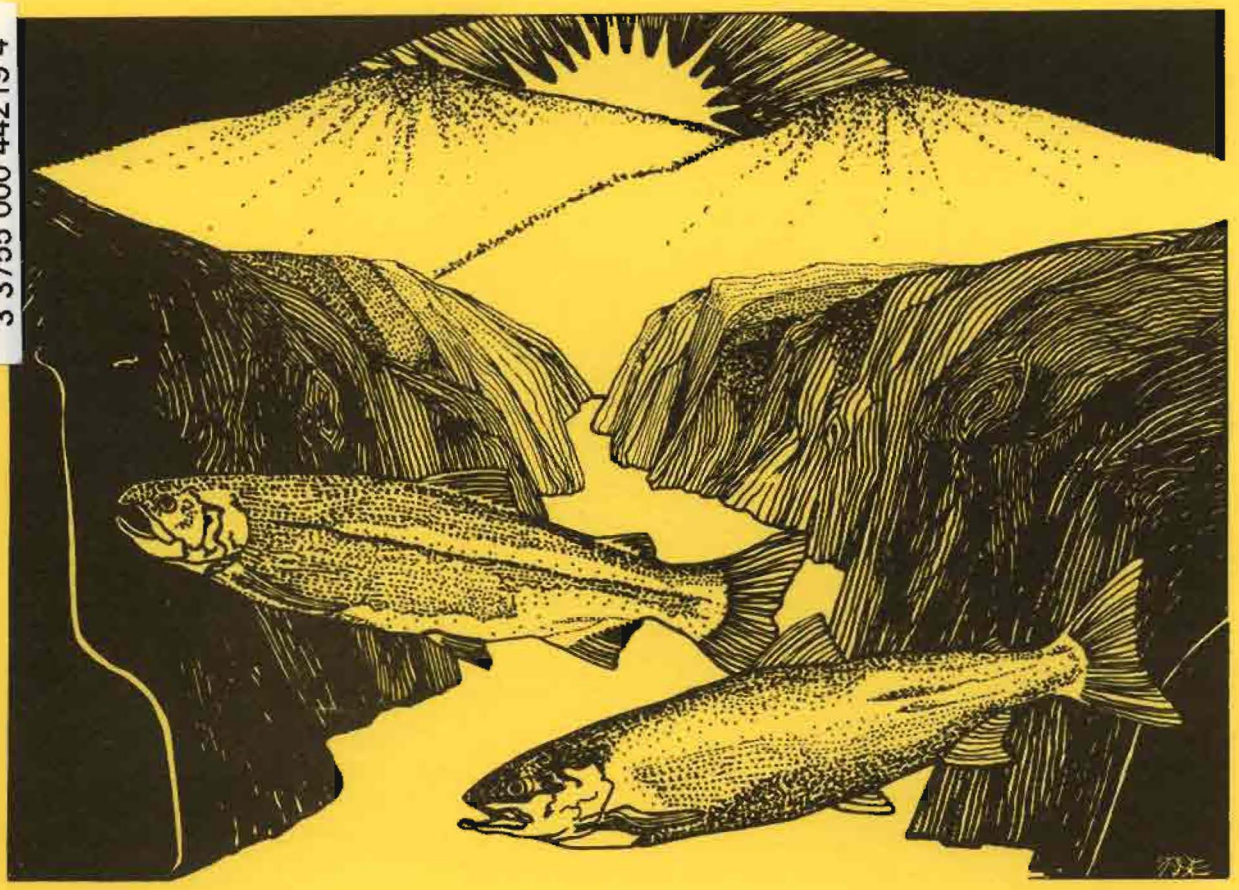

Subtask 7.10

AQUATIC STUDIES PROCEDURES MANUAL

PHASE I - Final Draft

ALASKA
DEPARTMENT OF FISH AND GAME

ALASKA POWER AUTHORITY

SUSITNA HYRDROELECTRIC PROJECT

Subtask 7.10

AQUATIC STUDIES PROCEDURES MANUAL

PHASE I - Final Draft

-by-
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APPENDICES

I. INTRODUCTION

The Susitna River, one of Southcentral Alaska's major river systems, 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.

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 aquatic and terrestrial habitat upsteam 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 Baxter and Glaude, 1980; Hocutt et al., 1980; Ward and Stanford, 1979). Regulation of the mainstem river will substantially alter the natural flow regime downstream. The transmission line corridor, substations, road corridor, and increased access to the area construction pad sites, will also impact aquatic and terrestrial communities and their habitat.

The proposed hydroelectric development necessitates gaining a thorough knowledge of the chemical, physical and biological parameters and their seasonal relationships to discharge 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.

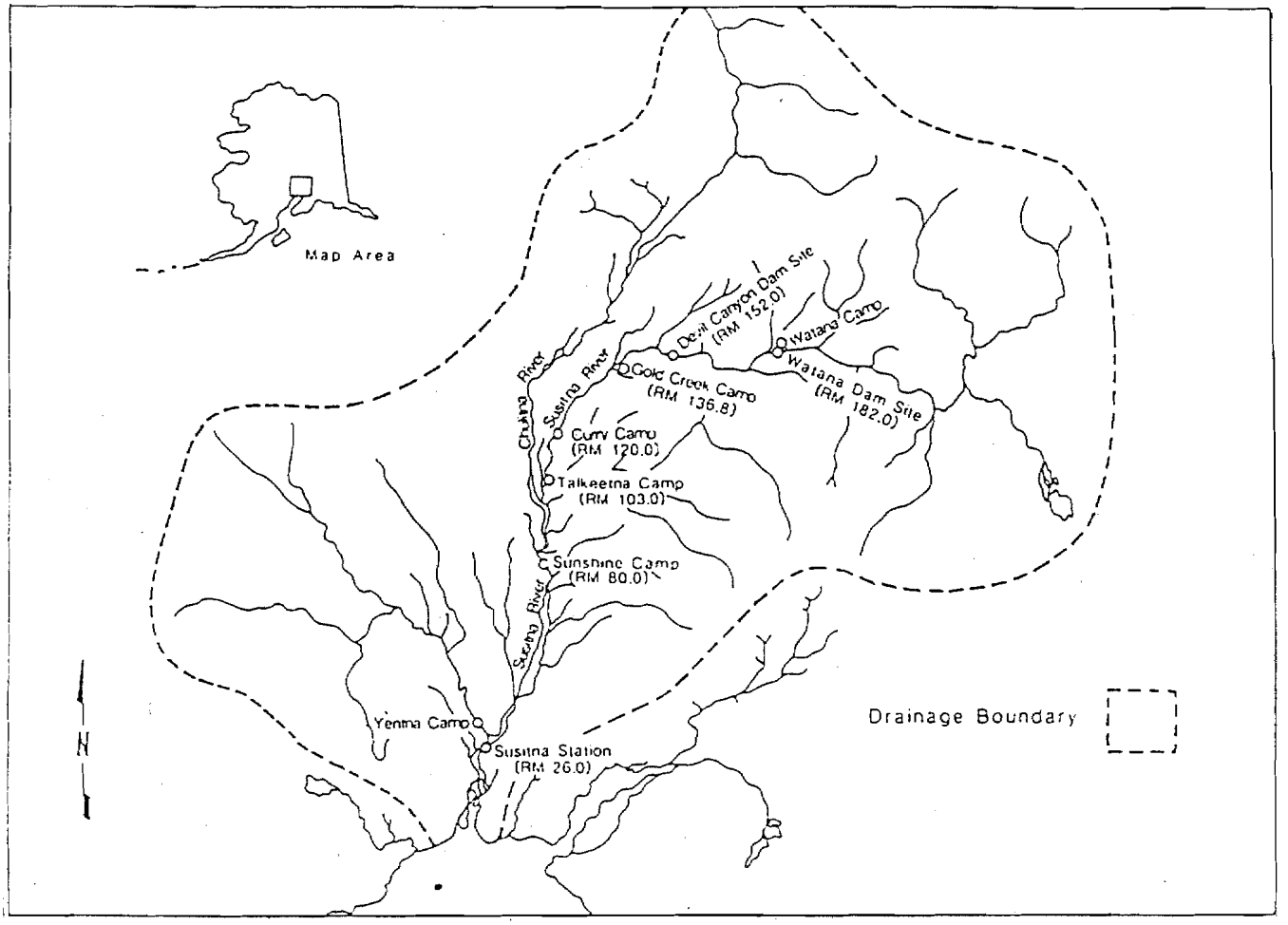

Figure 1. Susitna River Basin (approximate scale 1:2,200,000).

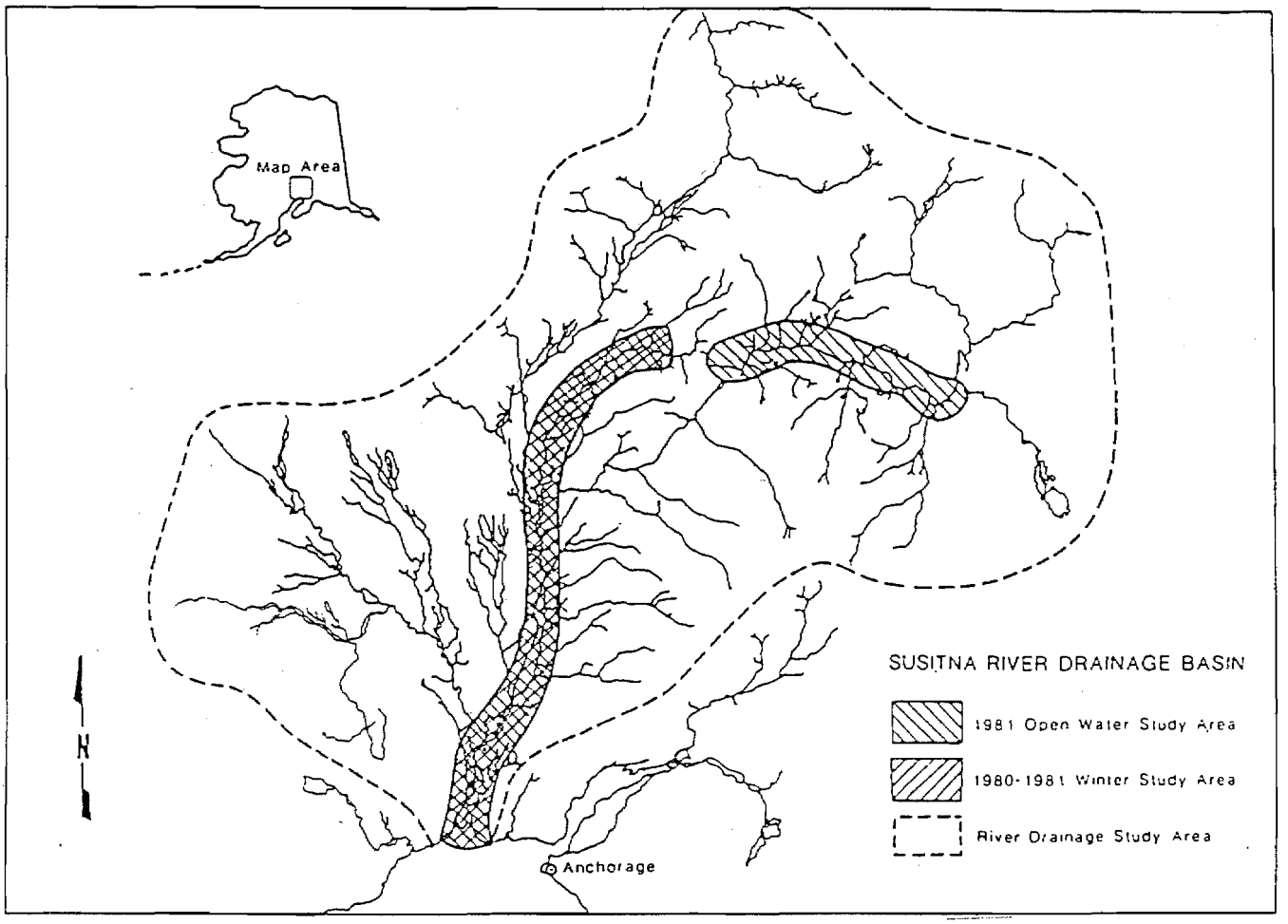

Figure 2. Phase I study areas, Susitna River basin.

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

Task 1.1 Enumerate and characterize the migration 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.

Task 1.4 Identify and determine methods, means and the feasibility of estimating the Susitna Rivers, contribution to the Cook Inlet commerical 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 and their relationship with mainstem discharge.

Task 3.1 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 Characterize the physical and chemical parameters of the various habitat types found in the study area as they relate to mainstem discharge.

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 Adult Anadromous and Resident and Juvenile Anadromous field investigations will be interrelated to and conducted in cooperation with Aquatic Habitat and Instream Flow Studies. The specific procedures for completion of each section of the program are described in this manual.

II. TECHNICAL PROCEDURES

A. ADULT ANADROMOUS FISHERIES STUDIES

Study Description and Rationale

Three principal methods will be used to determine the distribution, abundance, timing and migrational activity of adult anadromous salmon in the study area (Tasks 1.1 and 1.2). They are: 1. deployment of Side Scan Sonar (SSS) counters, 2. tag and recapture with fishwheels 3. aerial surveys. The SSS counters are expected to accurately monitor pink and sockeye salmon escapement and be reasonably effective on the other species with the exception of chinook salmon because returning adults characteristically migrate upstream in mid-channel beyond the operational limits of SSS counters. Tag and recapture data using fishwheels should effectively establish the timing and escapement levels on coho, sockeye, chum and pink salmon. Chinook salmon escapement and distribution will be provided through an aerial survey program covering all known and suspected spawning grounds of this species.

Various types of sampling gear will be used on the Susitna River mainstem and subreaches (sloughs, side channels and tributary confluences) along with ground and waterborne surveys to assist in determining the extent of salmon spawning activity (Task 1.3). Radio tagging will also be conducted to gather specific information on the migrational behavior, timing and spawning locations of chinook, coho and chum salmon in the upper Susitna River, principally between Talkeetna and Devil Canyon (Task 1.2 and 1.3).

Lastly, an evaluation will be made of the various means and methods available for assessing the Susitna River contribution to the Cook Inlet commercial salmon fishery. The emphasis will be directed toward formulating a plan which can be implemented in Phase II that provides stock identification (Task 1.4).

Sonar Counters:

Operation Dates:

A training class on sonar operation will be held from 1 May to 30 May; field activities for sonar enumeration will begin and terminate on the following dates:

Susitna Station	15 June to 7 September
Yentna Sonar	15 June to 7 September
Sunshine Sonar	15 June to 15 September
Talkeetna Sonar	15 June to 15 September

Methods:

Two Bendix Side Scanning Sonars (SSS) will be deployed at each of the four sonar sites (Figure VI-1A). This equipment will be operated by trained ADF&G personnel. A training program for two members of each crew will be conducted on the Kenai River by ADF&G/Commercial Fisheries Division biologists Ken Tarbox and Bruce King; both have several years of field experience each with SSS counters.

Procedures for deployment of the substrate and equipment operation are described in the 1980 Side Sonar Counter Installation and Operation Manual, Bendix Corporation (Appendix I).

Counts of salmon crossing the substrate will be recorded on printer tape each hour of the day. The paper printouts will be removed from the counters and the counts tabulated on a separate form each day. Counter accuracy will be monitored four times daily for 3.5 minutes by hand tallying fish related echos displayed on an oscilloscope (Appendix II). The ratio of visual counts to SSS counts will be used to derive a calibration factor. This calibration factor will then be used to adjust the daily raw sonar counts (III Data Procedures).

A fishwheel will be installed below each SSS counter to provide escapement samples and relative abundance data by species for apportioning sonar counts. The fishwheel will be placed so that its presence does not conflict with or bias the sonar counters performance. All fishwheel captured salmon will be enumerated by species and sampled for the data required below (III Data Procedures).

Sockeye Salmon: Forty sockeye salmon will be sampled daily for age, sex and length.

Chinook Salmon: Age, sex and length samples will be obtained daily from all captured chinook salmon.

Chum Salmon: Twenty five age, sex, and length samples will be obtained daily from all captured chum salmon.

Coho Salmon: Twenty five age, sex and length samples will be collected daily from fishwheel captured coho salmon.

Pink Salmon: Forty length and sex samples will be collected daily from fishwheel captured pink salmon.

The number of fish sampled for age, sex and length information is adequate to define escapement characteristics and variability based on previous findings by the ADF&G Stock Separation Office. Age samples will not be collected from pink salmon due to there being only one age class involved in the adult return.

Sonar counts and attendant data will be forwarded to the Anchorage office every two weeks.

Tag/Recapture

Operation Dates:

Field operations for tag/recapture projects will start and end on the following dates:

Sunshine Tag/Recapture	15 June to 15 September
Talkeetna Tag/Recapture	15 June to 15 September
Curry Tag/Recapture	15 June to 21 September

Methods:

Two fishwheels will be deployed off each bank of the Susitna River at both the Sunshine and Talkeetna sites (Figure VI-1A). Two fishwheels, one on each bank, will be operated at the Curry site. All fishwheels will be operated continuously, 24 hours per day. Fishwheels design and operation id described in Appendix III.

Each fishwheel will be checked five or more times daily to insure minimal holding time and reduce stress. All adult salmon with the exception of chinook salmon will be tagged and released. Chinook salmon escapement will be acertained by aerial survey of all known and suspected spawning areas. Tagging method is outlined in Appendix IV. Floy FT-4 spaghetti tags color coded International Orange and consecutively numbered, will be used exclusively at the Sunshine site. Yellow color coded FT-4 spaghetti tags will be used to mark adult salmon at the Talkeetna site; they will also be consecutively numbered. The Curry site will use one inch diameter Peterson disc tags, similarly consecutively numbered.

Fish recaptured at upstream tagging locations will be released immediately following identification and recording of the tag type, color and number (III Data Procedures).

The tagging crew at the Curry site will also collect age, length and sex data for each species as follows:

Sockeye Salmon: Forty sockeye salmon will be sampled daily for age, sex and length.

Chinook Salmon: Age, sex, and length samples will be obtained daily from all captured chinook salmon.

Chum Salmon: Twenty five age, sex and length samples will be collected daily from captured chum salmon.

Coho Salmon: Twenty five age, sex and length samples will be collected daily from fishwheel captured coho salmon.

Pink Salmon: Forty length and sex samples will be collected daily from fishwheel captured pink salmon.

The number of fish sampled for age, sex and length information is adequate to define escapement characteristics and variability based on previous findings by the ADF&G Stock Separation Office. Age samples will not be collected from pink salmon due to there being only one age class involved in the adult return.

Tag and recapture data will be forwarded to the Anchorage office every two weeks.

Survey

Operation Dates and Survey Reach:

Field operations for identifying Susitna River mainstem and slough spawning areas will begin and end on the following dates:

Susitna Station Survey	15 July to 1 October
Sunshine Survey	15 July to 7 October

Gold Creek Survey 15 July to 15 October

The geographic area of responsibility for each crew is:

Susitna Station Survey - Estuary to Kashwitna River
Sunshine Survey - Kashwitna River to Chase
Gold Creek Survey - Chase to Devil Canyon

Mainstem and slough survey will be performed weekly. The Sunshine and Gold Creek crews will perform the tag and recapture surveys as scheduled below:

CREW	LOCATION	SURVEY PERIOD	FREQUENCY
Sunshine	All tributary streams between Chulitna River and Chase	25 July to 10 Oct.	Weekly
	Birch Creek	1 Aug. to 15 Aug. and 7 Sept. to 21 Sept.	Weekly Weekly
	Troublesome Creek	7 Aug. to 15 Aug. and 7 Sept. to 21 Sept.	Weekly Weekly
	Byers Creek	7 Aug. to 15 Aug.	Weekly
	Byers Lake	1 Sept. to 15 Sept.	Weekly
	Question Creek	1 Sept. to 21 Sept.	Weekly
	Swan Lake Trib.	7 Sept. to 19 Sept.	Once
	Horseshoe Creek	7 Sept to 21 Sept.	Weekly
	Clear Creek (lower 2 miles)	7 Aug. to 15 Aug.	Once
Gold Creek	All Tributary streams between Chase and Devil Canyon with exception of Portage Creek and Indian River which, because of their length, will be surveyed only for the first 1/4 mile upstream from the mouth.	25 July to 1 Oct.	Weekly

From 25 July to 15 September, the Gold Creek crew will also be responsible for fishing gill nets at various locations on the Susitna River between Devil Canyon and a point approximately 1/2 mile above Portage Creek once every five days for four hours. Collections will be made in a manner as uniform and unbiased as possible to assure that the study area is satisfactorily sampled.

Chinook salmon enumeration surveys of mainstem and tributary systems will be conducted from July 15 through August 15, 1981.

All sampling periods and survey frequencies area based upon the results and experiences of previous studies conducted in the Susitna River basin by ADF&G.

Methods:

Mainstem Surveys:

The following gear will be used to determine the presence of mainstem spawning:

1. Drift gill nets
2. Electroshockers
3. Echo recorders
4. Egg deposition pump

Each crew will be assigned a 20 foot river boat powered by a 75 hp jet outboard.

Drift gill nets will be fished by extending the net out perpendicular to the river channel, with the outside end of the float line attached to a buoy and the other fixed to the boat. The boat will drift under just enough power to keep the net reasonably straight and perpendicular to the current. Mainstem areas fished by this method should be substantially free of surface and subsurface debris and sufficiently shallow enough to allow

the net to reach within a foot (or less) of the bottom. Catch data will be recorded as outlined in the drift net form (III Data Procedures). Salmon caught by drift netting will not be assumed spawning at the catch location unless all of the following criteria are met:

1. Fish exhibits spawning maturation color and morphology.
2. Fish expells eggs or milt when slight pressure is exerted on the abdomen.
3. Fish is in vigorous condition, with 25 percent or more of the eggs or milt remaining in the body cavity.
4. An additional drift produces fish meeting criteria 1 through 3 above.

Each crew will have an echo recorder (depth finder) available which will be used on the Susitna River mainstem in those areas where water depth precludes use of a drift gill net. Method of operating the echo recorder will be in accordance with manufacturer's guidelines except that the transducer beam will be directed horizontially across the river channel instead of vertically. Suspected fish targets will be verified at first opportunity with electroshocking equipment or any other methods which based on site conditions appear feasible.

Two electroshocking boom units will be available for use between the three crews. Operating procedures are outlined in Appendix VI. These units will be worked whenever feasible on the Susitna River mainstem. The same criteria outlined under drift gill netting will be used to ascertain whether captured fish are spawning at the catch location.

Where water depth allows, suspected mainstem spawning areas will be sampled for egg deposition. A standard backpack water pump and two circular standing sreeen cod and nets 18 inches in diameter will be used to sample the river bed. Equipment operating procedures will be demonstrated in the field. Results will be recorded in the appropriate sampling form (III Data Procedures).

Set gill nets will be deployed by the Gold Creek crew in slack water areas and eddies on Susitna River mainstem between Devil Canyon and a point approximately 1/2 mile upstream of Portage Creek. Deploying a gill net is achieved by tying one end of the float line to the shore and "playing out" the net from the side or bow of the boat and then releasing the end of the net with an anchor and buoy attached to the offshore end of the lead line and float line respectively. Properly positioned, the net should extend offshore in a straight line or with a slight downstream arc.

Each survey crew will report the location of suspected mainstem, slough and tributary spawning areas twice weekly to the Aquatic Habitat (AH) crew assigned to that area. This information will be transferred to the AH crew on duplicate sampling forms (III Data Procedures). Each Adult Anadromous (AA) crew will also perform those co-operative duties discussed in the AH technical procedures section.

Slough and Tributary Surveys:

Sloughs (clear water) and tributaries listed in the preceeding section will be surveyed in their entirity except as indicated according to the schedule. Surveys will be conducted on foot by two crew members; one counting live fish and one counting carcasses. Observers will wear polarized glasses and use tally counters when enumerating fish. Survey information will be recorded on the appropriate form along with the number of tagged fish, catagorized by tag type and color (III Data Procedures).

Survey data will be forwarded to the Anchorage office every two weeks.

Chinook Salmon Aerial Surveys:

Aerial surveys to enumerate individual chinook salmon will be conducted via helicopter over all known and suspected spawning grounds. Data reported will reflect the total number of fish observed.

Eulachon Survey:

Eulachon, are known to utilize lower portions of the river for spawning. A survey addressing Eulachon is planned for Phase II operations in the spring of 1982 and will not be discussed further here.

Stock Assessment

Operation Dates:

Program will begin and end on the following dates:

1 July to 1 December

Methods:

A Fisheries Biologist II will perform a comprehensive literature search on salmon stock identification methodology and procedures. All available fisheries data on each species and stock north of Anchor Point in Cook Inlet, focusing on age, size, run timing and abundance will also be complied. Data sources will include but not be limited to ADF&G Cook Inlet Data Reports, Management and Catch Statistic Reports, Federal Aid Reports, USFWS & NMFS publications, and unpublished data from ADF&G staff and other state, federal and private fisheries scientists.

After compiling available stock information and evaluating proven and suggested stock separation methods, an analysis will be made of the suitability of each stock separation technique in determining the results will be presented in a final report along with specific recommendations on implementing a stock separation program for Susitna River fish.

Radio Tagging

Operation Dates:

A training class will be held from 15 May to 1 June on the Kenai River for personnel assigned to the radio tagging program.

Field activities for radio tagging and tracking will begin on the Susitna River and terminate on the following dates:

15 June to 1 October

Methods:

The training class will be conducted under the direction of Carl Burger. All personnel assigned to the radio tagging program will be trained in the use of proven techniques to sample, tag and radio track salmon. Carl Burger is a biologist with the U.S. Fish and Wildlife Service and has considerable radio tagging expertise.

Following training, project personnel will radio tag approximately 40 adult salmon. The salmon will be collected at the Talkeetna fishwheel site which is far enough upstream of the Talkeetna/Chulitna/Susitna River confluence to insure that radio-tagged individuals are actually utilizing the drainage upstream of this point.

SPECIES	NUMBER RADIO TAGGED	TAGGING PERIOD
Chinook	15	15 June-15 July
Chum	13	1 August-7 September
Coho	12	15 July-1 September

All tags used will be low frequency (40 MHz) and will have a life expectency of 90 days or more, with a reception distance of not less than one mile.

The fish will be selected from fishwheel captures at the Talkeetna tag/recapture site. There will be no attempt to bias selection other than

no fish will be tagged with a transmitter that has been tagged previously with either Floy or Peterson disc tag or is lethargic or shows any external injury. Once a fish has been slected it will be transferred to a water tight box containing a fish anesthetic to subdue the specimen. The fish will be ready to tag within about two minutes.

The cigar-shaped radio transmitter to be used is next tested for signal reception in water. Thence, it is coated with water soluble glycerin, and with the help of plexiglass tubes, is slid through the mouth and escophagus and into the stomach. Prior to release of the fish, the transmitter is tested again. The salmon is gently transferred to the river near shore, where it is held until consciousness is regained and the fish can forcefully swim away. Preliminary tracking studies will commence from a boat.

When several fish have been tagged and released, periodic boat trips and flights will commence to document their new locations. In this study, boat tracking will occur at least twice weekly. At least two tracking flights will also be made per week (weather permitting), with fixed wing aircraft and/or helicopters. Both manual and scanning radio receivers will be used. From the boats, fish will be pinpointed to 20 +/- feet of their actual locations.

Data will be recorded on the appropriate forms (III Data Procedures) and will be forwarded to the Anchorage office every two weeks.

B. RESIDENT AND JUVENILE ANADROMOUS FISH STUDIES

Study Descriptions and Rationale

Phase I of Resident and Juvenile Anadromous (RJ) field operations will extend over one summer and two partial winter seasons. The following discussions outline seasonal work plans to be implemented.

Summer Field Operations

Summer field operations will be conducted from May through October utilizing riverboats, rafts, fixed-wing aircraft, helicopters and pick-up trucks as the primary means of transportation. A total of four riverboats, crewed by RJ and Aquatic Habitat and Instream Flow (AH) biologists, will operate on the Susitna River from the estuary to Devil Canyon.

The riverboat crews will be based at the Yentna, Sunshine and Talkeetna Adult Anadromous (AA) Studies fishwheel/sonar camps and at the Gold Creek RJ Camp. Basing the boats at these locations will provide the necessary security and logistical support required for project implementation. Each riverboat will be staffed by one to three RJ biologists accompanied by one AH biologist as indicated in Figure 1. The responsibilities assigned to the four RJ riverboat biologist crews will include:

Systematic sampling of resident and juvenile anadromous populations using established techniques including gillnets, minnow traps, adult traps, hook and line, seines and electrofishing.

Designing and effective downstream migrant trap to be deployed during Phase II.

Tagging and releasing adult resident fish and attempting recapture.

Conducting informal interviews of sport fishermen between Talkeetna and the Tyone River and recording the following information:

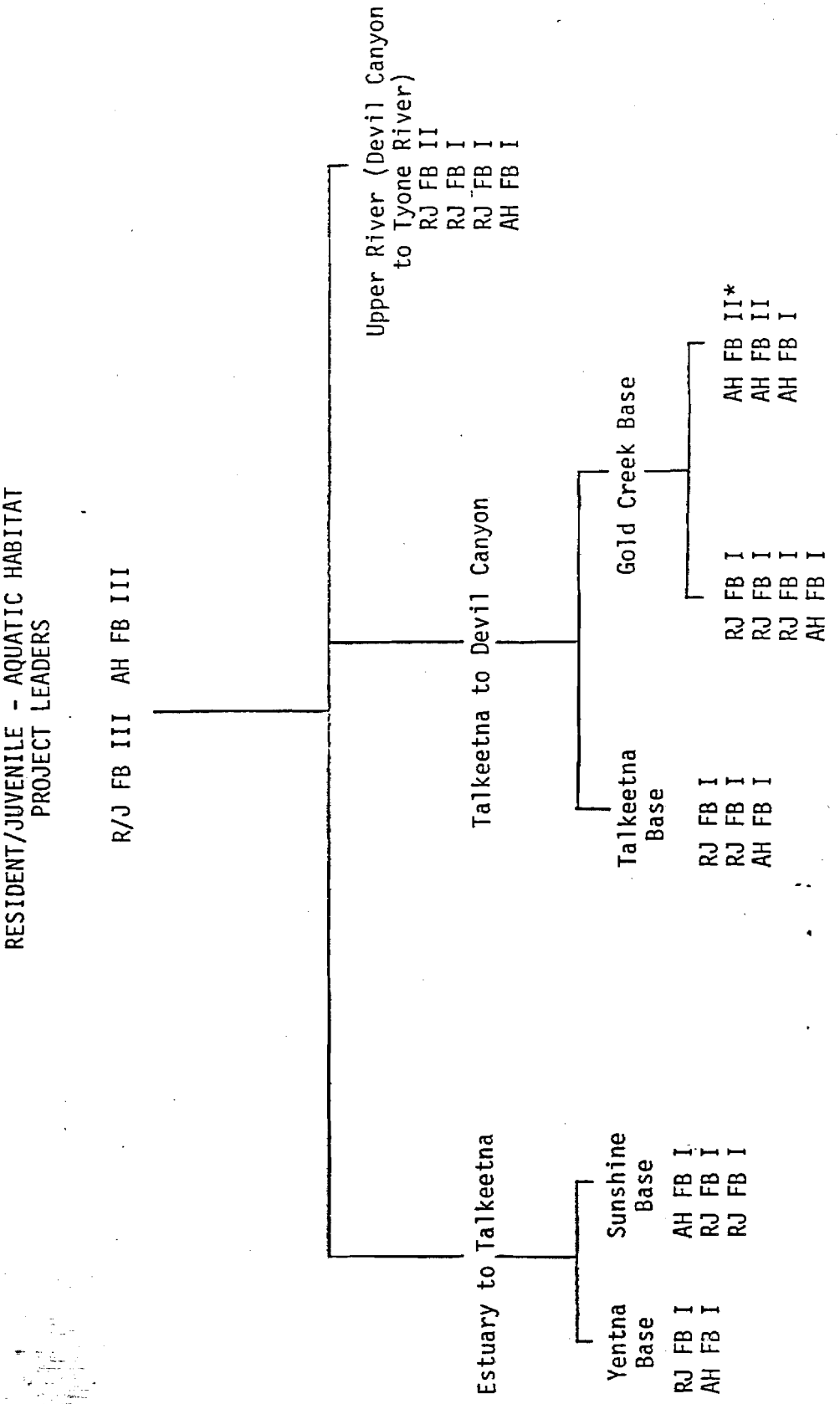

Figure 1. Resident and Juvenile Anadromous (RJ) and Aquatic Habitat and Instream Flow (AH) Study Personnel Deployment - Ice Free Months.

Data and location of catch.
Species, number of fish and number of hours fished.
Method of access to the area.

Carrying out those cooperative duties discussed in the AH procedures section.

A fifth crew consisting of three RJ biologists and one AH biologist will operate in the upper Susitna River Basin. This crew will enter the study area as soon as practicable after break up. They will be provided both fixed-wing and helicopter air support in addition to two inflatable rafts for primary river transportation. These biologists will be mobile; moving their base of operation between habitat locations every one to three days. Emphasis will be placed primarily at tributary mouths, tributary reaches and natural lakes which would be inundated after impoundment.

Winter Field Operations

Winter field operations were initiated in November 1980 along the Susitna River from the estuary to Devil Canyon. This period of the field program will continue to such time as ice-out (April) and begin the following November or December. Two to three crews as requred to complete sampling objectives, are operating from base camps at Gold Creek and Montana Creek. Primary river travel is by snowmachine with support from fixed or rotary wing aircraft as necessary. Field camps and local lodging facilities are being used as appropriate.

Winter field crews are assigned as depicted in Figure 2.

Study Habitat Locations

Resident and Juvenile Anadromous Fish Study sampling locations are depicted by number in Appendix VI, Figures 3-8. The general area of each habitat location is indicated by a corresponding number in the map code column of Table 1, Appendix VI. More specific locations follow each numerical group

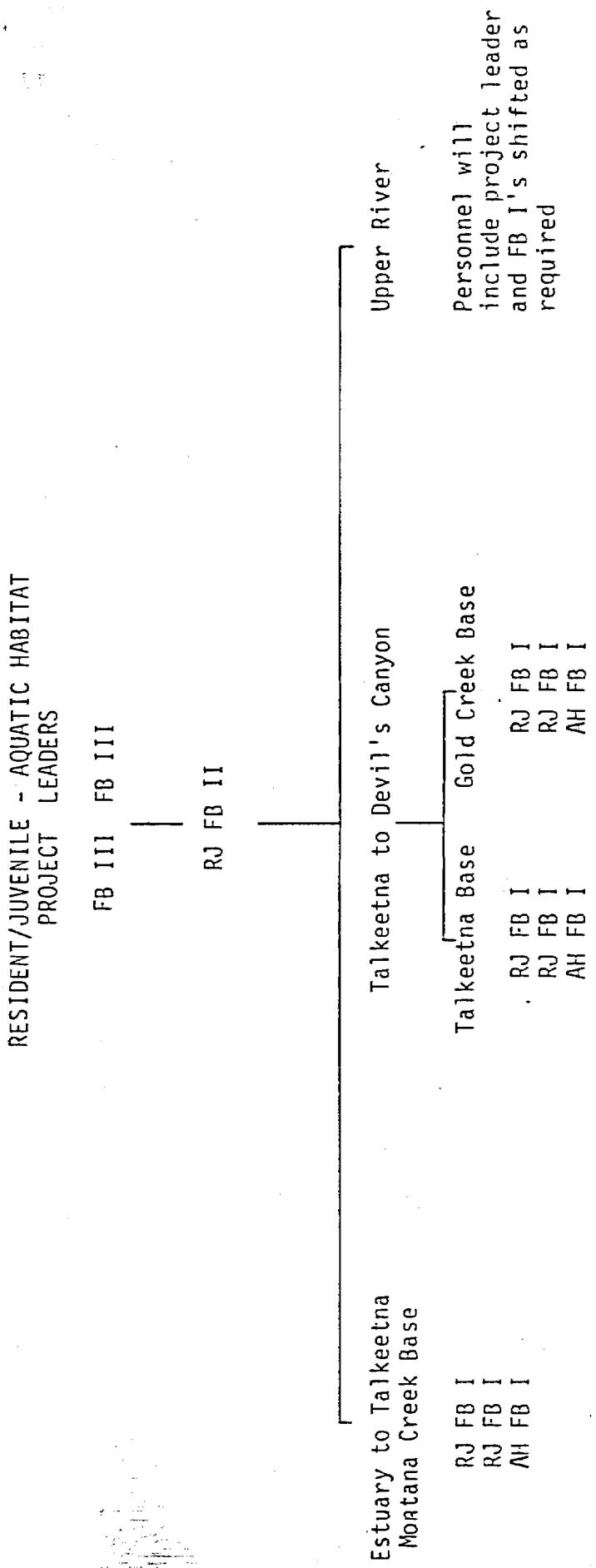

Figure 2. Resident and Juvenile Anadromous (RJ) and Aquatic Habitat and Instream Flow (AH) Study Personnel Deployment - Ice Covered Months.

code. An explanation of the system of specifying geographic locations is included in Appendix VI.

Due to the inherent variability of a dynamic system such at the Susitna River, actual placement of gear can not be precisely defined. However, every effort has been made to ensure that the reproducibility necessary for the acquisition of meaningful data has been incorporated into the sampling site selection scheme.

Selection of individual sites at habitat locations is based on the following criteria. Each site will be sampled bi-monthly.

Tributary Stream Mouth Sites

Selection of sites at tributary stream mouths will include up to three sites within the back-water pools commonly found at tributary/mainstem confluences. They are:

Mainstem river/tributary interface (a).
Approximately one half the distance up the back-water pool (b).
Interface of back-water and tributary flow (c).

On many smaller tributaries only sites (a) or (a) and (c) will be sampled, while it is anticipated that on larger tributaries all three sites will be sampled. This will be necessary to insure that the sampling gear is not spaced so close to influence overall gear effectiveness.

Slough Sites

Selection of sampling sites at sloughs will include up to three sites, depending on the size of the slough. They are:

Slough mouth.
Approximately one half the distance up the slough.
Slough head.

Mainstem River Sites

Mainstem river sites will be selected in areas suitable for effective deployment of the various gear types. The actual location of mainstem sites will be marked on a prominent shoreline object (tree) by blazing and/or placing an orange plywood diamond with the site location and number inscribed thereon.

Upper Susitna River Tributary Sites

Preliminary ground reconnaissances of upper Susitna River tributaries which will be affected by the proposed impoundment where conducted by the U.S. Fish and Wildlife Service (1974) and the Alaska Department of Fish and Game (Williams, 1976). Based on these findings, eight major tributaries have been selected for in-depth studies of fish populations. These streams, with the mile may be inundated, are listed in Table 1.

A typical tributary stream is shown in Figure 3. with sampling sites defined. Preliminary gound and aerial surveys have shown that prime fish habitat occurs primarily in the lower one mile of tributaries. A distance of one mile will be measured relative to the thalweg of the stream. Starting from the stream mouth, every other 500 foot section of stream will be sampled within this mile. Proceeding upstream, the sites will be numbered one through five. A non-sampling area of 500 feet will follow each site sampled.

At site one, gear fished will potentially include the following: Five minnow traps, two trot lines, one variable mesh gillnet, seines, electroshocker, and rod and reel. Gear fished at sites two through five will include: seine, electroshocker, and rod and reel.

Set gear will be fished for 48 hours. A maximum of one hour will be spent fishing seines and/or electroshockers at sites two through five to yield a qualitative and quantitative indication of fish present. At site six, extending from the end of mile one to the upper flood level,

Table 1. Sampling Streams Proposed Susitna Impoundment.

Sample No.	
	Impoundment - Lower 1,477
(1)	Fog 0.7 miles in impoundment. Talkeetna D4. Tributary to Right (South) side of Susitna to Next site 5 miles.
(2)	Tsusena Only mouth in impoundment. Talkeetna D4. Left (North) side tributary to next site 4.5 miles.
	Impoundment - Upper 2,185
1/ (3)	Deadman 2.3 miles in impoundment. Talkeetna D3. Left (North) side tributary to next site 4.5 miles.
(4)	Watana 9.0 miles in impoundment. Talkeetna D3. Left side tributary to next site 21 miles.
(5)	Kosina 4.0 miles in impoundment. Talkeetna D2. Rt. Right side tributary to next site 1.5 miles.
(6)	Jay 3.0 miles in impoundment. Talkeetna D2. Left side tributary to next site 21 miles.
(7)	Goose 1.5 miles in impoundment. Talkeetna C1. Right side tributary to next site 2.0 miles.
(8)	Oshetna 2.0 miles in impoundment. Talkeetna C1. Right side tributary to next site 11 miles.

1/ High flows in lower river are likely to prohibit upstream fish passage to the upstream sampling areas.

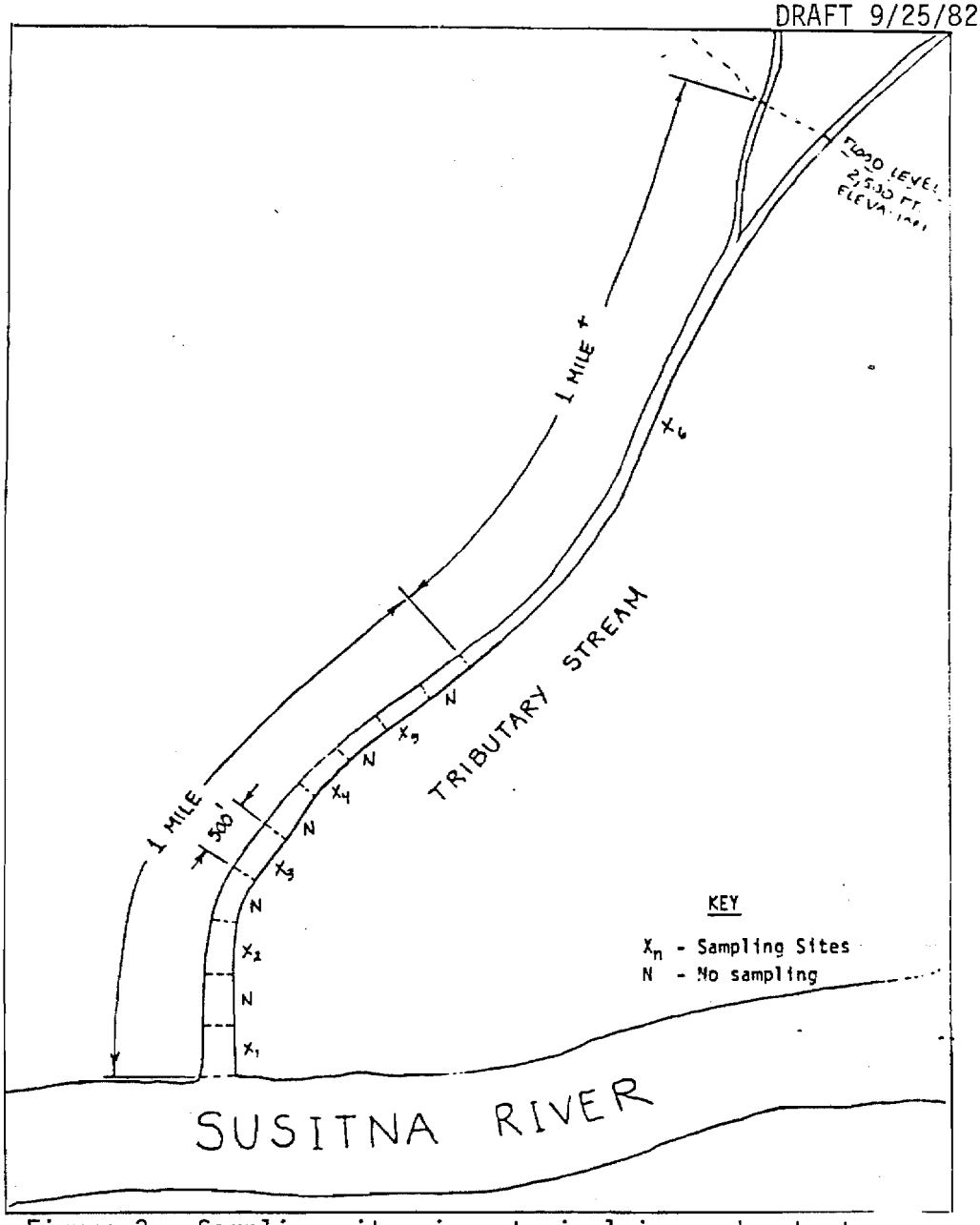

Figure 3. Sampling sites in a typical impoundment stream.

any or all of the mobile gear will be fished to determine the presence or absence of fish.

Sample sites will be blazed and tagged to ensure the same areas are sampled each time.

Selective Sampling of Fish Concentrations

To augment the tag and recapture portion of the project, areas of observed fish concentrations will be sampled without regard to sampling design or quantitative comparison. It is envisioned that this sampling will ensure that adequate numbers of resident species are tagged for study of migratory behavior.

Study Methods

A variety of sampling techniques and equipment will be used to capture resident and juvenile fish. The Transactions of the American Fisheries Society have through the years presented articles on the relative effectiveness of gear types. Discussions and illustrations of gear alone with fishing techniques are presented by Lagler (1959) and illustrated by Sundstrom (1957). The use of the rod and reel in the capture of the various fish species is discussed at length by McClane (1965).

Gear types are divided according to season of intended use and mobility of deployment. Minnow traps, burbot sets, trot lines, jigging sets and under-ice gillnets are intended for winter use while minnow traps, trot lines, burbot sets and set gillnets are intended for summer use. Beach seining, hook and line angling, electro-shocking and drift gillnetting are primarily mobile techniques intended for summer use.

Detailed instructions on the assembly, use (setting) and checking of the various gear types used are in Appendix VII.

Tagging of Resident Adult Species

Efforts will be made to capture up to 3,000 resident adult fish for tagging. Species to be tagged are Arctic grayling, burbot, rainbow trout, round whitefish, humpback whitefish, and longnose suckers.

The Floy Tag and tagging system described in (Appendix IV Figure IV-1) will be utilized in all tagging except for burbot. Burbot will be marked with a disk dangler type tag (Appendix IV: Figure IV-2 and Figure IV-3) using methodology described by Mauney (1965) and Rounsefell (1963). Abbreviated instructions for attaching the disk-dangler are in Appendix IV section B.

Resident Adult Tag Recovery

Recovery of tags placed on adult resident fish will be accomplished by the following means:

The angling public will be requested to return recovered tags to Fish and Game, or if a captured fish is released, to report the tag number.

Resident and Juvenile Anadromous field operations.

Radio Telemetry

An experimental telemetry program will be conducted with large resident species. The purpose of the program will be to determine if resident fish can be successfully tagged and monitored. Ten tags will be employed with tagging commencing just prior to freeze-up. The movement of resident fish will be monitored to determine intra-system migration patterns. The limited data will provide a basis for determining the feasibility of more extensive studies during Phase II.

Details of tagging procedures are discussed in the Adult Anadromous section.

Level of Effort

Schematics of study personnel by primary area of responsibility are given in Figures 1 and 2 the full staff on RJ will include: one Fisheries Biologist III, one Fisheries Biologist II, and 10 Fisheries Biologist I's. Personnel of AH staff will participate in field operations.

C. AQUATIC HABITAT AND INSTREAM FLOW STUDIES

Study Description and Rationale

Phase I (FY 82) of the Aquatic Habitat and Instream Flow Study (AH) will be subdivided into two segments (Figure 4): 1) Point specific and general habitat evaluations of the principal resident fish, and juvenile and adult anadromous salmon and their relationships to changes in mainstem discharge and 2) selected habitat evaluations which will be a more detailed study of habitat characteristics and their relationships to seasonal mainstem discharges of the Susitna River in selected representative study sites.

Fishery Habitat Evaluations

Fishery habitat evaluation studies will be performed during the winter and summer field seasons and are subdivided into point specific and general habitat evaluations (Figure 5).

Point Specific Evaluation:

Velocity, depth, and substrate data will be collected at the gear placement sites (gps) to characterize the range of these streamflow dependent characteristics which appear to be influencing the suitability of various habitat types for the species and life stages of interest. Point specific data are required to ascertain the degree and extent to which specific habitat criteria (e.g. depth, velocity, substrate, water temperature, etc.) are utilized by an individual fish species for each life phase (i.e. spawning, incubation, rearing, and passage). These data provide the basis for defining the types and ranges of habitat characteristics which are associated with the continued existence of various life phases of a fish species. By comparing point specific utilization criteria with hydraulic data (which quantifies the wetted area having various point specific values at a range of discharges), one can predict the potential impacts of various flow regimes on fish habitat availability.

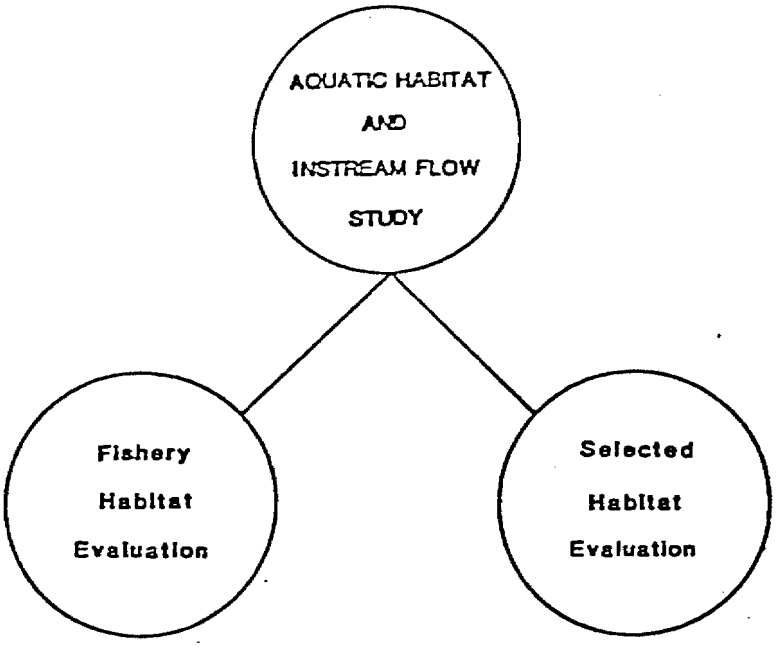

Figure 4. Aquatic Habitat and Instream Flow Study Program Components.

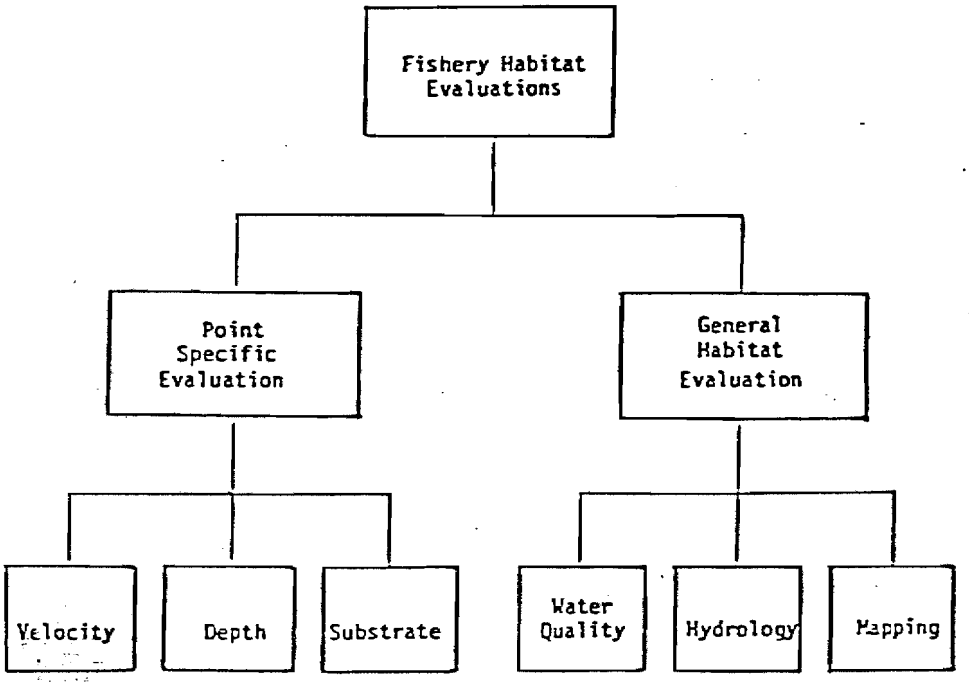

Figure 5. Fishery Habitat Evaluation Components.

These data will be collected according to the RJ sampling schedules. Fish trapping locations will be selected by RJ staff on the basis of professional biological judgment, the primary objective being to select locations optimum for capturing fish as opposed to selecting locations representing the range of habitat types present at the individual fish collection site. Accordingly, observed relationships between trapping incidence and point selected depths and velocities will be limited to the distribution of depths and velocities occurring at specific trap sites.

General Habitat Evaluation:

General habitat evaluations will provide the necessary data to describe the overall seasonal habitat characteristics of RJ and AA study sites and their relationships to mainstem discharges of the Susitna River. These data (Table 2) will be collected in the study area below Devil Canyon on a twice

Table 2. General Habitat Evaluation Parameters.

Water Quality	Hydrology	Mapping
temperature (air and surface water)	velocity	photography
	stage*	substrate
pH		cover
dissolved oxygen	substrate	pools
		riffles
specific conductance		dimensions (planimetric and cross sectionals*)
turbidity		gear placement sites

*Note: These parameters will not be measured in the study area above Devil Canyon, and only where feasible in the study area below Devil Canyon.

per month basis. Data will be collected in the study area above Devil Canyon, according to the schedule detailed in the RJ section.

Selected Habitat Evaluation

Study sites in the Talkeetna to Devil Canyon reach can be used to represent slough habitat types that have comparable physical and chemical characteristics and will be evaluated one time per seasonal low, medium, and high flows of the mainstem Susitna River. Additional sites between Cook Inlet and Devil Canyon will be selected for the installation of thermographs.

These data (Figure 6), similar to general habitat evaluation data, will be used to determine how the different types of habitats (sloughs, mainstem, etc.) are related to mainstem discharge. Selected habitat evaluation data unlike general habitat data are more comprehensive and include continuous measurements of surface and intragravel water temperatures. These data, in conjunction with other techniques, can also be used to determine what percent of this section of the river has similar characteristics. The types of data and mapping components to be collected are listed in Table 3.

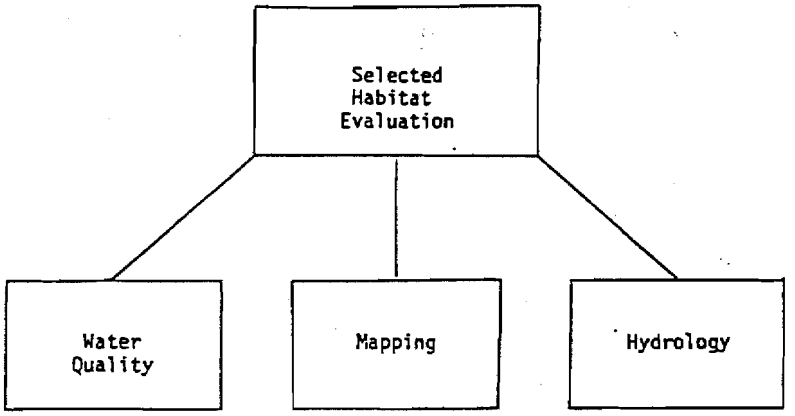

Figure 6. Selected Habitat Evaluation Components.

Table 3. Selected Habitat Evaluation Parameters

Water Quality	Mapping	Hydrology
temperature (surface and intragravel)	photograph	velocity
water* and air	substrate	stage
pH	cover	discharge
dissolved oxygen	channel dimensions	substrate
		gradient
specific conductance	pools	
	riffles	
turbidity		
	morphometry	

* Instantaneous measurements and continuously monitored.

Additional water quality data will be collected jointly by AH and U.S. Geological Survey (USGS) personnel (Table 4).

Study Site Locations

Fishery Habitat Evaluation Sites

Point specific measurement and general habitat evaluation data will be collected at each RJ sampling site location as described in the RJ study habitat location section of this manual.

Selected Habitat Evaluation Sites

Project personnel will review and analyze past studies, aerial photographs, topographic maps, and the water surface profile analysis of the study area between Talkeetna and Devil Canyon to identify five representative habitat locations for comprehensive water quality and hydraulic analysis.

Table 4. ADF&G/USGS Additional Water Quality Measurements

Nutrients and Organics

NO_2 + NO_3 dissolved	NH_4 Organic N Total
NH_4 dissolved	Phosphorus Dissolved Total
NH_4 + Organic N dissolved	Phosphorus Total
NO_2 + NO_3 Total	Dissolved Organic Carbon
	Suspended Organic Carbon

Inorganic Constituents

Silica	Chloride
Calcium Magnesium	Fluoride
Sodium	Sulfate
Potassium	Turbidity
	Dissolved Solids (residue at 180°C)

Minor Elements (Dissolved and Total)

Arsenic	Iron
Barium	Lead
Cadium	Manganese
Chromium	Mercury
Cobalt	Nickel
Copper	Selenium
Zinc	

Field Parameters

Specific conductance, alkalinity, pH, temperature, dissolved oxygen.

Sediment Analysis

Suspended sediment concentration and complete particle size analyzed.

Thermograph placement sites will be located in the mainstem Susitna River upstream of the confluence of major tributaries in the Cook Inlet to Devil Canyon reach of the study area. These locations will be selected in May, 1981. Additional sites will be added at a later date if they are determined to have value to the Phase I study.

Methods

Water Quality

Water Quality will be evaluated at the fishery habitat evaluation and selected habitat evaluation sites in the study area below Devil Canyon and from the center of each index area in the study area above Devil Canyon. General habitat evaluation water quality data will be collected on an instantaneous basis at each study site twice monthly below Devil Canyon and once per month above Devil Canyon. Selected habitat evaluation water quality data at the five slough locations will be collected on an instantaneous basis one time per seasonal period of low, medium, and high flows. Instantaneous measurements will be collected as follows:

Dissolved oxygen (DO), pH, temperature, and specific conductance of surface waters will be measured in the field with a Hydrolab model 4041 multiparameter meter. Intragravel water temperatures will be measured with a combination Digi-sense thermistor C-8522-10 and YSI 400 series semi-solid insertion probe system. The instruments will be operated following the manufacturers' instructions (Appendix VIII) and when applicable calibrated according to the procedures established by the USGS (USGS, 1981). Water samples for turbidity analysis will be collected at the same time the preceding water quality field parameters are measured. Samples will be collected in 250 ml plastic bottles filled approximately two-thirds full and stored in a cool, dark location prior to analysis. Turbidity samples will be returned to Anchorage at the end of each sampling trip for analysis on a Hach model 2100A turbidimeter. Air temperature will be measured at these sites with a thermometer shielded from the direct rays of the sun.

Surface water temperatures will be continuously monitored by Model J-90 Ryan thermographs to identify thermal characteristics within the study area. These sites will include, but not be limited to, the five selected sloughs, the mouths of major tributaries below Devil Canyon; the mainstem above these streams and other selected mainstem sites. In addition to surface water temperatures, intragravel temperatures will also be continuously monitored by thermographs buried in the gravel in order to determine the relationships between surface and intragravel temperatures at the five selected habitat slough locations.

Installation of the Ryan thermographs will be as in Figure 7 and below:

1) Install chart assembly and check battery (to be done prior to going out in the field).

2) Record water temperature,* date, serial number of thermograph location, time and your initials on the chart; set the pen point on the chart to the proper time; and make a mark with pencil to show the beginning of the date. Check battery again and then TURN ON THE INSTRUMENT. Do not move the pen manually.

3) Be sure the "O" ring is clean and properly lubricated and close the thermograph with the coupler (clamp). Use a paper clip or "clamp lock" to secure the coupler.

4) Lace the end of a 1/4 inch plastic coated wire cable through the minnow trap at one end. Then lace the same end of the cable through the two holes on each end of the thermograph, then back through the other side of the same end of the trap forming a loop. Secure the loop with two cable clamps.

* Water temperature is to be measured with a mercury thermometer submerged for a sufficient length of time to allow equilibration (2-3 minutes).

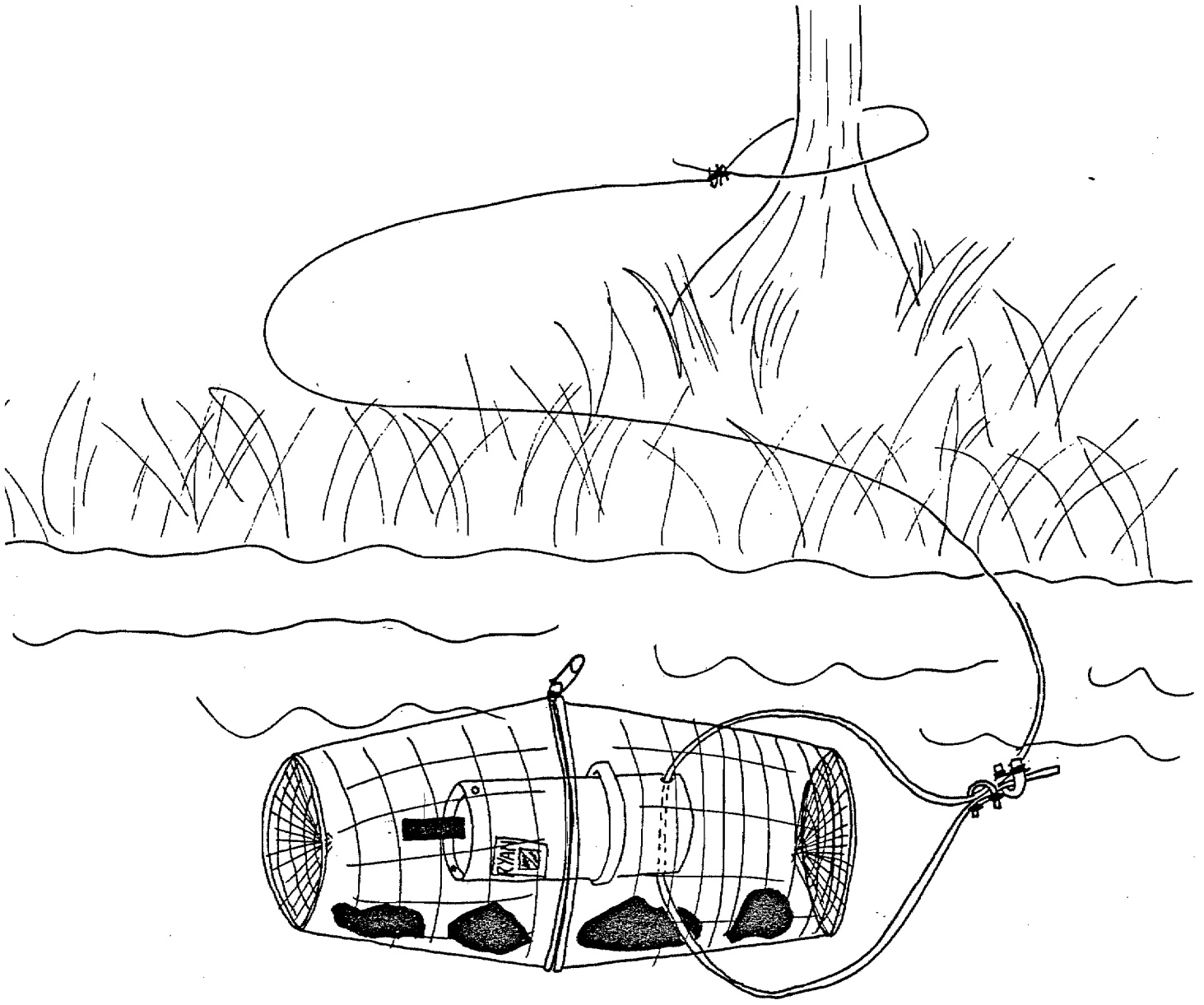

Figure 7. Installation of Ryan Thermograph.

5) Put several rocks into the trap for ballast, with the thermograph and close the trap.

6) Secure the other end of the cable to a large, permanent tree as far from shore as possible. Submerse the thermograph in an area which will adequately represent the temperature regime to be sampled and avoid damaging the instrument due to velocity, erosion or rocks.

The thermographs will be checked at least twice monthly and the time, date, a pencil mark at the pen point to mark the end point, the samplers initials and the word "end" will be written on the chart. The chart will be removed and returned to the office for data reduction. A new chart assembly will be installed and thermograph reset following steps 2, 3, 5 and 6.

The time on the chart will also be compared with the time indicated by a wrist watch to determine if the thermograph is running fast or slow. If the thermograph is found in error it will be replaced with another thermograph and returned for repair. The battery will also be checked and replaced if faulty. Necessary thermograph equipment includes: one small screw driver, spare "O" rings, couplings, lubricant, charts, pen assemblies and batteries. The Peabody Ryan operating instructions will be carried into the field for reference.

In addition to surface water temperatures, intragravel temperatures will also be continuously monitored by thermographs buried within the substrate at a depth sufficient to record intragravel temperatures. The installation procedure for these thermographs is the same as for the surface water thermographs with the exception that the intragravel thermographs will be checked within 90 days and full 90 day charts will be used. The intragravel thermographs will be accompanied by a surface water thermograph and installed at 5 selected habitat slough sites to characterize the relationships between surface and intragravel temperatures.

Hydrology

Velocity, depth, discharge and stage measurements will be made in a variety of contexts as part of both sections of this study. Marsh-McBirney, Price AA, or Pygmy flow meters and topsetting wading rods or cable suspension systems will be used according to the respective manufacturers' instructions and procedures approved by the USGS (Smoot and Novak, 1977; Buchanan and Somers, 1973).

When using a Price AA or Pygmy flow meter, the velocity at the point of the current meter is determined by counting the number of signals ("clicks") per unit of time. Each meter is calibrated by the commercial supplier and an equation for the relationship between velocity and revolutions per unit time is derived. To facilitate field use of the Price AA, the equation is solved for a number of revolutions ("stop counts") at various time steps and a rating table (Figure 8) which shows the velocity for a given number of revolutions per time interval is provided with each meter. The Pygmy meters used on this project are calibrated so that velocity, in feet per second, equals (1) X (revolutions per second). The objective in using the rating table for the Price AA is to memorize the stop counts. One must count clicks for at least 40 seconds, then stop counting at one of the stop counts in the rating table. Failure to stop at a stop count will negate the ability to obtain the velocity directly from the rating table. One cannot simply interpolate between stop count values given in the table; the rating curve equation must be solved. The rating table is constructed in one-second steps from 40 seconds to 70 seconds. When using both the Price AA and the Pygmy meters counts should be made for at least 40 seconds.

When using a Marsh-McBirney electronic flow meter, allow the meter to calibrate, place in the proper location and read the meter. The Marsh-McBirney flow meters are equipped with a variable time constant. This option allows the meter to measure "average" velocity readings for every two, six or 20 seconds. The two second time constant can be used to allow the meter to quickly equilibrate to the approximate velocity; however, the reading to be recorded should be read at the six or 20 second time constant. At high velocities (greater than two fps) the 20 second time

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RATING TABLE FOR TYPE AA CURRENT METER

EQUATIONS: V=2.180R + .020 (2.200) 2.170R + .030 Std Rating No. 1

Time in Seconds	VELOCITY IN FEET PER SECOND									Time in Seconds
	Revolutions									
	3	5	7	10	15	20	25	30	40	
40	.183	.292	.401	.565	.837	1.11	1.38	1.65	2.20	40
41	.180	.286	.392	.552	.818	1.08	1.35	1.62	2.15	41
42	.176	.280	.383	.539	.799	1.06	1.32	1.58	2.10	42
43	.172	.273	.375	.527	.780	1.03	1.29	1.54	2.05	43
44	.169	.268	.367	.515	.763	1.01	1.26	1.51	2.00	44
45	.165	.262	.359	.504	.747	.989	1.23	1.47	1.96	45
46	.162	.257	.352	.494	.731	.968	1.20	1.44	1.92	46
47	.159	.252	.345	.484	.716	.948	1.18	1.41	1.88	47
48	.156	.247	.338	.474	.701	.928	1.16	1.38	1.84	48
49	.153	.242	.331	.465	.687	.910	1.13	1.35	1.80	49
50	.151	.238	.325	.456	.674	.892	1.11	1.33	1.76	50
51	.148	.234	.319	.447	.661	.875	1.09	1.30	1.73	51
52	.146	.230	.313	.439	.649	.858	1.07	1.28	1.70	52
53	.143	.226	.308	.431	.637	.843	1.05	1.25	1.67	53
54	.141	.222	.303	.424	.626	.827	1.03	1.23	1.63	54
55	.139	.218	.297	.416	.615	.813	1.01	1.21	1.61	55
56	.137	.215	.292	.409	.604	.799	.993	1.19	1.58	56
57	.135	.211	.288	.402	.594	.785	.976	1.17	1.55	57
58	.133	.208	.283	.396	.584	.772	.960	1.15	1.52	58
59	.131	.205	.279	.389	.574	.759	.944	1.13	1.50	59
60	.129	.202	.274	.383	.565	.747	.928	1.11	1.47	60
61	.127	.199	.270	.377	.556	.735	.913	1.09	1.45	61
62	.125	.196	.266	.372	.547	.723	.899	1.07	1.43	62
63	.124	.193	.262	.366	.539	.712	.885	1.06	1.40	63
64	.122	.190	.258	.361	.531	.701	.872	1.04	1.38	64
65	.121	.188	.255	.355	.523	.691	.858	1.03	1.36	65
66	.119	.185	.251	.350	.515	.681	.846	1.01	1.34	66
67	.118	.183	.248	.345	.508	.671	.833	.996	1.32	67
68	.116	.180	.244	.341	.501	.661	.821	.982	1.30	68
69	.115	.178	.241	.336	.494	.652	.810	.968	1.28	69
70	.113	.176	.238	.331	.487	.643	.799	.954	1.27	70
	3	5	7	10	15	20	25	30	40	

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RATING TABLE FOR TYPE AA CURRENT METER

Actual Rating Limits: 0.25 to 8.0 feet per second Date: 03-05-70

Time in Seconds	VELOCITY IN FEET PER SECOND									Time in Seconds
	Revolutions									
	50	60	80	100	150	200	250	300	350	
40	2.74	3.28	4.37	5.45	8.17	10.88	13.59	16.30	19.02	40
41	2.68	3.21	4.26	5.32	7.97	10.62	13.26	15.91	18.55	41
42	2.61	3.13	4.16	5.20	7.78	10.36	12.95	15.53	18.11	42
43	2.55	3.06	4.07	5.08	7.60	10.12	12.65	15.17	17.69	43
44	2.50	2.99	3.98	4.96	7.43	9.89	12.36	14.83	17.29	44
45	2.44	2.92	3.89	4.85	7.26	9.67	12.09	14.50	16.91	45
46	2.39	2.86	3.80	4.75	7.11	9.46	11.82	14.18	16.54	46
47	2.34	2.80	3.72	4.65	6.96	9.26	11.57	13.88	16.19	47
48	2.29	2.74	3.65	4.55	6.81	9.07	11.33	13.59	15.85	48
49	2.24	2.69	3.57	4.46	6.67	8.89	11.10	13.32	15.53	49
50	2.20	2.63	3.50	4.37	6.54	8.71	10.88	13.05	15.22	50
51	2.16	2.58	3.43	4.28	6.41	8.54	10.67	12.79	14.92	51
52	2.12	2.53	3.37	4.20	6.29	8.38	10.46	12.55	14.64	52
53	2.08	2.49	3.31	4.12	6.17	8.22	10.27	12.31	14.36	53
54	2.04	2.44	3.24	4.05	6.06	8.07	10.08	12.09	14.09	54
55	2.00	2.40	3.19	3.98	5.95	7.92	9.89	11.87	13.84	55
56	1.97	2.35	3.13	3.90	5.84	7.78	9.72	11.65	13.59	56
57	1.93	2.31	3.08	3.84	5.74	7.64	9.55	11.45	13.35	57
58	1.90	2.27	3.02	3.77	5.64	7.51	9.38	11.25	13.12	58
59	1.87	2.24	2.97	3.71	5.55	7.39	9.22	11.06	12.99	59
60	1.84	2.20	2.92	3.65	5.45	7.26	9.07	10.88	12.69	60
61	1.81	2.16	2.88	3.59	5.37	7.14	8.92	10.70	12.48	61
62	1.78	2.13	2.83	3.53	5.28	7.03	8.78	10.53	12.28	62
63	1.75	2.10	2.79	3.47	5.20	6.92	8.64	10.36	12.09	63
64	1.72	2.06	2.74	3.42	5.12	6.81	8.51	10.20	11.90	64
65	1.70	2.03	2.70	3.37	5.04	6.71	8.38	10.05	11.71	65
66	1.67	2.00	2.66	3.32	4.96	6.61	8.25	9.89	11.54	66
67	1.65	1.97	2.62	3.27	4.89	6.51	8.13	9.75	11.37	67
68	1.62	1.94	2.58	3.22	4.82	6.41	8.01	9.60	11.20	68
69	1.60	1.92	2.55	3.17	4.75	6.32	7.89	9.46	11.04	69
70	1.58	1.89	2.51	3.13	4.68	6.23	7.78	9.33	10.88	70
	50	60	80	100	150	200	250	300	350	

Figure 8. USGS Type AA Current Meter Rating Table.

constant should be used. Extreme care must be taken to keep the instrument dry, it is sensitive to moisture.

The mean column velocity is the measurement of the average velocity in a column of water. In water depths less than 2.5 feet the mean column velocity will be measured at one point located .6 of the total depth from the surface of the water. For depths of 2.5 feet or greater, two velocities will be measured to compute the mean column velocity. They will be measured at .2 and .8 of the total depth from the surface of the water and averaged. To measure the .6 depth on the topsetting rod align the number on the round sliding rod corresponding to the whole number portion of the water depth to the point on graduated handle corresponding to the decimal portion of the depth. (e.g. for a depth of 1.7 align the 1 on the round rod to the .7 on the graduated handle). This automatically sets the meter to the proper .6 depth. To obtain the .2 and .8 depths simply multiply the depth by 2 for the .2 and divide the depth for the .8 readings and align these numbers as above.

The manufacturer's instruction manuals and USGS instructions for use, maintenance and trouble-shooting for these instruments in the appendix should be thoroughly understood.

Point specific velocity, depth, and substrate measurements will be taken at minnow traps, salmon redds, gillnets, and trot line sites in order to describe the physical characteristics of the habitat present. Each will be made in the following manner.

Minnow trap velocities will be measured at the upstream mouths of traps each time they are set. Location and identification of salmon redds where velocity and depth will be measured are based on standards established by the ADF&G (Estes, Hepler, and Hoffmann, 1981) and the Arctic Environmental Information and Data Center, AEIDC (Baldridge, 1981). Biologists will select vantage points within study sites that allow both good visibility for observation and create the least disturbance to the fish. Polarized sun glasses will be worn to screen out reflected glare from the water and

increase the observer's efficiency. Redds will be defined by direct observation of the repeated fanning and digging actions of the female at the same site. Redds will also be located by observing characteristic spawning behavior including biting and chasing of intruders by a male-female pair, or an individual adult remaining over a distinct excavated depression in the streambed. When a redd is located, the site will be marked by methods similar to those used by Bovee and Cochnauer (1977). After all of the redds within a sampling site have been identified, the velocities and depths will be measured.

Velocities at set gillnet and trot line sites will be measured at three foot intervals along the length of the initial set when set perpendicular to the flow. When set parallel to the flow, one velocity measurement will be taken immediately upstream of the net or trot line.

Every attempt will be made to obtain velocity measurements. When the location of fish sampling gear and/or water depth or velocity make these measurements unsafe to obtain, this will be noted on the point specific habitat evaluation form.

Staff gages will be installed at fishery habitat and selected habitat evaluation sites in the study area below Devil Canyon. Staff gages will be read at least twice monthly to determine the stage/discharge relationship between sloughs, side channels, and the mainstem river. Gages installed at sonar and fishwheel sites will be read daily when the sites are manned by AA crews.

Staff gages will be installed as follows (Figure 9):

1) Select a location where hydraulic conditions reflect what you want to examine and where gages will have a reasonable chance of representing low and high water conditions (without washing away during high water conditions).*

* Keep in mind that these areas may be navigated by boats. Selection of staff gage sites should therefore include this consideration.

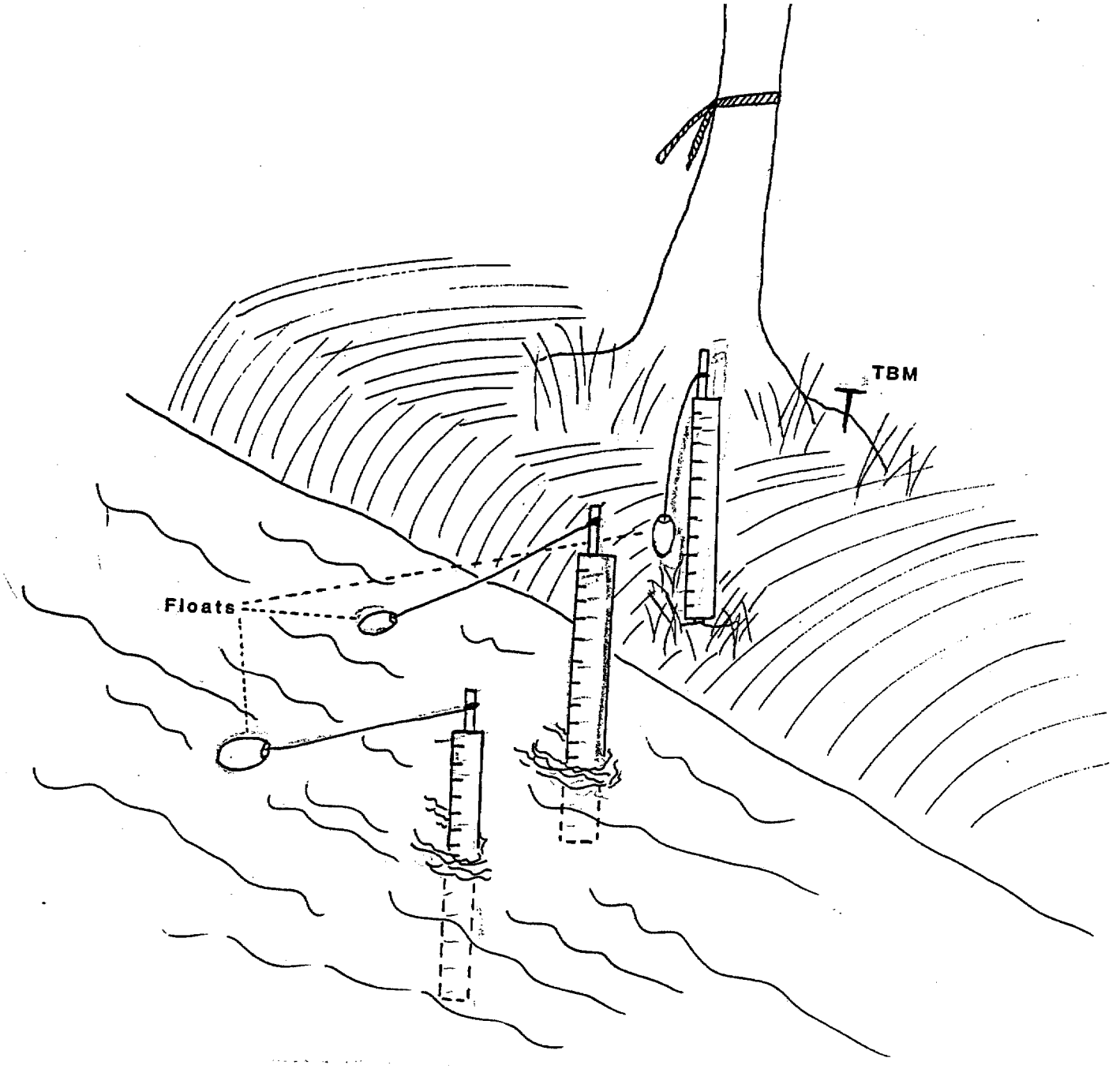


Figure 9. Staff Gage Installation.

2) Place in a six to seven foot steel "T" post (fence post) in a perfect, upright, vertical position leaving an adequate amount of post to secure a gage to.

3) Install the necessary number of posts (two through five), along a transect perpendicular to the flow, to measure the full range of stage events at that particular site. Keep in mind that the gages have to overlap (.5 feet), so that stage data from all gages can be normalized.

4) Attach gages firmly to the post with wire being sure that the gages don't move up and down on the post.

5) Attach painted fluorescent orange floats to the post and also paint the top of the post to help insure that boaters are aware of the post locations.

A transect will be surveyed and the stream bed profile determined in a plane perpendicular to the flow of water at each selected habitat slough staff gage site. Staff gage elevations at the five study sloughs in the study area between Talkeetna and Devil Canyon will be referenced to datum surveyed by R&M Consultants to establish streambed elevations. Discharge will be measured at these sites and the staff gage will be read before and after collecting the discharge data. This information will be used to develop stage/discharge rating curves and to estimate reach specific streamflows. Where possible, mainstem discharge information will be obtained from the closest USGS gaging station in order to determine relationships between a specific site and the mainstem. Discharg will be measured during three seasonal flow periods (high, medium, and low). These measurements and the following discussion are based on procedures developed by the USGS (Smoot and Novak, 1977; Buchanan and Somers, 1973), and USFWS Instream Flow Group (Bovee and Milhous, 1978; Trihey and Wegner, 1981).

Discharge will be computed from the mean column velocity and depth information recorded in vertical columns (verticals) collected along the

transects surveyed when placing the staff gages. A tagline will be stretched across the water parallel to the transect. One should attempt to subdivide the channel such that no more than 5% of the total flow passes between successive verticals. The spaces between verticals are termed cells. Verticals are to be placed such that they best describe velocity distribution and changes in the cross sectional channel geometry. If the direction of flow is not at right angles to the cross section, find the velocity vector normal to the section. Measure the cosine of the horizontal angle (Figure 10) by holding the discharge measurement note sheet in a horizontal position with the point of origin (O) on the left edge over the tag line, bridge rail, or any other feature parallel to the cross section. With the long side parallel to the direction of flow, the tagline or bridge rail will intersect the value of the cosine of the angle (a) on the top, bottom, or right edge. Multiply the measured velocity by the cosine of the angle to determine the velocity vector component normal to the measuring section.

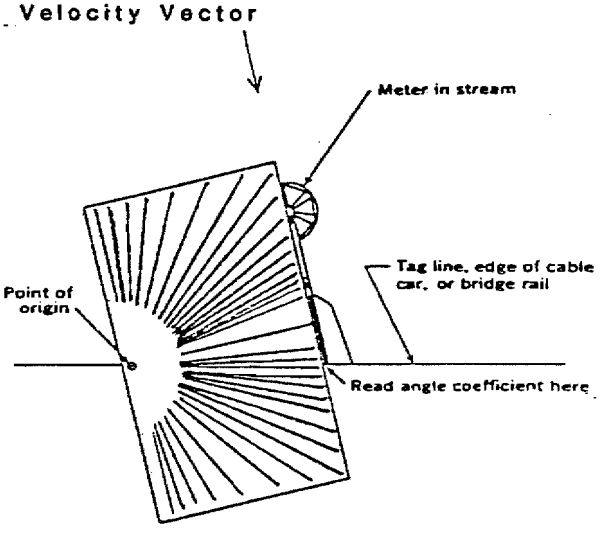


Figure 10. Measurement of Horizontal Angles (from Buchanan and Somers, 1973.

Substrate

Substrate data will be collected based on procedures used by the AEIDC (1981), ADF&G (Estes, Hepler, and Hoffmann 1981) and Shirazi (1979), at fishery habitat evaluation (point specific and general habitat) and selected habitat evaluation sites.

Selected habitat evaluation substrate data will be collected along the discharge measurement transect(s) at each velocity and depth measurement site. Point specific habitat evaluation substrate data will be collected from a two foot radius around the velocity and depth measurement site.

Substrate classes will be assessed by selecting up to three dominant substrate groups and recording the percent of each. The size and type of substrate are grouped into the following classes:

0.	Organic Detrius	5.	1" - 3"
1.	Silt Clay	6.	3" - 5"
2.	Sand	7.	5" - 10"
3.	1/16" - 1/4"	8.	10" +
4.	1/4" - 1"	9.	Bedrock

Notes will also be made as to the presence and estimated amount (% cover) of periphyton (attached algae) and other aquatic vegetation. The degree of embeddedness will also be recorded. Embeddedness is defined as the filling of interstitial space by fines between substrate of Class Five or greater (Figure 11).

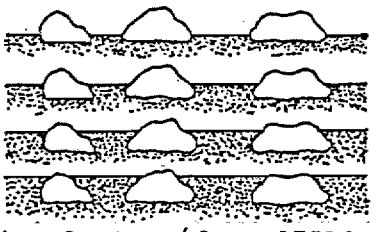
Code	Degree of Imbededness (%)	Illustration
2	25	
5	50	
7	75	
9	90 to 100	

Figure 11. Embeddedness Classification System (from AEIDC, 1980).

Maps will be drafted which identify substrate data, sampling sites and the locations of various substrate classes (III. DATA PROCEDURES). The boundary between each distinct substrate class area within the sampling site will be delineated on the Planimetric Map form (AH-81-03). The substrate classification within each of these distinct areas will also be identified and recorded on the map. Substrate from each of these areas will be photographed; and three photographs will be taken at one third intervals along each transect in the Selected Habitat sites using photography procedures similar to those used by R&M Consultants (Griffiths 1981). A 60 x 60 cm grid subdivided into 5 x 5 cm squares (Figure 12) will be placed on top of the substrate and photographed (Kellerhals and Bray, 1970; Griffiths, 1981). Rulers will be used when grids are unavailable.

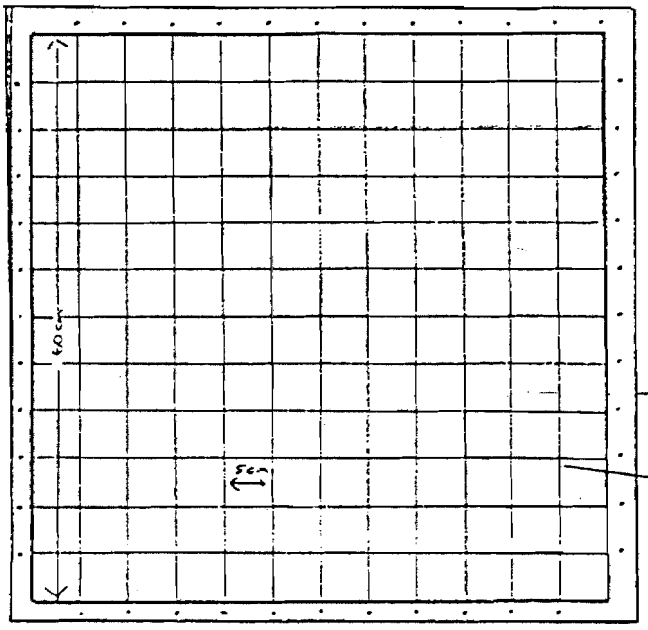
Mapping

An upstream view cross sectional profile map will be drafted for each staff gage transect (Figure 13). The staff gage location and the channel dimensions; top width, wetted perimeter, bankfull top width, and water's edges, of the cross sectional profile will be included. Definition of terms follow:

Top Width: The width of the water surface of a channel cross section measured in a plane perpendicular to the direction of the flow between the two water's edges.

Wetted Perimeter: The width of the submerged portion of a channel cross section measured in a plane perpendicular to the direction of flow between the two water's edges.

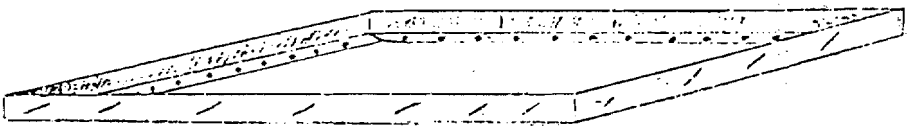
Bankfull Top Width: The top width of a channel cross section measured in a plane perpendicular to the direction of flow between the two highest water's edgemarks.



ANGLE ALUMINUM FRAME

STAINLESS STEEL WIRE

TOP VIEW



SIDE VIEW WITH FRAME UPSIDE DOWN
SHOWN WITHOUT WIRES

Figure 12. Substrate Grid Diagram.

Water's Edge: The point where the water surface comes into contact with the bank.

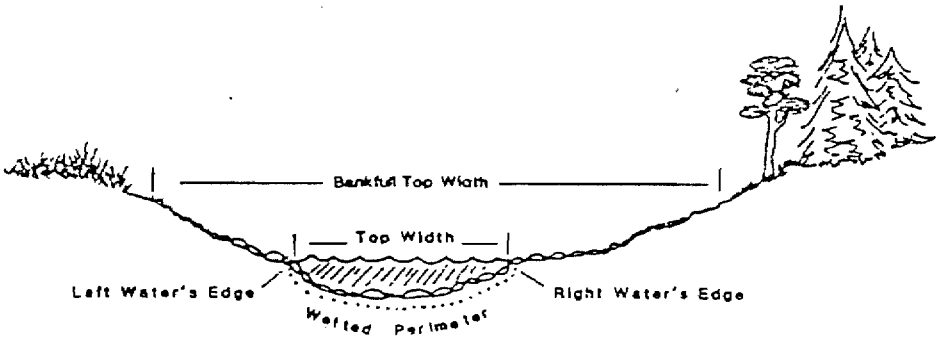


Figure 13. Cross Sectional Profile Diagram.

A planimetric (aerial view) map will be drawn for each sampling site and will include the following information. Variations will be noted each time the site is sampled (III. DATA PROCEDURES):

Substrate Types: The boundary of areas covered by a distinct substrate composition using the substrate classification system. The degree of embeddedness of Class Five and larger substrate, and the percent of area covered by attached algae and higher aquatic plants.

Cover: Overhanging vegetation, trees, dead fall obstructions, large boulders, and undercut banks.

Channel Dimensions: The boundaries of the water's edges and the bankfull water's edges.

Pools and Riffles: The locations of pools and riffles within study areas. Pools will be defined as a deeper, placid, and slower moving section of a stream and riffles as the shallow

rapids in an open stream, where the water surface is broken into waves by obstructions wholly and partly submerged (Stalnaker and Arnette, 1976).

Compass Direction: Orientation to the magnetic north.

Sampling Points: The position of each gear placement site, and staff gage and transect locations.

Selected habitat slough evaluation sites will be morphometrically mapped (Figure 14). A tag line will be stretched along transects to determine horizontal distances between the two banks and the position of each vertical depth measurement between them. An Electronic Distance Meter (EDM) will be substituted for taglines when the distance between the bank is greater than 150 feet. Depths will be measured from a boat with a Raytheon Model DE 719B portable survey fathometer or on foot with a wading rod depending upon depth and accessibility. Where use of the tag line and/or wading rod is not feasible due to the length of transect and depth of water, the following method will be used. A person located on the shore will operate an EDM and direct the boat operator via two-way radio. When the boat crosses the transect, a distance will be registered on the EDM and manually recorded. At the same time that distances are measured, a radio signal will be transmitted to the boat and a marking device will be triggered by the boat operator to record the depth on the fathometer chart (Figure 15).

At least one photograph will be taken at each of the fishery habitat and selected habitat evaluation sampling sites which represents the general habitat. Additional slides will be taken to depict a unique situation or notable change of habitat characteristics.

The information recorded on the top of the General Aquatic Habitat form (AH-81-01) will be photographed for site identification prior to photographing the sampling site. Each AH crew member will maintain a personal log book and establish a section to record the photography information. Orientation (i.e. upstream view, downstream view, etc.),

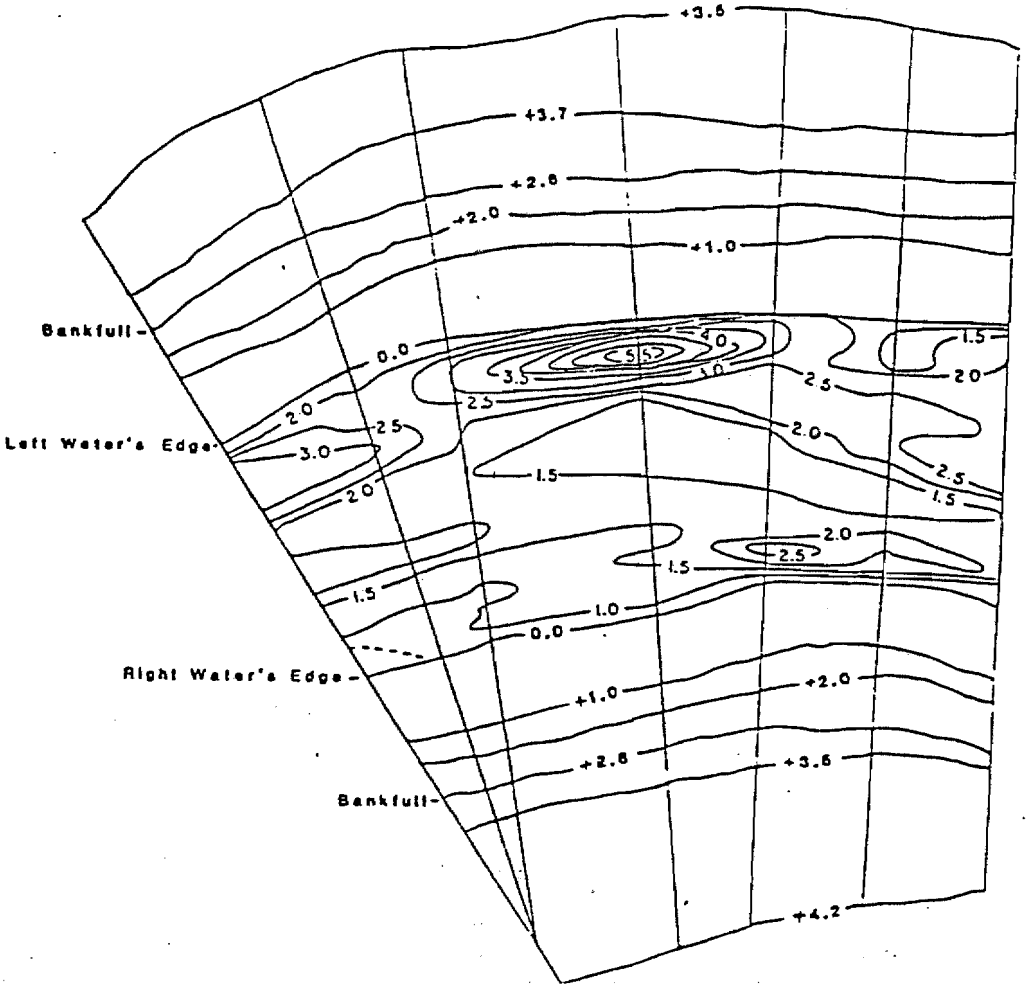


Figure 14. Example of morphometric map with depths and elevations in feet (modified from Bovee and Cochnauer, 1977).

subject, time, and date will be noted. Each roll of film and canister will be assigned a number before use. For example, the first roll of film being used by Roy Ball in 1979 would be labeled RB-79-01, the second RB-79-02, etc. He would list each photo under this number in his logbook, identify the date, stream name, survey area, and section number. The roll and canister number and the quantity of photos taken will also be recorded in the related data column space of the General Habitat Evaluation form (AH-81-01).

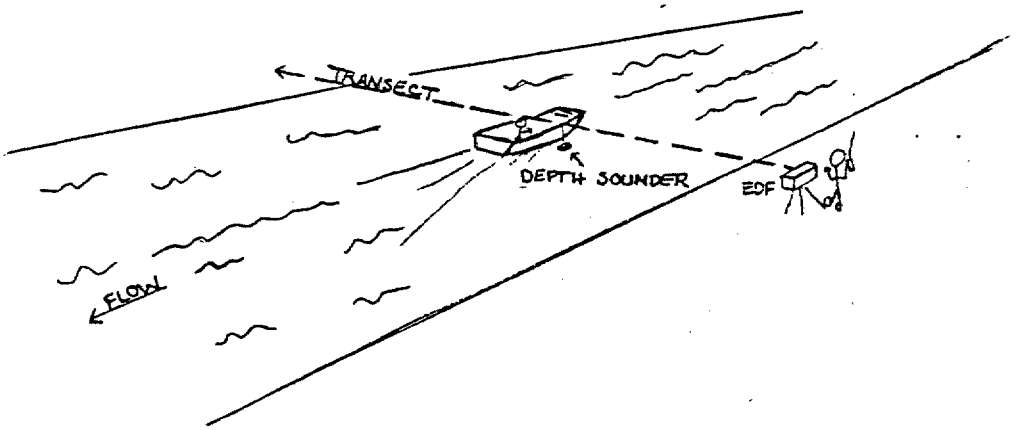


Figure 15. Large River Velocity and Depth Procedure Diagram.

Level of Effort

Aquatic Habitat personnel will be distributed within the study area as illustrated in Figures 5 and 6. The AH staff will include one FB III, two FB II's and six FB I's. Aquatic Habitat, RJ and AA crew members will jointly collect data as indicated in this manual.

III. DATA PROCEDURES

A. ADULT ANADROMOUS FISHERIES STUDIES

Sonar Data Collection and Preparation

Daily Procedures:

1. PRINTER TAPE STAMP: Each day's printer tape should be stamped (Figure 1) at the at the beginning and end of the tape as well as anytime during the day that control settings are changed. Each morning the tape is removed from the counter, stamped on both sides of the tear and filled with the same information on each stamp.

2. DAILY LOG FOR SSS CONTROL: This is a summary of changes in controls which should be updated daily (Table 1). The information is necessary when interpreting raw counts and calibration factor data.

3. SIDE SCANNER COUNTER LOG: Details the mechanics of operation of the counter, substrate and related equipment (Table 2). Any apparent malfunctions should be recorded with description, frequency, and consistency noted. Also, changes in sensitivity, spare card changes, raising or moving of substrate, anticipated problems and needed repairs on equipment. This is the place where suggestions on improving operations, notes on river conditions which might have an effect on the equipment, and general comments should be noted.

4. SIDE SCANNER COUNTS: Raw counts from printer tapes are entered by hour and sector (Table 3). Counts which register debris or are skipped in printing should be noted with a "d" or "s" in the appropriate hour-sector box. Enter "0" if there are no counts. To tabulate data: An average of the hour on each side of a skip should be used for the skip and counts should be totaled for each sector and each hour. The grand total is the total of all sectors or all hours (they should be equal). This is known as the "daily raw count". In addition the percent of total raw by sector and hour should be

recorded in parentheses next to the total. After each day's counts are tabulated and reported, printer tapes and SSS count forms should be placed in notebooks until sent to the main office.

5. FIELD COUNTER CALIBRATION: Raw counts will be calibrated in season by visual monitoring of the counters with an oscilliscope. Field crews will be instructed by permanent staff in the procedure for visual counting and filling out the FIELD CALIBRATION FORM FOR SIDE SCANNING SONAR COUNTER (Table 4).

6. DAILY DATA REPORTS: Side scanner counts and field counter calibration results should be recorded on the DAILY ESCAPEMENT DATA form (Table 5). Data should be recorded by bank and the four daily calibration counts should be recorded individually.

Location: _____

Date: _____ Time: _____

Beam Angle: _____

Velocity: _____

Dead Range: _____

Live Range: _____

Observers: _____

Remarks: _____

_____

Figure 1. Printer tape stamp.

Table 1. Daily log for side scan sonar counter.

River: ________ Bank: ________ S/N: ________ Year: ________

Date	Time	Fish Velocity	Beam Angle	Dead Range	Counting Range	Command Print Time	Printout Time	Auto Test Time

Table 2. Side scanner counter log.

Location _____ Year _____

Date	Time	Remarks

Table 3. Daily sonar counts.

AA-82-09

Page ___ of ___ Daily Sonar Counts

Bank: _____ Date: _____

Station: _____

Time	Sector 1	2	3	4	5	6	Total	Sector 7	8	9	10	11	12	Total
0100														
0200														
0300														
0400														
0500														
0600														
0700														
0800														
0900														
1000														
1100														
1200														
1300														
1400														
1500														
1600														
1700														
1800														
1900														
2000														
2100														
2200														
2300														
2400														
Total														

_____ (Total raw counts)
- _____ (Total debris counts)
= _____ (Total good counts)
_____ (debris blocks)

Total good counts _____ x 144 =
Total good blocks _____

Adjusted Raw Count
(Sectors 1-6) _____

_____ (Total raw counts)
- _____ (Total debris counts)
= _____ (Total good counts)
_____ (debris blocks)

Total good counts _____ x 144 =
Total good blocks _____

Adjusted Raw Count
(Sectors 1-6) _____

TOTAL DAILY ESCAPEMENT (Adjusted raw count sectors 1-6 + 7-12) = _____

COMMENTS ON BACK

Date	Time In	Time Out	Total Time	Visual Count	Electronic Count	Total Over-Counts	Total Sub-Threshold	Range		Beam Angle	Remarks
								Begin	Live		

Table 4. Field counter calibration.

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Escapement Sampling - Age Length Data

Fish Sampling Procedures

1. Check species of each intended sample (see Pacific Fishes of Canada, Fisheries Research Board of Canada, Bulletin 180, Ottawa 1973).

2. A scale should only be taken from the left side fo the fish (see Figure 2).

3. The "preferred scale" is located two rows above lateral line on the diagonal from the posterior insertion of the dorsal fin to the anterior insertion of the anal fin.

4. If the preferred scale is missing take a scale, again on the left side of the fish, within the area behind the dorsal fin but forward of the ventral fin, and no more than four rows above the lateral line.

5. If no scales are present in this area, discard the fish.

6. If the scale is stuck or dried, moisten and pull toward the head of the fish gently rather than straight back.

7. Clean all slime, grit, skin and silver pigment from the scale by moistening and rubbing it between the fingers. The scale should be completely clean and transparent.

8. Mount on gum card after moistening. Scales are mounted on the gum card number which corresponds to Age Weight Length (AWL) form number containing the length, weight and sex information for that fish. Place it directly over the number on the gum card with the anterior edge facing the bottom of the card (Figure 3). The ridged side of the scale must be facing upward or no impression will be made in the acetate card. This is the same side that is exposed on the salmon.

Table 5. Daily escapement data.

River: _____ Year: _____

Year	Month	Day	Bank	Raw Sonar Count	Visual Count	Elec-tronic Count	No. Wheels	Hours Open	Red	Pink	Chum	Coho	Kin

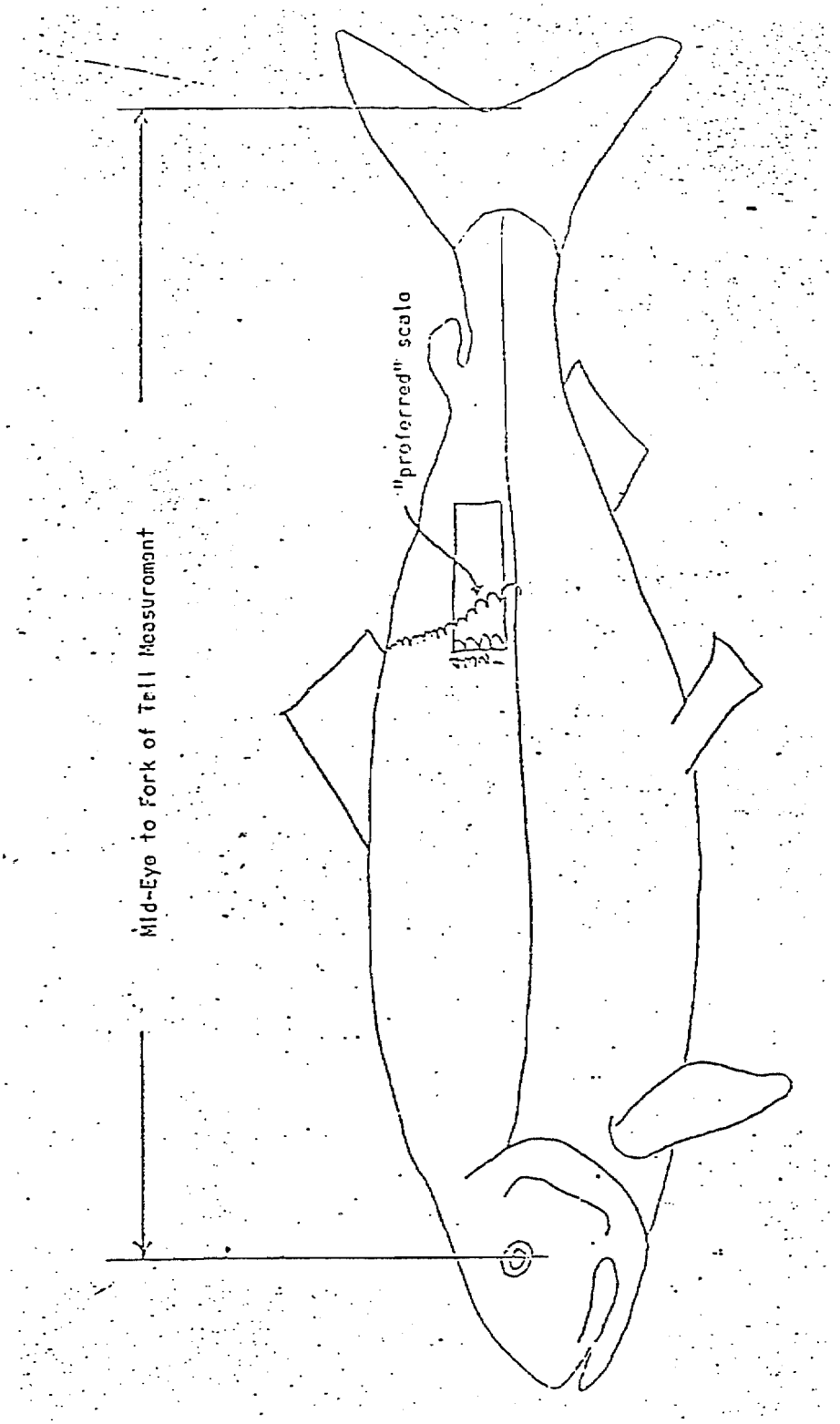
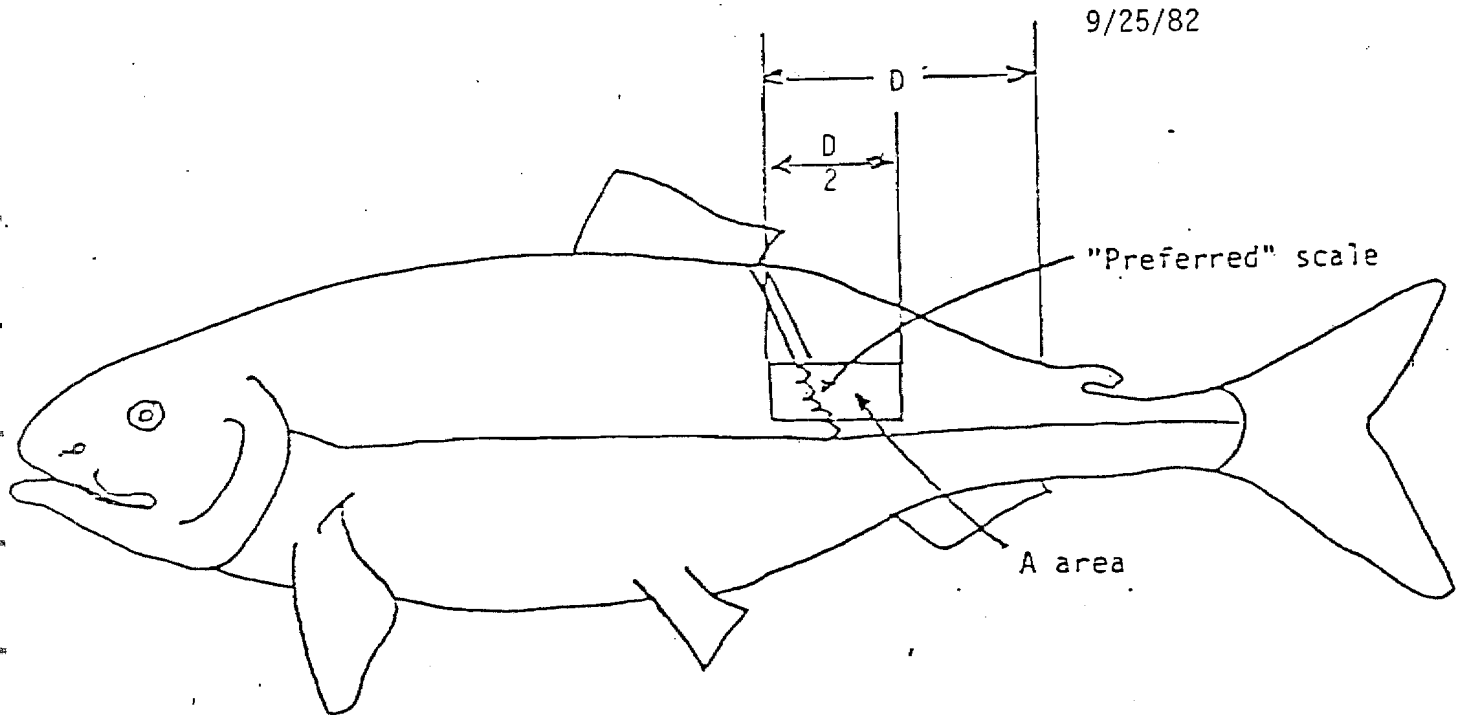


Figure 2. Preferred scale, preferred scale zone, and length measurement.



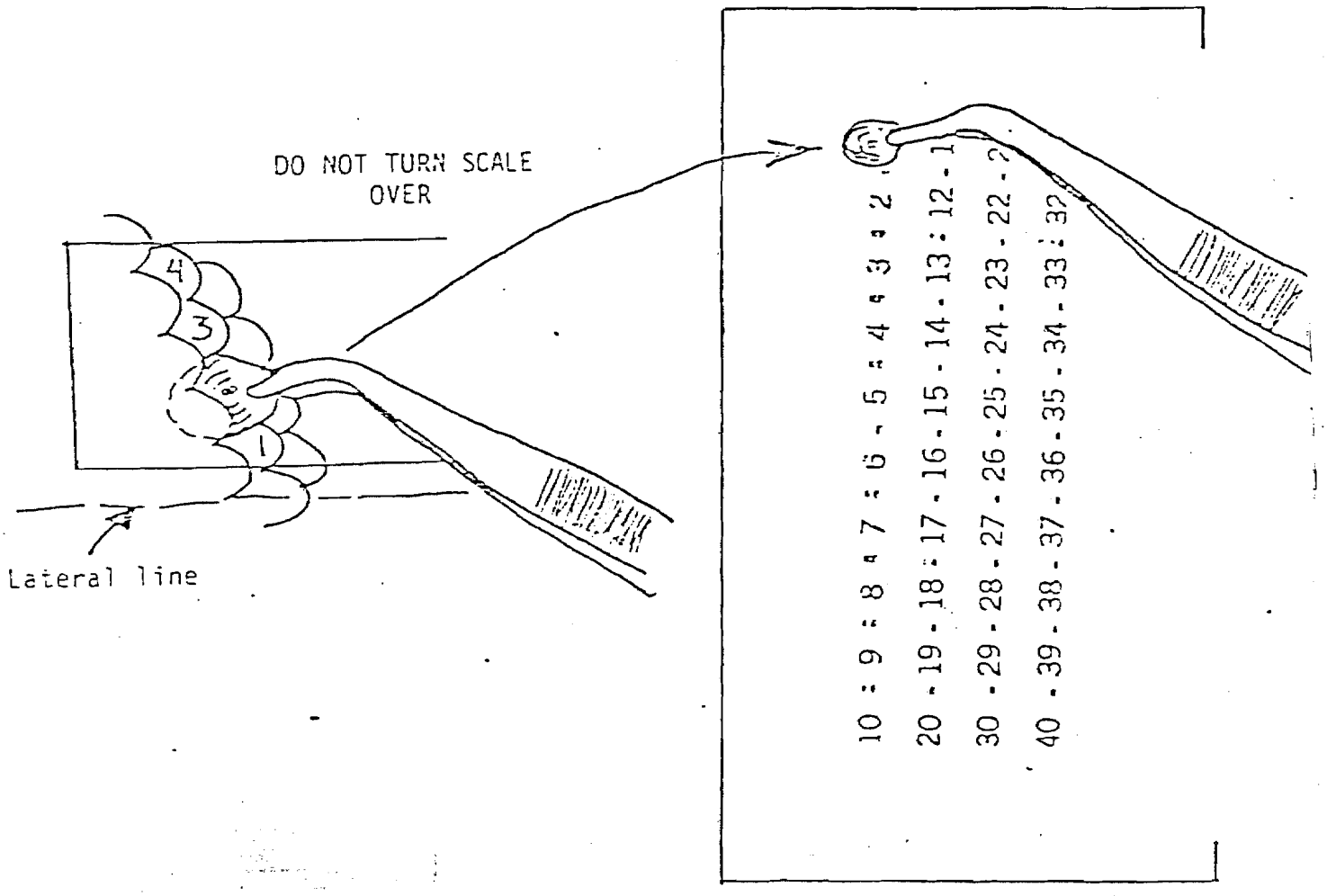


Figure 3. Scale selection and mounting on gummed card.

9. Cover completed gum cards with was paper after drying, if possible.

10. Length measurements should be taken mid-eye to fork of tail and recorded to nearest millimeter.

Labeling Procedures

The functions of proper labeling is to produce a set of sample data which includes a gum card, an acetate impression and an AWL Form (Table 6A and 6B). These have corresponding location, date, species, gear code and subsample number. None ever has more than a single location, data, species, gear code or subsample number.

A. Numbering

Numbering begins with 001 for each species at each escapement sampling location for the 1980 season. Each card, AWL and acetate for a specific group is consecutively numbered throughout the season (i.e., CI Yentna R. 6-29-80 Red 001 to CI Yentna R. 7-29-80 Red 025). It is the responsibility of collectors to check the numbers being used each sampling day to maintain correct sequence and omit duplication.

B. Gum Cards

1. General Guidelines

(a) Note which number to begin with, for each sample location, for the data in question.

(b) Prior to sampling, cards may be filled out with species, date, gear, locale, and collector's name. They may also be numbered when the total cards for a given area are known for the date. These must be carefully checked when scales are to be fixed to assure correct information.

(c) On location before mounting scales, all pertinent information should be completed on that card, in pencil.

Table 6A. Age, weight and length (AWL) form.

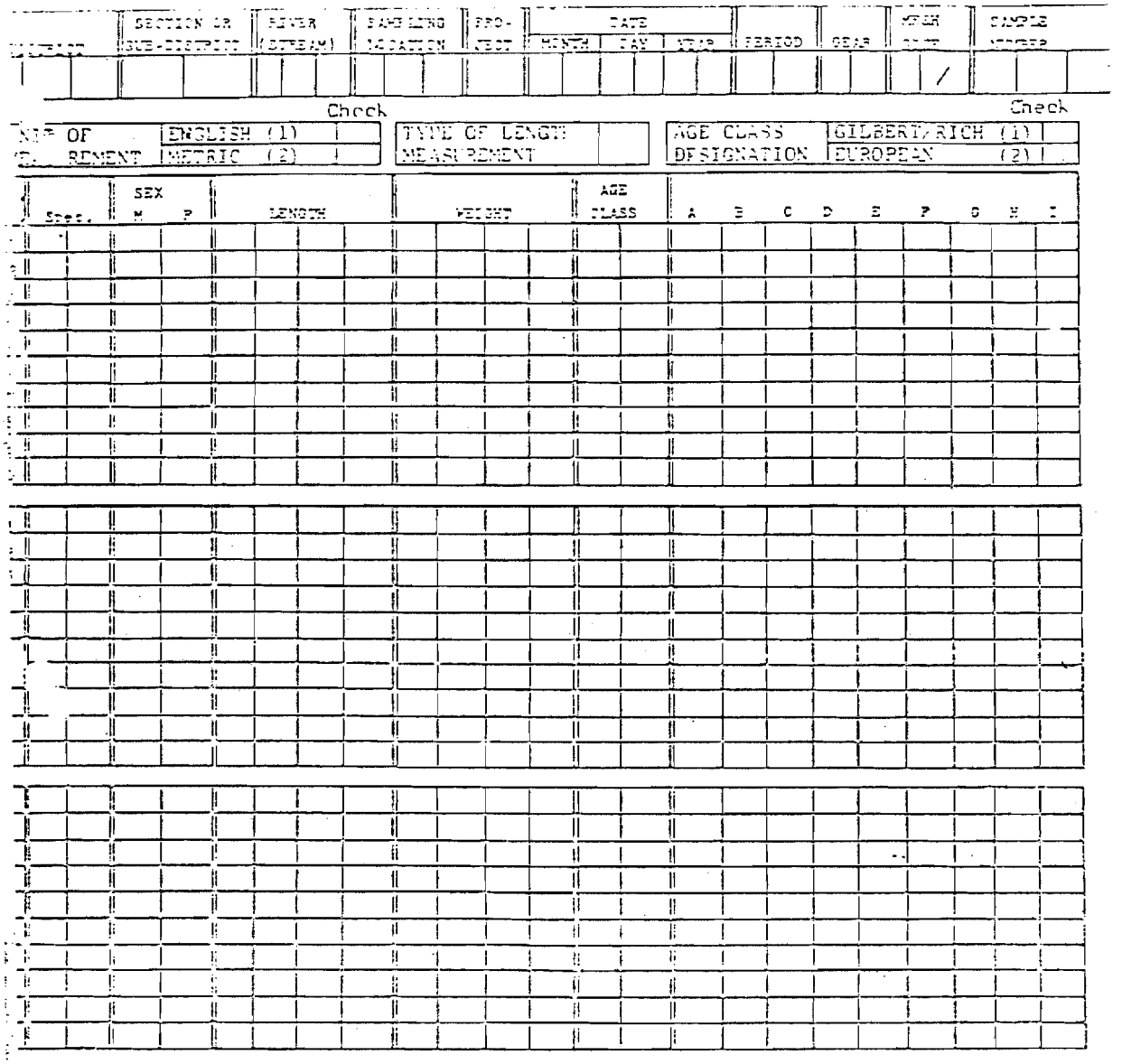


Table 6B. Commerical catch sampling information (AWL codes).

CATCH DATE _____ DELIVERY DATE _____
Month Day Month Day

TENDER (Scow, Boat) NAME & ADF&G NO. _____

TOTAL FISH DELIVERED	KINGS	REDS	COHO	PINK	CHUM

CODING

Note: District, Subdistrict, River (stream) and sampling location codes will be provided separately.

PROJECT
1 - Commercial Catch
2 - Subsistence Catch
3 - Escapement (tower, weir, etc.)
4 - Escapement (spawning grounds)
5 - Test Fishing
6 -

GEAR
0 - Trap
1 - Purse Seine
2 - Beach Seine
3 - Drift Gillnet
4 - Set Gillnet
5 - Troll
6 - Long Line - Skates
7 - Otter Trawl
8 - Fish Wheel
9 - Pots
11 - Herring Purse Seine
12 - Handpicked
13 - Dip Net
17 - Beam Trawl
18 - Shovels
19 - Weir
20 -

SPECIES
41 - King
Red, Sockeye
43 - Coho, Silver
44 - Pink
45 - Chum

51 - Smelt
52 - Arctic Char
53 - Dolly Varden
54 - Steelhead
55 - Lake Trout
56 - Northern Pike
57 - Sheefish
58 - Whitefish
59 -

TYPE OF MEASUREMENT
1 - Snout to Fork of Tail
2 - Mid-eye to Fork of Tail
3 - Orbit 1/ to Fork of Tail
4 - Mid-eye to Hypural Plate
5 - Orbit 1/ to Hypural Plate

1/ Orbit refers to posterior edge of eye socket.

BLANK COLUMNS
A - F -
B - G -
C - H -
D - I -
E -

INJURY
1 - Inshore Net
2 - High Seas Net
3 - Canine-Tooth Predator
4 - Shark
5 - Beluga
6 - Lamprey
7 - Other

AGING DATA
1 - Otolith Sample
2 - Inverted
3 - Regenerate
4 - Illegible
5 - Missing
6 - Resbsorbed

REMARKS

1) If the same code is to be used throughout a column, enter the code for the first fish, then draw an arrow vertically through the column.

2) Length-weight measurement. This form is designed for: a) length measured to the nearest millimeter or tenth of an inch, b) weight measured to the nearest ten grams (i.e. decagram or thousandth of a kilogram) or tenth of a pound.

When recording length-weight data, be sure to enter the digits in their proper columns. For example, a 4.7 lb. fish should be recorded in the 2nd and 3rd colums, not the 1st and 2nd columns. If for some reason length is measured to inches rather than tenth of inches, a zero should be entered in the third column.

3) Blank Columns. These colums are for use as needed. It is anticipated that those uses will vary from area to area, but might include written remarks, tag data, circuit counts, etc.

2. Information Explanation

(a) Species: (O. nerka or Reds) Scientific or common name of sample.

(b) Card No.: Consecutive for this area and species (see A. Numbering).

(c) Locality: Name of beach, river or area and may include cannery or site name. Use the COOK INLET SAMPLE LOCATION CODES. (Table 6).

(d) Scow/Gear: Gear number code is listed on reverse of AWL for appropriate type used.

(e) Sampling date: mo./day/year that the scales were taken. Omit if the same as period date.

(f) Period date: mo./day/year fish actually caught.

(g) Collector: Last name(s) of person(s) collecting scales and data.

(h) Remarks: Include anything unusual about weather, the sample or anything else considered pertinent by collectors.

3. Example

Species _____ Card No. _____
Locality _____
Scow/Gear _____
Sampling Date _____ Period Date _____
Collector _____
Remarks _____

C. Age Weight Length (AWL) Form

1. General Guidelines

(a) Information on the back of the gum card should be the same as that on the corresponding AWL form.

(b) Each finished scale card should be attached to the corresponding AWL form with a paper clip.

(c) Always use No. 2 or softer pencil.

(d) When filling in length data, place the decimal point in the same column consistantly.

(e) Put zeros in columns where data not taken - do not leave columns blank.

Table 7. Anadromous Adult Invenstigations - Susitna Hydro Statistical Codes and Code Samples.

DISTRICT	SUBDISTRICT	RIVER	LOCATION CODE	LOCATION NAME
247	41	100	101	Yentan Sonar
247	41	100	102	Sunshine Sonar
247	41	100	103	Talkeetna Sonar
247	41	100	104	Curry Tag/Recapture

2. Information Explanation (See Table 7).

(a) Heading: At the top of each AWL form, the sample name is written out. The log number will be filled out in Anchorage.

(b) District, sub-district and river: See Table 7 for proper codes.

(c) Sampling location: See Table 7.

(d) Project: Code from reverse side of AWL form.

(e) Note first date only.

(f) Period: Not necessary to fill out.

(g) Gear: Code for type used to catch the fish. Obtained from the reverse side of the AWL form.

(h) Mesh size: Remains blank.

(i) Sample number: Sequential number which matches an appropriate gum card (see A. Numbering).

(j) Spec.: Code for each species (see reverse of AWL form).

(k) Sex: Check male or female appropriately. Use 1 for male, 2 for female.

(l) Length: Recorded in millimeters from mid-eye to fork of tail.

(m) Weight: Recorded to nearest one-tenth kilogram.

(n) Age class: Completed by biologists after viewing scale impressions.

(o) Column A and I: Used by Stock Identification - do not use.

(p) Column B: River bank designation.

(q) Column C: Injury code (see reverse of AWL form. Table 6b).

(r) Column D-H: Remarks

Tag/Recapture Data Collection and Preparation

Daily Procedures

1. Daily fishwheel catch will be reported on the Daily Log/Individual Fishwheel Catch Record form (Table 8). Each fishwheel will have it's own log. Eact time a fishwheel is checked, the catch will be recorded along with the corresponding time in military hours. Following, the last daily check, a summation shall be entered in the appropriate space on the form (Table 8).

2. Fish which are tagged will be recorded on the Tag Deployment Record form (Table 9). This form may be used between fishwheels. Appropriate information recorded on each fish tagged shall include: date; tag number; fishwheel location; species; and sex. A sheet summary on the number of fish tagged by species shall be entered in the appropriate location (Table 9).

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Table 8. Individual fish catch record.

INDIVIDUAL FISHWHEEL CATCH RECORD

PROJECT SITE: FISHWHEEL LOCATION:

TIME	NUMBER OF FISH CAPTURED					
	SOCKEYE	PINK	CHUM	COHO	CHINOOK	OTHER [1]
DAILY TOTAL						

HOURS OPERATED _____

[1] IDENTIFY SPECIE

Table 9. Tag Deployment Record

SITE:

TAG TYPE:

TAG COLOR:

DATE	TAG NUMBER	FISHWHEEL LOCATION	SPECIES	SEX M	SEX F	

SUMMARY

NO. FISH TAGGED

SOCKEYE _____

PINK _____

CHUM _____

COHO _____

TOTAL : [ ]

Table 10. Tag Recapture Record

TE	FISHWHEEL LOCATION	TAG DATA			SPECIES	LEAVE BLANK (OFFICE USE ONLY)
		NUMBER	COLOR 1/	TYPE 2/		

SHEET SUMMARY/
No. RECAPTURES

SOCKEYE ____
PINK ____
CHUM ____
COHO ____
TOTAL: ____

1/ COLOR: INT. ORANGE = O
YELLOW = Y

2/ TYPE: FLOY SPAGHETTI = S
PETERSON DISC = P

Table 11. Stream Survey Log

STREAM OR SLOUGH	DATE	SURVEY CONDITIONS	SPECIES SURVEYED	NO. OBSERVED			NO. TAGGED OBSERVED (LIVE)			REMARKS [1]
				LIVE	DEAD	TOTAL	ORANGE DISC	YELLOW FLOY	ORANGE FLOY	

[1] GENERAL OBSERVATION INFORMATION INCLUDING: ① SURVEY DISTANCE (AREA)
② SURVEY PERSONNEL
③ PREDATOR ACTIVITY
④ CARCASS TAG NUMBER & TYPES & COLOR

3. Tagged fish which are recaptured shall be logged on the Tag Recapture Record form (Table 10). Information recorded on each recatpure shall include: fishwheel location; tag number; color and type; and species. A sheet summary of recaptures by species shall be entered at the location indicated on the form (Table 10).

Survey Data Collection and Preparation

Foot surveys on clear water sloughs and stream will be recorded on the Stream Survey Log form (Table 11). Data recorded on each survey will include: stream or slough name; data; survey conditions (Excellent, Good, Fair, Poor); individual species surveyed; live and dead counts on particular species surveyed; and number of live tagged members by tag type/color. The "Remarks" column, in particular, will include information on tagged carcasses (tag type, number and color by species).

Deployment of electrofishing gillnet and other sampling gear will be recorded on the Variable Gear Log form (Table 12). Information recorded will include: gear type; survey location (general and legal); date; time (beginning and end); and catch by species.

Egg pumping results will be recorded on the Egg Deposition Log form (Table 13). A separate form will be used for each sampling site. Number of eggs and fry collected will be logged as either dead or alive by individual plot. Sampling location will be identified in legal and general terms.

Development of data forms for the chinook salmon survey is pending review of the survey design by the absent project biometrician.

Table 12. Variable Gear Log

DATE	GEAR TYPE & SPECS [1]	LOCATION		FISHING TIME (MILITARY)			CATCH						REMARKS [4]
		GENERAL	LEGAL [2]	BEGIN	END	TOTAL	SOCKEYE	PINK	CHUM	COHO	CHINOOK	OTHER [3]	

[1] INCLUDE NET LENGTH, DEPTH, MESH SIZE. (IF APPLICABLE)

[2] SECTION, TOWNSHIP, RANGE

[3] IDENTIFY SPECIES

[4] INCLUDE COLLECTORS NAME(S), RECAPTURES, & MATURATION (ie. PRESPAWNER, SPAWNER, POST SPAWNER).

Table 13. Egg deposition log.

DATE:
SITE:
GENERAL:
LEGAL[1]:
COLLECTORS:

PLOT NUMBER (SEQUENTIAL)	NUMBER				REMARKS
	EGGS		FRY		
	LIVE	DEAD	LIVE	DEAD	

[1] SECTION, TOWNSHIP, RANGE

B. RESIDENT AND JUVENILE ANADROMOUS FISH STUDIES

Resident and Juvenile Anadromous Fish Studies field froms are presented in draft form (Tables 14-16) pending review by the project biometrician. At such time as this review is complete, the final forms and procedures will be released.

Biological Data

General guidelines for collection of biological data on individual fish by species or group of species are as follows:

Juvenile Anadromous

1. Age class composition: Age class composition will be accomplished by scale reading and size frequency analysis for juvenile chinook, coho, and sockeye salmon. Scale samples will be taken monthly from approximately 25 fish of each of these three species captured in the mainstem river and its major tributaries.

2. Size sample: The size class sample will consist of the first 50 juvenile salmon captured in each size class and 10% of those captured in each size class thereafter. Measurement will be in mm to total length.

Rainbow Trout, Dolly Varden/Arctic Char, Round Whitefish, Humpback Whitefish, Lake Trout, and Longnose Sucker

1. Age class composition: Age class composition will be accomplished by scale reading and size frequency analysis. Scale samples will be taken from all adults of these species captured.

Table 14. Susitna Hydro Resident and Juvenile Anadromous Study Biological Data, RJ 81-02.

File No. _____ Page ____ of ____

SUSITNA HYDRO RESIDENT & JUVENILE ANADROMOUS STUDY
BIOLOGICAL DATA RJ 81-02

Habitat Location _____ Sampling Site _____ River Mile _____ __/__/__/__/__/__

Date(s) Collected _____ Collector(s) _____

	species code	length (mm)	sex	age	scale card #	gear type code	PSN	mesh size	remark on back		species code	length (mm)	sex	age	scale card #	gear type code	PSN	mesh size	remark on back
1										26									
2										27									
3										28									
4										29									
5										30									
6										31									
7										32									
8										33									
9										34									
10										35									
11										36									
12										37									
13										38									
14										39									
15										40									
16										41									
17										42									
18										43									
19										44									
20										45									
21										46									
22										47									
23										48									
24										49									
25										50									

GEAR TYPE CODE

beach seine	3
burbot set	10a
drift gillnet	1a
electroshock	2
gillnet	1
hook & line	9
minnow trap	5
trot line	10

SPECIES CODE

burbot	590	humpback whitefish	582
chinook 0+	410	lake trout	550
chinook 1+	411	longnose sucker	920
chum salmon	450	pink salmon	440
coho 0+	430	rainbow trout	541
coho 1+	431	round whitefish	586
coho 2+	432	smelt/eulachon	511
cottid	910	sockeye 0+	420
dolly varden	530	sockeye 1+	421
grayling	610	stickleback	660

Table 14. Susitna Hydro Resident and Juvenile Anadromous Study Biological Data, RJ 81-02.

File No. _____ Page ____ of ____

SUSITNA HYDRO RESIDENT & JUVENILE ANADROMOUS STUDY
BIOLOGICAL DATA RJ 81-02

Habitat Location _____ Sampling Site _____ River Mile _____ __/__/__/__/__/__

Date(s) Collected _____ Collector(s) _____

	species code	length (mm)	sex	age	scale card #	gear type code	PSN	mesh size	remark on back		species code	length (mm)	sex	age	scale card #	gear type code	PSN	mesh size	remark on back
1										26									
2										27									
3										28									
4										29									
5										30									
6										31									
7										32									
8										33									
9										34									
10										35									
11										36									
12										37									
13										38									
14										39									
15										40									
16										41									
17										42									
18										43									
19										44									
20										45									
21										46									
22										47									
23										48									
24										49									
25										50									

GEAR TYPE CODE

beach seine	3
burbot set	10a
drift gillnet	1a
electroshock	2
gillnet	1
hook & line	9
minnow trap	5
trot line	10

SPECIES CODE

burbot	590	humpback whitefish	582
chinook 0+	410	lake trout	550
chinook 1+	411	longnose sucker	920
chum salmon	450	pink salmon	440
coho 0+	430	rainbow trout	541
coho 1+	431	round whitefish	586
coho 2+	432	smelt/eulachon	511
cottid	910	sockeye 0+	420
dolly varden	530	sockeye 1+	421
grayling	610	stickleback	660

Table 15. Susitna Hydro Resident and Juvenile Anadromous Study Tag and Recapture Data, RJ 81-03.

File No. _____ Page _____

SUSITNA HYDRO RESIDENT & JUVENILE ANADROMOUS STUDY
TAG AND RECAPTURE DATA RJ 81-03

TAGGING DATA								RECAPTURE DATA					
				LOCATION						LOCATION			
tag no.	date	species code	length (mm)	Habitat Location	T	R	S	date	length (mm)	Habitat Location	T	R	S

SPECIES CODE

burbot	590	humpback whitefish	682	rainbow trout	541
dolly varden	630	round whitefish	686		
grayling	610	lake trout	550		

Table 16. Susitna Hydro Resident and Juvenile Anadromous Study Catch Data, RJ 81-01.

File No. _____ Page 1 of _____

SUSITNA HYDRO RESIDENT & JUVENILE ANADROMOUS STUDY
CATCH DATA RJ 81-01

Habitat Location _____ Sampling Site _____ River Mile _____ __ __/__ __/__ __/__ __/__

DATE: Gear Set _____ Gear Pulled _____ Collector(s) _____

gear type code	PSN	net length	mesh size	no. hooks	TIME set	TIME pulled	TIME total*	CATCH – SPECIES CODE NO.								REMARKS

* total time for beach seine haul, electroshock and hook & line

GEAR TYPE CODE

beach seine	3
burbot set	10a
drift gillnet	1a
electroshock	2
gillnet	1
hook & line	9
minnow trap	5
trot line	10

SPECIES CODE

burbot	590
chinook 0+	410
chinook 1+	411
chum salmon	450
coho 0+	430
coho 1+	431
coho 2+	432
cottid	910
dolly varden	530
grayling	610
humpback whitefish	582
lake trout	550
longnose sucker	920
pink salmon	440
rainbow trout	541
round whitefish	586
smelt/eulachon	511
sockeye 0+	420
sockeye 1+	421
stickleback	660

2. Size sample: All individuals of these species captured will be measured for fork length in mm.

3. Sex composition, maturity, and spawning condition determination: Necropsies will be performed on all sampling mortalities but no more than 10% of fish captured will be killed specifically for these purposes.

Arctic Grayling

Data taken same as above species with the exception that if large numbers of grayling are captured for tagging in the upper study area, 10-20% sample will be taken. Fork length will be recorded in mm.

Burbot

1. Age class composition: Age class composition will be accomplished by reading otoliths of all burbot killed.

2. Size sample: All burbot captured will be measured for total length in mm.

3. Sex composition, maturity, and spawning condition determination: Necropsies will be performed on all sampling mortalities, but no more than 20% of fish captured will be killed specifically for these purposes.

Threespine Stickleback, Cottids, and Lamprey

1. Size sample - If possible, a sample of fifty fish or 10%, whichever is greater, will be collected and measured for total length in mm on a monthly basis.

C. AQUATIC HABITAT AND INSTREAM FLOW STUDIES

Assigning Gear Placement Site Numbers (GPSN)

The GPSN is a two-part code which identifies gear type and sample number, thus providing a sampling location designation for each point specific measurement made within a given sampling site.

The first part of the code indicates gear type employed at the sampling location; the second part indicates sample number. For example, if three minnow traps were set within a sampling site, the GPSN's would be: 5-01, 5-02, 5-03. Gear code designations are as follows:

Gear Type	Code
Beach Seine	3
Burbot Set	10a
Drift Gillnet	1a
Electroshock	2
Gillnet	1
Hook and Line	9
Minnow Trap	5
Trot Line	10
Observation	0

GPSN's will be included when mapping a sampling site. Resident Juvenile crew members will assign GPSN's and will provide AH personnel with this information to facilitate the correlation of data. AH personnel will assign GPSN's when fishery data are not being collected.

Geographic Code

In this study, locations of features such as reaches, sampling sites, etc., were specified by a code containing up to fourteen characters (Figure 4).

The first letter identifies the Alaska Meridian; the next three characters identify the Township of the sampling point; the next three, the Range; and, the next two, the section number within the Township. Following these eight characters, one to four letters are used to indicate the location of the sampling point within the 640-acre section. Each letter progressively subdivides the section into quarters, designating them A, B, C, and D in a counterclockwise direction. The first letter following the section number therefore represents the location of the site within the quarter section (160-acre tract); the next, the quarter-quarter section (40-acre tract); the next, the quarter-quarter-quarter section (10-acre tract); etc. When more than one site is sampled within the same subsection, the number of sites is added at the end of the code. For example, if two samples were collected in the Seward Meridian, Section 21, Township 9 North, Range 20 West, the geographic code would be S09N20W21DAA2. The letters DAA indicate that the samples were collected in the 10-acre NE quarter-quarter-quarter section of the 40-acre NE quarter-quarter section of the 160-acre SE quarter section of Section 21 in the Seward Meridian. The number 2 following the letters DAA indicates there were two sampling locations in this 10-acre tract.

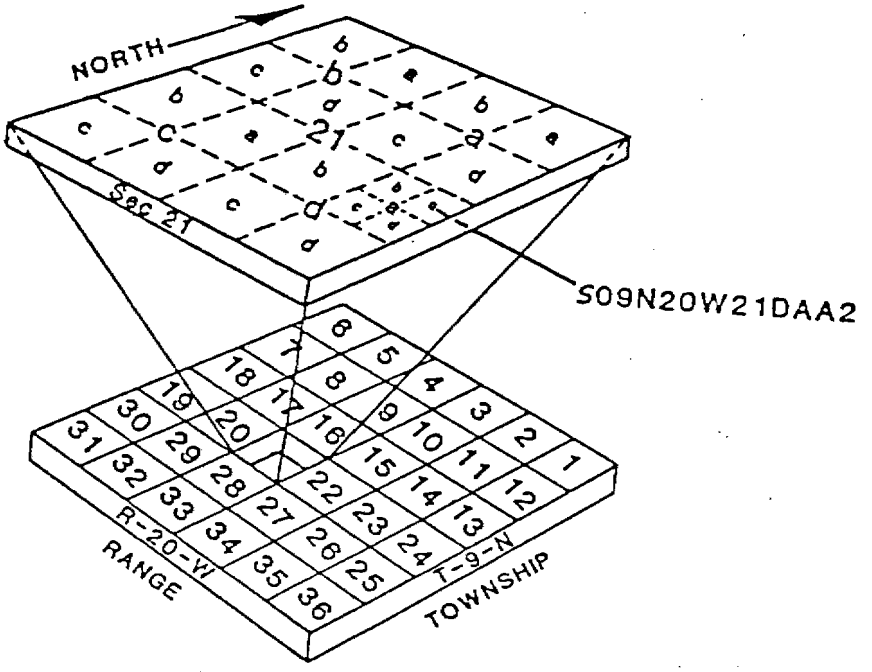

Figure 4. ADF&G Geographic Location System.

Personal Log Book

A personal log book will be maintained by each AH crew member. Daily entries will include the following:

Date: Year, month day
Sites visited and activities of that day
Weather: Air temperature, precipitation, cloud cover, wind, etc.
Military Time: Twenty-four (24) hour system
Water Conditions: Turbidity, clarity, color, odor, ice stage, floating debris, etc.
Biological Organisms: Fish, benthics, and other observations of organisms, their activities.
Sampling Conditions
Equipment Problems
Suggestions for changes or improvements
Personal Impressions: Professional judgement of habitat relation-ships to fishery resources, etc.
Record of Photographs: Establish a separate section in the personnel log book for the following data: frame number, roll number, orientation, location, date, and time.
Crew Members: Names of AA, RJ, and AH sampling crew.

This log will be maintained so a continual journal of the events occurring at a site can be followed from one sampling period to another. The log book will thus provide a narrative of the response of the fisheries, physical and chemical conditions over time at a site and the hydraulic changes that differ from sampling period to sampling period.

Any other field notes that will assist in the interpretation of the data should also be recorded during the sampling periods. This includes unusual conditions, or observations you consider to be important to note. These field notes will provide the basis for preparation of the narrative portion of final reports.

Completing Aquatic Habitat Forms

Instructions for completing the AH forms are explained in this section. The numbers introducing each instruction corresponds to a number encircled in the appropriate form. Numbers one through ten apply to all forms with the exception of Staff Gage form (AH-81-05) while numbers greater than ten apply to the specific form under which they are listed. On the staff gage form, numbers one through six refer to the general instructions whereas numbers seven through thirteen refer to specific information.

General Instructions

1. File No.: Indicates file location.

2. Crew: List names or initials of personnel making measurements and entering data on form.

3. Habitat Location: Enter descriptive name of study area (i.e. Slough 8A).

4. Sampling Site: Enter descriptive name of the sampling area within the habitat study location (i.e. head, mouth, etc.).

5. River Mile: Enter the number of miles from the river mouth to the habitat location. River miles are indicated on the Alaska Power Authority's Susitna River hydrographic map set.

6. Geographical Code (GC): Enter the 12 digit code identifying the sampling location.

7. Gage Number (no.) and Height (ht.): Record the established identification number for the gage and the stage reading (i.e., water depth at the gage).

8. Sampling Period: Enter the period (e.g. early June, late August) being sampled.

9. Page: Indicate the page number and the total number of pages used (i.e. 1 of 5, 2 of 5, 5 of 5).

10. Description: Enter any information which helps describe the sampling site or the sampling location (i.e. bend in river, riffle 100 yards downstream of small island, river is braided, straight, or meandering, etc. Figure 5).

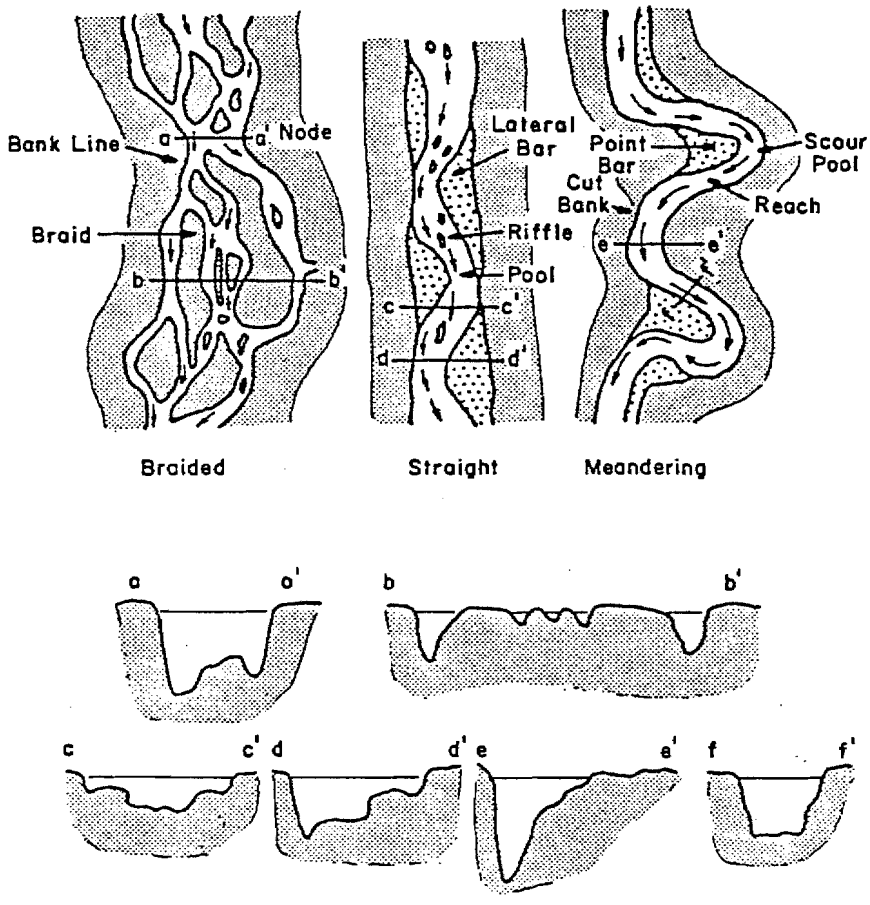

Figure 5. River Channel Patterns (from Richardson et al, 1975).

General Aquatic Habitat Evaluation Form (AH-81-01)

This form to be completed in the field when measuring the general aquatic habitat parameters discussed in the study description.

Instructions:

1-10. Refer to general instructions.

11. Date: Enter date measurement is being taken.

12. Military Time: Enter time using the 24 hour system (i.e. for 1:00 p.m., enter 1300).

13. Temperature (Temp) °C: Enter air and water temperature.

14. Dissolved Oxygen (D.O., mg/l): Enter value as measured following the procedure in the methods section.

15. pH: Enter value as measured using the procedure described in the methods section.

16. Specific Conductance (Cond, mhos/cm): Enter specific conductance value as measured by the procedure described in the methods section.

17. Meter and Serial Number: Enter the meter type used and its serial number.

18. Turbidity (NTU): Indicate with a check on the left side of the space that a turbidity sample was taken, enter turbidity value after analysis.

19. Discharge (cfs): Indicate with a check on the left side of the space when measurement is made, enter value after calculated from the discharge data form.

20. Related Data: Record number of any data forms that you know were filled out at the same time and place, film roll number and number of photos taken and identification of photographer or other data that will relate (i.e., USGS, R&M etc.).

21. Include any information which will help to interpret data and the physical, chemical, and biological conditions observed. For example: document any deviation from the methods described in the manual and the conditions which prevented use of conventional methods, i.e., unusual weather, hydraulic conditions, etc.

Point Specific Aquatic Habitat Evaluation Form (AH-81-02)

This form to be completed in the field when measuring the point specific habitat parameters discussed in the study description.

Instructions:

1-10. Refer to general instructions.

11. Date: Enter date data was taken.

12. GPSN: Enter the two-part gear placement site number (GPSN) which identifies the type of fish sampling gear indicated in the gear code and the sample number (i.e. trot line sample #3 would be 10-3).

13. Depth: Enter water depth at the gear placement site.

14. Velocity: Enter the point velocity at the depth of the sampling gear and the mean column velocity.

15. Meter and Serial Number: Enter meter type used and its serial number.

16. Substrate: Enter the percent and the class number of each sediment size class (up to three) identified within a two foot radius of each velocity/depth measurement point.

17. Embeddedness: Enter the class number for the size of substrate Class Five and larger embedded in surrounding materials, the percent (%) of embeddedness and the class number for the size of the embedding material, within the same area as the substrate evaluation.

18. Aquatic Vegetation: Enter the percent (%) cover of algae or vascular plants within a two foot radius of the gear placement site.

19. Related Data: Record the data form number of any data collected at the same time and site. Also note any observation which may be pertinent to the sample (i.e. minnow trap placed under cut bank, number of fish at three foot intervals along gill net, etc.).

20. Notes: Include any information which may help in interpreting data. For example: document any deviation from the methods described in the Procedures Manual and the conditions which prevented use of conventional methods, unusual weather or other circumstances.

Planimetric View Map Form (AH-81-03)

A map describing the study habitat site is drawn on this form in the field.

Instructions:

1-10. Refer to general instructions.

11. Enter date map was prepared.

12. Draft map to include the following (see Figure 5 for symbols):

    Substrate
    Cover
    Bankfull top width and top width
    Pools and riffles
    Channel dimensions
    Location of staff gages and transect
    Location of sampling gear (use GPSN)
    Compass orientation

Discharge Form (AH-81-04)

This form to be completed in the field to record total discharge measurements and calculations.

Instructions:

1-10. Refer to general instructions, except number 8, enter date discharge was measured.

11. Type Meter and Number: Record the type of meter (i.e., Price AA, Pygmy or Marsh McBirney meter) and the serial number.

12. Distance From Head Pin or Water's Edge: The horizontal measurement from the head pin or waters edge to each vertical along the transect.

13. Angle Coefficient: A correction factor for the angle of flow as it intersects the transect line. Values fall between 0.00 and 1.00 and are determined by use of an angle coefficient chart.

14. Velocity Depth: This is the vertical distance from the water surface to the channel bottom at each vertical measured to the nearest 0.1 foot if possible.

15. Streambed Elevation: Computed at each vertical by subtracting the velocity depth from the average of the right bank (RB) and left bank (LB) water surface elevations for that transect at that particular flow. Left and Right banks are determined by looking upstream. These data are collected only where surveyed head pins are established.

16. Observation Depth: Indicate at what depth the point velocity was measured. Velocity will be measured at .6 of the depth from the surface for a depth less than three feet and .2 and .8 for depth greater than three feet.

17. Revolutions: Recorded number of revolutions when using a Price AA or Pygmy flow meter. When using a Marsh McBirney meter draw a line through this column.

18. Time: Recorded in seconds by use of a stopwatch, when using a Price AA or Pygmy flow meter. When using a Marsh McBirney meter draw a line through this column.

19. Point Velocity: This is the velocity obtained from the rating table using revolution and time information or the velocity reading from a direct readout meter.

20. Mean Vertical Velocity: The average of the 0.2 and 0.8 point velocity readings for the vertical. If the velocity was measured only at 0.6 the depth this is the same as the point velocity.

21. Mean Cell Velocity: The average of the two adjacent mean vertical velocities are normally grouped beginning from the LB to the RB water's edges.

22. Mean Cell Depth: The average of the depths of two adjacent verticals.

23. Cell Width: The horizontal distance between adjacent verticals.

24. Cell Area: Computed by multiplying each mean cell depth with the cell width.

25. Flow (Discharge): Computed by multiplying each cell area by its respective mean cell velocity, and when applicable, the angle coefficient and totalling the resultant values.

26. Q: Enter total of flow column.

Staff Gage Form (AH-81-05)

Used to keep a complete record of all readings made on a specific staff gage.

Instructions:

1-6. Refer to general instructions.

7. Page: Indicate the page number and the total number of pages used.

8. Staff Gage No.: Enter the established identification number.

9. Calibration Factor: Distance from channel bottom to zero mark on gage.

10. Date: Enter date of reading.

11. Time: Record military time of reading.

12. Height: Record stage reading to the nearest 0.01 foot.

13. Q: Enter discharge data taken at nearest USGS gage.

14. Initial: Initials of person who records staff gage data.

IV. QUALITY CONTROL

A. ADULT ANADROMOUS FISHERIES STUDIES

Field sampling techniques and data recording procedures of each crew will be monitored weekly by the Adult Anadromous Project Leader or his appointed designee. This will insure consistency, accuracy and comformance with standard sampling and data collection and recording methods.

Sampling gear and support equipment will be maintained in good working order. It will be the responsibility of each crew leader to insure that preventive maintenance is conducted on all equipment. Minor equipment breakdowns will be repaired in the field. Major equipment breakdowns and/or losses will be reported immediately to Anchorage headquarters. Replacement equipment or parts will be provided at first available opportunity.

B. RESIDENT AND JUVENILE ANADROMOUS FISHERIES STUDIES

Fishing techniques utilized in the various sampling schemes have veen proven for effectiveness in earlier biological studies (Langler, 1956; Sundstrom, 1957; and McClane, 1965). Personnel will be instructed to use proven lures. Natural baits, when used, will be changed regularly in insure "freshness" and ensure maximum scent transfer to the water.

Gillnets and seines will be kept mended or will be replaced if badly damaged in operations. Equipment such as tagging guns, fishing tackle, firearms, and other tools used in day-to-day operations will be cleaned and oiled after each use to prevent rust.

Data forms will be filled out in a neat and legible manner and will be subject to periodic review by the project leader or his assistant.

C. AQUATIC HABITAT AND INSTREAM FLOW STUDIES

A systematic approach for maintaining desired standards for the measurement of field parameters has been established for the instruments used in this study. Thermometers are periodically compared to a National Bureau of Standards (NBS) standard thermometer for the range of temperatures to be encountered. If present, variations are noted and correction factors are calculated and taped onto each thermometer.

Thermographs are calibrated following the above procedures. Timing mechanisms are also evaluated for accuracy. Operational thermographs are periodically inspected comparing the temperature and time on the chart with the known time and temperature data. A mark is made on the chart at that point.

Hydrolabs will be calibrated and checked after each field trip. Whenever a question arises concerning quality control, the USGS, EPA, and manufacturer of the data collection device will be consulted.

Literature is periodically reviewed to insure that state-of-the-art data collection and analysis techniques are being observed. A hydraulic engineer will be consulted to evaluate the accuracy of data collection and analysis techniques. The USFWS is periodically consulted to evaluate the accuracy of instream flow data collection and analysis techniques.

The project biometrician is consulted to evaluate the accuracy and statistical merit for collecting data.

State-of-the-art habitat data collection and analysis courses are attended when it is determined attendance will improve the quality of the program.

The field data are reviewed periodically by the field biologist responsible for its collection. A brief narrative is prepared summarizing the habitat characteristics described by the data set. Any abnormal or intervening field conditions or sampling problems which might have biased the data set are also to be discussed in the narrative.

Data Routing

Raw data from the respective project sections will be forwarded to the Anchorage Su Hydro office for copying and filing. Actual routing will follow the path in figure 1.

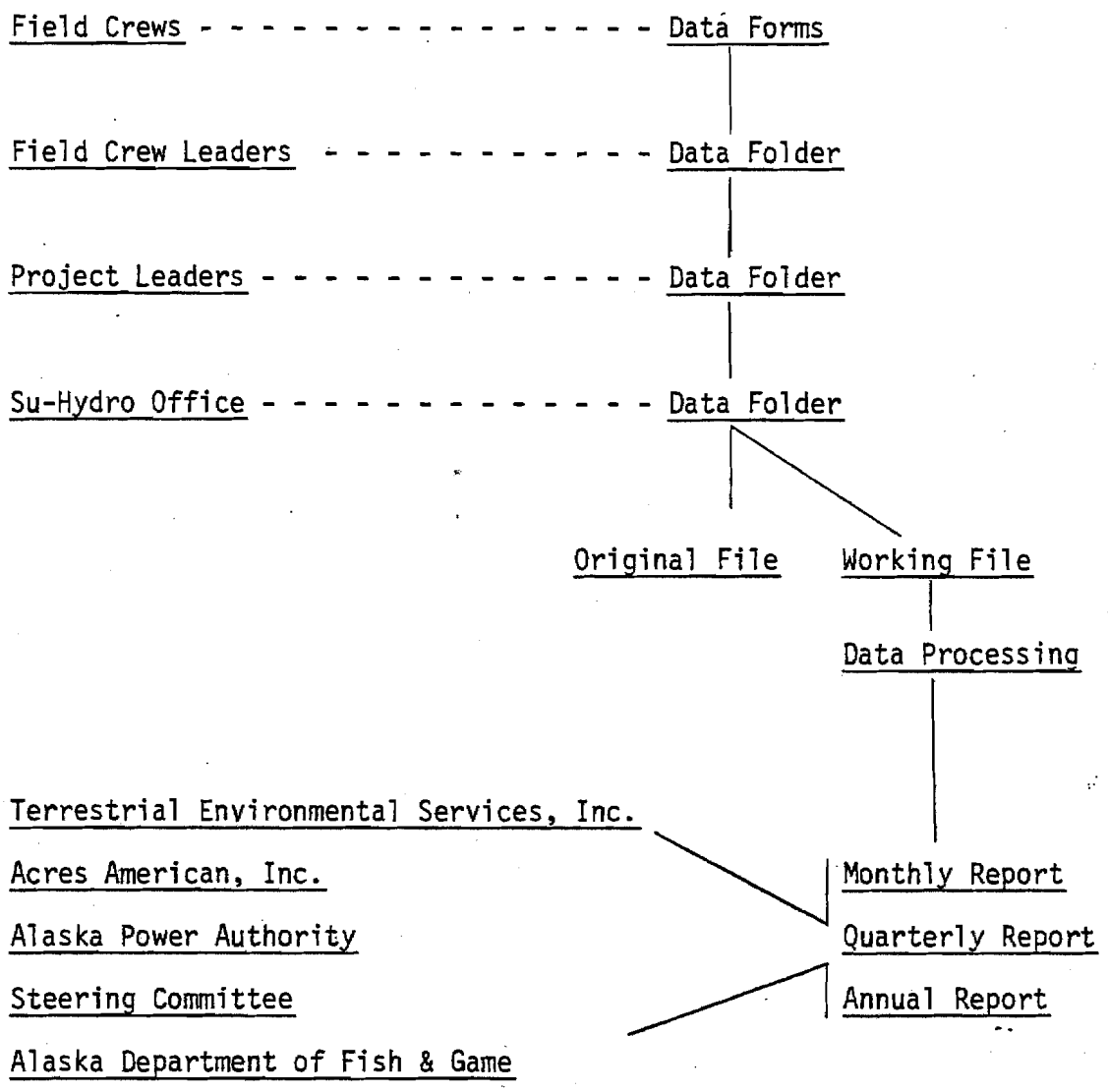

Figure 1. Data Routing, Phase I, 1981.

V. SCHEDULE

Project scheduling is as outlined in Figures 1, 2, and 3. By inspecting the figures, it becomes evident that the Adult Anadromous Fisheries Project will conduct it's field program between June 15 and October 17 at the sites indicated on Figure 1. The Resident and Juvenile Anadromous Fisheries Project will integrate it's field program with the Aquatic Habitat and Instream Flow Project along those river reaches indicated in Figure 2. These projects will operate year round from the estuary to Devil Canyon and from March 15 through October 15 upstream from Devil Canyon.

Reporting dates for all projects are depicted in Figure 3.

January -
10 - Monthly Report

February -
10 - Monthly Report

March -
10 - Monthly Report

April -
10 - Monthly Report

May - Quarterly Report
10 - Monthly Report

June -
10 - Monthly Report

July -
10 - Monthly Report

August - Quarterly Report
10 - Monthly Report

September -
10 - Monthly Report

October -
10 - Monthly Report

November - Quarterly Report
10 - Monthly Report

December -
10 - Monthly Report

15 - Anadromous Phase I Draft Report

Figure 3. Proposed Reporting Schedule, 1981.

VI. PERSONNEL

Mr. Thomas W. Trent will supervise coordination of the Su Hydro Aquatic Studies. Tom is a 1965 graduate of the University of North Dakota with a degree in biological and physical sciences. After graduation, he undertook extensive post-baccalaureate and graduate studies at Oregon State University in fisheries and water resources.

Tom acquaire professional experience in fisheries science and water pollution biology as a trainee for the Federal Water Quality Administration and with the Oregon Game Commission Research Division before he joined the Alaska Department of Fish and Game in 1971. Since joining ADF&G, Tom has held positions with the Sport Fish Division in the Anchorage area and West Side Susitna River sport fisheries management programs, and with the Habitat Protection Section dealing with development activities and environmental impact evaluation. In 1974, the Commissioner of Fish and Game delegated Tom the responsibility of developing and coordinating the Department's positions and policies on the proposed Susitna River hydroelectric project.

Tom resigned from The Department of Fish and Game in early 1975 to accept a position with the U.S Bureau of Land Management as the State Fisheries Biologist. He subsequently rejoined the Alaska Department of Fish and Game in 1976 as supervisor of the Region II Habitat Protection Section. In this capacity, Tom was responsible for coordination of fish and wildlife resource planning and policy input to the DNR State land disposal program, management of the Title 16 regulatroy program for Southcentral Alaska, and coordination of ADF&G Susitna River hydro project matters.

Mr. Larry D. Bartlett will act as Assistant Project Coordinator. Larry has attended Shasta College and Humboldt State University in California, and Western Washington State University in Bellingham, Washington. He also holds a Master of Science degree from the University of Idaho Moscow, Idaho.

Undergraduate studies specialized in Glacial/Pliestocene Geology, Alpine and Aquatic Entomology, Cellular Physiology and Genetics, Limnology, Oceanography and Chemistry.

Graduate research specialized in water quality parameters assosiated with inductrial pollution. The research was coordinated with the College of Civil Engineering, Washington State University Pullman, Washington. Larry conducted this research under a NSF/OWRR fellowship.

In addition to employment in the field of water quality, Larry has been employed as a Research and Development Chemist with a Canadian Corporation researching germicidal ultra-violet radiation for the sterilization of potable water supplies in developing nations.

In recent years Larry has been employed in the field fisheries biology which includes several years with the U.S. National Marine Fisheries Service working as a shell fish biologist in International Fisheries and the Outer Continental Shelf Development Program, two years with the Alaska Department of Fish and Game in pink and chum salmon research, and one year as an advisor to the planning team of a private non-profit aquaculture association before joining the Su Hydro project in March, 1981.

Larry is an accomplished author and has several noteworthy papers and publications in the field of alpine entomology, water quality and shellfish biology and fisheries.

Mr. Bruce M. Barrett will supervise the Adult Anadromous Project. Bruce holds a Bachelor of Science degree in fisheries from the University of Alaska in Fairbanks and completed one year of graduate study in fisheries before joining the Alaska Department of Fish and Game in 1972.

Bruce has held several key positions with the Department of Fish and Game involving anadromous fish investigations in Cook Inlet and the Susitna River system. In 1974 he conducted the first ADF&G anadromous fish study on the Susitna River between Devil Canyon and the village of Talkeetna.

Mr. Kevin Delaney will head the Resident and Juvenile Anadromous Fisheres Study. Kevin holds a Bachelor of Science degree from St. Cloud State University in St. Cloud, Minnesota. In 1974 he joined the Alaska Department of Fish and Game in Kodiak, Alaska as a shellfish research biologist. Kevin transferred to Anchorage in 1976 where he coauthored the Alaskan Fisheries Atlas Volumes I and II.

Kevin has been involved with Susitna River studies since 1977. He conducted research on Susitna River juvenile chinook and coho salmon and held the assistant area Sport Fish biologist position for the western Susitna drainage before joining the Su Hydro feasibilities study.

Mr. Christopher Estes will lead the Aquatic Habitat and Instream Flow studies. Christopher holds a Bachelor of Arts degree in Environmental Science from Prescott College, Prescott, Arizona. Graduate course work at Washington State University was directed toward instream flow and aquatic habitat evaluation procedures.

Christopher conducted his first instream flow and aquatic habitat evaluation study for the Montana Department of Fish, Wildlife, and Parks in 1975. He joined the ADF&G as a fishery research biologist in 1977 and has been associated with the Su Hydro feasibility studies since that time. In 1979, he initiated the ADF&G Instream Flow Program. During the same year, he was appointed Co-chairman of the Western Division of the American Fisheries Society Water Development and Streamflow Committee, a position he continues to fill.

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