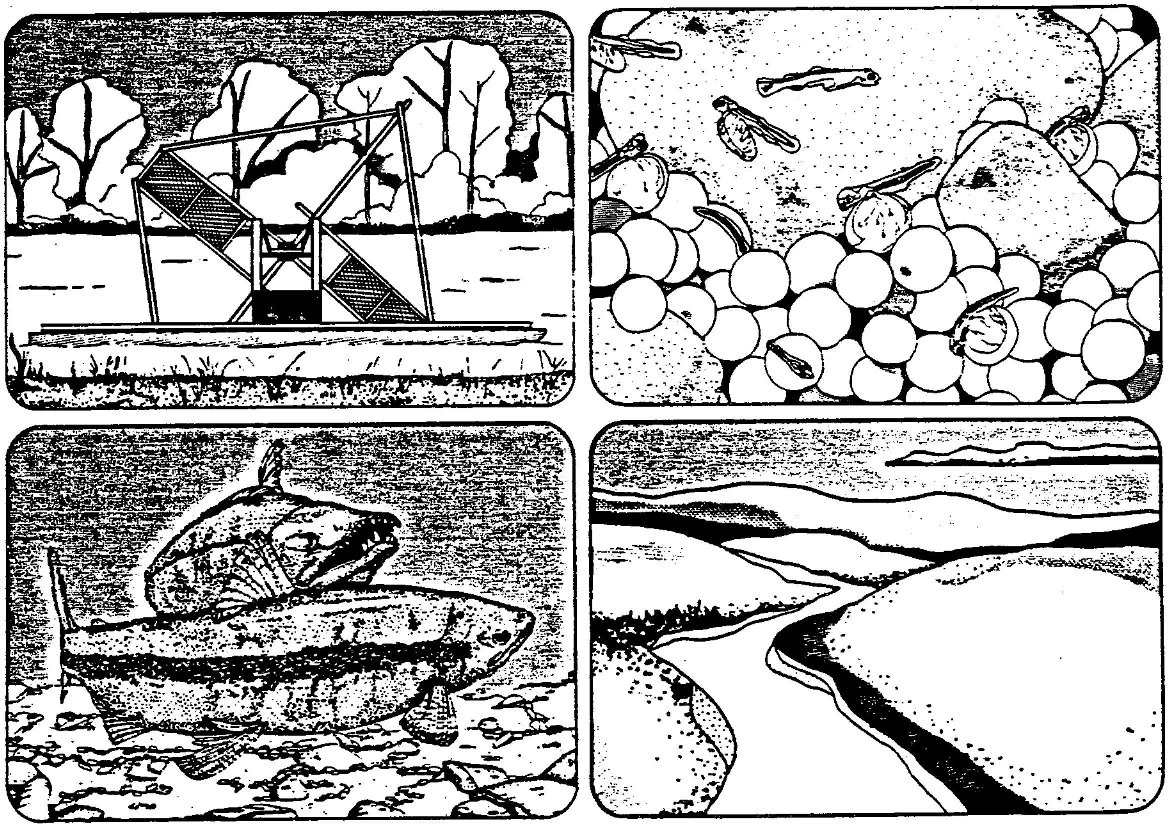

REPORT NO. 3

AQUATIC HABITAT AND INSTREAM FLOW INVESTIGATIONS (MAY-OCTOBER 1983)

Chapter 10: Evaluations of the Effectiveness of Applying Infrared Thermal Imagery Techniques to Detect Upwelling Groundwater

21j.

APA Doc #1939

ALASKA DEPARTMENT OF FISH AND GAME
SUSITNA HYDRO AQUATIC STUDIES REPORT SERIES

(#21j)

EVALUATIONS OF THE EFFECTIVENESS OF APPLYING INFRARED THERMAL IMAGERY TECHNIQUES TO DETECT UPWELLING GROUNDWATER

1984 Report No. 3, Chapter 10

By:
Gene Sandone
and
Christopher Estes

(2 of 3)

Alaska Department of Fish and Game
Susitna Hydro Aquatic Studies
Anchorage, Alaska 99503

ABSTRACT

Studies by the Alaska Department of Fish and Game Susitna Hydroelectric Aquatic Studies Team suggest that upwelling groundwater is one of the principal variables influencing the suitability of habitat for chum salmon spawning in the middle reach of the Susitna River (ADF&G 1983). Three infrared heat sensing devices (Hughes Probeye, Xedar Pyroscan, and AGA Thermovision) were tested to evaluate the feasibility of using infrared thermal imagery as a remote sensing technique for detecting and quantifying the amount of upwelling groundwater in slough habitats of the Susitna River. Results of these investigations indicate that the application of infrared heat sensing devices for locating upwelling is contingent on a host of environmental conditions and the level of detail desired. Areas of upwelling groundwater and their relative magnitude were identified using these techniques; however, some areas known to have upwelling based on ground truthing surveys were not detected. This inconsistency is due to the wide variety of environmental conditions that occur within the Susitna River combined with the physical limitations of the technology. For these reasons, it is doubtful whether this technique can be applied on a large scale for the detection and quantification of upwelling areas.

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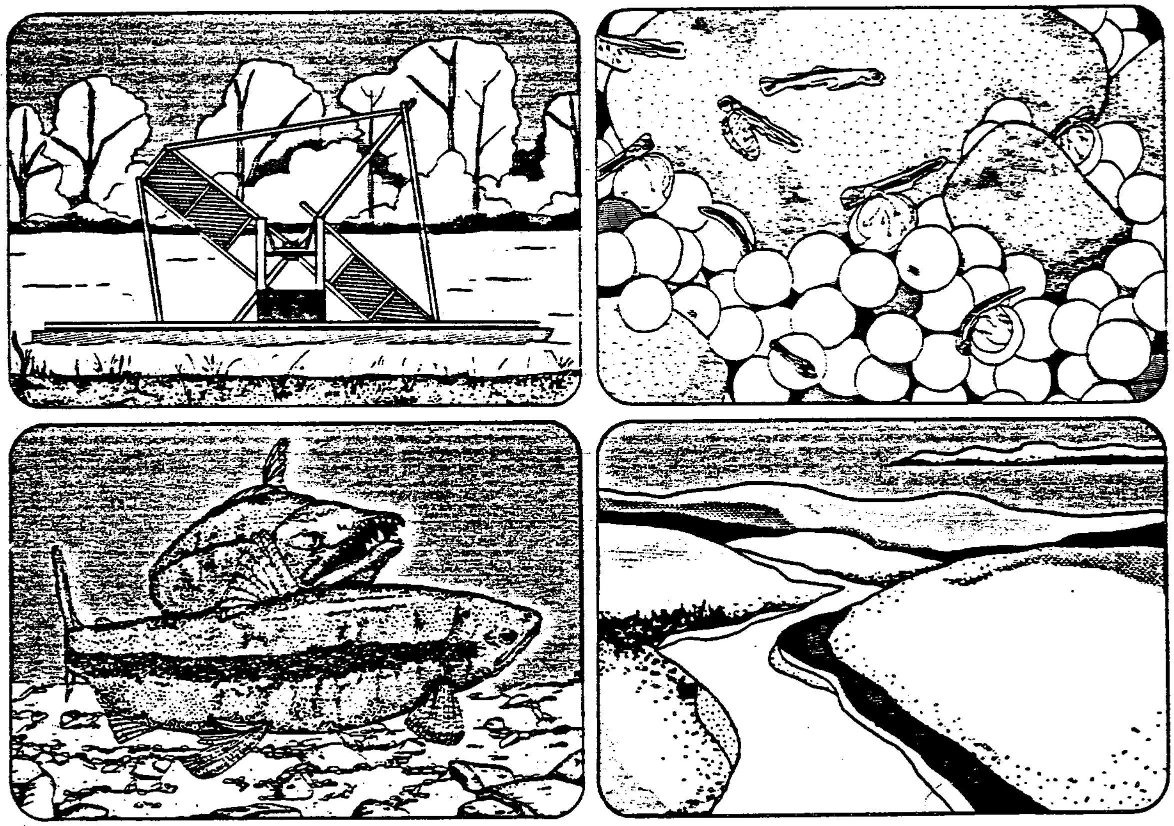

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REPORT NO. 4

ACCESS AND TRANSMISSION CORRIDOR AQUATIC INVESTIGATIONS (JULY - OCTOBER 1983)

22.

APA Doc#2049

ALASKA DEPARTMENT OF FISH AND GAME

SUSITNA HYDRO AQUATIC STUDIES REPORT SERIES

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INTRODUCTION

Part 1. Access and Transmission Corridor Studies.

Part 2. Population Dynamics of Arctic Grayling in the Upper Susitna Basin.

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ACCESS AND TRANSMISSION CORRIDOR STUDIES

(#22)

1984 Report No. 4, Part 1

by Joe S. Sautner and Mike E. Stratton

(3 of 9)

Alaska Department of Fish and Game
Susitna Hydro Aquatic Studies
2207 Spenard Road
Anchorage, Alaska 99503

ABSTRACT

Construction of the proposed access and transmission corridors (ATC) associated with the development of the Susitna Hydroelectric Project may affect the aquatic habitat and fish resources along these routes. Studies were conducted by The Alaska Department of Fish and Game during a portion of the 1983 open water field season to provide information on the aquatic habitat and fish resources within the proposed corridors to enable project participants to assess potential impacts on these resources from construction activities. Forty-two proposed stream crossing sites and ten lake habitats were sampled within the ATC study area. Three study reaches of Deadman Creek, which closely parallels the ATC, were also sampled. A total of 13 fish species were found to inhabit the streams and lakes within the ATC study area. Arctic grayling, Dolly Varden and lake trout were the major sport fish species identified within these habitats. General water quality (dissolved oxygen, pH, conductivity and water temperature), discharge, and substrate data were collected at stream crossing study sites. Selected physical and chemical data were collected in Deadman Lake. Population estimates were generated for Arctic grayling within the three study reaches of Deadman Creek. Among the impacts which could result from development of the ATC, the increase in sport fishing pressure, due to the increased access to the area, may have the greatest effect on various sport fish species within the study area. The increase in sport fishing pressure may result in reduced numbers and sizes of fish species such as Arctic grayling, Dolly Varden and lake trout. Other impacts which may occur at proposed stream crossing sites include alterations of stream hydraulics, deterioration of water quality, and removal or shifting of substrates.

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POPULATION DYNAMICS OF ARCTIC GRAYLING IN THE UPPER SUSITNA BASIN

(#22)

1984 Report No. 4, Part 2

(8 of 9)

by Dana C. Schmidt and Mike E. Stratton

Alaska Department of Fish and Game
Susitna Hydro Aquatic Studies
2207 Spenard Road
Anchorage, Alaska 99503

ABSTRACT

The effects of an anticipated sport fishery for Arctic grayling on the tributary streams of the upper Susitna basin are examined by modelling the effects of hypothetical harvest. The increased levels of mortality created by a sport fishery cause a rapid shift in the age structure and consequently the size of the fish caught. To maintain a "trophy" fishery on a sustained yield basis, a catch and release fishery appears to be warranted. Under the assumptions of the model, the total number of all fish caught is not substantially reduced with comparatively high levels of fishing. Possible explanations of the differences in population structures of the Deadman Creek drainage and the impoundment tributaries are discussed.

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Adult Anadromous Studies
Procedures Manual
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ADF&G
1985

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23 Alaska Department of Fish and Game (ADF&G). 1985. Adult Anadromous Studies Procedures Manual (June 1984 - June 1985). Draft. Susitna Hydro Aquatic Studies Program. Alaska Department of Fish and Game, Anchorage, Alaska (Unpublished report). APA Document #2748.

Technical procedures and data procedures used by Adult Anadromous Studies personnel during the period June 1984 - June 1985 of the Susitna Hydro Aquatic Studies Program are detailed.

An Adult Anadromous Studies procedures manual was not actually produced. Instead objectives and procedures for the period June 1984 - June 1985 were extracted from Barrett, et al, 1985, ADF&G Susitna Hydro Aquatic Studies Report No. 6; APA Document #2748, RTS #29.

(2 of 2)

December 1984
Alaska Power Authority
Susitna Hydroelectric Project

(1 of 5)

Resident and Juvenile Anadromous Studies Procedures Manual Draft

(May 1984 - April 1985)

#24.

- Prepared by -

Alaska Department of Fish and Game
Susitna Hydro Aquatic Studies
2207 Spenard Road

APA Doc #3014

- For -

Alaska Power Authority
334 West 5th Avenue
Anchorage, AK 99501

(#24)

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2.2.2.1 Juvenile Outmigration Studies of the Middle River

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Coded Wire Tagging
Talkeetna Stationary Outmigrant Traps
Cold Branding

2.2.2.1.2 Study Locations (3 of 5)

Coded Wire Tagging
Talkeetna Stationary Outmigrant Traps
Cold Branding

2.2.2.1.3 Schedule of Activities and Frequency of Sampling

Coded Wire Tagging
Talkeetna Stationary Outmigrant Traps
Cold Branding

2.2.2.2 Juvenile Outmigration Studies of the Lower River

2.2.2.2.1 Methods

Flathorn Stationary Outmigrant Trap
Flathorn Mobile Outmigrant Trap
Deshka River Fyke Net Weir/Minnow Trapping
Talkeetna River Beach Seining

2.2.2.2.2 Study Locations

Flathorn Stationary Outmigrant Traps
Flathorn Mobile Outmigrant trap
Deshka River Fyke Net Weir/Minnow Trapping
Talkeetna River Beach Seining

2.2.2.2.3 Schedule of Activities and Frequency of Sampling

Flathorn Stationary Outmigrant Traps
Flathorn Mobile Outmigrant trap
Deshka River Fyke Net Weir/Minnow Trapping
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2.2.3 Winter Studies of Resident and Juvenile Anadromous Fish

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Aquatic Habitat & Instream Flow Studies
Procedures Manual

(May 84 - April 85)

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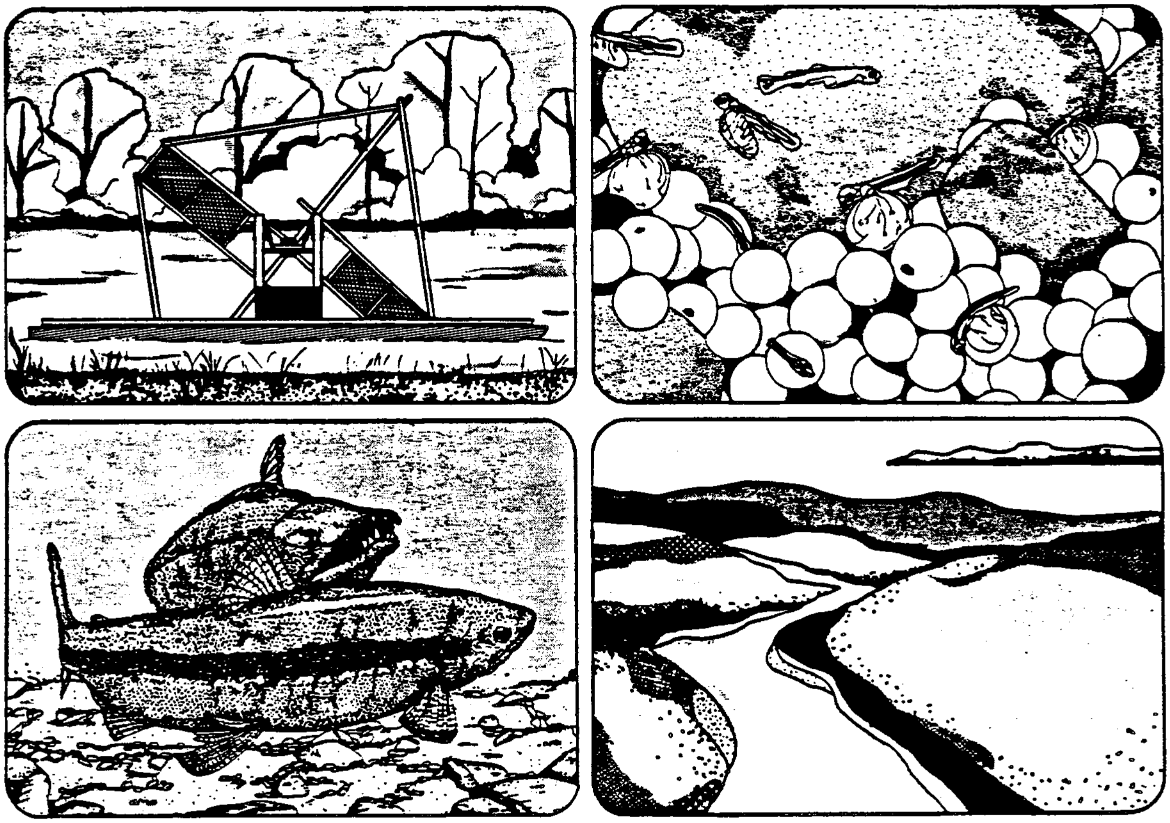

TASK 32 SUPPORT TECHNICAL REPORT

CONTINUOUS WATER TEMPERATURE INVESTIGATIONS

by: Theresa Keklak and Timothy Quane

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ALASKA DEPARTMENT OF FISH AND GAME
SUSITNA HYDRO AQUATIC STUDIES REPORT SERIES

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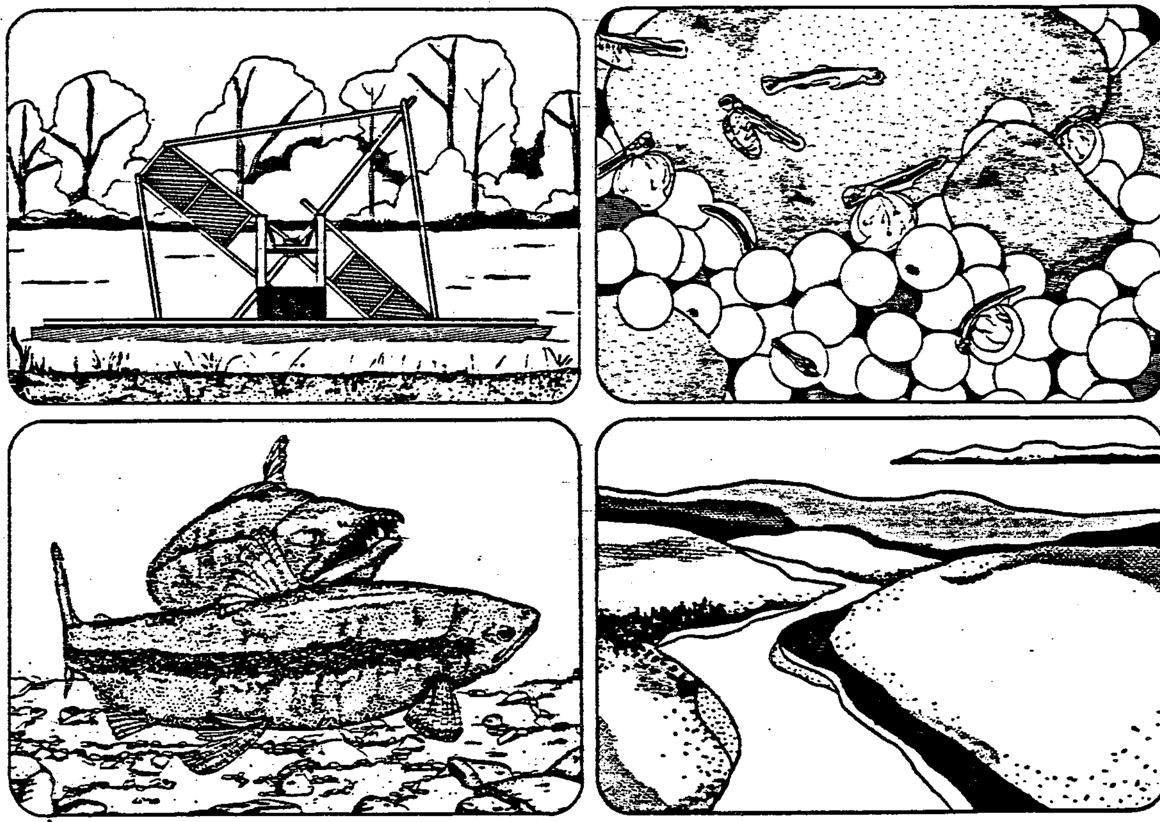

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REPORT NO. 5

WINTER AQUATIC INVESTIGATIONS (SEPTEMBER 1983–MAY 1984)

Volume 1: An Evaluation of the Incubation Life-Phase of Chum Salmon in the Middle Susitna River, Alaska

26a.

APA Doc#2658

ALASKA DEPARTMENT OF FISH AND GAME
SUSITNA HYDRO AQUATIC STUDIES REPORT SERIES

(#262)

WINTER AQUATIC INVESTIGATIONS:

SEPTEMBER, 1983 - MAY, 1984

REPORT NUMBER 5

VOLUME 1

AN EVALUATION OF THE INCUBATION LIFE-PHASE OF CHUM SALMON IN THE MIDDLE SUSITNA RIVER, ALASKA

(2 of 6)

By:

Leonard J. Vining,
Jeffery S. Blakely,
and
Glenn M. Freeman

1985

Alaska Department of Fish and Game
Susitna Hydro Aquatic Studies
620 E. 10th Avenue
Anchorage, Alaska 99501

ABSTRACT

An evaluation of the pattern of survival and development of chum salmon embryos incubated in artificial redds in slough, side channel, tributary, and mainstem habitats of the middle Susitna River was conducted in conjunction with an assessment of the currently available chum salmon incubation habitat conditions within these habitat types. Chum salmon eggs obtained from local stocks were artificially fertilized, placed within modified Whitlock-Vibert Boxes (WVBs) and then implanted in artificial redds in the streambed at selected study sites. At each of these sites, a polyvinyl chloride standpipe was also installed to obtain instantaneous intragravel water quality measurements of temperature, dissolved oxygen, pH, and conductivity which were later correlated to the percent survival of embryos (100% hatched) at each site. In addition, representative substrate samples were obtained at selected study sites using a modified McNeil substrate sampler to characterize the substrate conditions present at incubation study sites.

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(# 26a)

The survival rates of embryos in slough, side channel and tributary habitats were 17, 9, and 11 percent, respectively. Survival of embryos in mainstem habitat was 19 percent but did not reflect the effects of dewatering and freezing due to a difference in the method of site location. Thus, estimates of percent survival for this habitat type are probably higher than would be expected for natural conditions.

The largest demonstrated cause of embryo mortality at study sites was due to dewatering and subsequent freezing of the streambed. Greater than 47% of the total number of WVBs used to estimate survival became frozen. This effect was greatest in side channels and least in sloughs, and was observed to be directly related to the presence and quantity of upwelling water. Areas particularly vulnerable to the effects of dewatering and freezing include large portions of side channel habitats as well as the mouth areas of slough and tributary habitats which may lack sources of upwelling water.

A quantitative analysis of the effect of each variable on survival was hampered by the high embryo mortality due to dewatering and subsequent freezing of substrate. When frozen embryos were removed from the survival data base, no significant correlations were obtained between measured water quality variables and percent survival of embryos ($p<0.05$). However, the correlation between dissolved oxygen (mg/l) and percent survival of embryos decreased to zero at dissolved oxygen concentrations below 3.0 mg/l. The percent survival of embryos was also correlated to the percent of fine substrate particles ($<$0.08 in. diameter) contained within WVBs. Although there was no significant correlation, the percent survival of embryos decreased to zero when the percent of fines exceeded 18%.

The rate of embryonic development at study sites was found to be strongly influenced by the degree of upwelling present. Chum salmon embryos which were fertilized on August 26, 1983, and incubated in an upwelling area in a side channel, reached the 100% hatch in late December, whereas those incubated in a non-upwelling area in the mainstem Susitna River experienced delayed development and did not reach 100% hatch until mid-April. Therefore, the presence of upwelling water in middle Susitna River habitats appears to be a key component which maintains the integrity of chum salmon incubation habitats by preventing substrate from dewatering and freezing and by maintaining suitable incubation temperatures which allow embryos to develop properly.

A comparison of the rates of in situ embryo development observed in this study to those observed in the laboratory study of Wangaard and Burger (1983) was hampered by problems encountered with temperature recorders installed at each site. Incomplete temperature records were obtained at study sites used to compare thermal unit requirements for development. However, based on a quantitative assessment of development data collected in these study sites and a previous ADF&G study (ADF&G 1983), it is the opinion of the authors that the predictive equation of Wangaard and Burger are an adequate model to use in predicting rates of chum salmon development of the middle Susitna River.

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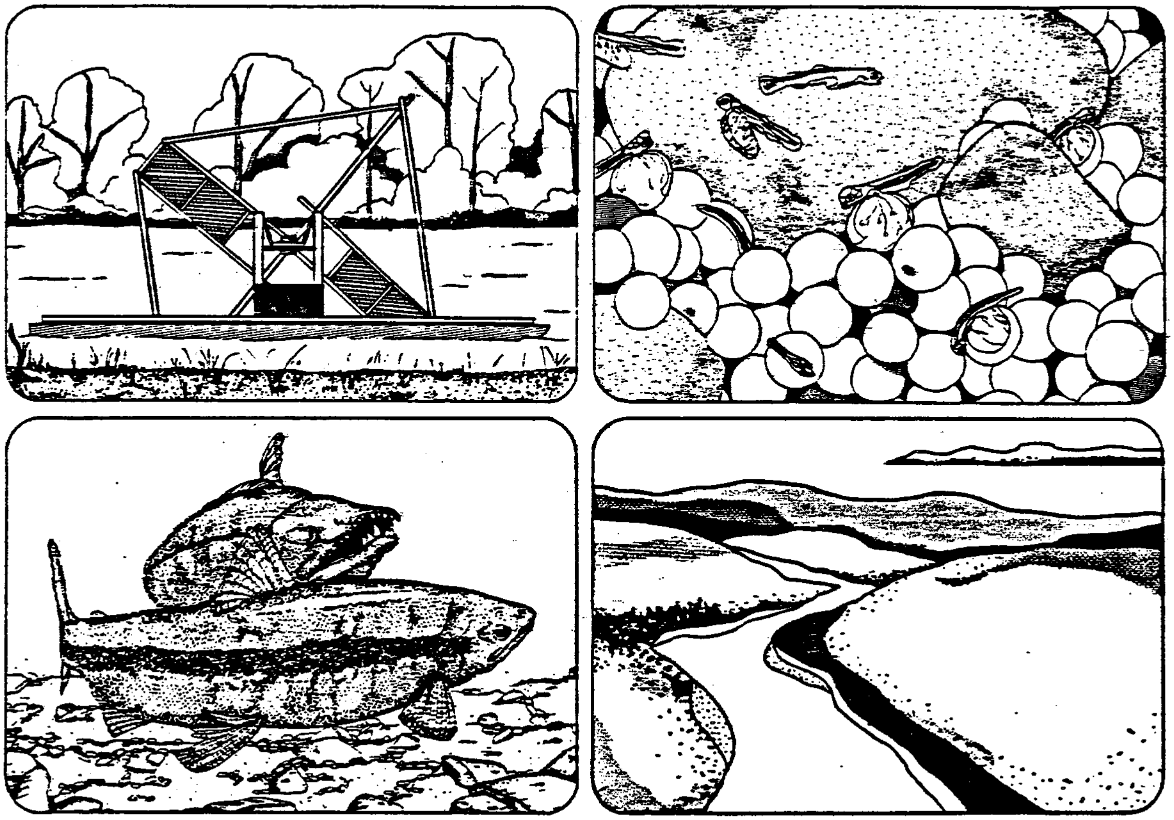

REPORT NO. 5

WINTER AQUATIC INVESTIGATIONS
(SEPTEMBER 1983-MAY 1984)

Volume 2: Appendix F

Winter Temperature Data

(1 of 5)

26b.

APA Doc#2659

ALASKA DEPARTMENT OF FISH AND GAME
SUSITNA HYDRO AQUATIC STUDIES REPORT SERIES

(#26b)

Appendix F: Winter Temperature Data

by: Theresa Keklak and Tim Quane

Alaska Department of Fish and Game
Susitna Hydro Aquatic Studies
620 East 10th Avenue, Third Floor
Anchorage, Alaska 99501

Appendix F is presented in standard report format including an introduction section, an objectives section, a methods section, a results section, and a discussion section. This format was selected to increase the usability of the information for purposes other than those related to salmon incubation. The appendix is limited to a summarization and review of the temperature data. Subsequent analyses are addressed in the body of this report and in other reports.

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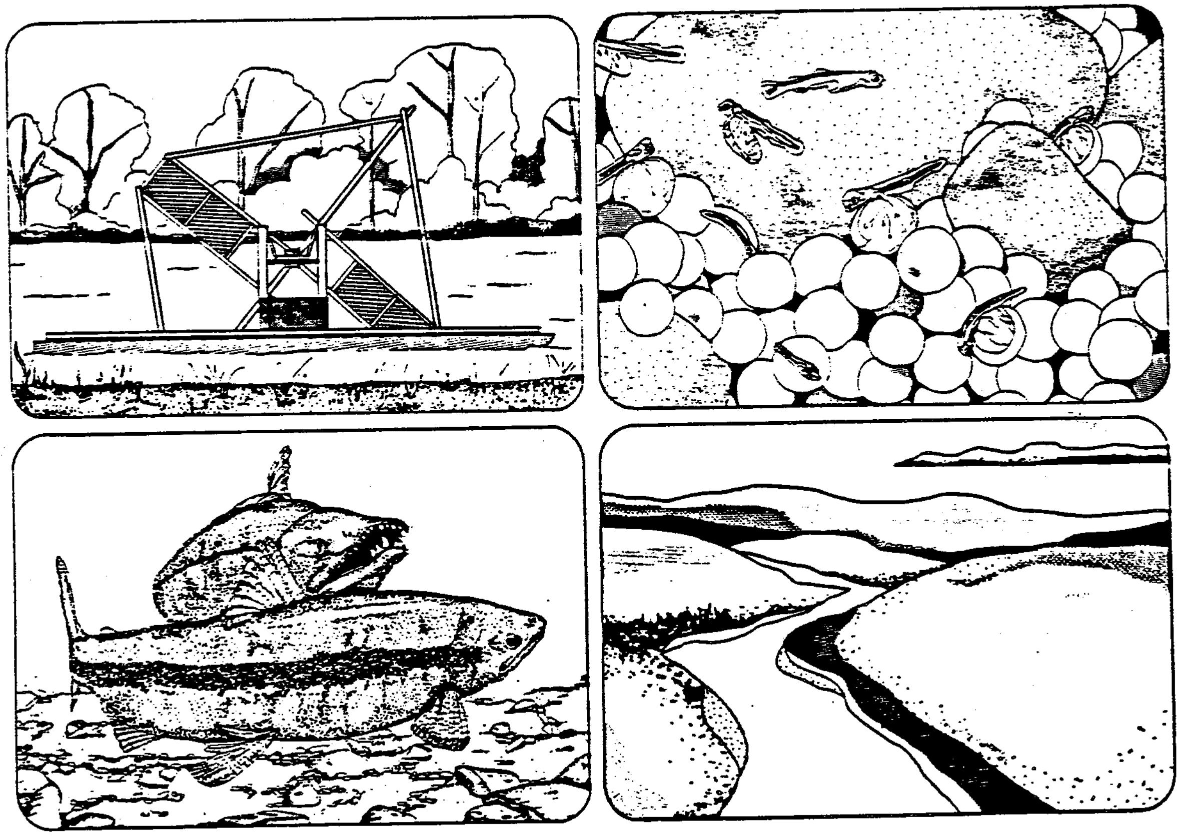

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TASK 36 SUPPORT TECHNICAL REPORT

HYDROLOGICAL INVESTIGATIONS AT SELECTED LOWER SUSITNA RIVER STUDY SITES

by: Tim Quane, Pat Morrow, and Isaac Queral
Aquatic Habitat and Instream Flow Project

#27.

APA Doc #2704

ALASKA DEPARTMENT OF FISH AND GAME
SUSITNA HYDRO AQUATIC STUDIES REPORT SERIES

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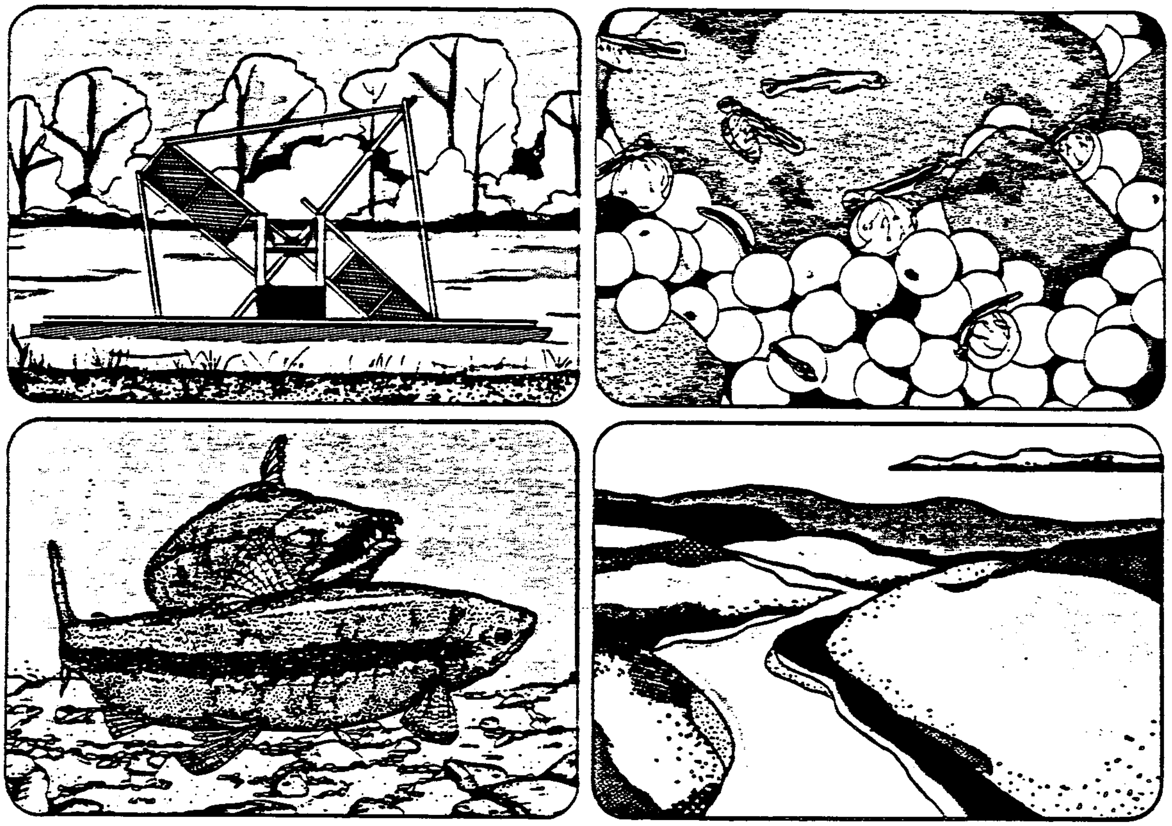

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TASK 14 SUPPORT TECHNICAL REPORT

HYDROLOGICAL INVESTIGATIONS AT SELECTED LOWER SUSITNA RIVER STUDY SITES

by: Timothy Quane, Patrick Morrow, and Isaac Queral
Aquatic Habitat and Instream Flow Project

#28.

APA Doc #2736

ALASKA DEPARTMENT OF FISH AND GAME
SUSITNA HYDRO AQUATIC STUDIES REPORT SERIES

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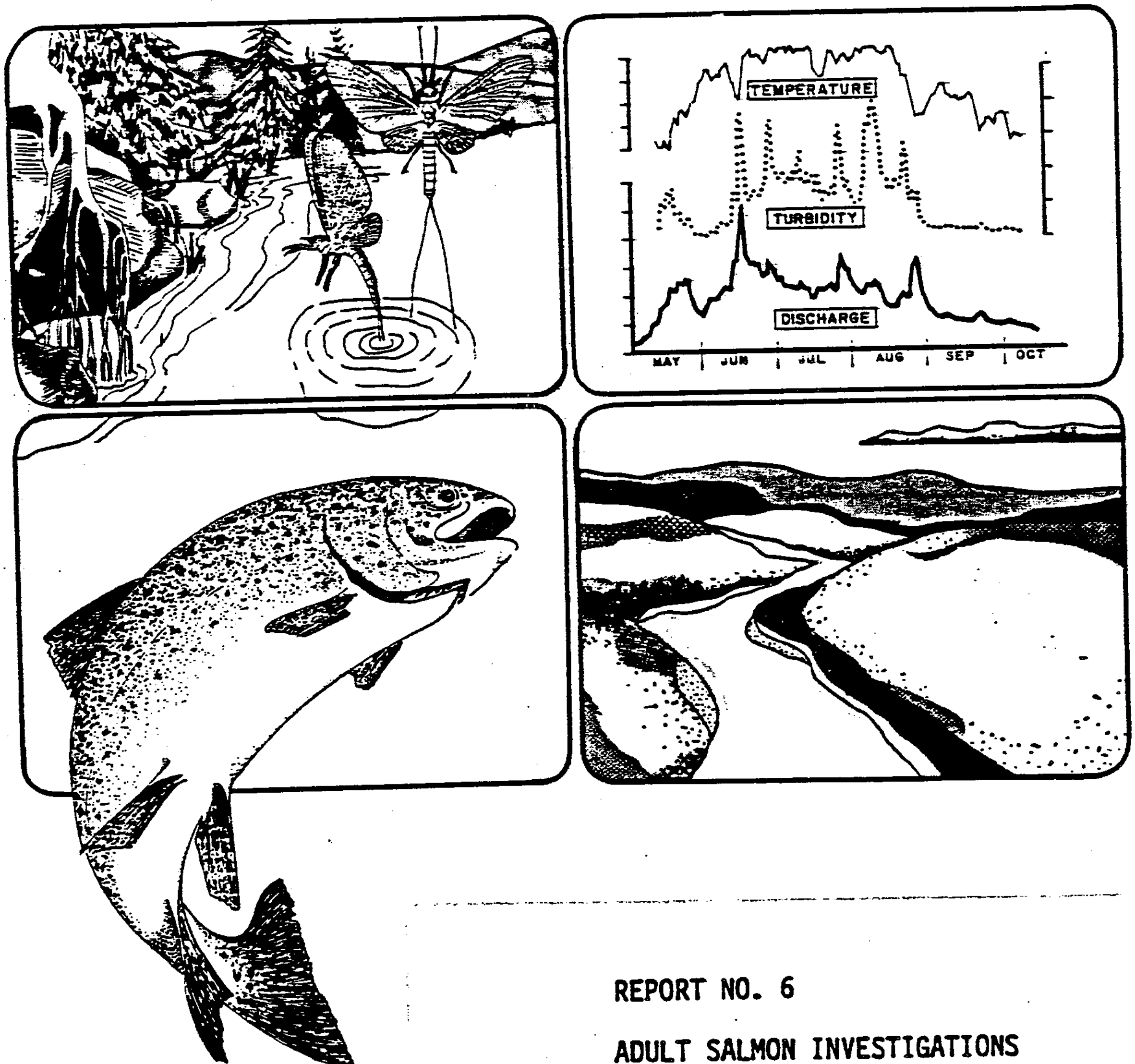

REPORT NO. 6

ADULT SALMON INVESTIGATIONS
MAY - OCTOBER 1984

(1 of 4)

#29.

APA Doc #2748

ALASKA DEPARTMENT OF FISH AND GAME
SUSITNA HYDRO AQUATIC STUDIES REPORT SERIES

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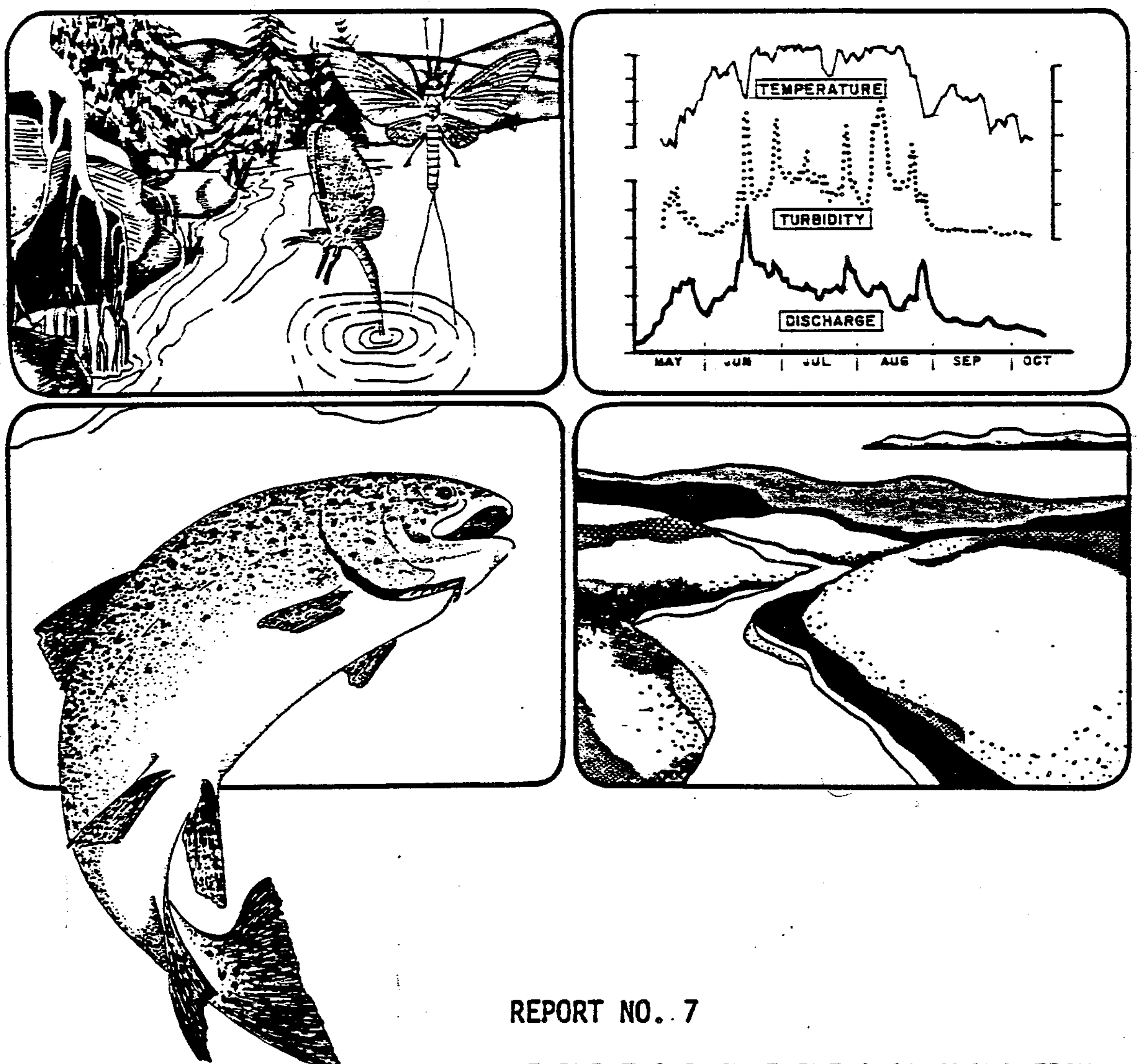

REPORT NO. 7

RESIDENT AND JUVENILE ANADROMOUS FISH INVESTIGATIONS (MAY - OCTOBER 1984)

PARTS 1 AND 2 AND 3

(10615)

#30a. parts 1+2

APA Doc #2836

ALASKA DEPARTMENT OF FISH AND GAME
SUSITNA HYDRO AQUATIC STUDIES REPORT SERIES

See #30 b part 3

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THE MIGRATION AND GROWTH OF JUVENILE SALMON IN THE SUSITNA RIVER

(#302)

Report No. 7, Part 1

by Kent J. Roth and Michael E. Stratton

(3 of 15)

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620 East 10th Avenue, Suite 302
Anchorage, Alaska 99501

ABSTRACT

Studies of salmon spawning, embryo incubation, and juvenile rearing are all critical in understanding the current life history and habitat dynamics of salmon in the Susitna River. However, the final measure of the value of a reach of river to the freshwater life stages of salmon is the number and condition of the fry which outmigrate from the reach to the ocean. Baseline data on salmon outmigration have been collected at Talkeetna Station (river mile 103.0) for the past three years. The data from 1982 and 1983 have shown that a substantial number of chinook, coho, and sockeye fry outmigrate from the middle river during their first summer. Because the majority of returning adults have spent at least one winter rearing in freshwater, an important question was whether these age 0+ fish overwintered in the lower river or had a low survival rate. To help answer this question, outmigrant traps were also operated near the mouth of the Susitna River (RM 22.4) during 1984. Mark and recapture studies gave population estimates for chum and sockeye fry (marked by coded wire tags) in the Susitna River above Talkeetna Station (middle river) and for chinook fry (marked by cold branding) in Indian River and other rearing sites. The cold branding study also monitored outmigration timing from Indian River and obtained estimates of juvenile chinook residence time in mainstem rearing areas. The Talkeetna River and Deshka River were intermittently sampled to help explain the mainstem outmigrant trap data. A portion of the age 0+ chinook fry apparently outmigrate from the middle river upon reaching a critical size but a large number remain to overwinter and then outmigrate during their second summer. Coho fry outmigrate at a wider range of lengths than chinook fry so the cumulative biomass of coho fry lags behind the cumulative numbers of individuals by one or two weeks. Age 0+ chinook and coho fry grow about 30 mm in length during the

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open-water season. Juvenile sockeye salmon appear to seek out lake-like rearing areas at a size of about 50 mm. The limited amount of this habitat type in the middle river is the major influence on their redistribution to the lower river. The estimated 1984 middle river population size was about 300,000 for age 0+ sockeye and 2,040,000 for chum fry. Chum fry rearing in the middle river was demonstrated by their growth and by analysis of stomach contents.

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TIME SERIES ANALYSIS OF DISCHARGE, TURBIDITY, AND JUVENILE SALMON OUTMIGRATION IN THE SUSITNA RIVER, ALASKA

(#30 2)

by: Stephen S. Hale

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(8615)

ABSTRACT

During the three years of study of juvenile salmon outmigration from the middle reach of the Susitna River, a correspondence has been noted between the peaks of river discharge and the peaks of outmigration. Further investigation of the relationship of outmigration to discharge was required because two large hydroelectric dams have been proposed for a region above the salmon rearing areas. These dams will markedly change the downstream discharge and turbidity regimes, factors which influence not only salmon outmigration, but almost all fish species and life stages including juvenile salmon rearing. Box-Jenkins models were developed for the 1983 and 1984 time series of river discharge, turbidity, and chinook and sockeye salmon fry outmigration rates in order to better understand the forces that shape the series and to statistically describe the natural conditions as a baseline against which future changes can be measured. The time series examined were described by relatively simple models, using mostly first-order autoregressive terms. About 85% of the variance in turbidity for one day was explained by the value for turbidity of the previous day. This figure was 44% for chinook salmon outmigration and 43% for sockeye salmon outmigration, the lower numbers indicating the effect of behavioral decisions on biological time series. Although the form of the time series plots of discharge and chinook salmon outmigration was different between the two years, the underlying stochastic processes which generated these series were the same. Bivariate transfer function models were constructed for turbidity and salmon outmigration rates which explain present values of these variables in terms of their own past values as well as past values of discharge.

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CEF

THE RELATIVE ABUNDANCE, DISTRIBUTION, AND INSTREAM FLOW RELATIONSHIPS OF JUVENILE SALMON IN THE LOWER SUSITNA RIVER

(30a)

Report No. 7, Part 2

by Paul M. Suchanek, Karl J. Kuntz, and John P. McDonell

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(10 of 15)

ABSTRACT

Juvenile salmon abundance and distribution were studied in the lower Susitna River (below the Chulitna River confluence) and juvenile salmon rearing habitat was modelled at 20 sites within the reach. Chinook, chum, and sockeye salmon juveniles made use of side channels; however, high turbidity limited use of side channels located in the Chulitna River plume. Coho salmon juveniles were found primarily in tributary mouths; sockeye, chinook, and chum salmon also were present in these areas. Sloughs, which were limited in occurrence, were not used heavily by any of the salmon species.

Both tributary mouths and side channel/slough sites were modelled using one of two habitat models. At tributary mouths, an increase in weighted usable area with a rise in mainstem discharge resulted from the formation of backwater areas which led to lower velocities and an expansion of the area and amount of cover inundated. At side channels, chinook weighted usable area increased after overtopping due to a gain in cover suitability (turbidity), velocity, and area. The weighted usable area response to a rise in mainstem discharge for sockeye and chum salmon juveniles at side channels was also usually positive. Habitat indices at side channels for chinook, chum, and sockeye juveniles at mainstem discharges and side channel flows above the overtopping discharge declined as velocities became unsuitably high. Weighted usable area for these species did not always decline at high discharges, however, because of the compensating effect of a larger surface area.

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APPENDIX D

HYDRAULIC MODELS FOR USE IN ASSESSING THE REARING HABITAT OF JUVENILE SALMON IN SIX SIDE CHANNELS OF THE LOWER SUSITNA RIVER

(130f15)

By:

James Anderson,
Andrew Hoffmann, and
Jeffrey Bigler

of

Alaska Department of Fish and Game
Susitna River Aquatic Studies Program
Third Floor, Michael Building
620 East Tenth Avenue
Anchorage, Alaska 99501

ABSTRACT

Six side channels (Island, Mainstem West Bank, Circular, Sauna, Sunset, and Trapper Creek) in the lower reach of the Susitna River were evaluated using an Instream Flow Incremental Methodology (IFIM) physical habitat simulation (PHABSIM) modelling approach to describe the effects that site flow and mainstem discharge have on rearing juvenile salmon habitat. These sites were thought to contain potential habitat for rearing juvenile salmon and were chosen to range greatly in size, shape, and overtopping discharge.

Six hydraulic simulation models (either IFG-2 or IFG-4) were calibrated to simulate depths and velocities associated with a range of site-specific flows at the six modelling study sites. Comparisons between corresponding sites of simulated and measured depths and velocities indicated that the models provide reliable estimates of depths and velocities within their recommended calibration ranges.

The recommended of ranges of mainstem Susitna River discharge over which these models can hydraulically simulate the habitat of rearing juvenile salmon are: Island Side Channel from 35,000 to 70,000 cfs mainstem discharge; Mainstem West Bank Side Channel from 18,000 to 48,000 cfs; Circular Side Channel from 36,000 to 63,000 cfs; Sauna Side Channel from 44,000 to 63,000 cfs; Sunset Side Channel from 32,000 to 67,000 cfs; and Trapper Creek Side Channel from 20,000 to 66,000 cfs.

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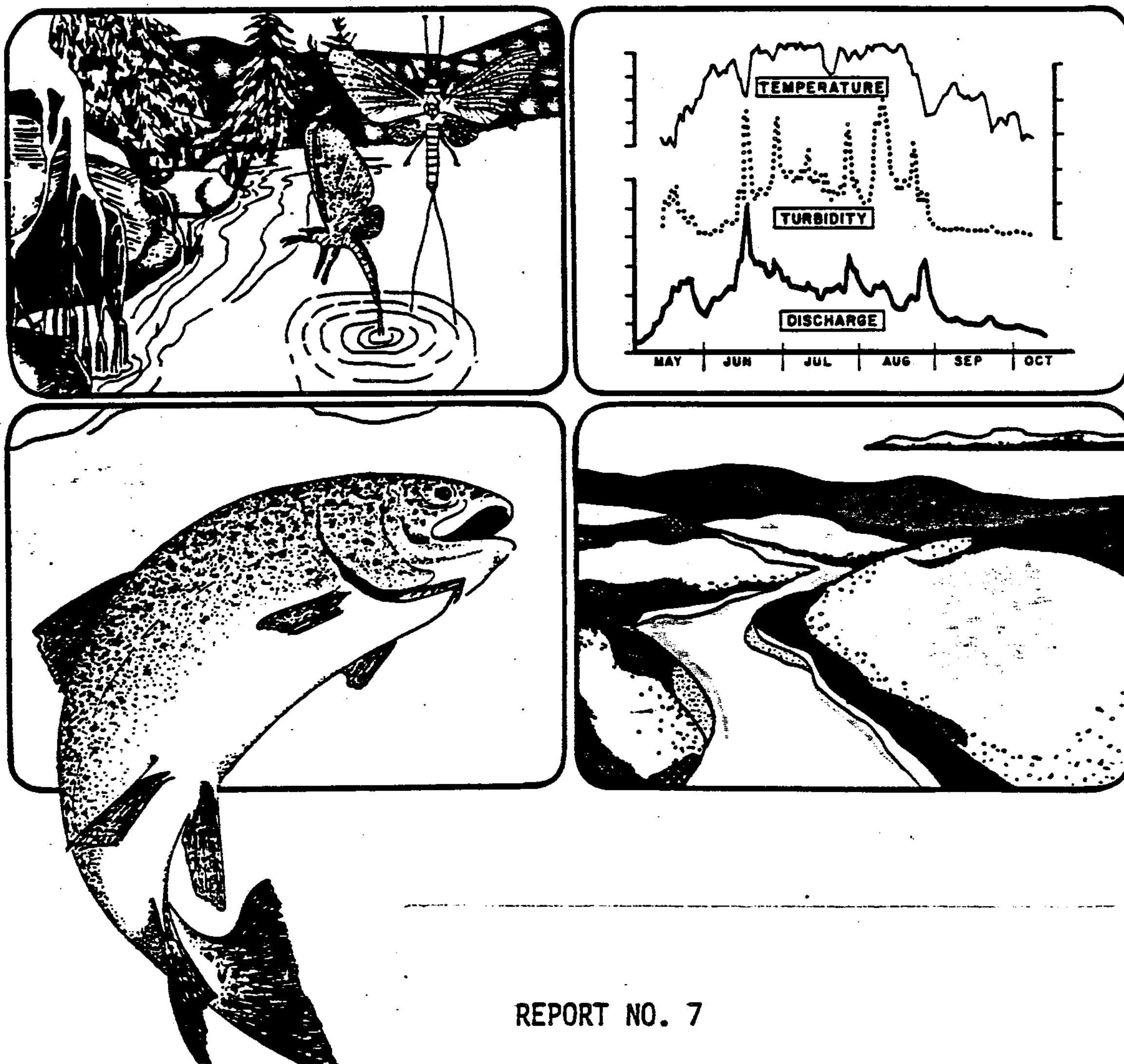

REPORT NO. 7

RESIDENT AND JUVENILE ANADROMOUS FISH INVESTIGATIONS (MAY - OCTOBER 1984)

PART 3

(1065)

#30b.

APA Doc #2837

ALASKA DEPARTMENT OF FISH AND GAME

SUSITNA HYDRO AQUATIC STUDIES REPORT SERIES

(#30b)

RESIDENT FISH DISTRIBUTION AND LIFE HISTORY IN THE SUSITNA RIVER BELOW DEVIL CANYON

Report No. 7, Part 3

by Richard L. Sundet and Stuart D. Pechek

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(2065)

ABSTRACT

Studies of resident fish were conducted in both the lower (below Chulitna River confluence) and middle (Devil Canyon to Chulitna River confluence) Susitna River in 1984. The primary objectives in the middle river were to determine the seasonal distribution, timing of spawning, and spawning areas of rainbow trout, and to monitor 13 index sites as part of the long term monitoring effort. Most of the rainbow trout data was collected by use of radio telemetry. Results showed that rainbow trout are relatively few in numbers and that spawning occurs at selected areas which are influenced by lakes. Much of the rainbow trout population in the middle river probably originates in lakes which drain into middle river tributaries. Rainbow trout were abundant in lakes located at the headwaters of Fourth of July Creek and in the upper reaches of Portage Creek. Rainbow trout were also found to use Portage Creek more extensively than previously thought. Spawning occurred during the first week of June. All rainbow trout moved out of tributaries by early October (probably triggered by low fall discharges), and most overwintered in the mainstem Susitna River slightly downstream (0.1-4.0 miles) of the tributary where they were captured. Other middle river studies suggest Arctic grayling overwinter in the mainstem Susitna then ascend and spawn in tributaries in late May. Arctic grayling also outmigrated from tributaries at the same time as rainbow trout. Catch data at middle river index sites in 1984 were similar to 1982 and 1983 findings. Studies in the lower river reinforced the belief that some humpback whitefish are anadromous, and that rainbow trout and Arctic grayling outmigrate from most east side tributaries in September. Lower river studies also found that burbot move into the Deshka River in mid-September.

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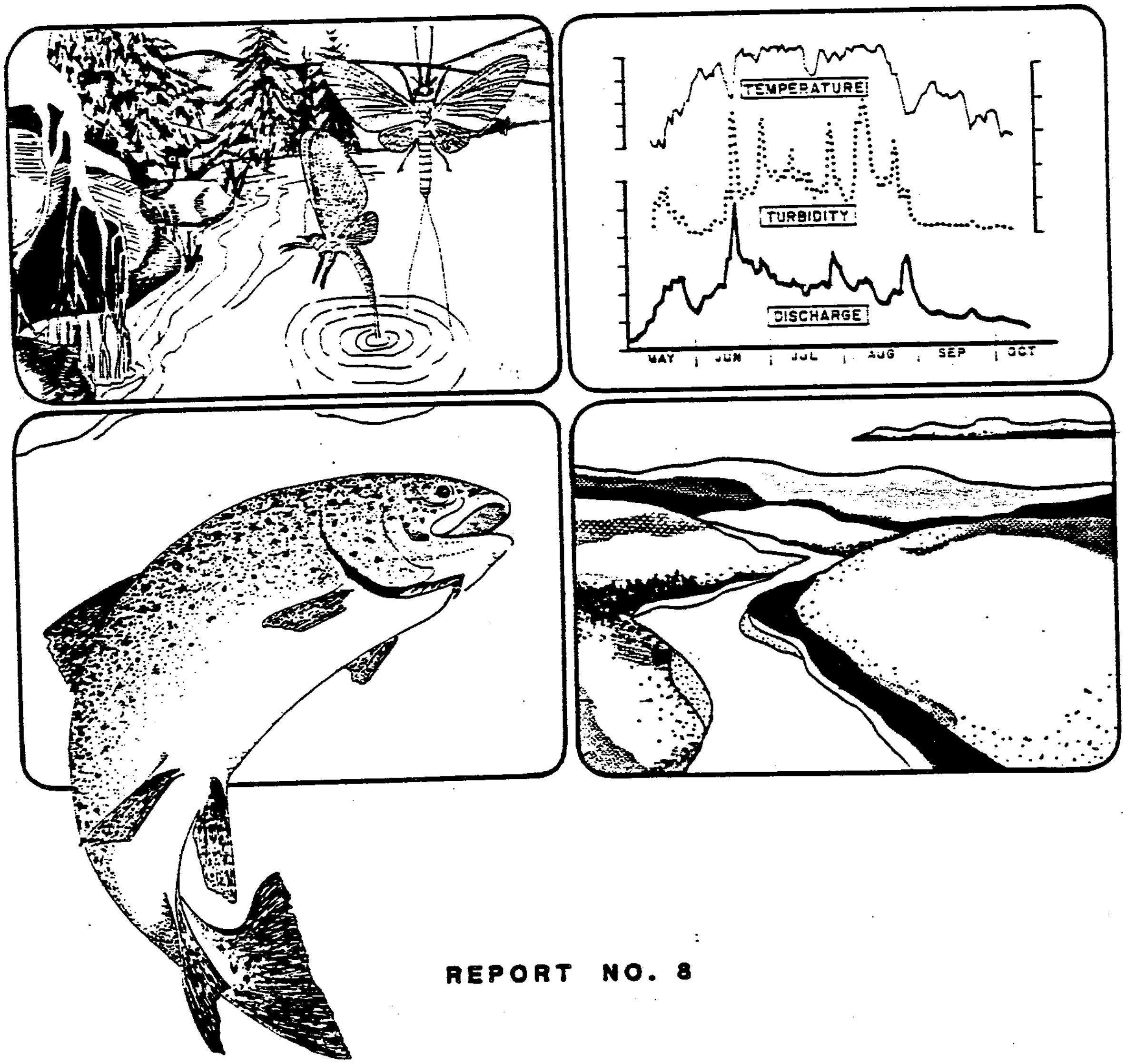

REPORT NO. 8

Availability of Invertebrate Food Sources for Rearing Juvenile Chinook Salmon in Turbid Susitna River Habitats

(166)

#31.

APA Doc #2846

ALASKA DEPARTMENT OF FISH AND GAME
SUSITNA HYDRO AQUATIC STUDIES REPORT SERIES

(#31)

AVAILABILITY OF INVERTEBRATE FOOD SOURCES FOR REARING JUVENILE CHINOOK SALMON IN TURBID SUSITNA RIVER HABITATS

1985 Report Number 8

by

Tim F. Hansen and J. Craig Richards

Alaska Department of Fish and Game
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(266)

ABSTRACT

Benthic and drifting invertebrates were sampled from May through October 1984 to evaluate available fish food resources and the gain and loss of benthic invertebrate habitat resulting from changes in flow. Four side channel and side slough sites were sampled at head and mid-section locations using drift nets and modified Hess type samplers. Juvenile chinook salmon were also sampled using electro-fishing techniques to correlate the available food sources with that being utilized.

A total of 52 invertebrate taxa were identified in drift and benthic samples, with Chironomidae being the dominant taxa. The proportions of numbers of invertebrates found in the stomachs of juvenile chinook salmon were closely correlated with the proportions of invertebrates available in the drift. Drift samples collected under breached conditions indicated that invertebrates were being transported from the mainstem into the side channels and side sloughs. The quantity of drifting invertebrates in side channels and side sloughs under unbreached conditions was negligible compared to the drift under breached conditions when total drift was considered.

Habitat suitability criteria were developed and weighted usable area was estimated for invertebrates which were common to drift, benthos, and the diet of juvenile chinook salmon by behavioral type (i.e. burrower, swimmer, clinger, and sprawler). The densities of each of the behavioral types generally correlated with water velocity and substrate type. Depth of water did not appear to be an important factor influencing the density of organisms. Water velocities less than 0.4 ft/sec and substrates comprised of silts and sands generally supported the

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highest mean densities of burrowers which were made up primarily of Chironomidae. Rubble substrates with components of large gravel or cobble and water velocities between 1.6 ft/sec and 2.6 ft/sec generally supported the highest mean densities of swimmers and clingers. Sprawlers did not appear to preferentially utilize any particular substrate or water velocity.

Projected weighted usable area for each of the behavioral types was clearly a function of mainstem discharge. The minimum controlling mainstem discharge for each of the study sites generally produced the greatest amount of burrower habitat weighted usable area. The maximum amount of weighted usable area for swimmer, clinger, and sprawler habitat at all study sites was reached at a mainstem discharge above 25,000 cfs.

In conclusion, naturally fluctuating mainstem flows which occasionally inundated sampling sites appeared to maintain a diverse benthic fauna and appeared to provide drifting food organisms within sampling sites thereby contributing to the overall rearing potential of these sites for juvenile chinook salmon.

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ALASKA DEPARTMENT OF FISH AND GAME
SUSITNA HYDRO AQUATIC STUDIES REPORT SERIES

REPORT NO. 9

SUMMARY OF SALMON FISHERY DATA FOR SELECTED MIDDLE SUSITNA RIVER SITES

by: Andrew G. Hoffmann
Aquatic Habitat and Instream Flow Project

(1 of 3)

#32.

APA Doc #2749

Prepared for:

ALASKA POWER AUTHORITY
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ANCHORAGE, ALASKA

(#32)

ABSTRACT

The fishery data collected by the ADF&G on the Susitna River is a necessary component for use in evaluating effects of variations in natural flow regimes on the life history cycles of the various species present. These data, used in conjunction with the hydraulic data now available for the river, provide the basis for recommending various flow regimes, mitigation options, etc. for the proposed hydroelectric development with respect to the fishery. This report indexes the fishery data collected by a variety of ADF&G studies under one cover in order to better facilitate this process.

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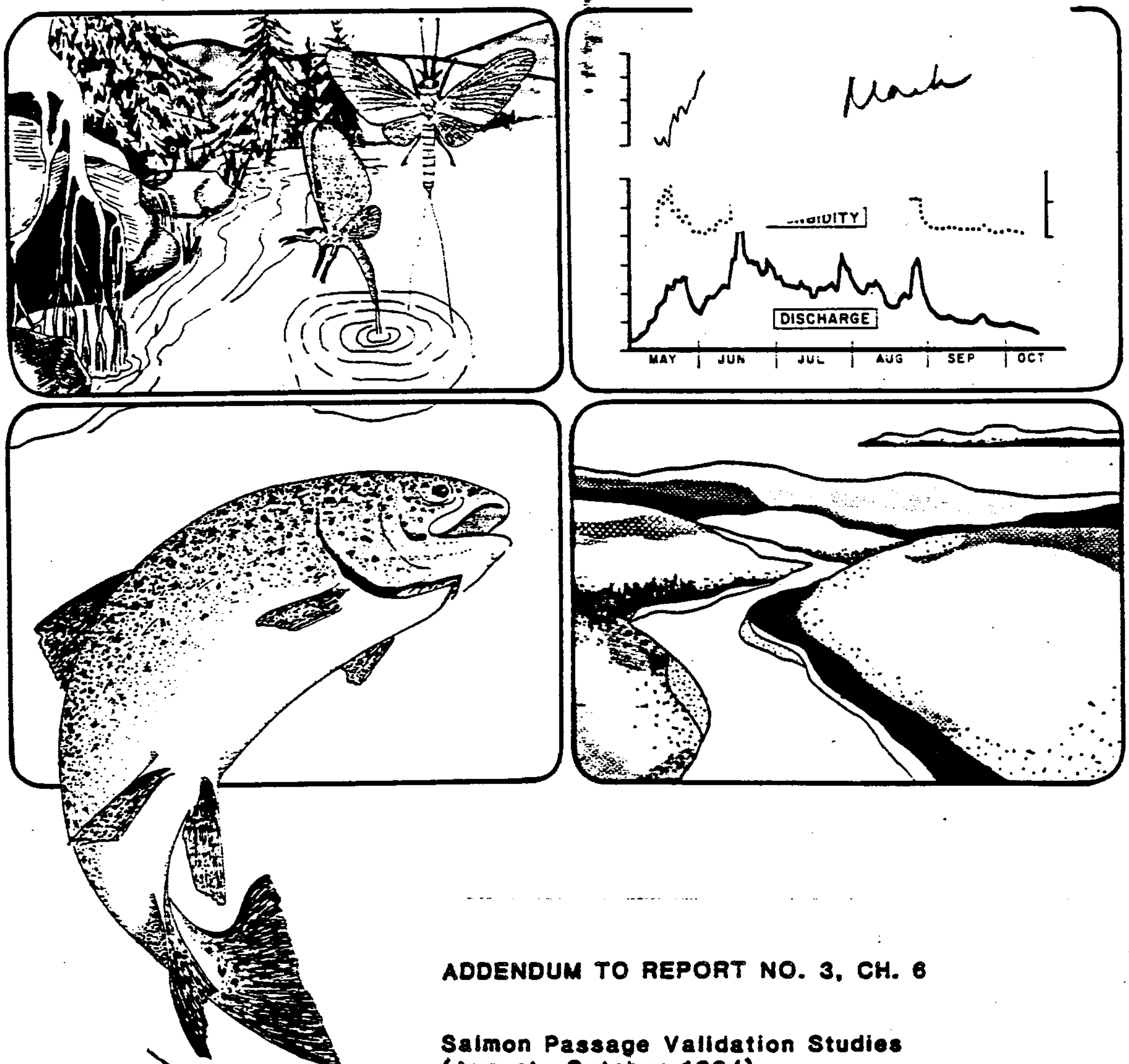

ADDENDUM TO REPORT NO. 3, CH. 6

Salmon Passage Validation Studies (August -October 1984)

(1985)

#33.

APA Doc# 2854

ALASKA DEPARTMENT OF FISH AND GAME
SUSITNA HYDRO AQUATIC STUDIES REPORT SERIES

ADDENDUM TO ALASKA DEPARTMENT OF FISH AND GAME

REPORT NO. 3, CHAPTER 6:

SALMON PASSAGE VALIDATION STUDIES

AUGUST - OCTOBER, 1984

(#33)

By:

Jeffery S. Blakely
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(2 of 5)

and

Larry A. Rundquist
and
N. Elizabeth Bradley

Entrix, Inc.
4794 Business Park Boulevard
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1985

ABSTRACT

An interim evaluation of the effects that mainstem discharge and local flow have on passage conditions for adult salmon at selected slough and side channel habitats of the middle reach of the Susitna River was previously presented in Sautner et al. (1984). Due to the limited data available for this interim evaluation, the Passage Validation Studies (PVS) were initiated during the 1984 open water field season to collect additional physical and biological data to reevaluate the passage criteria and the local flow and mainstem discharge values required for successful and unsuccessful salmon passage within these habitats. In addition, the methodologies used for the backwater and local flow analyses were revised to reflect the additional data which were

CE

collected. Physical data collected included channel cross section and thalweg profiles, substrate assessments, and local flow measurements. Biological data consisted of salmon passage criteria based on visual observations of adult chum salmon movement in selected slough and side channel habitats.

The salmon passage criteria previously presented in Sautner et al. (1984) were reevaluated and revised based on these data using a modified analytical approach. The revised analysis resulted in the development of a single set of salmon passage criteria thresholds for defining successful and unsuccessful passage conditions at study sites. A total of 85 passage reaches were identified at slough and side channel sites during the 1984 PVS compared to 74 passage reaches identified in Sautner et al. (1984). Using the revised criteria thresholds as guidelines, a reevaluation of the breaching, backwater, and local flow analyses for these passage reaches indicates that mainstem discharge and local flow requirements for successful and unsuccessful passage are similar to values previously established. The most significant differences occurred in the backwater analysis for some sites, where required mainstem discharges decreased over 1,000 cfs. Water depth was determined to be the primary physical variable affecting passage conditions at passage reaches; passage conditions were not greatly affected by changes in passage reach length. Variations in channel configuration and substrate size were assumed to have a negligible influence on the salmon passage criteria. The revised passage criteria thresholds are based on an upper thalweg depth of 0.5 feet thereby voiding all previous analyses that utilized 0.67 feet as the upper limit of thalweg depth.

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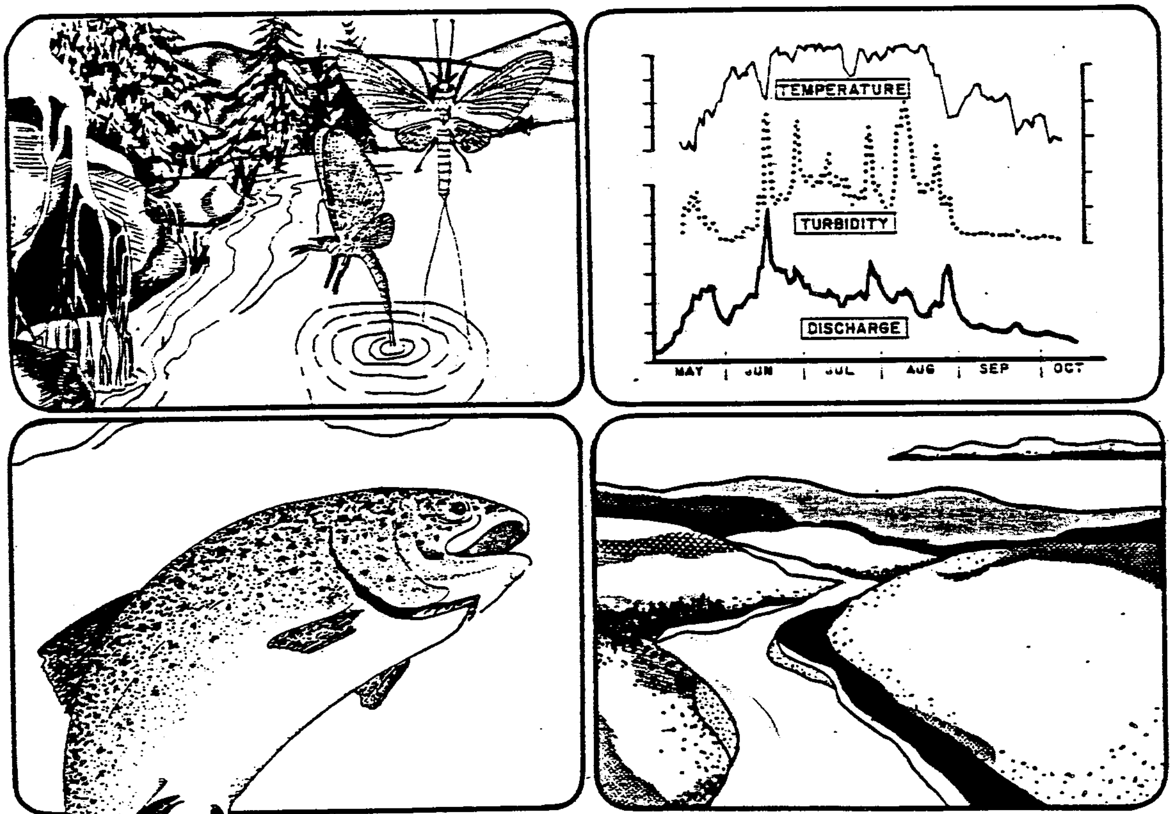

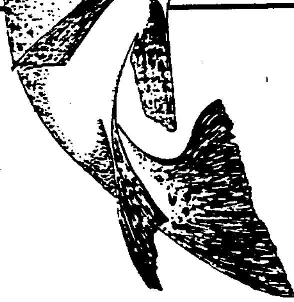

ASKS 29 and 37 SUPPORT TECHNICAL REPORT

ONTINUOUS WATER TEMPERATURE INVESTIGATIONS

y: Theresa Keklak and Tommy Withrow

(1 of 2)

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APA Doc #2867

ALASKA DEPARTMENT OF FISH AND GAME

SUSITNA HYDRO AQUATIC STUDIES REPORT SERIES

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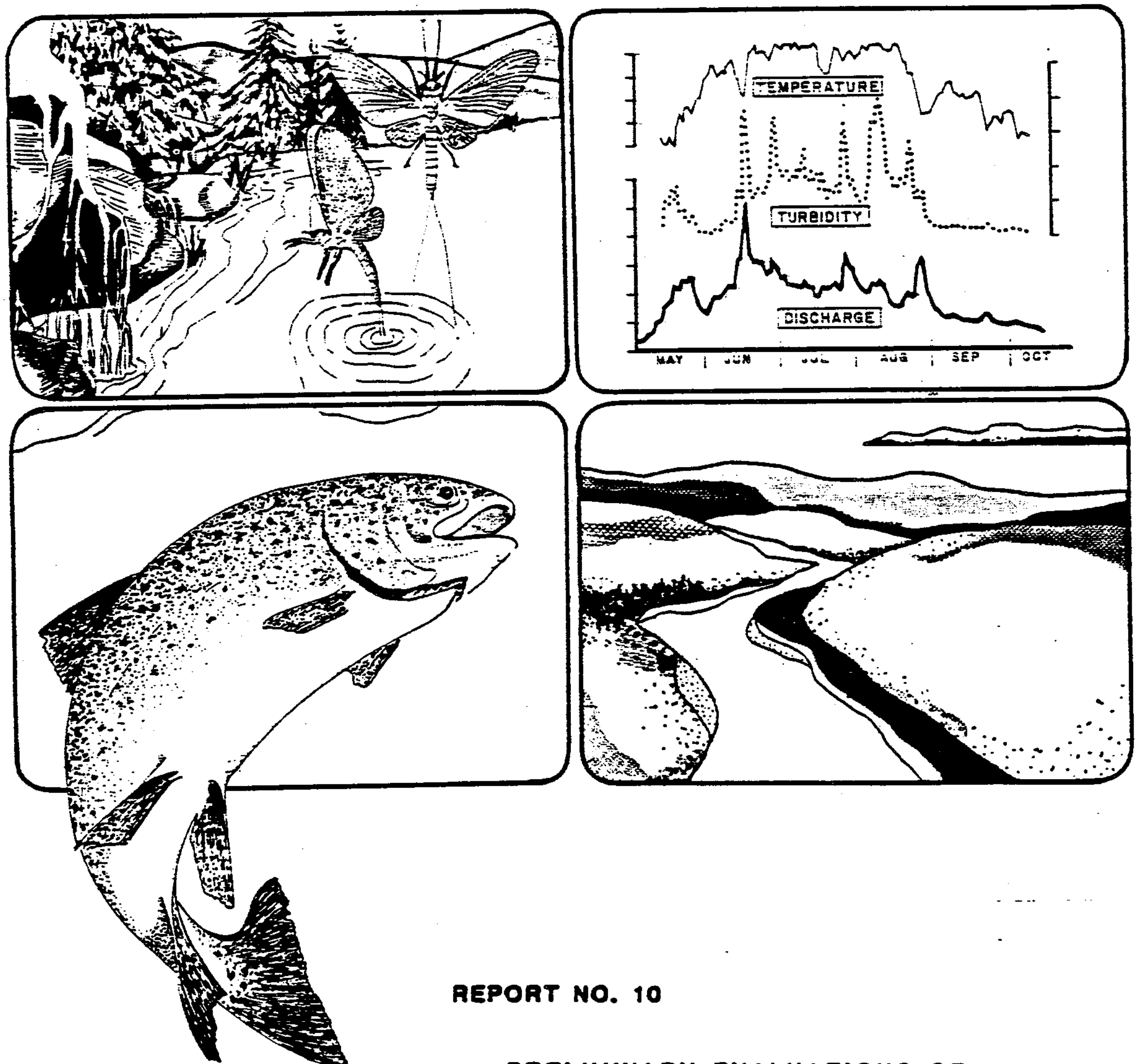

REPORT NO. 10

PRELIMINARY EVALUATIONS OF POTENTIAL FISH MITIGATION SITES IN THE MIDDLE SUSITNA RIVER

(1 of 5)

#35.

APA Doc #2908

ALASKA DEPARTMENT OF FISH AND GAME
SUSITNA HYDRO AQUATIC STUDIES REPORT SERIES

PRELIMINARY EVALUATIONS OF POTENTIAL FISH MITIGATION SITES

IN THE MIDDLE SUSITNA RIVER

Report No. 10

(#35)

by Donald R. Seagren and Robert G. Wilkey

(2865)

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Susitna River Aquatic Studies Program
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Anchorage, Alaska 99501

ABSTRACT

Development of the Susitna Hydroelectric Project is expected to alter the natural seasonal flow regime of the Susitna River downstream of Devil Canyon (RM 152.0). Changes in the natural flow regime of the Susitna River may impact salmon spawning and incubation habitat in the middle reach of the river from Talkeetna (RM 98.0) to Devil Canyon (RM 152.0). This study was conducted by the Alaska Department of Fish and Game during 1984 and 1985 to evaluate potential slough and side channel sites that may be used to mitigate for adverse impacts to salmon spawning and incubation habitat resulting from operation of the hydroelectric project. These evaluations focused on habitat modification as a mitigation alternative to improve fish passage, upwelling, and substrate conditions. Forty-four potential fish mitigation sites were identified during the open-water portion of this study. Of these 44 sites, 23 were side slough habitats, 16 were upland slough habitats, and 5 were side channel habitats. From the initial 44 sites, three representative sites were selected for more detailed evaluations of habitat modification alternatives during the ice-covered season. Baseline information on surface and intragravel water quality, substrate conditions, upwelling sources, and fish passage restrictions were collected during the open-water season. The ice-covered studies evaluated incubation conditions (water quality and substrate) and specific habitat modification techniques which may be applicable for mitigation purposes. Recommendations for specific sites which generally appear to be most suitable for mitigation are presented in the discussion. However, the selection of these sites was based on field observations and limited data, therefore a more detailed evaluation should be conducted to determine if these sites are the most practical sites for mitigation purposes. This study only evaluates the mitigation potential of sites under current habitat conditions and any changes to the habitat that may take place in the future may necessitate a reevaluation of these sites.

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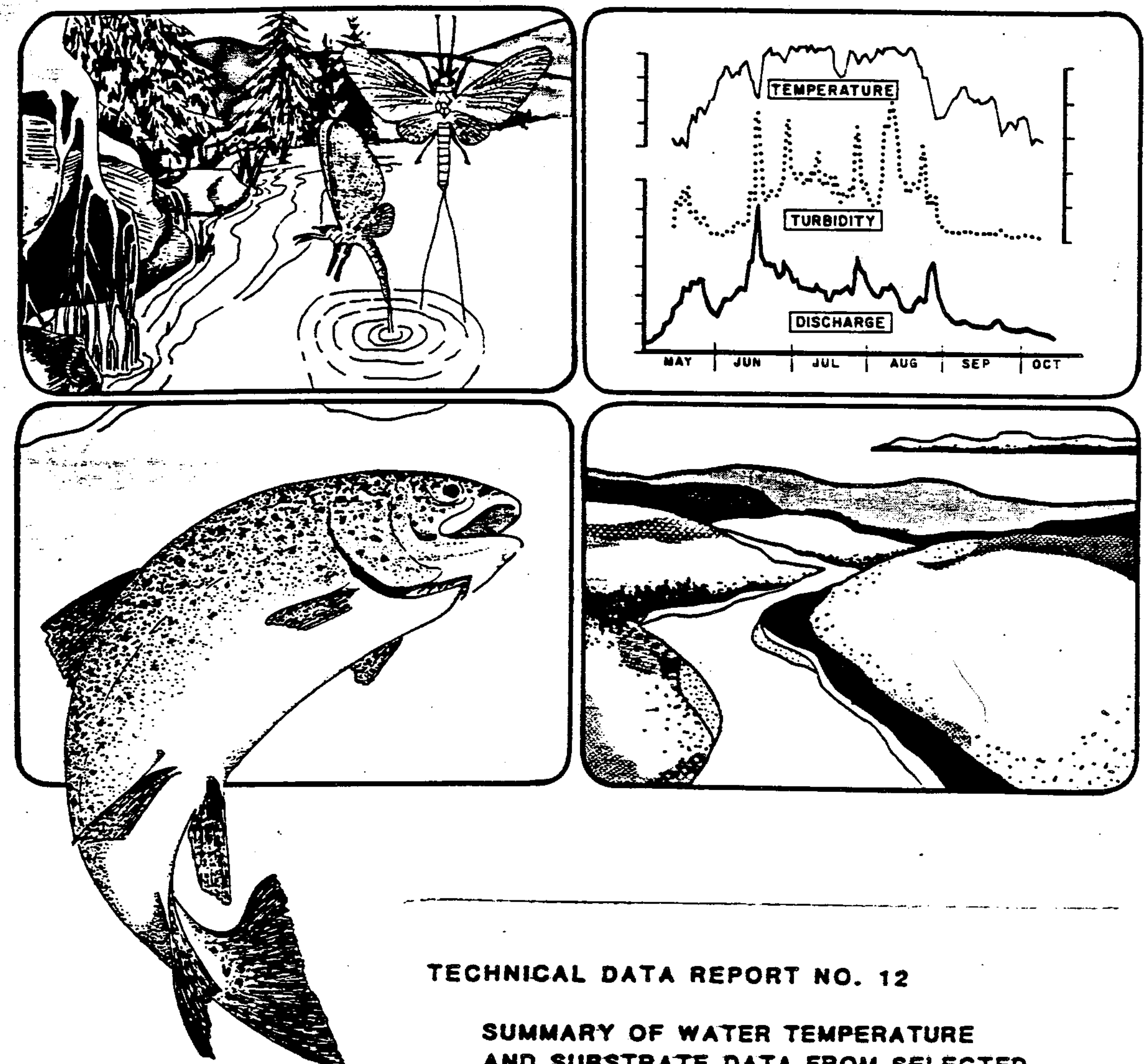

TECHNICAL DATA REPORT NO. 12

SUMMARY OF WATER TEMPERATURE AND SUBSTRATE DATA FROM SELECTED SALMON SPAWNING AND GROUNDWATER UPWELLING SITES IN THE MIDDLE SUSITNA RIVER

(1 of 4)

#36.

APA Doc #2913

ALASKA DEPARTMENT OF FISH AND GAME
SUSITNA HYDRO AQUATIC STUDIES REPORT SERIES

(#36)

SUMMARY OF WATER TEMPERATURE AND SUBSTRATE DATA FROM SELECTED SALMON SPAWNING AND GROUNDWATER UPWELLING SITES IN THE MIDDLE SUSITNA RIVER

Technical Data Report No. 12

(2 of 4)

by

Donald R. Seagren

and

Robert G. Wilkey

Alaska Department of Fish and Game
Susitna River Aquatic Studies Program
620 East 10th Avenue, Suite 302
Anchorage, Alaska 99501

December 1985

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LOWER SUSITNA RIVER PRELIMINARY CHUM SALMON SPAWNING HABITAT ASSESSMENT

Draft Technical Memorandum

by

Jeff Bigler
Kim Levesque

1985

(1 of 3)

#37.

ALASKA DEPARTMENT OF FISH AND GAME

Susitna Hydro Aquatic Studies
620 East 10th Avenue
Anchorage, Alaska 99501

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SUSITNA PROJECT REVIEW

Division of Commercial Fisheries

Central Region

October 2 - 4, 1985

See also RTS Files

I 800.200.400 (1),(2)

for draft FY86

RSA/POS

I 800. 100.200(4)

(1 of 3)

ADFG 37a

(#37a)

REVIEWERS GUIDE

Your participation in the Susitna Project Review is sincerely appreciated. As a reviewer, your comments and recommendations will assist the Commercial Fisheries Division develop and refine future fisheries study plans for the Susitna River.

The Division presently has two primary management goals for the Susitna. The first goal is "TO ENSURE THAT OPTIMUM ("ADEQUATE") SPAWNING ESCAPEMENTS ARE MAINTAINED FOR SUSITNA RIVER SALMON STOCKS." The second primary goal addresses monitoring potential changes resulting from the construction and operation of the Susitna Hydroelectric Project on fish populations and their habitats. More specifically the goal is "TO DESCRIBE THE NATURAL PRE-PROJECT VARIATIONS IN FISH POPULATIONS AND THEIR HABITATS AT A LEVEL OF RELIABILITY NECESSARY TO DETECT AND EXPLAIN POSSIBLE FUTURE CHANGES CAUSED BY THE HYDRO-ELECTRIC DEVELOPMENT".

Given the reality of shrinking budgets and rapidly increased resource demands, we must carefully assess our fisheries projects to ensure 1) technical merit 2) cost effectiveness, and 3) relevance to primary management goals. In this regard, please attempt to use the following list of questions as an outline to structure your comments and recommendations.

1. Do the objectives of this project appear to adequately address the Division's primary goals? How might project objectives be modified to more clearly address our goals?

2. If you believe that technical difficulties associated with this project may exist; what are they and how might they be remedied?

3. Could our sampling programs be modified to reduce project costs without unreasonably sacrificing technical quality.

4. What priority would you give this project in terms of meeting the Division's primary goals?

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Susitna Project Review
October 2 - 4, 1985

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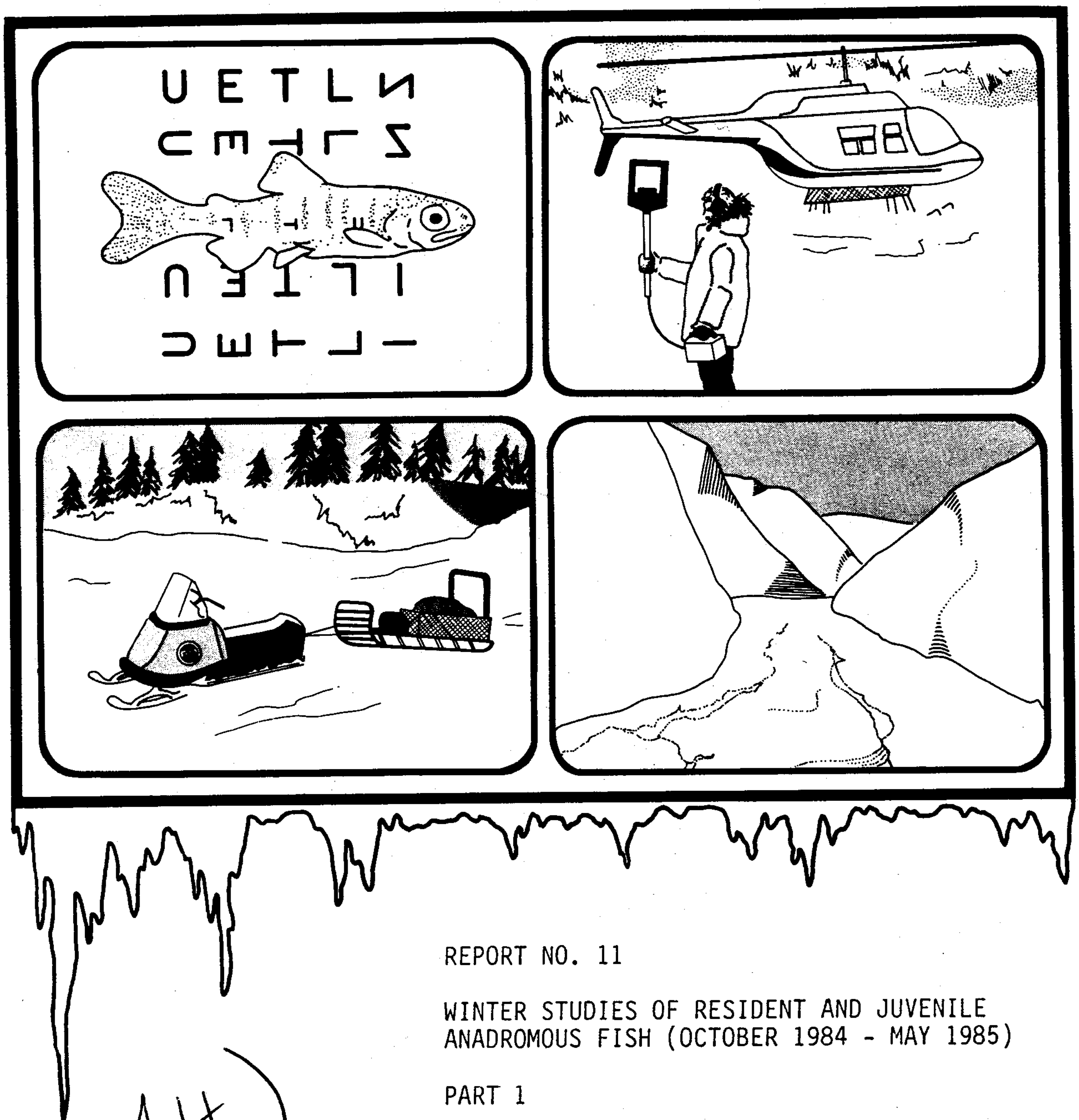

REPORT NO. 11

WINTER STUDIES OF RESIDENT AND JUVENILE ANADROMOUS FISH (OCTOBER 1984 - MAY 1985)

PART 1

(1064)

#38a.

APA Doc#3062

ALASKA DEPARTMENT OF FISH AND GAME
SUSITNA HYDRO AQUATIC STUDIES REPORT SERIES

WINTER RESIDENT FISH DISTRIBUTION AND HABITAT STUDIES

CONDUCTED IN THE SUSITNA RIVER BELOW DEVIL CANYON, 1984-85

(#38a)

Report No. 11, Part 1

By Richard L. Sundet

(284)

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ABSTRACT

Studies of selected resident fish species were conducted in both the lower (below the Chulitna River confluence) and middle (between the Chulitna River confluence and Devil Canyon) Susitna River during the winter of 1984-85. These studies present distribution and habitat data collected from resident fish which were radio tagged in the spring and fall of 1984. Additional studies were done on the lower Susitna River to document the timing and locations of spawning burbot. Findings from radio telemetry studies indicate that middle river rainbow trout overwintered in the mainstem Susitna River, whereas lower river rainbow trout usually overwintered in side channels. Most rainbow trout overwintered from 0.0 to 4.0 miles below the mouth of the tributary they were tagged at. Rainbow trout in both reaches of river overwintered in areas of low to moderate water velocities (0.0-2.5 fps) and in areas with surface ice. No rainbow trout overwintered in areas that had anchor ice. Middle river rainbow trout were found in slightly deeper waters than lower river rainbow trout. Several middle river rainbow trout overwintered close to each other suggesting that this species congregate during the winter or that overwintering habitat is limited, resulting in cohabitation. Two pronounced winter movements were recorded for rainbow trout in both reaches of river: one between mid-September and mid-October, and one between mid-December and mid-January. Most rainbow trout begin to migrate from the mainstem to tributaries during breakup in May. Lower river burbot spawned between late January and early February. Four spawning sites at the Deshka River were documented. Several radio tagged burbot probably spawned in the mainstem Susitna River between RM 13.0 and RM 92.0. Burbot showed both a pre- and post-spawning migration of up to 20 miles. Monitoring data suggest some middle river Arctic grayling overwinter in the mainstem at RM 147.0, near Portage Creek (RM 148.8), while other stocks migrate 40.0 miles downriver to overwinter in the mainstem Susitna River near Talkeetna.

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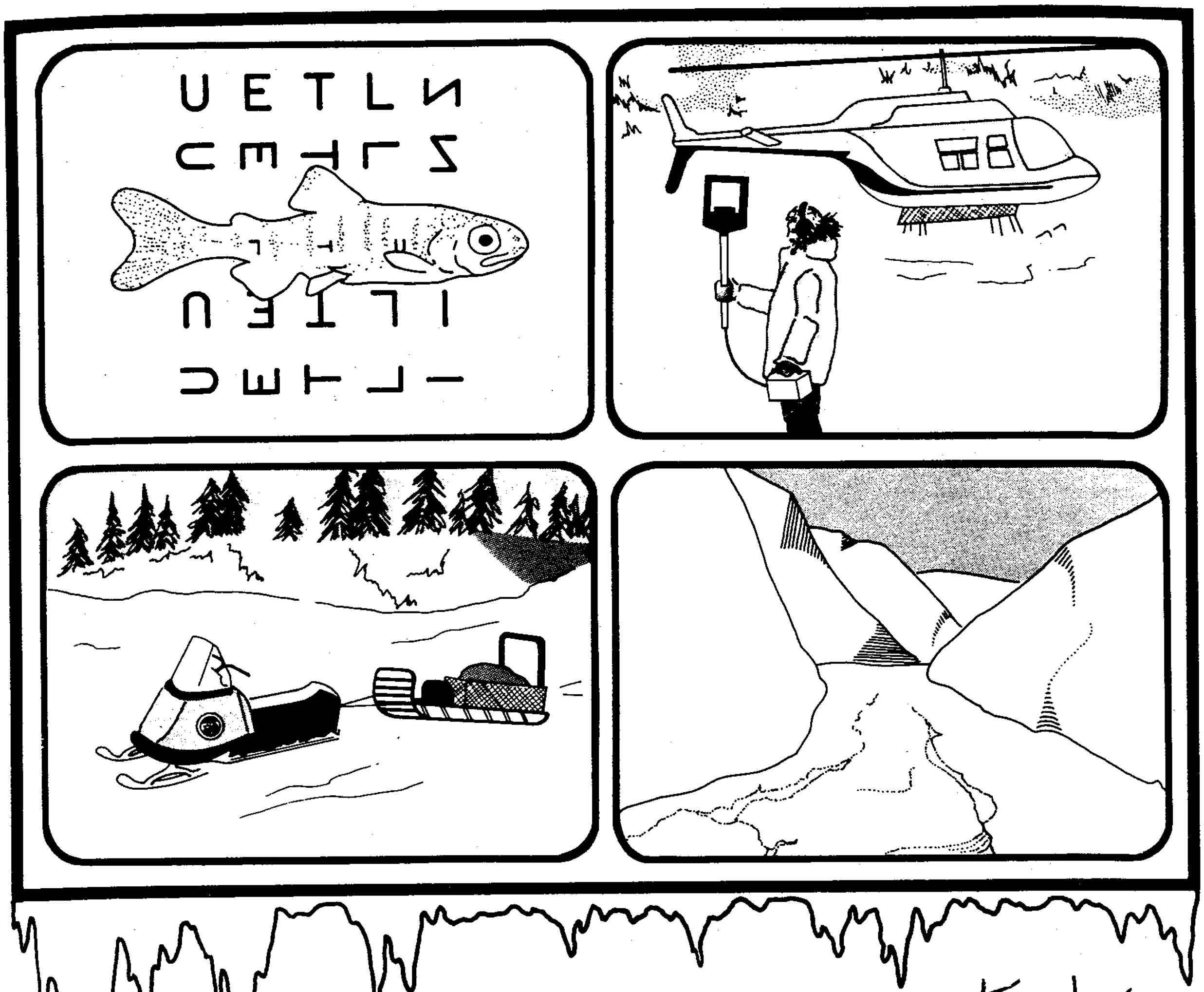

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REPORT NO. 11

WINTER STUDIES OF RESIDENT AND JUVENILE ANADROMOUS FISH (OCTOBER 1984 - MAY 1985)

PART 2

(1064)

#38b.

APA Doc #3063

ALASKA DEPARTMENT OF FISH AND GAME
SUSITNA HYDRO AQUATIC STUDIES REPORT SERIES

~~? 3063 or 3863?~~

(#38b)
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SUMMARY OF JUVENILE CHINOOK AND COHO SALMON WINTER STUDIES IN THE MIDDLE SUSITNA RIVER, 1984-85

Report No. 11, Part 2

by Michael E. Stratton

Alaska Department of Fish and Game
Susitna River Aquatic Studies Program
620 East 10th Avenue, Suite 302
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April 1986

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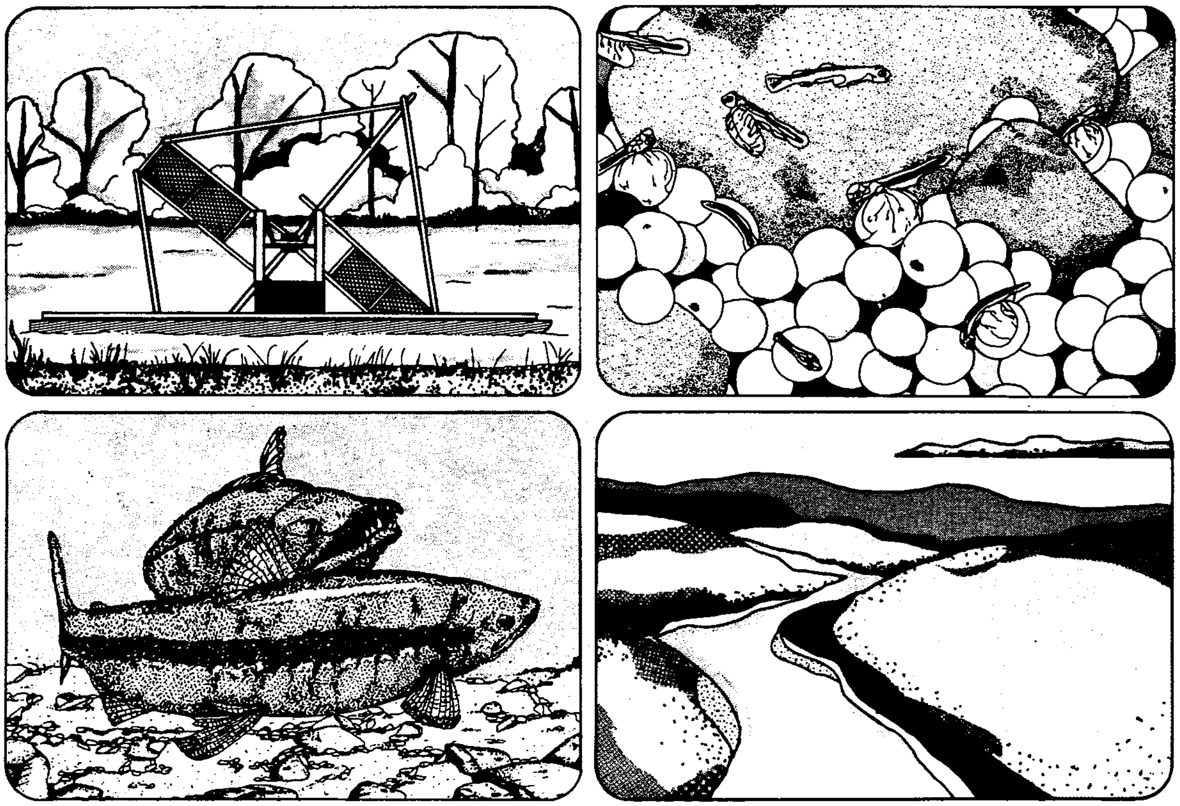

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Report No. 13

Adult Salmon Investigations:
May - October 1985

DRAFT

#39.

APA Doc #3412

ALASKA DEPARTMENT OF FISH AND GAME
SUSITNA HYDRO AQUATIC STUDIES REPORT SERIES

(#39)

ADULT SALMON INVESTIGATIONS:

MAY - OCTOBER 1985

(2864)

Technical Data Report No. 13

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April 1986

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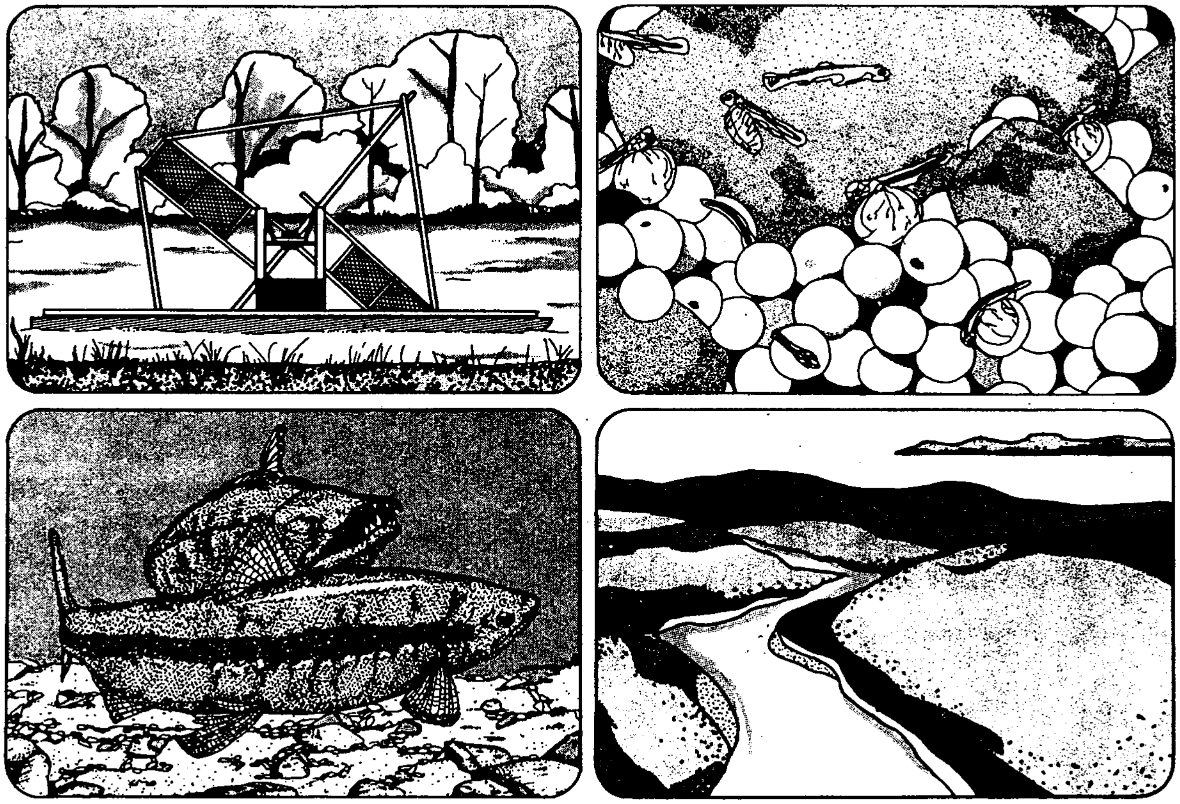

Report No. 14

The Migration and Growth of Juvenile Salmon in the Susitna River, 1985.

(184)

Authors: Kent J. Roth
Danial C. Gray

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APA Doc #3413

ALASKA DEPARTMENT OF FISH AND GAME
SUSITNA HYDRO AQUATIC STUDIES REPORT SERIES

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ALASKA DEPARTMENT OF FISH AND GAME

SUSITNA RIVER AQUATIC STUDIES PROGRAM

Report No. 14

The Migration and Growth of Juvenile Salmon in the Susitna River, 1985.

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Prepared for:

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701 East Tudor Road
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June 1986

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