Subtask 7.10

AQUATIC STUDIES PROCEDURES MANUAL

PHASE III - Draft

1983-84 (FY 84)

- by -

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I. INTRODUCTION

The Resident and Juvenile Anadromous Fish Studies (RJ) are directed toward accomplishing the general objectives described in 1979 by the Alaska Department of Fish and Game for the Susitna Hydroelectric Project. These objectives are stated below:

A. Define seasonal distribution and relative abundance of resident and juvenile anadromous fish in the Susitna River between Cook Inlet and Devil Canyon.

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

The Resident and Juvenile Anadromous Fisheries Studies began in November of 1980 and will continue through the licensing process. From the onset of these studies, general surveys of the lower Susitna River mainstem and associated habitats, and the portions of the upper Susitna River basin to be inundated by the proposed impoundments, have been conducted. During the winter of 1981, and the spring and summer of 1982, the studies have been concentrated on those areas that may be most severely affected by the development of the Susitna Hydroelectric Project.

The primary purpose of the RJ studies was to address the distribution and abundance of resident and juvenile anadromous fish (Objective A). During the 1982 summer investigations, the studies concentrated on developing more information on habitat relationships of rearing resident and juvenile anadromous species that may be affected by the Susitna Hydroelectric Project (Objective B).

Amended studies proposed for the 1983-84 season address geographical areas where data have not previously been collected and provide a more direct and focused effort on habitat and rearing relationships of the juvenile anadromous species and selected resident species of importance.

II. TECHNICAL PROCEDURES

A. ADULT ANADROMOUS FISHERIES STUDIES

B. RESIDENT AND JUVENILE ANADROMOUS FISHERIES STUDIES

1. Study Description and Rationale

a. Resident Fish Studies

(1) Habitat and population data

(a) Sub-objectives

Quantify the important habitat parameters associated with spawning and rearing (growth) of selected resident fish species and measure fish density in spawning and rearing habitats to provide an estimate of habitat quality.

(b) Rationale

Habitat conditions in the mainstem Susitna River between the Chulitna River confluence and Devil Canyon will be altered by the regulation of discharge from the proposed hydroelectric dams upstream. Several species of resident fish are currently harvested by sport fishermen in this reach of the Susitna River. Rainbow trout (Salmo gairdneri) and burbot (Lota lota) are the most sought after resident species (Mills, 1983).

Our investigations indicate that burbot are widely distributed in the mainstem Susitna River, while rainbow trout are more closely associated with tributary mouths. Catch data indicate that burbot largely avoid clear water areas during the open water season. An evaluation of the suitability of the mainstem Susitna River for burbot under post- project conditions can be made by comparing post-project turbidity data and hydraulic conditions with the data on the habitat conditions used by the species under pre-project conditions.

The resident fish studies will address the following questions:

- How will the rainbow trout population respond to decreased turbidity and altered post-project mainstem discharges?

- What is the current population of burbot in the mainstem Susitna River and what will their response be to altered turbidity and discharge under post project conditions?

(c) Field study design

i. Definition of the problem

The resident fish studies conducted during 1981 and 1982 on the Susitna River between Devil Canyon and the Chulitna confluence provided information on the general distribution of the resident fish species, their relative abundance, and macro-habitat preference. Most of the data collection sites were located near the confluences of clear water tributaries or in sloughs, although mainstem and sidechannel habitat sites were also sampled. Data collected in 1981 and 1982 provides a general description of the distribution of resident fish; however, further quantification of their micro-habitat and populations is desirable.

Studies done in 1981 and 1982 did not included clear water tributary habitat and consequently have not allowed any comparison of use or distribution of the species among habitats influenced by the mainstem Susitna discharge and the habitats not affected by the mainstem. To properly assess impacts to or enhancement potential of resident species, it is necessary to determine the portion of their life cycles in which they are associated with mainstem habitats. To estimate resident fish habitat conditions under altered mainstem Susitna River flow regimes it is necessary to develop physical habitat criteria using all utilized habitats. These data can then be used to estimate the suitability of unoccupied habitats in areas influenced by the mainstem under alternative flows. These areas are being evaluated by the ADF&G Aquatic Habitat and Instream Flow Study Group to apply the data can be applied to the physical habitat models being assembled.

It is necessary to establish population index areas for the primary resident species of interest. These areas can be repetitively sampled to provide indicators of the response of resident fish populations to annual changes in habitat, and provide the basis for measuring responses of the populations to altered habitat conditions after the hydroelectric dams are operating.

The following questions are the primary items being addressed by the Resident Fish Studies:

- What proportion of the primary resident species populations currently use the mainstem Susitna and adjacent habitats and what is the timing of this use?

- What are the current populations in selected index areas of the primary resident species?

- What are the physical and biological environmental factors that determine the distribution and abundance of resident fish species in this portion of the Susitna Basin?

Although answers to all of these questions would be desirable so that an accurate quantitative prediction of the Susitna Hydroelectric Project impacts can be made, complete answers are not possible because of cost limitations and the length of study time necessary to provide complete answers. However, our previous studies (ADF&G 1983a) suggest certain hypotheses as to possible answers to these questions. The study design proposed attempts to test these ideas.

ii. Hypotheses to be tested

Because of the correlative nature of impact studies, specific hypotheses that can be experimentally tested under laboratory conditions are not possible in field studies of this type. Rather, it is necessary to evaluate the validity of the hypotheses by correlations and inference. The following are some of the specific hypothesis that will be addressed by the proposed study design.

- Rainbow trout abundance is limited by available spawning habitat with successful rearing attributable to clear water tributaries with mainstem areas primarily being used for migration and overwintering.

- Burbot abundance is restricted to light-limited environments and are closely associated with mainstem Susitna turbidity.

- Mainstem habitat conditions limit production of resident species because of unstable flows, turbidity, and consequent limited food production.

- Potential production in the mainstem and sidechannels for the primary resident species is predicated on turbidity, depth, and velocities available during the summer rearing months.

iii. Analytical approach

To test these hypotheses, the following analytical approach is planned.

- The rearing period of the life cycle will be examined for rainbow trout and burbot by monitoring macro-habitat conditions used by radio-tagged adults and the location of fish captured by other means. This data will be the basis for determining the timing and the proportion of the populations in this reach of river that utilize the habitats affected by the mainstem Susitna River.

- Micro-habitat utilization and preference will be evaluated by comparing catch per unit effort or population density values associated with the available habitat conditions.

- Population index areas will be established to compare annual changes and variations in fish population densities.

- The effects of instream flow incremental changes on physical habitat will be used in concert with the micro-habitat criteria to estimate the effects of flow variation on the species being studied.

Specific analytical methods will be further defined in the data analysis section of this manual.

b. Juvenile Anadromous Fish Studies

(1) Abundance, outmigration, timing, and survival

(a) Sub-objectives

Estimate the total number of sockeye and chum salmon outmigrants and their survival and provide an estimate of the relative abundance of pink, chinook, and coho salmon juveniles outmigrating from the Susitna River above the Chulitna River confluence.

(b) Rationale

The relative abundance of all species of salmon juveniles in the Susitna River has been determined by the operation of a downstream migrant trap during the 1982 open water season. Because pink and chum juvenile salmon outmigrated before the trap was in place, limited information on these and on the early outmigration rates of other salmon species was accrued. To determine the stimuli that trigger the outmigration of juvenile salmon in the Susitna River, further data are necessary on the timing and rates of outmigration.

A pilot program was initiated during the spring of 1983 to determine the feasibility of obtaining population estimates of juvenile sockeye and chum salmon by mark and recapture methodology at six selected sloughs. The entire drainage production will also be estimated by recovery of marked fish at two downstream migrant traps. By comparing egg production for sockeye and chum with juvenile outmigration numbers, survival can be estimated for the freshwater life phase of these species of salmon in the Susitna River above the Chulitna River confluence. These data can then be used to correlate the survival versus the habitat conditions experienced at the individual sloughs which have been monitored over the past season, and will provide an indication of contribution that these sloughs make to the overall production of chum and sockeye salmon juveniles in this reach of river.

The low flow year experienced during 1982 provides a unique opportunity to assess the effect of these low flow conditions on overall survival in the Susitna River drainage above the Chulitna confluence. The coded wire tags will provide the opportunity to monitor the returning adult salmon for survival throughout one entire life cycle of sockeye and chum salmon.

The coded wire tag program will also add to the understanding of the importance of sockeye salmon in the Susitna River from the Chulitna River confluence to Devil Canyon. Available data suggests that limited sockeye rearing occurs in this reach (ADF&G 1983a). Although not an integral part of the study, the option will remain open for further adult salmon tag recovery work to provide definitive evidence concerning the contribution that sloughs provide to the overall production of salmon in the system. Depending upon the results of the 1983 program, the option is available to continue the study during the 1984 spring period, and provide a comparison of survival under different habitat conditions and escapement that will probably occur.

(c) Field study design

i. Definition of the problem

The study design described in this section addresses only the open water portion of the field season for juvenile rearing chum, sockeye, chinook, and coho salmon. Observations of the timing and distribution of juvenile anadromous species in the Susitna River between the Chulitna River confluence and Devil Canyon, have been compiled since the winter of 1980. These data have suggested certain trends and hypotheses regarding the timing and distribution of these species but have provided limited information on the populations and quantification of the populations of juvenile fish as they are primarily based on catch per unit effort which are dependent upon the habitat types sampled and gear types used.

The data from the following work plan will provide a baseline data set to use to determine mitigation requirements, timing of flow or discharge releases necessary to maintain existing rearing stocks, and the ability to monitor survival of existing stocks as a function of natural annual changes in discharge. Although habitat models are to be used to estimate habitat response to discharge, the only true test of the models is to provide measurements of the survival of juvenile salmon under variable discharge conditions. Therefore, the problems to be addressed include the following:

- What are the current numbers of salmon outmigrants?

- What is the survival from egg to outmigrant and what is the condition of the outmigrants under current environmental conditions?

- What are the outmigrant timing windows and consequently length of rearing residence time for chinook, coho, sockeye, and chum salmon and how do these timing windows respond to discharge?

- Of the major habitat types identified, what is the contribution of the particular habitat areas to juvenile salmon production?

Although answering all of these questions for all species would be desirable, only part of them can be addressed with available resources. Based on previous observations and experience, the 1983 field program will be designed to collect data necessary to further our understanding of the basic biology of juvenile salmon in the system. This program will provide initial data that can be used to test, over the long term, specific hypotheses about the relationship of mainstem discharge to the survival and consequent production of salmon during their freshwater residence in the Chulitna River confluence to Devil Canyon reach of the Susitna River.

ii. Hypotheses to be tested

The monitoring of outmigrants and the determination of outmigrant timing and survival does not lend itself to short term hypotheses testing methods commonly used in experimental biology. These data products have their most immediate use in the support of other analytical studies, such as determining the timing windows of necessary downstream discharges, determining the populations that will be affected by flow regulation on the river, and determination of short term flow variations and other environmental conditions on survival. These products will be further defined under the "Analytical Approach" section that follows. However, specific hypotheses that can be tested by use of these data sets on the long term, are applicable to this program. The following are examples of the types of hypotheses that can be resolved with longer term data collection coupled with continued monitoring of adult escapement and habitat parameters in the system.

- Annual survival of outmigrant sockeye and chum salmon from egg to juvenile is dependent upon discharge-determined habitat conditions during the spawning and incubation stages of their life cycle in sloughs and sidechannel habitats associated with the mainstem Susitna River.

- The condition (growth) of the outmigrant sockeye, chum, chinook, and coho salmon juveniles is independent of mainstem discharge effects on rearing habitat.

- o The redistribution and length of rearing of juvenile sockeye, chum, chinook, and coho salmon is dependent upon the mainstem discharge effects on available habitat.

To effectively test these hypotheses, several years of data will be required. However, short term phenomena, such as high water peaks, coupled with analysis of available habitat by use of physical habitat models, and the collection of fish distribution data at the various macro-habitat sites affected by the mainstem discharge changes, should provide an initial test as to the validity of these hypotheses. In addition to the juvenile salmon, the data base collected on juvenile resident species will provide an insight as to the effects of discharge on the migration and redistribution of resident fish species.

iii. Analytical approach

The following analytical approach will be used to address the previous questions and hypotheses. The analysis will include:

- o The relative abundance of outmigrants of all species over time.

- o The proportion of the population and the length of time the populations of juvenile salmon rear in the reach of river being examined.

- The 1982 brood year outmigrant populations of sockeye and chum salmon.

- The survival of 1982 brood year sockeye and chum salmon during the portion of their freshwater life cycle spent above the outmigrant trap.

- Correlations of the outmigrant timing, survival, and growth with mainstem discharge habitat conditions and other habitat or other variables.

- Preliminary data and analysis of the contribution of selected sloughs to the outmigrant populations and relative survival estimates from these sloughs.

Based on these analyses, the support for the hypotheses and questions previously listed will be discussed and evaluated. These data can then be used by other investigators to provide timing for downstream flow releases, to provide different weights or relative values on the different species for a given time period, and to assess the validity of the instream flow habitat analysis being undertaken.

(2) Emergence and development

(a) Sub-objective

Determine emergence timing and rates of embryonic development under the natural variable conditions that occur in mainstem, slough, and tributary sites in the Susitna River above the Chulitna River confluence for pink, coho, and chinook salmon. Complete the monitoring activities on chum and sockeye salmon development rates initiated during the winter of 1982-1983.

(b) Rationale

To determine if the post-project conditions will be sufficiently altered to allow spawning by chinook, pink, and coho salmon in the mainstem Susitna River, data on habitat conditions currently experienced by these species in side sloughs and tributaries are needed. Limited use of the mainstem for spawning by all of these species suggest that conditions in the tributaries more closely reflect the conditions necessary for successful reproduction of these species. By testing the hypothesis: The mainstem and slough substrate and/or temperatures limit the reproduction of these species at these sites; the study will suggest whether or not post-project mainstem conditions have the potential to provide alternative spawning habitat. The data analysis will be limited to testing the previous hypothesis and to correlating development rates and observed mortality to habitat conditions such as temperature and substrate. An assessment of late fall floods will also be evaluated to determine their effects on egg survival. Data collected during the 1982-83 winter on pre-emergent sockeye and chum salmon have provided useful information on factors (such as intragravel temperatures) which may have major influences on survival within a slough environment. Because of the significance of these findings on possible winter post-project operations, a further refinement of the data for sockeye and chum in the slough environment is warranted.

(c) Field study design

i. Definition of the problem

The distribution of adult salmon spawning areas in the upper Susitna River indicates that each species segregates into specific areas of macro- and micro-habitat. Chinook and coho spawn almost exclusively in tributaries, pink predominately in tributaries with some slough spawning, chum in both sloughs and tributaries in addition to mainstem/sidechannel areas, and sockeye, exclusively in sloughs. This distribution pattern suggests that variable environmental parameters among these habitat sites may contribute to the selection of the different species with regard to macro-habitat types.

Under post-project conditions, the thermal properties of the mainstem are speculated to be significantly different from the current conditions although multiple outlet ports in the dam may provide the ability to regulate downstream temperatures. To determine desirable incubation temperatures for all five species of salmon, it is necessary to develop a data set indicating the development rate and the associated thermal regimes under natural conditions. These data may then be used to determine potential adverse conditions as well as potentials for enhancement of spawning conditions in the mainstem and sidechannels of the Susitna River under alternative thermal regimes created by release of water from the reservoirs.

Investigations by ADF&G and parallel U.S. Fish and Wildlife Service laboratory studies of the thermal requirements of chum and sockeye spawning in the sloughs have been conducted. Although these data provide a basis for estimating the impacts of altered downstream thermal conditions on these species, data for the tributary spawning chum salmon, chinook, coho, and pink salmon have not been developed.

The primary focus of the 1983-84 winter studies on juvenile salmon incubation in the Susitna River address the following questions:

- o What are the baseline intragravel temperatures at sites currently used by tributary spawning salmon in the Susitna River between the Chulitna River confluence and Devil Canyon?

- o What are the baseline development rates of incubating eggs and developing alevins under current tributary thermal regimes?

- o How do these rates compare with the species or populations currently using slough or sidechannels for spawning?

Our answers to these questions can then be used by other investigators to determine the limitations or affects of altered mainstem thermal regimes on all five salmon species. This analysis can then be used to estimate, for thermal requirements only, the impacts of the hydroelectric project on habitats influenced by mainstem Susitna water. The analysis can also be used to estimate the mitigation potential of the post-project thermal regime.

ii. Hypotheses to be tested

To answer the previous questions, we propose the following hypotheses on the importance of temperature with regard to its effects on distribution and the success of salmon egg incubation in the Susitna River basin areas under study.

- o Sockeye and chum salmon embryos survive in the Susitna River because of their ability to tolerate cold (near 4°C) temperatures of sloughs or tributaries during their initial development stages and can successfully incubate and develop in water of a constant temperature.

  This hypotheses suggests that tributary chum spawners, as well as sockeye and chum slough spawners, key on upwelling water that is initially colder but warmer throughout the remainder of the development period, when compared with other species.

- Sockeye salmon are limited to spawning in upwelling areas in sloughs and are unable to exploit tributary areas because of other unknown and undefined limits on their life cycle.

- Chinook salmon require warmer initial temperatures for successful incubation and therefore spawn in tributaries rather than sloughs because of the cold temperatures associated with ground water upwelling in sloughs.

- Coho salmon are limited in selection of spawning areas because of non-thermal factors associated with their development.

- Pink salmon require initial warmer temperatures (tributary habitats) to successfully spawn and slough spawners are strays or relatively less successful in completing incubation in these habitat types.

Because the study will address only thermal requirements and associated development rates, the ability to test the hypotheses related to non-thermal effects is limited. However, data collected by other study components should be of value in addressing the validity of these hypotheses as well.

iii. Analytical approach

To test the validity of the above hypotheses and address the questions raised, the following analytical components will be completed. The hypotheses proposed are not directly testable by analytical means because of the nature of this type of data. Instead the hypotheses must be addressed by correlations and examining other data sets which address other habitat parameters. The suitability of spawning habitat may often be limited by other habitat components, even if thermal data analysis does not suggest that temperature limits the spawning habitat of these species.

The following are specific analysis which will be completed on the field data sets to be collected:

- o Calculate the thermal units associated with developmental stage of chinook, coho, chum and pink salmon spawning in the Susitna River tributaries.

- o Compare the intragravel and surface temperatures of tributary spawning habitats among the species and with slough spawning areas.

- o Evaluate the hypothetical effects of alternative mainstem, sidechannel and slough intragravel and surface temperatures on the development rates of each of the species.

These analysis will then be used to discuss the validity of the hypotheses when compared with other types of habitat data collected on other study components for the species in question and from the literature. This discussion will address the validity of using thermal analysis in projecting available spawning habitat in the mainstem river if the thermal regime changes after the system is regulated.

(3) Rearing habitat

(a) Sub-objectives

Determine the relationship of juvenile salmon distribution to hydraulic parameters, temperature, turbidity, and cover at selected study sites that will provide a representative sample of mainstem, slough and clear water tributary rearing habitat in the study area.

(b) Rationale

Because post-project turbidity, temperature, and discharge will be substantially different from pre-project conditions, we are proposing to continue our evaluation of the effect of these changes on the ability of juvenile salmon to successfully rear in the Susitna River drainage. The key parameters that affect the successful rearing of the juvenile salmon are hypothesized as being different for each of the five salmon species that occur in this reach of river. For juvenile chum salmon the hypothesized parameters include water velocity, available cover, and access. The same factors are hypothesized for sockeye juveniles, plus the development of plankton populations. Pink salmon juveniles require adequate water for passage out of the natal area. Coho and chinook rearing requirements may differ by age class. Adequate cover and food are considered to be main factors for these species, with passage into sloughs and other backwater rearing areas also being important. Food studies are not included in this study plan.

Study sites are being selected with specific study field designs that will provide an ability to test the above hypotheses to determine important factors which influence the distribution of juvenile salmon. If a factor or combination of factors is found to be important in determining the distribution of the fish species present, an evaluation of the response of the factor to mainstem discharge or temperature changes will be undertaken.

(c) Field study design

i. Definition of the problem

All five species of Pacific salmon spawn in the reach of the Susitna River between the Chulitna River confluence and Devil Canyon. With the exception of pink salmon, substantial freshwater rearing and growth occur in this reach of the river during the juvenile portion of their life cycle. The data collected during 1981 and 1982 indicate the general distribution patterns of these species and their habitat utilization. The 1982 studies also investigated the response of selected macro-habitat areas to mainstem discharge changes. This study demonstrated species differences in the use of "hydraulic zones". These zones were subsections of the slough and tributary mouth areas that were affected by backwater of the mainstem Susitna River, mixing areas of the mainstem with slough or tributary flow, and free-flowing tributary or slough water above the backwater zone. The surface area of these zones, as a function of discharge, was analyzed using the relative use of the zones by each of the juvenile salmon species. This analysis provided an incremental index of habitat availability for each species as a function of mainstem discharge. "Habitat", in this case, was defined as different hydraulic zones. This analysis provided an initial indication of the effects of discharge changes on macro-habitat areas under the range of flows investigated. During the course of this study, observations of the distribution of juvenile salmon suggested certain micro-habitat parameters within the zones studies may respond to discharge changes at a higher rate than the responses of zone surface areas that were being evaluated. These micro-habitat factors include cover and turbidity, with depth and velocity having a somewhat lesser importance. Evaluation of this hypotheses will require a substantial change in the study design for 1983. The numbers of habitats to be examined will need to be limited to available resources as the revised methods require more intensive study at each of the sites.

ii. Hypotheses to be tested

Based on 1981 and 1982 studies, the following hypotheses are proposed for evaluation during the 1983 open water field season Juvenile Anadromous Study program:

- o Juvenile chinook, coho, chum, and sockeye salmon use of habitat is correlated to micro-habitat parameters such as turbidity, velocity, depth, and cover.

- o Variations in these micro-habitat parameters caused by changes in mainstem discharge have a significant influence on the distribution of juvenile salmon.

As with other study components, strict analytical testing of the above hypotheses is not possible because of the correlative nature of the data base being collected. The analytical approach will address these hypotheses by inference from the data set.

iii. Analytical approach

Preference curves will be developed for all juvenile salmon species (except non-rearing pink salmon) by examining frequency curves of habitat availability and use of each habitat parameter by juvenile salmon at all sites. Interactions between parameters may be considered in the development of the curves.

Hydraulic models of sites in three sloughs and four side- channels are being developed for use in determining the response of spawning salmon habitat to discharge. These study sites can also be used to evaluate juvenile salmon and resident fish habitat. Six additional sites will also be used to determine the response of juvenile salmon rearing habitat to mainstem discharge without the use of a hydraulic model.

Evaluation of the habitat at these last six sites will be conducted with a regression analysis of available cover and wetted area over variable discharges of the mainstem Susitna River. This analysis requires much less field data collection and analysis and will complement the hydraulic models implemented at the other sites.

Study sites selected will represent the major macro-habitat types that are affected by mainstem discharge. These habitat types will be mapped and the total area of each habitat type in this reach will be calculated by a different study component undertaken by Trihey and Associates.

One of the problems encountered with conducting instream flow studies and development of the impacts of incremental flows involves the assignment of flows during different time periods that will affect life cycle stages of the different species in different ways. The method developed by Bovee (1982) involved projection of habitat ratios, based on density information on the life cycles of a particular species. This requires a data base not obtainable in the Susitna River.

To address the problem of determining instream flows for different portions of the life cycles, an alternative approach can be used in the Susitna studies. Because such habitat ratio information is not available, other techniques must be found. One method could be based on timing of the species movements. Adult salmon have a short period of residency in fresh water and the timing of flow requirements for adult salmon is much shorter than an equivalent timing for adults of resident species. This timing window also overlaps with the rearing of juvenile chinook, coho, and sockeye salmon in the river. The data base obtained on juvenile rearing will allow estimates of the relative proportion of the populations that will be influenced by mainstem flows during this period of overlapping flow requirements. These data can be used by other investigators to assess the importance of the juveniles versus the adult spawners during this period of time.

The analytical approach will include the following items:

- o Determine the timing and relative use of macro-habitat areas by each of the juvenile salmon species over time.

- o Determine physical habitat criteria for use of cover, depth, velocity, and turbidity for each of the species for various timing windows of their use of macro-habitat areas associated with the mainstem Susitna River.

- o Project changes in the micro-habitat parameters of wetted areas and cover for six study sites located within macro-habitat areas associated with the mainstem Susitna River by regression analysis over the range of mainstem flows measured during the 1983 open water season.

- o Project changes in the micro-habitat parameters of velocity, depth, cover, substrate, and turbidity at three sloughs and four sidechannels sites by use of habitat simulation models (to be completed by the Aquatic Habitat and Instream Flow component of the studies).

- o Project incrementally available habitat over the range of mainstem flows for sites studied under the two previous items listed above for those physical parameters that have significant positive correlation with the distribution of fish. Test projected habitat values with fish distribution data collected.

- o Plot the habitat available versus discharge for each of the study sites for each of the rearing salmon species.

c. Fish and Habitat Surveys Along the Proposed Access/ Transmission Corridors

(1) Sub-Objectives

Inventory the resident fish species in the streams and lakes within and adjacent to the proposed access and transmission corridors. Collect baseline aquatic habitat data to document the physical and chemical characteristics of streams and lakes within and adjacent to the proposed access and transmission corridor routes.

(2) Rationale

Establishment of construction camps and development of the access and transmission corridors will have an impact on many of the adjacent lakes and streams both during and after development. By providing information on the resident fish populations and their habitat requirements in areas that may be affected by road crossings, camp construction, borrow areas, and a major increase in sport fishing pressure, impact analysis can be made and appropriate mitigation activities planned.

Arctic grayling and lake trout are the two major sport fish in the proposed study area. Access to the area will allow a substantial increase in sport fishing pressure on fish populations that have been virtually unexploited due to the inaccessibility of the area. The Deadman Lake and Deadman Creek system, which is adjacent to the proposed access road for approximately 10 miles, is one of the few trophy sport fishing areas for Arctic grayling in interior Alaska. Because of the importance of this stock of Arctic grayling it is necessary to document the present abundance and biological structure of the species in the area to use as a basis to predict the impacts of increased fishing pressure and increased harvests.

(3) Field study design

(a) Definition of the problem

Survey work conducted in the Deadman Creek and Lake system during 1982 suggested the population of Arctic grayling and lake trout may be of above average importance to the sport fishery because of the comparatively large size of the fish in this drainage. Because this drainage is now separated from the mainstem Susitna River by a waterfall, the population may be subjected to influences not found in tributaries without barriers to the mainstem Susitna River. Because this drainage will be paralleled for much of its length by the proposed access road, and because the inundation of the Deadman Creek falls by the impoundment will allow movement of stocks from the mainstem Susitna River into the drainage, there is a potential for substantial changes in the population and the age/size structure.

The 1983 open water study is designed to answer the following questions:

- o What are the baseline fishery and aquatic habitat resources in the streams to be crossed by the proposed access corridor?

- o What are the populations of sport fish species found in selected streams and lakes that will have substantially improved access and consequently major increases in sport fisheries?

By answering these two questions, it may be possible to determine the potential impacts of new sport fisheries at proposed access corridor stream crossings and suggest management strategies to mitigate impacts to areas where access is being enhanced by the development of the project. Further analysis of the Arctic grayling population structure in Deadman Creek may also determine the probable consequences of inundation of the falls on this population.

(b) Hypotheses to be tested

In addition to the presentation of descriptive baseline data, the following hypotheses will be examined:

- o The age/size distribution of Arctic grayling in the Deadman Lake drainage is the result of low recruitment and, consequently, reduced density-dependent mortality. The isolation of this drainage from other systems limits recruitment by reducing overwintering and juvenile rearing habitat.

- o The population of lake trout in Deadman Lake is similarly limited by recruitment.

- o The population of grayling in the Deadman Creek drainage have a very low maximum sustained yield because of the recruitment limitations and as a consequence, the population will rapidly decrease with small increases in sport fishery induced mortality.

Ideally, these hypotheses could be examined quantitatively by obtaining population data for all age classes of Arctic grayling and lake trout. In practice, obtaining quantitative data on the young age classes is not practical with reasonable limits on expenditures, so certain assumptions may have to be made, based on comparisons of density of catchable adults and age class mortality observed in the older fish, and the limited information that will be obtained on spawning and fecundity rates.

(c) Analytical approach

Analysis of the data will consist of the following:

- Report information on the fish species, size, and habitat conditions in study sites on streams and lakes in the vicinity of the access road and transmission corridors.

- Calculate population estimates for representative reaches of lower Deadman Creek for Arctic grayling and population estimates for the whitefish species and lake trout of Deadman Lake.

- Analyze the population structure of the grayling and lake trout in the Deadman drainage and model the effects of incremental increases in sport fishing induced mortality on the population structure. Project the maximum sustained yield for alternative sport fish harvest management strategies.

The last two descriptions above are dependent upon the quality of the data base that is obtained using the methods described in the following sections. The quality of such projections and estimates is dependent upon the quality of the data base that can be obtained on age classes of the fish being examined.

2. Field Data Collection Work Plans

a. Resident Fish Studies

A two man crew will take samples of resident fish on the Susitna River between the Chulitna River confluence and Devil Canyon for habitat and relative abundance studies, fish preference studies, population estimates, and a radio telemetry-migrational study. River boats, fixed wing aircraft and helicopters will be used for support. Sampling methods to be used in this study are electrofishing, angling, trotlines, gill nets, and hoop nets. During the open water season the crew will operate out of tent camps located on the Susitna River at Talkeetna Station and Gold Creek. After freeze-up radio tracking and sampling will be conducted by aircraft out of Anchorage or Talkeetna.

(1) Methods

(a) Habitat and Relative Abundance

Resident fish will be collected at mainstem and tributary sites with a boat mounted electrofishing unit.

All resident fish captured will be identified to species. Biological data (age, length, sex, and sexual maturity) will be collected as defined in the 1982 procedures manual (ADF&G 1982).

The following habitat parameters will be collected at all resident fish spawning sites, at all sites where radio tagged fish are located, and at a select number of resident fish preference sites: water temperatures, water depths, water velocities, specific conductance, dissolved oxygen, pH, turbidity, intragravel temperatures, and substrate composition.

The tag recapture program to monitor the seasonal movements of adult resident fish will be continued. In 1981, 1,550 adult resident fish were tagged in the Susitna River between Cook Inlet and Devil Canyon (ADF&G 1981a). During 1982, 3,118 adult resident fish were tagged in the same reach (ADF&G 1983a). Tagging crews will attempt to tag an additional 3,000 resident fish during the 1983-1984 field season.

Floy anchor tags will be used to tag seven species of adult resident fish. Species to be tagged are humpback whitefish, round whitefish, burbot, longnose suckers, rainbow trout, Arctic grayling, and Dolly Varden.

With the exception of burbot, all resident fish that appear to be healthy after capture and have a fork length greater than 200 millimeters (mm) will be tagged. Burbot with a total length of 225 mm or greater will be tagged.

Floy anchor tags will be inserted between the lateral line and the posterior ray of the dorsal fin with a Floy tagging gun.

Tags will be recovered by the following means:

- o Boat electrofishing crews

- o The angling public will be requested to return recovered tags or report the tag number to the nearest office of the Alaska Department of Fish and Game with information regarding the location and date of catch and if the fish was released with the tag intact. The public will be informed of the tagging program by news releases to the media, RJ Su Hydro staff, and posters placed in conspicuous place frequented by anglers.

- o Adult Anadromous fishwheel operations.

(b) Fish Preference Studies

Ten locations will be designated as resident fish preference study sites. Locations selected as resident fish preference sites were chosen from sites that were reported to contain large numbers of resident fish in 1982 (ADF&G 1983a).

Each resident fish preference site will be divided into one to three grids. Grids will be located so that the water quality within them will be as uniform as possible and so that the grids will encompass a variety of habitat types. Resident fish preference sites at tributary mouths will be divided into three grids. At tributary mouths one grid will be located in the mainstem Susitna River above the confluence of the tributary, the second grid will be set up within or below the confluence where the tributary is the primary water source, and the third grid will be situated in the zone where the mainstem Susitna River and the tributary waters are mixed (Figure B-1). Resident fish preference sites located in the mainstem Susitna River, will have only one grid. Because grids at resident fish preference sites are dependent upon specific hydraulic characteristics, their locations can and will change from one sampling trip to the next. Therefore the location of grids at each resident fish preference site will be redetermined during each sampling trip based on differences in turbidity and water chemistry readings.

Grids will be subdivided into cells. Each cell within a grid will contain a specific habitat type (i.e. substrate, depth, cover). Cells will be rectangular and the length and width of each cell will vary according to the habitat parameters being studied within each cell.

The length boundaries of cells within each grid will be clearly marked with orange flagging prior to sampling. The width boundaries of cells within a grid will not be marked. Cell widths will be five feet or a multiple of five feet depending on the habitat parameters involved. Five feet was chosen as a standard cell width because it is the average effective capture width of the electrofishing sampling equipment used.

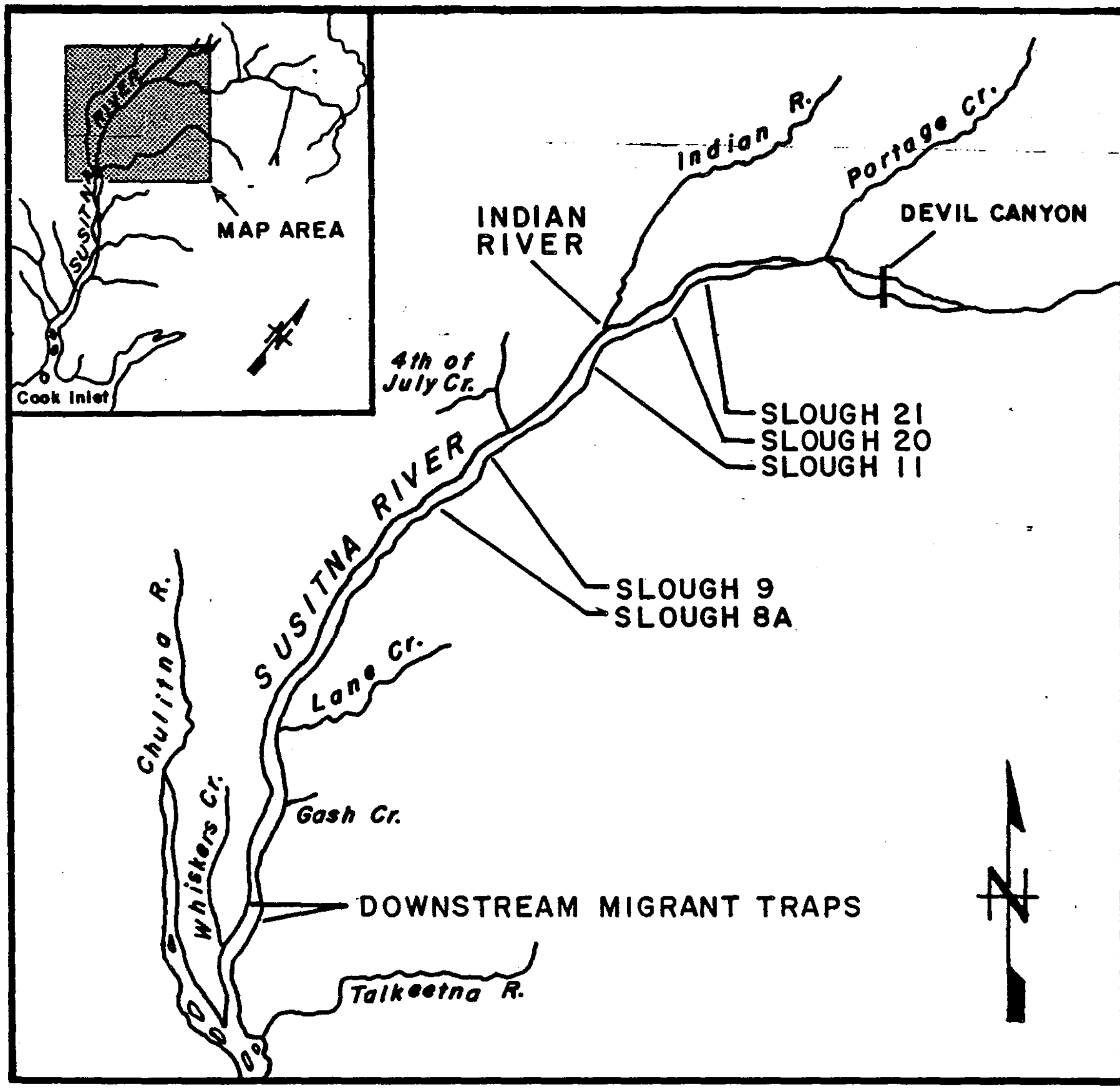


Figure B-2. Map showing the locations of five juvenile salmon coded wire tagging sites and two downstream migrant traps on the Susitna River, 1983.

All resident fish collected will be identified to species. Age, length, sex, maturity, and spawning condition data will be recorded as specified in the 1981 and 1982 procedures manuals (ADF&G 1981; 1982). All healthy adult resident fish will be Floy anchor tagged and released.

Microhabitat parameters (e.g., dissolved oxygen, specific conductance, pH, turbidity water temperature, water velocity, and water depth) will be recorded for each cell at Resident Fish Preference sites. However, if the microhabitat parameters within a grid are relatively constant, only one sample will be recorded to represent all cells within that grid. Turbidity samples will be collected in 250 ml plastic bottles and stored in a cool dark place until they are analyzed.

Substrate data will be collected in accordance with modified procedures used by the Aquatic Habitat and Instream Flow Group at Habitat Model and Fisheries Data Collection sites (ADF&G 1982).

Fisheries data at Resident Fish Preference study sites will be collected with a Coffelt boat mounted electrofishing unit, Model VVP-3E powered by a 2500 watt Onan portable generator. A stop watch will be used to record the time electrofished per cell. Procedures used for boat electrofishing are described in the 1982 procedures manual (ADF&G 1982).

The mean depth of each study cell will be measured to the nearest tenth of a foot with a topsetting weighing rod.

The mean velocity of each cell will be measured with a Price Model AA velocity meter and the standard rating tables supplied with each meter. Turbidity measurements will be recorded for each grid, immediately following sample collection, using a HF Instrument turbidometer, Model DRT-15.

Water quality measurements will be taken in each grid with a Hydrolab multi parameter meter, Model 4001. These meters will be recalibrated prior to each field sampling trip.

A 200 feet Leitz brand fiber-plastic surveyors tape or a calibrated range finder will be used to make all length measurements.

(c) Population Estimates

Data for population estimates will be collected for the following species of resident fish in the Susitna River between the Chulitna River confluence and Devil Canyon: rainbow trout, Arctic grayling, burbot, round whitefish, and longnose suckers.

Rainbow trout population estimate data will be collected in Fourth of July Creek using hook and line sampling techniques. Hook and line sampling will be repeated with the same gear and effort at least three times at 24 hour intervals.

Arctic grayling, round whitefish, and longnose sucker population estimate data will be gathered using electrofishing gear. Sites containing these species will be electrofished at least three times at two hour intervals.

Burbot population estimate data will be collected using trotlines, hoop nets, and fish traps as capture methods. These gear types will be set and checked at least three times at 24 hour intervals.

Population estimates will be made using a multiple removal model (White et al. 1982). This method entails plotting a regression of the fish removal data, an estimate of the total population of each target species of resident fish in a defined area of the Susitna River can be determined.

The removal model requires that all captured fish be marked so that recaptured fish can be identified and not counted on successive sampling trips. Consequently, all captured resident fish over 200 millimeters in length will be Floy anchor tagged and all fish under 200 millimeters will have the tip of the upper caudal fin clipped.

To use the multiple removal model to generate population estimates the capture probability must have a value of 0.2 or greater. The ratio between recaptured and unmarked fish will be recorded at each site during each sampling trip to calculate the capture probability. The percentage of the total number of fish that are recaptured is the capture probability for that species.

To account for differences in capture probability for fish of different sizes, the data will be divided into two groups (lengths less than or equal to 200 millimeters, and lengths greater than 200 millimeters) and analyzed separately for all species.

(d) Radio Telemetry

During 1983-84, the resident fish studies crew will attempt to deploy 40 radio tags. Between May and October, 1983, radio tags will be implanted in approximately 30 rainbow trout and 10 burbot in the Susitna River between the Chulitna River confluence and Devil Canyon.

Tagging crews will radio tag healthy adult resident fish collected within the proposed study area.

Tags to be implanted in rainbow trout during the 1983-84 radio telemetry study are Advanced Telemetry Systems, Model 10-35. Smith Root model 4500L radio transmitters will be used to radio tag burbot.

The same procedures to surgically implant radio tags in resident fish that were previously described in the 1982 procedures manual (ADF&G 1982) will be used in 1983.

(2) Study Locations

(a) Habitat and Relative Abundance Measurements

Most sites to be sampled by boat electrofishing crews will be selected randomly and will include mainstem, sidechannel, slough, and tributary mouth sites on the Susitna River between the Chulitna River confluence and Devil Canyon. However, 12 habitat and relative abundance sites will be sampled regularly to monitor seasonal trends in relative abundance of resident fish (Table B-1).

Adult resident fish caught by fishwheels and the downstream migrant traps will also be recorded to help evaluate trends in relative abundance and seasonal movements.

In May and early June, 1983, surveys will be conducted on upper Fourth of July Creek, upper Indian River and upper Portage Creek to locate rainbow trout spawning areas and document the time of spawning for this species.

(b) Fish Preference Studies

Resident Fish Preference Studies will be conducted at 11 sites on the Susitna River between the Chulitna River confluence and Devil Canyon (Table B-1).

Table B-1. Resident fish study sites on the Susitna River between the Chulitna River confluence and Devil Canyon.

Site	River Mile	Fish Habitat & Relative Abundance Site	Fish Preference Site	Population Estimate Site/Reach
Whiskers Creek Slough - Mouth	101.2	X	X	
Slough 6A	112.3	X	X	
Lane Creek - Mouth	113.6	X	X	
Skull Creek - Mouth	124.7	X		
Slough 8A	125.3	X	X	X
Susitna Mainstem	128.4-129.4			X
Susitna Sidechannel	131.0-131.8			X
Fourth of July Creek - Mouth	131.1	X	X	
Slough 11	135.3		X	
Susitna Mainstem	137.2		X	
Susitna Mainstem - West Bank	137.2-138.2	X	X	X
Indian River - Mouth	138.6	X	X	
Susitna Mainstem	138.9-140.1			X
Slough 20 - Mouth	140.1	X		
Jack Long Creek - Mouth	144.5	X	X	X
Portage Creek - Mouth	148.8	X	X	
Susitna Mainstem - Eddy	150.1	X		
	TOTAL	12	11	6

(c) Population Estimates

Data for resident fish population estimates will be collected at 6 sites on the Susitna River between the Chulitna River confluence and Devil Canyon (Table B-1). These sites will include 1 slough, 1 sidechannel, 1 tributary mouths, and 3-one mile stretches of the mainstem Susitna River in this reach.

Data for resident fish population estimates will also be collected at selected sites in the upper reaches of Fourth of July Creek, Indian River, and Portage Creek.

(d) Radio Telemetry

Selection of radio tagging sites in the mainstem Susitna between the Chulitna River confluence and Devil Canyon will be based on resident fish distribution data collected during the 1981 and 1982 open water field season (ADF&G 1981a; 1983a). Rainbow trout which may be spawning or rearing in the upper reaches of Fourth of July Creek, Indian River, and Portage Creek will also be tagged.

(3) Schedule of Activities and Frequency of Sampling

(a) Habitat and Relative Abundance Measurements

The open water field season will be divided into three time periods: ice-out to June 30th, July 1st to August 30th, and September 1st to freeze-up.

From ice-out to June 30th and from September 1st to freeze-up, emphasis will be placed on capturing and tagging as many resident fish as possible, identifying and characterizing resident fish spawning habitat, recording timing of resident fish spawning, and collecting adult resident fish for radio telemetry studies.

Between July 1st and August 30th, field crews will identify and characterize rearing areas for juvenile and adult resident fish. During this time, habitat preference data on resident fish will also be collected.

Point specific habitat data will be collected periodically between September, 1983 and March, 1984 at sites where radio tagged fish are rearing and/or spawning.

Winter sampling efforts will concentrate on determining the timing and locations of burbot spawning on the Susitna River below Devil Canyon.

Based on 1982-1983 winter data (ADF&G 1983b), burbot sampling will be conducted above and below the Chulitna River confluence once every two weeks between January 15th and February 15th.

(b) Fish Preference Studies

Resident Fish Preference Study sites will be sampled at least once between August and October, 1983 to provide baseline fisheries and habitat data for preference curves to be used in conjunction with the habitat models.

(c) Population Estimates

Data for population estimates of Arctic grayling, rainbow trout, round whitefish, and longnose suckers will be collected in July, 1983.

During August, 1983, population estimates of burbot in selected reaches of the mainstem Susitna River will be attempted.

(d) Radio Telemetry

Two to three days during each sampling trip between May and October, 1983 will be allotted to the capture of and implanting of radio tags in resident fish.

From May, 1983 to October, 1983, radio tracking surveys will be made every 10 to 20 days by boat or fixed-wing aircraft. After freeze up radio tracking will be conducted from fixed-wing aircraft, helicopter, or snowmobile every 15 to 30 days until all of the radio tag batteries have expired.

During the spring of 1984, attempts will be made to locate radio tagged rainbow trout on their spawning grounds. During May and June, frequent aerial surveys will be flown to locate and monitor movements of potential spawners. When a tagged rainbow trout is suspected to be in a spawning area, the site will be visited by helicopter to map the sites, characterize the spawning habitat, and evaluate the relative spawning maturity of other rainbow trout in the immediate vicinity of the radio tagged fish.

From late June through mid August, 1983, similar techniques will be used to identify summer rearing habitats of radio tagged fish.

In January, 1984, attempts will be made to recapture radio tagged fish with gill nets and trotlines. This will be done to locate and define the overwintering habitats of resident fish.

b. Juvenile Anadromous Fisheries Studies

(1) Abundance, outmigration, timing, and survival

(a) Methods

i. Coded Wire Tagging

A five man crew will conduct the coded wire tagging operation at selected sites in the Susitna River above the Chulitna River confluence. The crew will be based at the Gold Creek field station (RM 136.8) and use an 18 foot riverboat as the primary means of transportation.

Binary coded one-half length wire tags will be used in conjunction with adipose fin clips to field mark post emergent sockeye and chum salmon fry.

Coded wire tagging operations will take place at the individual collection sites with equipment and personnel being transferred at the end of each tagging period. However in the event of logistical or equipment problems, the fish to be tagged will be transported from the collection area to the Gold Creek field station for tagging and will be returned to the collection site for release following the tagging procedure.

The primary fisheries collection techniques will include beach seines (both active and passive), dip nets, and backpack electrofishing units.

One or more passive beach seines will be set at fixed locations across the lower end of the sampling location and fished as necessary during the tagging period. The seines will be made from 3/16 inch or 1/4 inch square mesh, four feet deep and 25 to 40 feet in length. Passive seines will be checked periodically to collect fish and remove debris. All captured fish will be removed by dipnet and placed in live boxes for holding until the tagging operation. Active beach seining, dip netting, and backpack electrofishing will supplement the passive seines at sites where passive seining does not provide enough fish for the tagging operation, or at those sites at which passive seines are not deployable.

The coded wire tagging equipment will be leased from Northwest Marine Technology, Inc. (Shaw Island, Washington) and operated in accordance with the manufacturer's instruction and operation manual. The equipment to be based will be the NMT, Model MK2A tagging unit and include the following:

- Coded wire tag injector with 1/2 length tag capability
- Quality Control Device (QCD)
- Water pump
- Portable power supply

This equipment is field portable and includes a more compact prototype of the standard quality control device.

The one-half length tag capability is necessary due to the small size of the fish to be tagged. Susitna River chum salmon emerge at mean total lengths of 40 mm and averaging 1,500 fish per pound, while sockeye salmon were observed emerging at a mean total length of 32 mm and averaging approximately 3,000 fish per pound. The small area of cartilage in the snout of fish at this size for tag implantation does not allow the use of full length tags.

The coded wire tags for the program are made from biologically inert stainless steel wire which are capable of magnetic detection, and have a continually repeating binary code etched into the wire which allows code reading of recovered tags. Half-length tags measure .02 inches (.533 mm) in length and .01 inches (.254 mm) in diameter.

A total of 68,000 one-half length coded wire tags consisting of ten separate binary code groups, six code groups of 10,000 tags each, and four code groups of 2,000 tags each, will be ordered for the program. As many tag code groups as possible will be implanted, however only one tag code being used at any given site during each collection and tagging period. A tagging period will consist of one to six days of tagging per site, depending on the availability of fish. At the completion of each tagging period, a new tag code group will be used for the next site to be sampled.

Up to three different tag code groups being implanted at any one site during the entire program. A minimum of ten days will separate the tagging periods of implantation and release of different tag code groups at the same site to minimize the recapture of previously tagged fish, and to provide a clear separation between tagging periods from the same site.

The coded wire tag implantation procedures will be similar to those outlined by Moberly et al. (1977). Adjustments to these procedures will be implemented as necessary by our particular field program.

At the end of the tagging day, a random sample of 100 tagged fish will be collected from the holding tank and run through the QCD to determine the percent tag retention. Tag mortality will be recorded the following day. All tagged fish will be released at the capture site at the end of each tagging period.

The necessary numbers of fish to be tagged of each species to provide accurate population estimates will be calculated using the estimator provided by Robson and Regier (1964). This will provide a Petersen estimate of population varying not more than 25 percent from the true population in 95 percent of the trials. To establish the numbers of marked fish necessary for accurate estimates, certain variables must be predetermined. These are the adult escapement, male to female ratio of adults, average fecundity, estimated survival from egg to fry, and the estimated number of fish which will be recovered and examined for marks.

Adult salmon escapement and male to female ratio data from both the Talkeetna and Curry fishwheels in 1982 will be used in the calculations.

The data collected from the Curry site is suspected to provide more accurate estimates due to the large amount of milling activity reported in the vicinity of the Talkeetna fishwheel site by fish ultimately bound for the Chulitna and Talkeetna Rivers (ADF&G 1983). It has also been observed during these past studies that almost all spawning of chum and sockeye salmon in the upper Susitna River occurs in the reach between Curry and Devil Canyon. Therefore fish comprising the escapement past Curry are those which will make up the spawning populations in this reach. Thus, the Curry data should be more indicative of the true spawning escapement for this reach.

Chum salmon fecundity will be determined from Bird (1980), and sockeye salmon fecundity will be taken from Thompson (1964). Egg to fry survival is dependent on the interplay of many environmental factors including temperature and dissolved oxygen and survival varies widely under changing habitat conditions (Bjornn, 1968; Hunter, 1959; Mathison, et al., 1962). Expected numbers of fish to be recovered and examined for marks will be expanded from the results of the 1982 operation of the downstream migrant trap and will take into consideration the deployment of a second trap.

ii. Dye Marking

A separate study to test the feasibility of utilizing dyes to mark post emergent fish will be tested. Bismark Brown dye will be used to mark some of the juvenile salmon collected to determine dye retention and its ability to be observed on recovered fish.

The dye will be used in conjunction with coded wire tagging as pilot study to determine the feasibility of providing population estimates of sockeye and chum salmon fry for individual sites within the study area using the multiple mark-recapture method outlined by Ricker (1975).

iii. Recovery of Marked and Unmarked Fish

A three man crew will recover coded wire tagged chum and sockeye salmon juveniles with two downstream migrant traps located at the Talkeetna Camp on the mainstem Susitna River (RM 103.0).

The downstream migrant traps have two polyethylene plastic modular pontoons to float a welded steel lattice frame in which is mounted the inclined plane and livebox. The steel infrastructure is covered by a two-feet wide plywood deck surrounding a five by ten feet center opening for suspension of the inclined plane and livebox. A three-feet high safety railing is attached to the rear of the trap. The entire trap structure measures 10 by 17 feet.

The inclined plane is eight feet long with an entrance opening measuring 4.5 feet square and is covered by one-quarter inch galvanized hardware cloth on the sides and bottom. Hand crank winches are used to adjust the fishing depth and to raise the inclined plane for cleaning. The livebox is covered by one-eighth inch hardware cloth on the sides and bottom, and is removable from the trap structure to accommodate cleaning and retrieval of captured fish.

The stationary inclined plane trap requires a river velocity of at least 1.0 feet per second for successful operation. The mesh of the inclined plane allows the major portion of the sampled water column to pass through the screen while retaining the fish and the remaining water which pass over a baffle and into the livebox. The trap will be secured with a cable and rope attached to large trees upstream of the trap and held off the bank by a boom log attached to the trap and shore.

Sampling of the trap catch will be done by lifting the livebox from its fishing position and placing it to the rear of the deck. The incline is then raised for cleaning using the hand crank winches. The livebox is picked clean by hand and the above procedure is reversed to return the trap to fishing mode.

Fishing depth and trap distance from shore will be adjusted to maximize catches and minimize mortalities. Distance from shore is adjusted by moving the attached boom log up or down the beach.

Additions and alternatives to the downstream migrant traps may be implemented depending on their success in capturing coded wire tagged fish. Wiers from shore to the traps may be added to divert more fish into the traps and the traps may be held in mid channel for shorter intervals using riverboats.

Untagged fish species expected to be caught by the downstream migrant traps include juvenile chinook, coho, and pink salmon, round whitefish, humpback whitefish, Arctic grayling, Dolly Varden, rainbow trout, slimy sculpin, longnose sucker, three-spine stickleback, Arctic lamprey, and burbot. All fish captured will be anesthetized using Tricane methane-sulfonate (MS-222). Chum and sockeye salmon juveniles will be visually checked for an adipose fin-clip which would indicate the presence of a coded wire tag. Fin-clipped fish will be passed through a Northwest Marine Technologies FSD-1 field sampling detector to audibly denote the presence of a tag and then preserved for later tag analysis. All other fish will be retained until anesthetic recovery is complete and then released downstream of the traps to minimize the chance of recapture.

Three pieces of equipment will be used in the collection of the habitat data at the downstream migrant traps. Turbidity samples will be analyzed using an HF Instruments turbidimeter, Model DRT 15. A Hydrolab multiparameter meter, Model 4041, will be used to collect water temperature, pH, DO, and conductivity measurements. Water velocity at each trap will be measured daily using a Marsh McBirney velocity meter, Model 201.

Secondary recovery operations will be conducted at the tagging sites during periods of fish collection for tagging. Recoveries may also occur during the sampling conducted by the Juvenile Anadromous Habitat Studies (JAHS) crews at the survey sites.

Dependent on the future of the Susitna Hydro Aquatic Studies, returning adults may be observed for tags at the fishwheels and the specific spawning sites.

(b) Study Locations

i. Coded Wire Tagging

Sites of the coded wire tagging program will be selected from locations where high density spawning has been documented (ADF&G 1983), and from surveys of the availability of sufficient numbers of juvenile chum and sockeye salmon for collection and tagging. Those locations which will be surveyed as possible tagging sites are Sloughs 8A (RM 125.3), 9 (RM 129.2), 11 (RM 135.3), 20 (RM 140.1), and 21 (RM 142.0) (Figure B-1). One tributary site on Indian River (RM 138.6) will also be surveyed as a potential collection site.

ii. Dye Marking

Dye marking will be conducted at Slough 11 and Slough 21 on sockeye and chum salmon juveniles.

iii. Recovery of Marked and Unmarked Fish

Two downstream migrant traps will be deployed on the Susitna River at the Talkeetna base camp (RM 103.0) above the confluence of the Chulitna River (Figure B-2). One trap will be set off the east bank and the other off the west bank of the river. The east bank site is deep and the bottom drops off quickly from shore. The west bank site is relatively shallow and has a gradual gradient (Figure B-3).

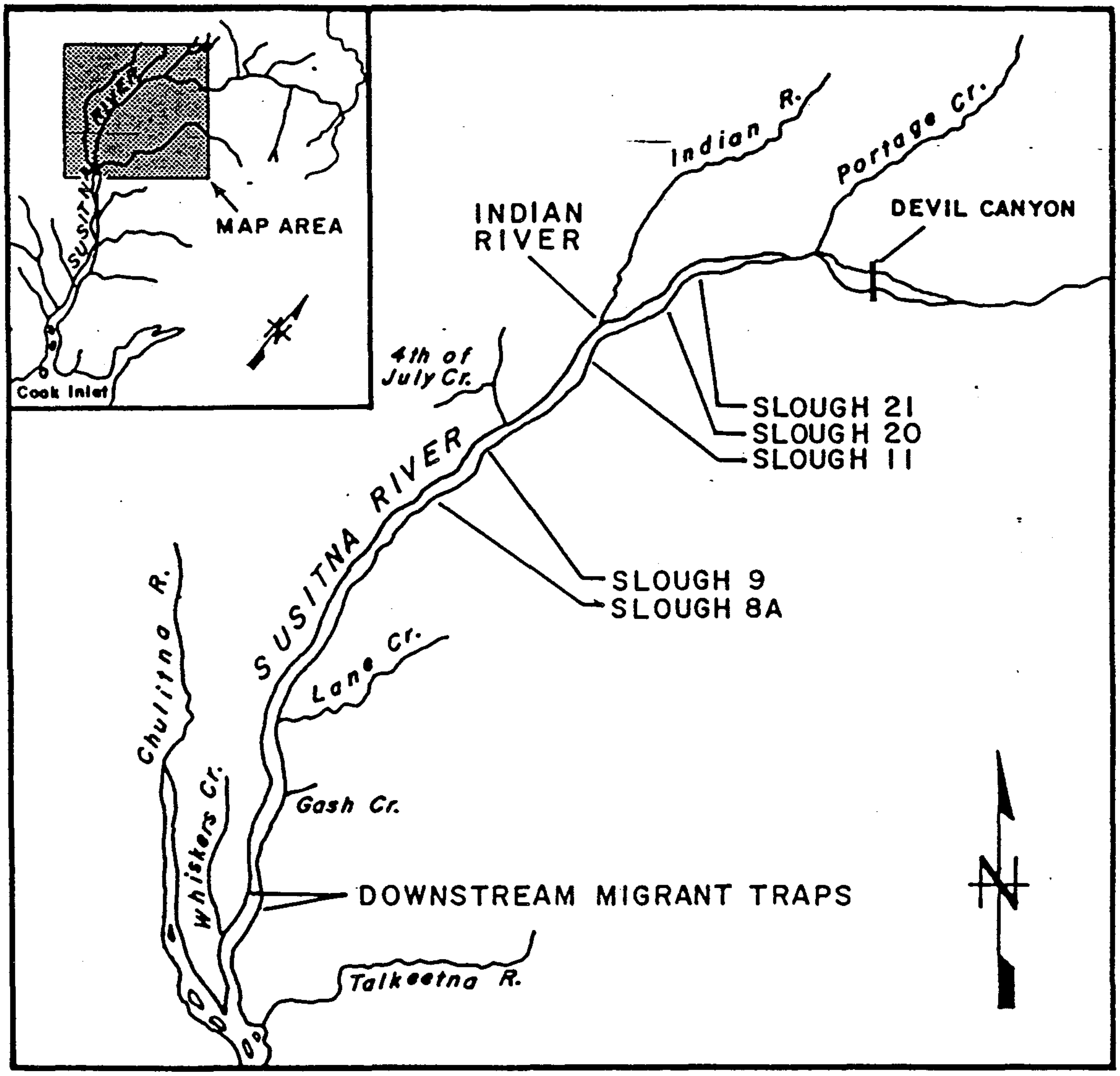


Figure B-2. Map showing the locations of five juvenile salmon coded wire tagging sites and two downstream migrant traps on the Susitna River, 1983.

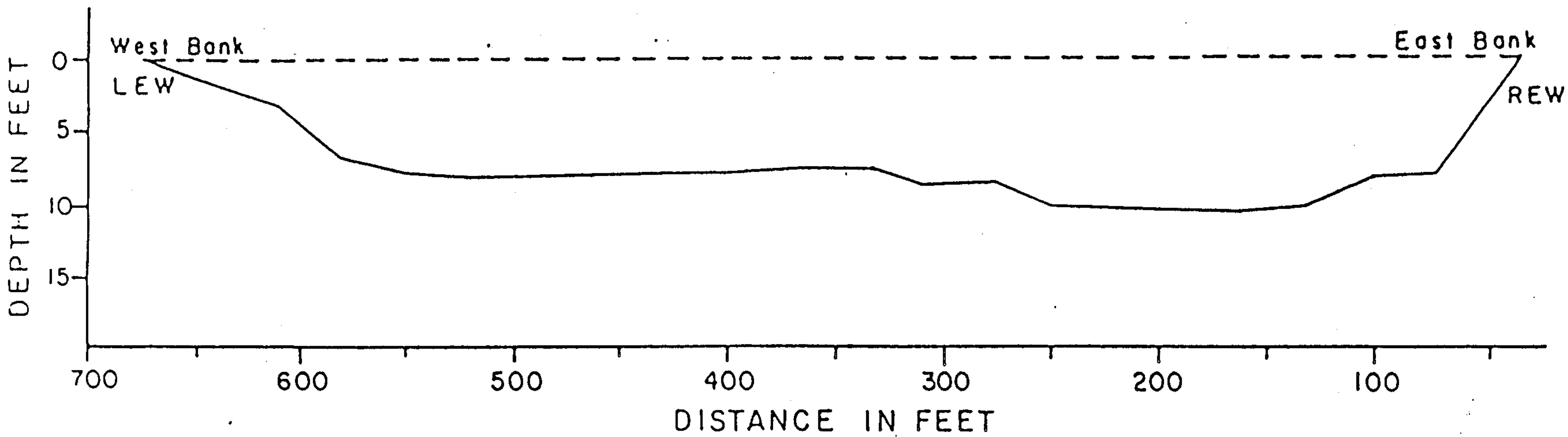


Figure B-3. Bottom profile of the Susitna River (RM 103.0) at the downstream migrant trap sites. USGS preliminary data - 37,348 cfs discharge on June 22, 1982.

(c) Schedule of Activities and Frequency of Sampling

i. Coded Wire Tagging

Coded wire tags will be deployed on a continual basis from May 21 through June 19, 1983.

ii. Dye Marking

Dye marking will be conducted from May 22 through June 6, 1983.

iii. Recovery of Marked and Unmarked Fish

The downstream migrant traps will be deployed on May 18. They will be operated periodically as river conditions permit until outgoing ice clears sufficiently to allow safe operation on a full-time basis. The traps will be operated as continuously thereafter until August 31 and on a periodic basis from September 1 until freeze-up.

The traps will be monitored according to river conditions. Periods of high discharge will require more frequent checks due to the associated debris. Checks will be conducted at least twice daily in order to collect captured fish and to clean the screens.

(2) Emergence and Development

A two man crew will conduct emergent and development studies at Lane Creek and Indian River from August, 1983 through April, 1984. The study will use modified Whitlock-Vibert boxes as artificial redds to determine the emergence timing and rate of embryonic development of chinook, chum, and pink salmon alevin at the tributary sites. Sampling will be conducted primarily from helicopters. The crew will operate out of the town of Talkeetna.

(a) Methods

Surveys will be taken during the peak spawning periods for chinook, chum, and pink salmon to identify and mark natural redds and locate suitable sites for artificial redds.

Three emergence and development sites will be selected from existing Adult Anadromous Study (AA) escapement survey sites. Selection of emergence and development study sites on each tributary will be made in the field. Prospective sites must be used by adult salmon for spawning must be accessible and must be able to accommodate artificial redds.

Up to three pair of sexually ripe male and female chinook, chum, and pink salmon will be captured by dip net or gill net and artificially spawned utilizing techniques specified in Aquatic Habitat and Instream Flow Study section of this procedures manual.

Fertilized eggs will be placed in Whitlock-Vibert incubation boxes. Up to 100 eggs will be placed in each box and up to ten boxes will be buried in the substrate at each artificial redd site. The location of each box will be identified by orange flagging. Only one species of salmon will be studied at each artificial redd site.

All emergent and development study sites will be clearly identified and marked. Natural and artificial redd sites will be identified by tributary, species, distances and coordinates from fixed markers on shore, and the date of installation or observation of actual spawning at the site.

Sampling of artificial redds will consist of removing snow or ice cover and excavating one or two of the Whitlock-Vibert boxes at each site per sampling trip with a shovel.

Natural salmon redds will be sampled concurrently with the artificial redds in each tributary from January through April, 1984 for comparative purposes. Sampling of natural redds will be accomplished by recovering eggs in a 1/4 inch mesh catch screen with the aid of a modified Homelite gas-powered water pump mounted on a backpack frame. This device, commonly called an egg pump, employs a high pressure jet of water to penetrate the substrate in a salmon redd and forces some of the embryos or alevins to the surface for collection. Once the embryos or alevins reach the surface they are collected in a cylindrical screen that is 2 feet high, 2 feet in diameter, and open at both ends. A 1/4 inch mesh catch sack trails downstream of the sampling area in the current to catch the dislodged embryos and alevins. In the event that the egg pump freezes up or malfunctions, a shovel and a dip net will be used as a backup recovery method. Embryos and alevins will be preserved in Stockard's solution (Velsen 1980) and alevins will be preserved in 10 percent formalin for later laboratory analysis.

Embryos and alevins will be examined using a binocular steroscope and procedures described by Velsen (1980).

(b) Study Locations

Three artificial salmon redd sites will be selected for emergence and development studies. Two artificial salmon redds, one for chinook and one for chum, will be established in Indian River (RM 138.6). A third artificial redd for pink salmon will be planted at Lane Creek (RM 113.6).

Natural salmon redds, of the same species as those being studied in each tributary, will be flagged in the vicinity of each artificial redds for comparative sampling throughout the winter months.

(c) Schedule of Activities and Frequency of Sampling

Selection and installation of artificial redds for chinook, chum, and pink salmon will conincide with the peak spawning period for each species. Chinook salmon will be established between late July and early August and pink and chum salmon between late August through September.

The first sampling trip is scheduled for mid-November to conicide with the approximate time that the pink and chum salmon embryos "eye-up". One Whitlock-Vibert box will be excavated at each artificial redd at this time to determine survival rates and current stages of development.

Beginning in January, 1984 two Whitlock-Vibert boxes will be excavated monthly at each artificial redd through April. Based on development rates observed throughout the winter, field crews will attempt to schedule their later sampling trips so that they conicide with the period of emergence.

Table B-2 presents a summary of emergence and development study activities.

(3) Rearing Habitat Studies

Two Juvenile Anadromous Habitat Study (JAHS) field crews, of two biologists each, will examine micro-habitat parameters of the rearing habitats used by juvenile salmon at selected sloughs, sidechannels, tributaries, and mainstem sites of the Susitna River between the Chulitna River confluence (RM 98.5) and Portage Creek (RM 148.8). JAHS sampling will be conducted from river boats during the open water seasons. Helicopter support will be enlisted as needed. Backpack electrofishing units and beach seines will be used to collect fisheries

Table B-2. Summary of emergence and development study activities, August, 1983 through April, 1984.

Activity	Aug. 1-31 1983	Sept. 1-30 1983	Oct. 1-31 1983	Nov. 1-30 1983	Dec. 1-31 1983	Jan. 1-31 1984	Feb. 1-28 1984	Mar. 1-31 1984	Apr. 1-30 1984
Survey and Mark Natural Redds	———	———							
Plant Artificial Redds	———	———							
Initial "Eye Up" Sampling				———					
Egg Pumping and Artificial Redd Excavation						———	———	———	———
Laboratory Analysis of Developmental Stage				———		———	———	———	———

data. Habitat data for fish preference studies and habitat modeling studies will be gathered using a Hydrolab multi parameter meter, a Price AA velocity meter, a topsetting wading rod, and a turbidometer. The crews will operate out of tent camps located on the Susitna River at Talkeetna Station and Gold Creek.

(a) Methods

i. Fish Preference Studies

Techniques

Twenty-nine study locations will be designated as fish preference sites. Locations selected as fish preference sites are: (1) sites that were reported to contain large numbers of spawning adult salmon in 1982 (ADF&G 1983) and, (2) sites where large numbers of rearing juvenile salmon were observed or collected by RJ biologists in 1981 and 1982 (ADF&G 1981b; 1983a).

Each fish preference site will be divided into one or two grids. Grids will be located so that water quality within them will be as uniform as possible and so that they will encompass a variety of habitat types. Each grid will consist of a series of transects which intersect the channels of the study sites at right angles as illustrated in Figure B-4.

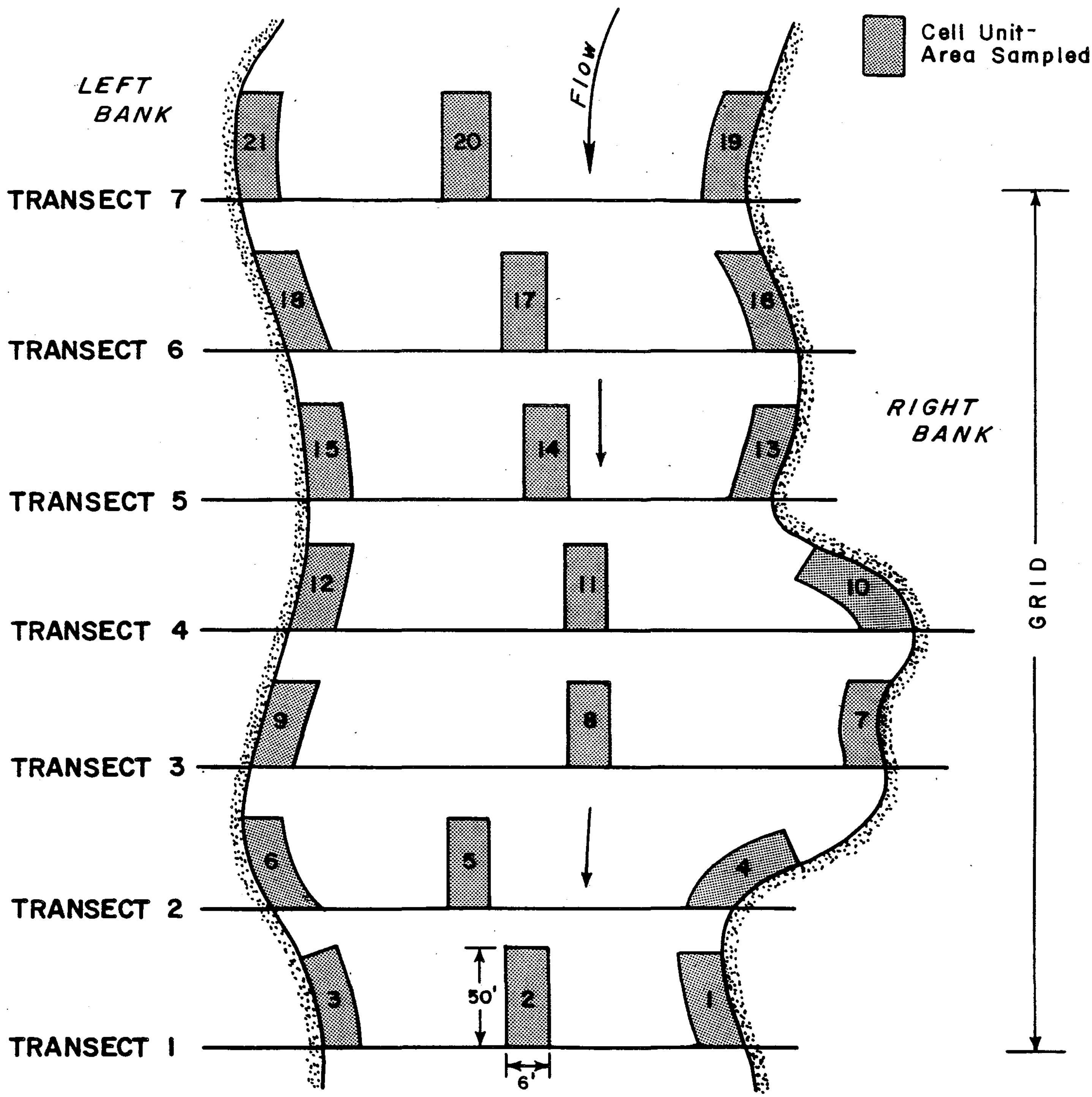


Figure B-4. Arrangements of transects, grids, and cells at a juvenile anadromous habitat study (JAHS) site.

There will be one to three cells at every transect within the grid. Attempts will be made to confine a uniform habitat type within each cell. Each of the cells will measure 50 feet in length and six feet in width. Two of the three cells will parallel both banks of the channel and the third cell will be located mid channel parallel to the bank cells. If the channel measures 18 feet or more in width at the transect, there will be a cell on each bank edge of the channel and one cell located approximately mid channel. If the slough is 12 feet to 18 feet in width, there will only be two cells, one on each side of the channel parallel with the bank, and if the channel is less than 12 feet in width there will only be one cell. Transects will be numbered consecutively beginning with the transect furthest downstream within the site (Figure B-3). Cells will also be numbered consecutively from right to left looking upriver. If there are less than three cells within a transect, cells will be numbered as if the missing middle cell were present.

Transects will be spaced at least 50 feet apart, and initial placement will be made so that the cell extends 50 feet upstream from the transect. Placement of the transects will be made to maximize a variety of habitat types. Survey stakes and orange flagging will be used to mark each transect within the grid.

Fisheries data will be collected from a minimum of seven cells within each grid at fish preference sites. Habitat data will be collected from only those cells actually sampled for fisheries data.

Table B-3. Juvenile Anadromous Habitat Study (JAHS) sites on the Susitna River between the Chulitna River confluence and Devil Canyon, July, 1983 through June, 1984.

Site	River Mile	Fish Preference Site	Habitat Modeling Site	IFG-4 Modeling Site
Whiskers Creek Slough	101.2	X	X	
Whiskers Creek	101.2	X		
Chase Creek	106.9	X		
Slough 5	107.6	X	X	
Slough 6	108.2	X		
Oxbow I	110.0	X		
Slough 6A	112.3	X	X	
Slough 8	113.6	X	X	
Mainstem II	114.4	X		
Lower McKenzie Creek	116.2	X		
Upper McKenzie Creek	116.7	X		
Slough 8A - grid 1	125.3	X		X
- grid 2	125.3	X		
Sidechannel 10A	127.1	X	X	
Slough 9	129.2	X		X
Slough 10 Sidechannel	133.8	X		X
Slough 10	133.8	X		
Slough 11	135.3	X		
Slough 11 Upper Sidechannel	136.2	X		X
Indian River - Mouth	138.6	X		
Indian River - helio #1	138.6	X		
Slough 19	140.0	X		
Slough 20	140.1	X		
Slough 21 Sidechannel	140.6			X
Slough 21	142.0			X
Slough 22	144.3	X	X	
Jack Long Creek	144.5	X		
Portage Creek - Mouth	148.8	X		
Portage Creek - helio #1	148.8	X		
- helio #2	148.8	X		
- helio #3	148.8	X		
Totals		29	6	6

All juvenile salmon collected will be identified to species in the field, measured for total length in millimeters and released. Those specimens that are not identified at the study site will be preserved in 10 percent formalin and later identified using a binocular stereoscope. The minimum sample size will be 50 fish of each species for each size class, and 10 percent of those captured in each size class thereafter.

Micro-habitat parameters such as water temperature, water depth, water velocity, pH, dissolved oxygen, specific conductance and turbidity will be collected from each cell sampled for fisheries data at fish preference sites. If the water quality is constant within a specific grid, only one sample will be recorded to represent that grid. Turbidity samples will be collected in 250 ml plastic bottles filled approximately two-thirds full and stored in a cool dark location prior to analysis.

Substrate data will be collected in accordance with modified procedures used by the Aquatic Habitat and Instream Flow project (ADF&G 1982) at habitat model and fisheries data collection sites.

Equipment

Sampling equipment that will be used to collect fisheries data from fish preference sites are backpack electrofishing units (Coffelt, Model BP1C and Smith Root, Model XVBPG) and beach seines. Procedures used for sampling with these techniques are described in the 1982 procedures manual (ADF&G 1982).

The mean depth of each study cell will be measured to the nearest one tenth of one foot with a topsetting weighing rod.

The mean velocity of each cell will be measured with a Price Model AA velocity meter and converted to feet per second using the standard rating tables supplied with each gage.

Turbidity measurements will be recorded for each grid, immediately following sample collection, using a HF Instruments turbidimeter, Model DRT-15.

Water quality measurements will be taken in each grid with a Hydrolab multi parameter meter, Model 4001. The meters will be recalibrated prior to each field sampling.

A Leitz brand fiber-plastic surveyors tape will be used to measure transect and grid lengths.

Data Recorded

Fisheries and micro-habitat data collected at fish preference sites or habitat model sites will be recorded on JAHS HABITAT AND CATCH DATA FORM RJ 83-01. This form will be used to maintain a record of micro-habitat and catch data from each cell sampled. The instructions to complete form RJ 83-01 are outlined in Appendix B-1.

ii. Fish Habitat Modeling Studies

Techniques

Six locations will be selected as fish habitat model sites. These fish habitat modeling sites will be chosen from upland sloughs, side sloughs and mainstem sidechannels which meet the following criteria:

- o The effects of mainstem discharge (stage and flow) on the sites are measurable.
- o The sites are documented or thought to contain significant numbers of rearing juvenile salmon.
- o The sites are accessible by boat at normal mainstem discharges during the open water season.

Habitat modeling sites will be divided using the same system of grids and cells that was described for fish preference sites. Survey stakes and orange flagging will be used to mark each transect within the grid. Initial measurements of each grid will include distances and angles between transect bench marks on each bank and the distances and angles between bench marks of each transect. Habitat modeling sites will be sampled over as large a range of mainstem flows as possible. Wetted edge measurements will be made at each transect at the different flows providing that the staff gage readings indicate a significant change in stage within a site or on the mainstem Susitna. At this time, all cell habitat parameters will be measured in all cells at all transects.

Water quality data taken at Habitat Modeling Sites will include turbidity, pH, temperature, conductivity and dissolved oxygen. Each wetted cell from all transects in a given grid will be measured for mean depth and velocity. Dominant and subdominant substrate (subdominant substrate must comprise at least 10 percent of the total substrate within a cell to be documented) will be recorded. Percent cover and substrate class in each cell will be estimated using the cover substrate description (see fish preference techniques) and recorded.

One or more staff gages will be installed by the Aquatic Habitat and Instream Flow Project at each site to document changes in the stage at each site with changes in mainstem discharge. These gages will provide an index to compare the changes of habitat and hydraulic conditions at the site to changes in mainstem discharge.

Fisheries distribution and abundance data will be collected at habitat model sites when site conditions permit and fish preference data is needed.

Equipment

Equipment used to sample fish habitat modeling sites is identical to that used at fish preference sites with two exceptions: (1) fisheries collection gear will not be used at habitat modeling sites unless fisheries preference data is collected and (2) a Silva sighting compass will be used at habitat modeling sites to obtain compass headings between transect markers.

Data Recorded

Data collected at fish habitat modeling sites will be recorded on forms RJ 83-01 and RJ 83-03. Data recorded on Form RJ 83-03 for fish habitat modeling sites will include wetted edge measurements, initial compass bearings, and distances between transect markers.

iii. IFG-4 Model Studies

The Aquatic Habitat and Instream Flow (AH) group is generating IFG-4 models for three sloughs and three sidechannels on the Susitna River between the Chulitna River confluence and Devil Canyon. JAHS crews will collect juvenile salmon and habitat data at these six locations. This data will be included in IFG-4 modeling studies. These models provide a computer model simulation of the relationships of stage and velocity vs. changes in mainstem discharge and utilizes linear regression techniques to predict velocities and depths.

Techniques

The criteria for selecting IFG-4 modeling sites are specified in the Aquatic Habitat and Instream Flow (AH) section of this procedures manual.

Transects for IFG-4 modeling sites will be established and surveyed in by AH field crews. JAHS crews utilized these transects to set up grid and cell sampling areas. Sampling will be done in the same manner as previously described for fish preference sites.

All other techniques employed by JAHS crews at the six IFG-4 modeling sites are identical to those described for fish preference study sites.

Equipment

The equipment utilized by JAHS crews to collect fish and habitat data at IFG-4 modeling sites will be the same as those previously described for fish preference studies.

Data Recorded

Fisheries and habitat data collected at IFG-4 modeling sites will be recorded solely on Form RJ 83-01.

(b) Study Locations

Table B-3 presents all of the sites which will be sampled on the Susitna River and its major tributaries between the Chulitna River confluence and Devil Canyon by JAHS crews. JAHS study locations include 29 fish preference study sites, 6 fish habitat modeling sites, and 6 IFG-4 modeling sites.

Table B-3. Juvenile Anadromous Habitat Study (JAHS) sites on the Susitna River between the Chulitna River confluence and Devil Canyon, July, 1983 through June, 1984.

Site	River Mile	Fish Preference Site	Habitat Modeling Site	IFG-4 Modeling Site
Whiskers Creek Slough	101.2	X	X	
Whiskers Creek	101.2	X		
Chase Creek	106.9	X		
Slough 5	107.6	X	X	
Slough 6	108.2	X		
Oxbow I	110.0	X		
Slough 6A	112.3	X	X	
Slough 8	113.6	X	X	
Mainstem II	114.4	X		
Lower McKenzie Creek	116.2	X		
Upper McKenzie Creek	116.7	X		
Slough 8A - grid 1	125.3	X		X
- grid 2	125.3	X		
Sidechannel 10A	127.1	X	X	
Slough 9	129.2	X		X
Slough 10 Sidechannel	133.8	X		X
Slough 10	133.8	X		
Slough 11	135.3	X		
Slough 11 Upper Sidechannel	136.2	X		X
Indian River - Mouth	138.6	X		
Indian River - helio #1	138.6	X		
Slough 19	140.0	X		
Slough 20	140.1	X		
Slough 21 Sidechannel	140.6			X
Slough 21	142.0			X
Slough 22	144.3	X	X	
Jack Long Creek	144.5	X		
Portage Creek - Mouth	148.8	X		
Portage Creek - helio #1	148.8	X		
- helio #2	148.8	X		
- helio #3	148.8	X		
Totals		29	6	6

(c) Schedule of Activities and Frequency of Sampling

The schedule of activities and frequency of sampling for the 1983 summer field season is listed in Table B-4. Field sampling trips, lasting approximately 7-10 days will be conducted bimonthly from May to September by two JAHS crews. Frequency of data collection will vary among the three general categories of study sites during the field season.

i. Fish Preference Studies

Fish preference study sites will be sampled one or more times during the summer field season to provide baseline fisheries and habitat data for preference curves to be used in conjunction with the habitat models.

The sampling schedule for fish preference study sites is dependent on the target species. Juvenile chum, pink, and sockeye salmon sites will be sampled in May and June. In late June or early July, sampling efforts will be redirected to collect data at sites previously identified as rearing areas for chinook and coho salmon. The chinook and coho salmon sites will be sampled until freezeup.

Table B-4. Juvenile Anadromous Habitat Study (JAHS) sampling and activity schedule, May, 1983 through June, 1984.

Target Species or Activity	May 1983	June	July	August	September	October	November	December	January 1984	February	March	April	May	June 30th 1984
Chum Salmon	———	Slough, Tributaries Side Channels	- - - - -	- - - - -	- - - - -	- - - - -	- - - - -						———	(1) Sloughs Tributaries
Sockeye Salmon	———	Slough, Tributaries Side Channels	- - - - -	- - - - -	- - - - -	Mainstem - - - - -	- - - - -						———	(1) Sloughs Tributaries
Pink Salmon	———	Tributaries	- - - - -	- - - - -	- - - - -	- - - - -	- - - - -						———	(1) Tributaries
Chinook Salmon	- - - - -	- - - - -	———	Tributaries, Sloughs	———	Mainstem	- - - - -						———	(1) Tributaries Side Channels
Coho Salmon	- - - - -	- - - - -	———	Tributaries, Slough	———	Mainstem	- - - - -						———	(1) Tributaries Side Channels
Open Water Field Preparation											———	———		

——— primary sampling
------- continued insidental data collection

ii. Fish Habitat Modeling Studies

Each of the fish habitat model sites will be sampled about five times at different mainstem flows. The sampling schedule for habitat model sites is dependent on the mainstem flow as well as target species.

iii. IFG-4 Modeling Studies

The sampling schedule for IFG-4 modeling sites will be conducted identically to the fish preference study sites. IFG-4 modeling sites will be sampled one or more times during the open water field season to provide baseline fisheries and habitat data for preference curves to be used in conjunction with the IFG-4 model.

c. Fish and Habitat Surveys Along the Proposed Access/ Transmission Corridors

(1) Methods

(a) Stream studies at proposed access road crossings

Study sites will be established at proposed road crossing sites on all streams along the selected access and transmission corridors. Study site locations will be determined from maps developed by R&M Consultants, Inc. (Selected Access Plan 18, map #252210, 9/1/82) on which the proposed route is overlaid on USGS topographic maps (scale 1:63,360, 1951 series). At present, the route is not physically marked and the exact location of stream crossing sites are not certain. Sampling will be conducted in each stream 500 feet above and 500 feet below the proposed road crossing site.

i. Fish Data Collection

Streams will be inventoried for fish species present using backpack electroshockers as a capture technique. Time of sampling will vary depending on the size of the stream and the catch. Sampling will be conducted until the presence or absence of fish at each study site has been verified. Streams which have negligible or intermittent flows will not be sampled.

Biological data to be collected from a representative number of captured fish at each location will include: species and length. Lengths will be measured as fork lengths or total lengths as specified in the 1982 Procedures Manual.

ii. Aquatic Habitat Data Collection

Data collected at these sites will include general water quality (pH, conductivity, water temperature, and dissolved oxygen), discharge, and substrate. Water quality and discharge data will be collected at a representative location within the study area. Discharge data will not be collected from smaller streams in which negligible or intermittent flows would make accurate discharge measurements difficult. Substrate will be evaluated for each stream in the general area of the proposed crossing site. Each study area will also be photographed during the season. These data will be collected according to procedures presented in the 1981 and 1982 procedures manual (ADF&G 1981; 1982).

(b) Reach studies on Deadman Creek

Three, one-mile reaches of Deadman Creek from the lake outlet downstream to the falls will be selected as study sites. These reaches will be sampled by hook and line to generate Arctic grayling population estimates. A backpack electroshocker will be used to determine what other species are present.

Data to be collected and recorded from captured fish includes: reach, species, length, sex, age and tag number. Lengths will be measured as specified in the 1982 procedures manual (ADF&G 1982). Scales will be collected from a representative subsample (20 percent) of grayling catch in each reach. Scales and otoliths will be collected from all mortalities for subsequent age determination. All fish over 150 mm and apparently in good health will be tagged using Floy anchor tags.

(c) Lake Studies

i. Fish Data Collection

Several of the major lakes adjacent to the proposed access corridor will be inventoried for fish species present. These will include, but are not limited to, Deadman Lake, Swimming Bear Lake, and the High Lake complex. Sampling will be conducted with gill nets, trotlines, and minnow traps set at selected areas along the shore of each lake. Time of sampling will vary depending on the effectiveness of the sampling methods.

In addition to survey work on Deadman Lake with gill nets and minnow traps, six Fyke nets (4 feet x 4 feet x 18 feet trap with two-4 feet x 40 feet wings) will be used to capture lake trout for a mark-recapture population estimate study. One Fyke net will also be used as a weir at the outlet of Deadman Lake in late September to identify and enumerate the various species of fish which move up Deadman Creek to overwinter in Deadman Lake.

Data to be collected includes: species, length, sex, age and tag number. Lengths will be measured as specified in the 1982 procedures manual (ADF&G 1982). Scales will be collected from all lake trout captured and otoliths will also be removed from all mortalities for subsequent age determination. All fish over 150 mm and apparently in good health will be tagged with Floy anchor tags.

ii. Aquatic Habitat Data Collection

Aquatic habitat data will not be collected from lakes adjacent to the proposed corridor other than Deadman Lake. Data collected from Deadman Lake will include water quality data for developing depth profiles for oxygen, pH, conductivity and temperature. These data will be collected by use of a Hydrolab and extension cables used according to manufacturers instructions. Depth contour profiles of Deadman Lake will be taken with a depth sounder (Lawrence, Model LRG-1510B) mounted on a boat powered by a 9.9 horsepower outboard motor traveling at constant trolling speed between points on specified transects. The location of the transects will be determined with a 1" to 400' scale aerial photo of the lake using landmarks for reference points. The profiles will be recorded on the instrument's recorder printout and to determine placement of depth contours on a depth contour map of Deadman Lake.

(d) Spawning Surveys (Spring 1984)

Spawning surveys will be conducted during the Spring of 1984 using electroshockers, gill nets, hook and line and visual observation to determine the present, timing, and locations of Arctic grayling and rainbow trout spawning.

Data to be recorded includes: species, length, sex, age, tag number and sexual maturity. Lengths will be measured as specified in the 1982 Procedures Manual. Scales will be collected from all fish captured and otoliths from all mortalities for subsequent age determination. All fish over 150 mm and in good health will be tagged using Floy Anchor tags.

Point specific habitat data (velocity, depth and substrate) and water quality (pH, DO, conductivity and water temperature) will be collected at selected spawning sites to characterize the baseline habitat conditions necessary for grayling spawning activities.

(2) Study Locations

The study locations for the 1983 access-transmission corridor and construction site surveys shown in Figure B-5 include the following areas:

(a) Stream Studies at Proposed Access Road Crossings

Watana access road corridor - Mile 114 of the Denali Highway, south 44 miles to the Watana damsite.

22 stream crossings

Devil Canyon access road corridor - Watana damsite west and south a total of 36 miles to Devil Canyon damsite.

14 stream crossings (including Tsusena Creek)

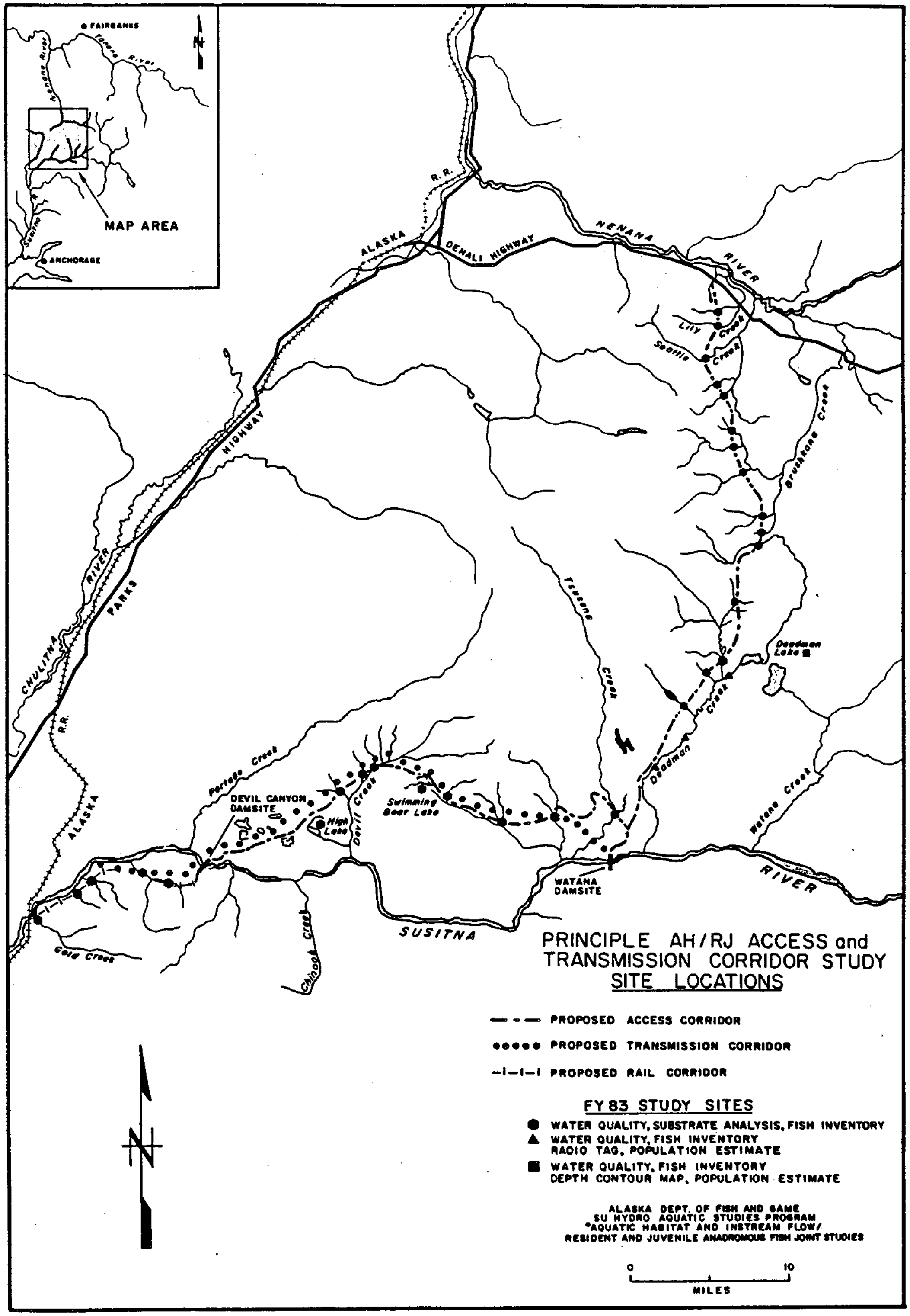


Figure B-5. Map showing the locations of the principle Access and Transmission Corridor Study sites.

Railroad spur and transmission line - Gold Creek 12 miles east northeast to the Devil Canyon damsite.

6 stream crossings

(b) Reach Studies on Deadman Creek

3 one-mile segments along Deadman Creek parallel to the access road for about 10 miles:

- one mile downstream from the Deadman Lake outlet
- a one mile segment in the middle reach
- a one mile segment in the reach just above Deadman falls

(c) Lake Studies

3 lakes:

- Deadman Lake
- Swimming Bear Lake
- the High Lakes complex

(d) Spawning Surveys (spring 1984)

Arctic grayling spawning:

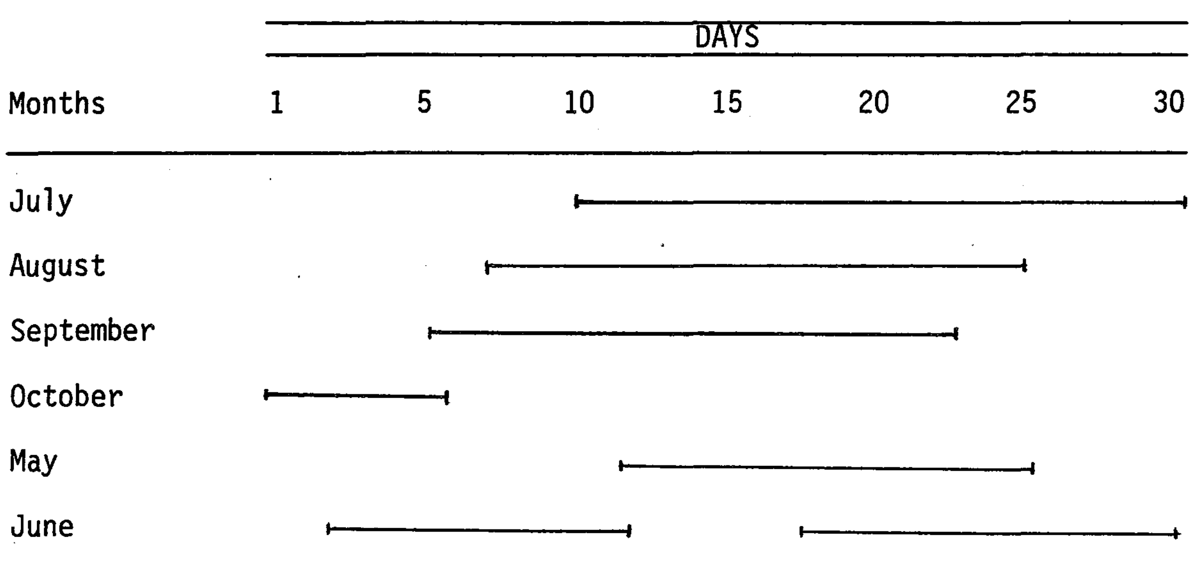
- Deadman Creek (above and below Deadman Lake)
- Brushkana Creek
- Seattle Creek

Rainbow trout spawning:

- High Lake

(3) Schedule of Activities and Frequency of Sampling

Tentative Field Schedule



(a) Stream Studies at Proposed Access Road Crossings

Study sites on the streams crossed by the access roads will be sampled once during the 1983 summer studies in August or early September.

(b) Reach Studies on Deadman Creek

All three reaches of Deadman Creek will be sampled in July. Each reach will be sampled five times.

(c) Lake Studies

Deadman Lake will be sampled monthly throughout the open water season.

Swimming Bear Lake and the High Lakes complex will be sampled for one, 24-hour period in August or September.

(d) Spawning Studies (spring 1984)

Spawning surveys for Arctic grayling and rainbow trout will be conducted in May and June, before, during, and after breakup.

C. AQUATIC HABITAT AND INSTREAM FLOW STUDIES

III. DATA PROCEDURES

A. ADULT ANADROMOUS FISHERIES STUDIES

B. RESIDENT AND JUVENILE ANADROMOUS FISHERIES STUDIES

1. Resident Fish Studies

a. Field data to be recorded

(1) Habitat and relative abundance

Biological data recorded at habitat and relative abundance study sites included species, length, sex, scale card number, age, and fate.

Catch data gathered at habitat and relative abundance sites are location, river mile/tributary mile, geographic code, date, collectors, catch by species, tag number, fate, recapture code/number, gear code, data set, date pulled, time set, time pulled total time fished or catch per unit effort, time shocked, distance shocked, conductivity, voltage, amps, net length, mesh size, bait type, hook size, and hook type.

Habitat data to be collected at habitat and relative abundance sites are water depth, water velocity, pH, dissolved oxygen, specific conductance, turbidity, surface water temperature, intragravel temperature, air temperature, substrate, percent cover, cover type, grid number, cell number and area.

Sampling forms to be utilized at habitat and relative abundance sites are presented in Figures B-6 to B-12.

(2) Fish Preference Studies

Biological data to be recorded at each resident fish preference study site include species, number of each species captured, length, and fate.

Habitat data that will be documented at each resident fish preference study site are turbidity, pH, dissolved oxygen, temperature, specific conductance, velocity, cell area, cell mean depth, substrate, percent cover, and cover classification.

Other data recorded include time sampled, date, location, grid number, cell number, gear code, and effort. The resident fish preference sites were also mapped at periodic intervals.

Resident fish preference study data will be recorded on Forms RJ 83-08 (Figure B-12).

(3) Population Estimates

Biological data recorded at population estimate sites included species, length, and fate.

Catch data will be composed of gear code, catch by species, tag number, recapture number, location, date, time, and collectors.

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SUSITNA HYDRO BIOLOGICAL DATA RJ 82-02

Location ______________________ RM/TRM ________ GC ___/___ ___ ___/___ ___ ___/___ ___/___ ___ ___

Date collected ____/____/____ (yr. / mo. / day) Collector initials ______________________

	Species Code	Length (mm)	Sex M	Sex F	Age	Scale Card No.	Gear Code		Mesh Size (in.)	Tag Number	[illegible]	Remarks
1									.			
2									.			
3									.			
4									.			
5									.			
6									.			
7									.			
8									.			
9									.			
10									.			
11									.			
12									.			
13									.			
14									.			
15									.			
16									.			
17									.			
18									.			
19									.			
20									.			

Comments:

Figure B-6. Susitna Hydro biological data form, RJ 82-02.

File No. 03-82-7.10-2.73

SUSITNA HYDRO TAG DEPLOYMENT DATA RJ 82-03

Tag Number	Gear Code	Date			Species Code	Length (mm)	Sampling Location	Mainstem	Tributary	River Mile
		yr.	mo.	day						
0										
0										
0										
0										
0										
0										
0										
0										
0										
0										
0										
0										
0										
0										
0										
0										
0										
0										
0										
0										

Comments:

Figure B-7. Susitna Hydro tag deployment data form, RJ 82-03.

File No. 03-82-7.10-2.74

SUSITNA HYDRO TAG RECAPTURE DATA RJ 82-04

Tag Number	Recapture Code	Gear Code	Date			Length (mm)	Sampling Location	Mainstem	Tributary	River Mile	Fate Code
			yr.	mo.	day						
0										.	
0										.	
0										.	
0										.	
0										.	
0										.	
0										.	
0										.	
0										.	
0										.	
0										.	
0										.	
0										.	
0										.	
0										.	
0										.	
0										.	
0										.	
0										.	
0										.	

Comments:

Figure B-8. Susitna Hydro tag recapture data form, RJ-82-04.

File No. 03-82-7.10-2.75 Page_____ of _____

SUSITNA HYDRO OPPORTUNISTIC GEAR CATCH DATA RJ 82-05

Location ____________________ RM/TRM __________ GC __/_____/_____/__/____

Date: Gear Set ____/____/____ Gear Pulled ____/____/____ Collector Initials ____________

Gear Code	PSN	Net Length	Mesh Size	TIME			Catch - Species Code Number								Remarks
				Set	Pulled	Total									

	Conductivity	Volts	Amps												Unit - Make and Model No.

	Bait Type	Hook Size	Hook Type												

Comments:

Figure B-9. Susitna Hydro opportunistic gear catch data form, RJ 82-05.

AA 82-03

Electroshocking Catch Form

Crew: __________ Location: ______________________________

Sample: ________ River Mile: ____________________________

Date (YY/MM/DD): ___/___/___ Trib. River Mile: ______________________

Time (military): ____________ Geographic Code: _/_ _ _/_ _ _/_ _/_ _/_ _ _/_

Distance Shocked (yards): _____ Time Shocked (minutes): ______________

Species		Catch	Remarks
Resident			
Dolly Varden	(530)		
Rainbow	(541)		
Humpback Whitefish	(582)		
Round Whitefish	(586)		
Arctic Grayling	(610)		
Longnose sucker	(640)		
Burbot	(590)		

Figure B-10. Electroshocking catch form, AA 82-03.

AQUATIC HABITAT ELECTROFISH SUMMER FORM AH-107

File No. ____________________ Location ____________________

Page _____ of _____ Description ____________________

Crew ____________________ R.M. __________ T.R.M. __________

Date ______________ Time __________ Geographic Code ___/_____/_____/_____/_____

Sample #	Depth (feet)	Velocity (feet/second) 0.2	0.8	x/0.6

PHYSIOCHEMICAL DATA

Sample #	Air (°C) Temp.	Intragravel Temp. (°C)	Surface Water (°C) Temp.	pH	Dissolved Oxygen (mg/l)	Specific Conductance (μmhos/cm) M.R. / C.R.

SUBSTRATE DATA

Comments

Hydrolab # ______________

Marsh-McBirney # __________

Figure B-11. Aquatic habitat electorfish summer form, AH-107.

RESIDENT FISH HABITAT AND CATCH DATA RJ 83-08 PAGE ___ OF ___

LOCATION: ________________ COLLECTOR'S INITIALS: ________

DATE: ___ / ___ / ___ (yr. / mo. / day) GRID NO.: __________ HYDROLAB NO.: __________ TIME: __________

TURBIDITY: ________ WATER TEMP.: ________ pH: ________ D.O.: ________ COND.: ________

HABITAT DATA							CATCH DATA								
Cell No	Area (sq/ft)	Vel. ft/sec.	Depth (ft)	Sub-strate	% Cover	Cover Type	Gear Code	Effort	Species Code	No. of Fish	Length (mm)	Fate Code	Tag No.	Recap. No.	REMARKS

SUBSTRATE CODE

1 SILT
2 SAND
3 SMALL GRAVEL (1/8"-1")
4 LARGE GRAVEL (1"-3")
5 RUBBLE (3"-5")
6 COBBLE (5"-10")
7 BOULDER (>10")

DOMINANT COVER

1 NO COVER
2 EMERGENT VEGETATION
3 AQUATIC VEGETATION
4 DEBRIS / DEADFALL
5 OVERHANGING RIPARIAN
6 UNDERCUT BANKS
7 LARGE GRAVEL 1"-3"
8 RUBBLE 3"-5"
9 COBBLE OR BOULDER >5"

% COVER

1 0-5 %
2 6-25 %
3 26-50 %
4 51-75 %
5 76-95 %
6 96-100 %

SPECIES CODES

412- CHINOOK
422- SOCKEYE
433- COHO
440- PINK
450- CHUM
541- RAINBOW TROUT
586- ROUND WHITE
590- BURBOT
610- ARCTIC GRAYLING
640- LONGNOSE SUCKER
660-3 SPINE STICKLEBACK

Figure B-12. Resident fish habitat and catch data form, RJ 83-08.

Habitat data gathered at population data sites will include water velocity, water depth, water temperature, turbidity, pH, dissolved oxygen, specific conductance, substrate, percent cover, cover type, grid number, cell number, and area.

Figure B-12 depicts the form which will be utilized to collect data for the resident fish population estimate studies.

(4) Radio Telemetry

Biological data to be collected from radio tagged fish are species, length, sex, scale card number, and age.

Catch data for radio tagged fish will include capture date, capture location, capture river mile, release date, release site, and release river mile.

The following surgical data will be recorded for each radio tagged fish: time anesthetized, time surgery begun, time surgery completed, and the total time for the operation.

Tag data to be recorded at the time of implantation and during each tracking flight are frequency, pulse per second, and seconds per pulse. The location, date, and river mile of each radio tag signal that is received will be recorded during each tracking flight.

Figure B-13 and B-14 presents the forms which were used to collect data for the radio telemetry studies.

b. Data Transfer

Data forms for resident fish habitat and relative abundance, population estimates, and radio telemetry will be checked for accuracy and completeness following each sampling trip. Habitat and relative abundance data is then submitted to the data processing unit for key punching and the population estimate and radio telemetry data are filed for hand compilation at a later date. Printouts of the initial habitat and relative abundance data are returned to the individuals who collected the data so that they can be rechecked for errors before they are incorporated into the computer data base for analysis (Figure B-15).

Field trip reports, which summarize the preliminary data finds, will be submitted after each sampling trip.

c. Data Analysis

Procedures used to analyze data for the resident fish studies will be similar to those presented for the juvenile anadromous habitat study in Figure B-19. The final products for the resident fish studies are: (1) description of the distribution and relative abundance for selected resident fish species, including an analysis of the environmental factors affecting distribution, (2) preference curves for selected resident fish species for various habitat parameters, (3) an analysis to

SUSITNA HYDRO RADIO TAG DEPLOYMENT DATA, RJ 83-06

					RADIO TAG DATA				CAPTURE DATA						TIME OF OPERATION		
Species	Fork lenght/age in mm	Sex	Floy tag #	Scale Card #	Freqeuncy	delta	Pulses per sec	Secs per pulse	DATE capt.	DATE rel	loc.	R.M.	Method of capt.	Aneth Time	Beg Sur.	End Sur.	Total Time

Figure B-13. Susitna Hydro radio tag deployment data form, RJ 83-06.

SUSITNA HYDRO RESIDENT FISH RADIO TRACKING DATA, RJ 83-07.

DATE: ___/___/___ TIME: ________ to ______ WEATHER: __________________

Species	Channel	Tag	Release Site	Date	RM	Last Position	Date	RM	New Position	RM
	1	600.5								
		600-1								
		600-2								
		600-3								
	2	610.5								
		610-1								
		610-2								
		610-3								
	3	620.5								
		620-1								
		620-2								
		620-3								
	4	630.5								
		630-1								
		630-2								
		630-3								
	5	640.5								
		640-1								
		640-2								
		640-3								
	6	650.5								
		650-1								
		650-2								
		650-3								
	7	660.5								
		660-1								
		660-2								
		660-3								
	8	670.5								
		670-1								
		670-2								
		670-3								
	9	680.5								
		680-1								
		680-2								
		680-3								
	10	700.5								
	11	710-1								
		710-3								
	12	730-2								

REACH OF RIVER FLOWN: ____________________

ESTIMATED ALTITUDE (ft.): ____________________

EQUIPMENT USED: ____________________

RELATIVE RIVER CONDITION: ____________________

NAMES OF PEOPLE FLYING: ____________________

FLYING SERVICE: ____________________

TRIBUTARY REACHES FLOWN: ____________________

Figure B-14. Susitna Hydro resident fish radio tracking data form, RJ 83-07.

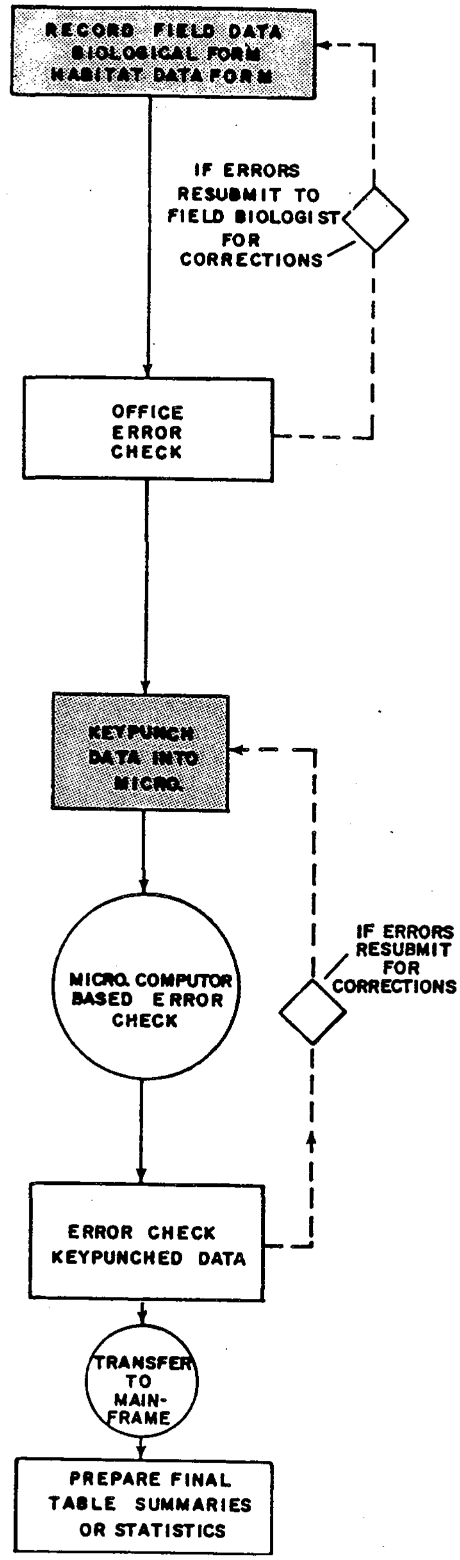

Figure B-15. Resident and Juvenile Anadromous Studies (RJ) data transfer flow chart (includes all RJ studies except outmigrant studies and access/transmission corridor studies).

determine if the data set will support an incremental analysis of instream flow on selected resident fish species, and (4) IFG-4 models with input from preference curves, if appropriate.

2. Juvenile Anadromous Fish Studies

a. Abundance, outmigration, timing, and survival

(1) Field data to be recorded

(a) Coded wire tagging

Tagging data to be recorded at each tagging site will include species, mean length, number of fish tagged, percent tag retention, and mortality. Site, data, tag code, and time of release will also be recorded.

(b) Recovery of marked and unmarked fish

Biological data to be collected at the downstream migrant traps will include fish species, length, fate of captured fish, and scale sampling. Upon reaching a total of 50 representatives of one species in a given day, a tally of that species will be kept for the remainder of that day minus the biological data.

Samples to be collected include scales from predetermined size classes of resident and juvenile anadromous species for age classification. All adipose fin clipped chum and sockeye salmon juveniles will be collected and preserved for future dissection and analysis of the coded wire tags.

Habitat data collected in association with the biological data at the downstream migrant traps will include depth fished (feet), distance from shore (feet), velocity at each trap (fps), river stage (feet), air and water temperature (°C), pH, dissolved oxygen (ppm), conductivity (um/hos), and turbidity (NTU). Depth fished is read from the water surface to the bottom of the front of the incline. Distance from shore will be measured from water's edge to the center of the incline plane. Velocity will be read from the center of the bow of each trap directly in front of the incline. If the depth at this point exceeds three feet, velocity readings will be read at 0.2 and 0.8 of the total depth and averaged. If the depth is less than three feet, one reading will be taken at 0.6 of the total depth. River stage will be read from a staff gage to be surveyed in by AH staff. Water temperature, pH, DO, conductivity and turbidity samples will be taken from the deck of the east bank trap and air temperature will be measured in camp.

Depth fished and distance from shore will be recorded for each trap at every check. All other parameters will be measured once daily.

Habitat and biological data will be entered directly into an Epson HX-20 microcomputer. This computer has printing and cassette drive functions. The microcomputer will provide an initial entry printout and a final corrected printout as well as recording the data on two micro-cassette tapes, a primary tape and a backup tape. The program for data entry includes "prompts" for all habitat and biological data (see Appendix B-2) and can store up to 100 individual entries per file.

Each trap check will correspond to a file number on the Epson printouts and cassette tapes, and consist of entries for all relevant water quality and habitat data followed by the biological data and individual species tallies. In the event that the Epson micro-computer fails to provide adequate storage or proves unworkable, data will be recorded by hand.

(2) Data transfer

(a) Recovery of marked and unmarked fish

Field data will be transferred to the data processing section by micro-cassette tape and paper printout from the Epson microcomputer as it is collected (Figure B-16). Trip reports will be submitted monthly to include total catch by species, coded wire tag recoveries, efficiency of the Epson as a data recording system, and river conditions.

(3) Data analysis

(a) Coded wire tagging

Preliminary data analysis will begin following the end of the tagging program in June with the preparation of a table for the Pacific Marine

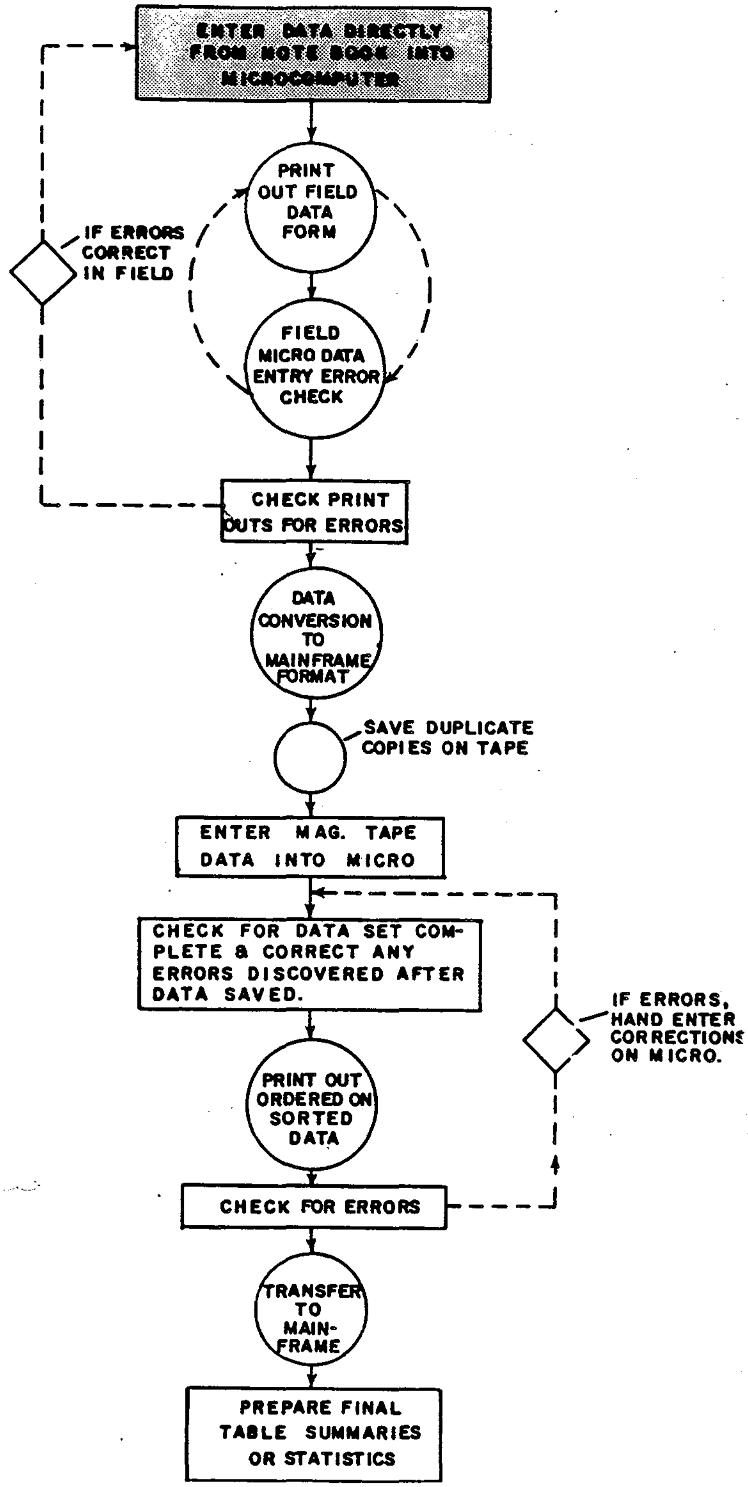

Figure B-16. Data transfer flow chart for outmigrant studies at the downstream migrant traps.

Fisheries Commission (PMFC). This table will outline the tagging sites, dates of release, species and numbers of fish tagged, and mean length of fish tagged. Also provided at this time will be a preliminary inner office report on the outcome of program implementation.

Tags collected from recovered fish will be read at the end of the field season. Population and survival estimates will be calculated following the compilation and preliminary analysis of data collected at the downstream migrant traps. A report on the coded wire tagging program will be included in the 1983 Aquatic Studies Basic Data report. Population estimates from the mark-recovery program will be provided using the Petersen and Schaefer estimators of Ricker (1975). Survival will be back calculated from using the estimates of total egg deposition and outmigrant populations.

(b) Recovery of marked and unmarked fish

All data will be compiled and organized by data processing personnel. Variables to be used in catch data analysis will include Gold Creek discharge, water temperature, diurnal timing, turbidity, seasonal timing, and horizontal and vertical distribution in the water column.

(c) Dye Marking

Dye mark retention on juvenile salmon will be checked at the study sites and at the downstream migrant traps to determine how long the dyes markings remain visible.

b. Emergence and development

(1) Data to be recorded

Data to be recorded at artificial redd sites will include: site location, species, hole number, counts of viable and inviable eggs in each Whitlock-Vibert box, siltation of Whitlock-Vibert boxes, water temperature, intragravel temperature, and ice conditions.

At natural salmon redds the following data will be recorded: redd location, species, approximate depth of the redd, substrate description, water temperature, intragravel temperature, and ice conditions.

Specimens of preserved salmon embryos and alevins collected in the field will be analyzed in our laboratory to describe the stage of organogenesis, the percentage of yolk vascularization, and the percent of yolk absorption. The number and percentages of each stage will be recorded by tributary, site, date, and species.

(2) Data transfer

Field data will be summarized in trip reports after the completion of each field trip. Salmon embryo and alevin collected will be classified by developmental stage and tabulated by tributary, site, date, and species.

(3) Data analysis

A regression analysis will be performed for mean temperature units versus development by species and site (see ADF&G 1983b, Section 3.4.1) to determine dates for 50 percent hatching and 50 percent emergence.

Survival of eggs to the eyed stage, and hatching and emergence will be calculated. Rates of development will be correlated with substrate type, and ice cover.

c. Rearing habitat studies

(1) Field data to be recorded

(a) Fish preference studies

Biological data to be recorded at each fish preference study site include species, number of each species captured, length, and fate (Figure B-17).

Habitat data that will be documented at each fish preference study site are turbidity, pH, dissolved oxygen, temperature, specific conductance, velocity, cell area, cell mean depth, substrate, percent cover, and cover classification (Figure B-17).

JAHS HABITAT AND CATCH DATA RJ-83-01

PAGE ___ OF ___

LOCATION: ____________ HABITAT MODEL ________ COLLECTOR'S INITIALS: ________

DATE: ___ / ___ / ___ (yr. / mo. / day) GRID NO.: ________ HYDROLAB NO.: ________ TIME: ________

TURBIDITY: ________ WATER TEMP.: ________ pH: ________ D.O.: ________ COND.: ________

	HABITAT DATA							CATCH DATA							
	Cell No.	Area (sq/ft)	Vel. ft/sec.	Depth (ft)	Sub-strate	% Cover	Cover Type	Gear Code	Effort	Species Code	No. of Fish	Length (mm)	Fate Code	Slide No.	REMARKS
1															
2															
3															
4															
5															
6															
7															
8															
9															
0															
11															
12															
3															
14															
15															

SUBSTRATE CODE

1 SILT
2 SAND
3 SMALL GRAVEL (1/8"-1")
4 LARGE GRAVEL (1"-3")
5 RUBBLE (3"-5")
6 COBBLE (5"-10")
7 BOULDER (>10")

DOMINANT COVER

1 NO COVER
2 EMERGENT VEGETATION
3 AQUATIC VEGETATION
4 DEBRIS / DEADFALL
5 OVERHANGING RIPARIAN
6 UNDERCUT BANKS
7 LARGE GRAVEL 1"-3"
8 RUBBLE 3"-5"
9 COBBLE OR BOULDER >5"

% COVER

1 0-5 %
2 6-25 %
3 26-50 %
4 51-75 %
5 76-95 %
6 96-100%

SPECIES CODES

412- CHINOOK
422- SOCKEYE
433- COHO
440- PINK
450- CHUM
541- RAINBOW TROUT
586- ROUND WHITE
590- BURBOT
610- ARCTIC GRAYLING
640- LONGNOSE SUCKER
660-3 SPINE STICKLEBACK

Figure B-17. JAHS habitat and catch data form, RJ 83-01.

Other data recorded include time sampled, date, location, grid number, cell number, gear code, and effort. The fish preference sites were also mapped at periodic intervals (Figure B-18).

(b) Fish habitat modeling studies

Habitat data recorded at fish habitat modeling sites included turbidity, pH, dissolved oxygen, temperature, specific conductance, velocity, cell area, cell mean depth, substrate, percent cover, and cover classification (Figure B-17).

Additional data recorded at fish habitat modeling sites are time sampled, date, location, grid number, and cell number. Maps of fish habitat modeling sites will include wetted edge measurements, initial compass bearings, and distance between transect markers (Figure B-18).

Biological data will not be collected regularly at fish habitat modeling sites. However, when the opportunity presents itself to collect data which will augment fish preference studies, biological data such as species, number of each species captured, length, and fate will be collected.

(c) IFG-4 modeling studies

Field data recorded for IFG-4 modeling sites will be the same biological, habitat, and other data parameters recorded for fish preference study sites.

JAHS SITE MAP RJ 83-03

LOCATION ____________ RM ____________ GC. ___/___/___/___/___

DATE ____/____/____ GRID NO. ______ COLLECTOR'S INITIALS ______

yr. mo. day

STAFF GAUGE	
NO.	READING

PAGE ____

OF ____

Figure B-18. JAHS site map form, RJ 83-03.

(2) Data transfer

After each sampling trip, fish preference study and habitat modeling study data forms will be checked for accuracy and completeness before submitting them to the data processing unit for key punching. Printouts of the initial data will then be returned to the individuals who collected the data so that it can be rechecked for errors before it is incorporated into the computer data base for analysis (Figure B-15).

Field trip reports will be completed immediately after each sampling trip and will summarize the initial data findings of each sampling trip.

(3) Data analysis

Data analysis will proceed as per Figure B-19. There are basically four final products: (1) description of distribution and relative abundance for each species (including an analysis of several environmental factors affecting distribution), (2) preference curves for each species for various habitat parameters, (3) IFG-4 models with input from preference curves, and (4) a model of juvenile rearing habitat at the RJ habitat model sites that will incorporate cover, turbidity, and velocity preferences record at these sites.

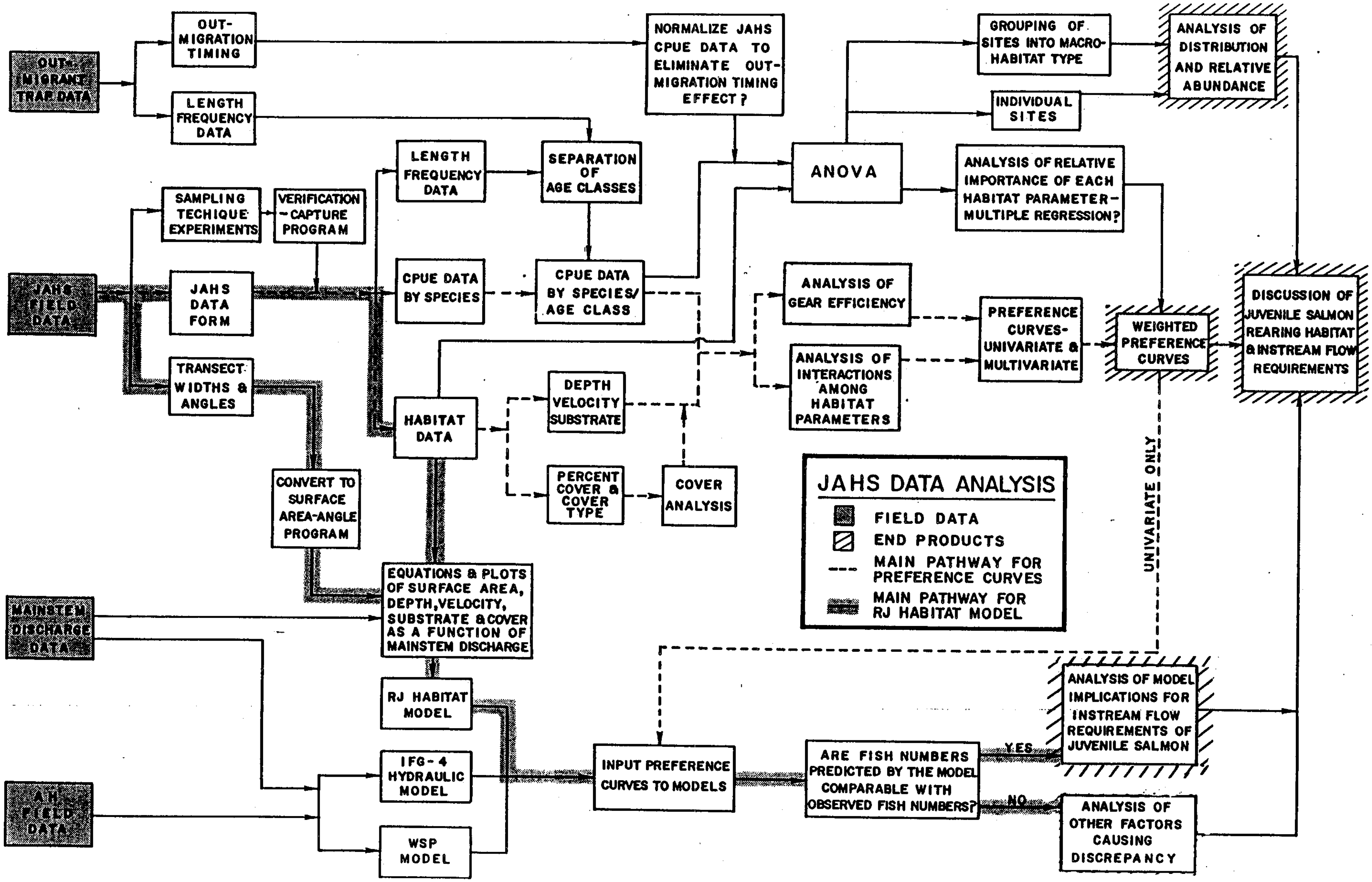

Figure B-19. Juvenile Anadromous Habitat Study (JAHS) data analysis flow chart.

3. <u>Fish and Habitat Surveys Along the Proposed Access/ Transmission Corridors</u>

a. Field data to be recorded

(1) Fish data collection

All field data will be recorded in, "Rite-in-the-Rain," notebooks and transferred to Forms RJ 83-04 and RJ 83-05 (Figure B-20 and B-21). This data will include site, date, effort, gear type, collectors, species, length, sex, scale card number, and tag number.

(2) Aquatic habitat data collection

Aquatic habitat data collected at proposed stream crossing sites will be recorded in field notebooks and transcribed to data forms (Figure B-22). These data will include dissolved oxygen, specific conductance, pH, air and water temperature, discharge and substrate. Other field data collected in associated with lakes and other areas of the study will be recorded in field notebooks. Upon returning to the office field notes will be copied on a copy machine and filed for use in the final report.

b. Data transfer

Trip reports will be written monthly summarizing field activities and preliminary data findings.

SUSITNA HYDRO CORRIDOR STUDIES, CATCH AND BIOLOGICAL DATA
RJ-83-04

PAGE ___ OF ___

LOCATION __________ MILE ______ G.C. __/__/__/__/__

DATE __________ COLLECTORS __________

Gear Code
2
9
5
1

Total Time

CATCH (Species Codes)

610	550	162			

REMARKS

Sample No.	Species	Length	Sex	Age	Scale Card No.	Tag No.	Sample No.	Species Code	Length	SEX	Age	Scale Card No.	Tag No.
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						

Figure B-20. Susitna Hydro corridor studies, catch and biological data form, RJ 83-04.

SUSITNA HYDRO CORRIDOR STUDIES TAGGING / RECAPTURE DATA
RJ-83-05

TAG DEPLOYMENT DATA					TAG RECOVERY DATA					
Tag Number	Species	Length	Date	Location*	Date	Length	Location*	Date	Length	Location*

*Study site name.
At stream crossings put "above" or "below".

Figure B-21. Susitna Hydro corridor studies tagging/recapture data form, RJ 83-05.

SUSITNA HYDRO CORRIDOR STUDIES-AQUATIC HABITAT DATA

AH-IMP 83-01

SAMPLING AREA: ____________ PAGE ____ OF ____

CREW: ____________ FILE NO. ____________ SAMPLING PERIOD: ____________

LOCATION	Corridor Mile	Date	Military Time	Hydrolab No.	D.O.			Spec. Cond.		pH	Temp °C		Turbidity	Gradient	Discharge	Substrate			
					Bar. Pres.	% Sat.	Conc mg/l	Meter	Adj.		H_2O	Air	NTU	%	cfs	% Embed	%-1 Class	%-2 Class	%-3 Class
G.C.																			
G.C.																			
G.C.																			
G.C.																			
G.C.																			
G.C.																			
G.C.																			
G.C.																			
G.C.																			
G.C.																			
G.C.																			
G.C.																			

(ADFG/SU HYDRO,5/83,JS)

Figure B-22. Susitna Hydro corridor studies - aquatic habitat data form, AH-IMP 83-01.

Two copies will be made of all data forms, one will be filed under the access and transmission corridor/impoundment sub-project, and one will be filed with the Aquatic Habitat and Instream Flow Studies quality assurance section.

c. Data analysis

Data will be collected only once during the field season at each proposed stream crossing site and will be presented in a general table format to be referenced as needed in the 1983 Basic Data Report.

The 1983 Basic Data Report for the Access-Transmission Corridor Studies will consist of a site by site narrative describing the fish and aquatic habitat components at each site sampled. Narratives will be derived from raw data, trip reports, and field notes.

C. AQUATIC HABITAT AND INSTREAM FLOW STUDIES

IV. QUALITY CONTROL

A. ADULT ANADROMOUS FISHERIES STUDIES

B. RESIDENT AND JUVENILE ANADROMOUS FISHERIES STUDIES

The Resident and Juvenile Anadromous Project Leader and his respective Sub-Project Leaders are charged with the responsibility of maintaining standards for collection, recording, and the processing of data. Sub-project Leaders report to the Project Leader after each sampling trip to discuss the progress of their individual studies. The Project Leader and/or his representative also inspect field operations periodically to insure that the sampling programs are conducted consistently and accurately.

Literature on the latest data collection and analysis procedures are continually reviewed to be sure that the best possible methods are being employed.

Field data from each sub-project are recorded and systematically checked for accuracy and completeness by each field crew. The data is then submitted to the Quality Assurance and Support Section where it is reviewed and routed to the Data Processing Section for key punching. Data processing returns a print-out of the data which is then cross checked with the original data forms by the individuals who initially collected it. When all parties concerned are satisfied with the data, it is routed through the project biometrician for final analysis before being incorporated into the basic data and analysis reports.

C. AQUATIC HABITAT AND INSTREAM FLOW STUDIES

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APPENDIX B-1

Instructions for Completing Juvenile Anadromous Habitat Studies (JAHS) Sampling Forms and Field Data Notes.

Instructions for Completing Forms RJ 83-01:

1. DATE - Year Month Date

2. LOCATION - Enter name identifying study site.

3. GRID NUMBER - Enter the established identification number.

4. HABITAT MODEL - Enter Yes or No.

5. COLLECTORS INITIALS - Initials of person who records habitat and catch data.

6. PAGE NUMBER - Indicate the page number and total number of pages used.

7. TIME - Military time.

8. HYDROLAB NUMBER - Enter equipment serial number located near digital readout.

9. TURBIDITY - Enter the turbidity, expressed in NTU's.

10. WATER CHEMISTRY - Enter the correct hydrolab readings in the correct heading for pH, D.O. (dissolved oxygen in ppm), temperature (°C), and specific conductance.

11. CELL NUMBER - Enter the number that identifies the cell sampled.

12. CELL AREA - Computed by multiplying mean cell width (6 ft) with cell length (50 ft). Generally cell area is constant 300 ft^2, however on occasion this value could be more than or less than 300 ft^2.

14. CELL MEAN DEPTH - Enter the average depth of the cell taken approximately 3 ft from the bank in an area in which the water depth is representative of the entire cell.

15. VELOCITY - Point velocity obtained from the rating table using revolution and time information or the velocity reading from a direct readout meter. The velocity was measured at 0.6 the depth of the water column.

16. SUBSTRATE - The substrate of each cell will be classified with a one or two digit substrate code number which expresses the dominant and subdominant substrates represented within the cell. Enter the dominant substrate code as the first digit in the column marked substrate. If a subdominant substrate is represented within the cell and exceeds ten percent then enter the subdominant substrate code as the second digit. For example a two digit substrate code of 17 would indicate that the dominant substrate consisted of silt, and the subdominant substrate consisted of boulders.

Substrate Code	Description
1	Silt
2	Sand
3	Small Gravel (1/8" - 1")
4	Large Gravel (1" - 3")
5	Rubble (3" - 5")
6	Cobble (5" - 10")
7	Boulder (greater than 10")

17. PERCENT COVER - Percent cover of each cell will be classified as a single digit code. Enter the percent cover code which represents the sum total of all available cover classes within an individual cell.

Percent Cover Code	Percentage
1	0 - 5
2	6 - 25
3	26 - 50
4	51 - 75
5	76 - 95
6	96 - 100

18. COVER CLASSIFICATION - The cover types of each cell will be classified with a one or two digit cover code, which will express the dominant and subdominant cover types represented within the cell. Enter the dominant and subdominant numerical cover codes in the same manner as detailed in the substrate classification.

Cover Code	Description
1	No cover
2	Emergence cover
3	Aquatic vegetation
4	Debris deadfall
5	Overhanging riparian
6	Undercut banks
7	Large gravel (1" - 3")
8	Rubble (3" - 5")
9	Cobble or boulder (greater than 5")

19. GEAR CODE - Enter appropriate gear code; 003 for beach seines, 002 for electrofishing.

20. EFFORT - Record beach seine effort as one for each seine haul. Electrofishing effort will be recorded in seconds.

21. SPECIES CODE - Enter the code that identifies the species of fish captured.

22. NO. OF FISH - Enter the number of fish caught.

23. LENGTH - Enter total length measured from tip of nose to tip of caudal lobe.

24. FATE - Enter the fate of the fish, whether the fish will be preserved, or released alive.

Instructions for Completing Form RJ 83-03:

1. DATE - Year, Month, Date

2. LOCATION - Name identifying study site.

3. GRID NUMBER - Enter the established identification number.

4. COLLECTOR'S INITIALS - Initials of person who records site map data.

5. STAFF GAGE NUMBER - Enter established identification number.

6. STAFF GAGE HEIGHT - Record stage height to the nearest 0.01 foot.

7. TRANSECT NUMBER - Enter established identification number.

8. LEFT (W) EDGE OF WATER - Enter distance rounded to feet from left transect marker to left edge of water.

9. RIGHT (E) BANK OF WATER - Enter distance rounded to feet from left transect marker to right bank of water.

10. RIGHT BOUNDARY - Enter distance in feet from left transect marker to right transect marker.

11. COMPASS BEARING TO RIGHT - Enter compass bearing from left transect marker toward right transect marker.

12. PAGE - Indicate the page number and total number of pages used.

Field Notes

Daily field notes recorded by biologists conducting JAHS studies will address the following items:

1. Hydraulic Conditions

This will include preparation of a narrative description of the mainstem Susitna stage and discharge that affect the hydraulic conditions within the grid system at each site. Changes between sampling periods and other phenomena such as changes in channel morphology caused by high water or icing conditions will also be recorded. A description of how changes in discharge of the mainstem have affected the availability of micro-habitat for juvenile salmon will also be noted in general terms. Problems with the data base recorded or keys to assist in its interpretation will also be noted.

2. Habitat, Temperature, Turbidity Data

This section will discuss any information required in interpreting the temperature data, turbidity data, cover or substrate descriptions on the data sheets. Factors such as observed upwelling of ground water, unusual readings or other conditions that depart from the expected and hypotheses as to the cause of the anomalies will be described. Any other unusual habitat, water depth or velocity conditions that may affect the micro-habitat availability, distribution, abundance of the fisheries in the area will be included.

3. Biology

This section will include any observations that are pertinent to the objectives of this study with regards to the juvenile anadromous fisheries. Observed juvenile fish, that were not collected from cells within the grid system and their distribution within backwater zones, and any interpretation required for the collected specimens will be included. The narrative should also include changes in the distribution observed during previous sampling periods and any new phenomena observed that are of particular interest to the objectives of the study. Hypothesis as to the factors that are, in the opinion of the field biologist, influencing the micro-habitat utilization and abundance of the juvenile salmon fisheries within the cell and sample grid will be described.

The notes will be recorded so that a continual journal of the events occurring at a site through the open water season can be followed from one sampling period to another. The response of the fisheries and habitat conditions within individual cells and grids at each site can be followed over time and can then be described with regards to effects of mainstem discharge that may 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 period. These field notes will provide an additional basis for the preparation of the final reports on the fisheries at these sites and the response of the fisheries to changes in the micro-habitat that occur during the course of the field season because of different mainstem Susitna discharges.

APPENDIX B-2

Operational Procedures for the Epson HX-20 Microcomputer Data Form Program.

OPERATIONAL PROCEDURES FOR THE EPSON HX-20 DATA FORM PROGRAM

Note to operator: You must type underlined material exactly as it appears.

TO OPERATE:

1. Turn on computer; turn printer switch on.

2. A menu (numbered list) should appear on the screen; choose the selection labelled "FORM" by typing the appropriate number.

3. A series of questions will follow. The statement "This is entry # " will appear, with the question "New Count?". If the observation number is correct, just hit the RETURN key. If the observation number appearing is incorrect, type Y. The question "What is the count?" should now appear; type in the new correct observation number followed with the RETURN key.

   The question "New tape?" will follow. If the tape is new or you are changing to the reverse side, type Y. The computer will ask you to enter a new tape at this time. Hit any key once the new tape is inserted. If this is not a new tape, hit the RETURN key in response to the "New tape?" question.

4. If a statement "Warning-tape has only ### units left" appears, you should replace or turn the tape over and type Y to above question unless you have only a very small number of entries.

5. Now the statement "Initializing - Data erased" will appear and, after a few seconds, a new menu. Choose "Enter Data" from the menu by typing 1. "Header data" and habitat questions should now appear on the screen. If the information is correct as displayed, hit RETURN key, otherwise type in the complete correct entry data followed by the RETURN key. If you hear a warning buzzer sound, you should reexamine the data entry by use of the arrow keys going backward or forward. Either the up or down arrows or the left-right arrows will take you back to the previous entry or the next entry, as appropriate. Correct the data entry as needed. If a number is 1.0, enter 1.0, not 1. If the set or check time is midnight, enter 0000 and the date of the coming day.

   After all general header information is entered, the buzzer will sound and two boxes will appear with "###" under the left one and "species" under the right one. The left box will contain a "1". Enter correct species code followed by RETURN or right arrow key. Enter remaining data according to prompts indicated below boxes. If the warning buzzer sounds, use the left arrow key to re-examine last entry. After entering the fate code (or RETURN key if the fate code is correct as listed), fish #2 will appear. Continue entering data as appropriate until all fish are accounted for. You may use the arrow keys to correct any previous entry or to enter only one field, such as length, if all other fields are constant between fishes; there is no need to hit RETURN key after entries as the arrow keys perform the same function. After completing the last entry, enter ! (hold down SHIFT key while pressing the ! key) and then press the RETURN key to end data entering. Maximum number of fish entries allowed is 100.

6. The data form menu will reappear. Choose #2 on the menu (type 2) to print data out on the Epson printer. Review this data to ensure its accuracy. Choose #1 to correct any errors in the habitat and header data, exiting the data entry after the fish # comes up by typing ! followed by the RETURN key. Correct any errors in the fish data entry by choosing #5 on the menu (type 5). To eliminate entries on the end of the list, choose selection #6 from the menu (type 6). The question "Last fish # to save? will appear. Enter the last valid fish number and press the RETURN key. Another method to correct errors in the fish entry data is to edit individual fish entries. To edit individual fish, also choose # 6 and then hit RETURN key in response to the first question. The questions "Fish # on print out?, Species Code?, Number of Fish?" etc., will appear. Enter complete information in response to each question. The menu will reappear after entering the fate code.

7. Reprint the data using selection #2 if the changes are extensive. Otherwise, just make pencil corrections on the paper printed out earlier. Note whether or not pencil changes on paper have been made on the Epson.

8. Select "File/Print" from the menu (type 3). After the data is stored, answer Y to the "Hit Y for Backup?" question. You must make a backup copy of the tape. After the backup copy is completed, the computer will ask "Backup OK?" If there were no problems with the backup procedure, such as inserting the wrong tape, etc., type Y to this question, otherwise insert new backup tape and repeat. You must exit this routine with a Y to "Backup O.K.?" in order to ensure that the next entry session will be properly updated.

9. To enter a new data set or the next trap number, choose "KILL" on the menu (type 4) or turn the computer off and repeat the process from item 1 on this list.

ADDITIONAL HELPFUL HINTS:

If you have entered a large amount of data and the program breaks, you can resume operation by typing CONT followed by the RETURN key. If an abort message appears, you must reenter all of the data. If typing CONT does not work, type GOTO 90. This will allow the menu to reappear and you can resave the data to file or edit any errors without updating the observation number. If this occurs before you have exited the "Backup OK?" question properly, the data set will overwrite the data entered earlier using the "Print/File option". Be sure this is what you want to happen before completing this procedure.

Any errors observed after the data are stored should be noted on both printouts with a large indication of the fact that they are inaccurate and need editing in the office. Any repeated or omitted observation numbers on the printouts should likewise be noted.

IF PROBLEMS OCCUR:

If the program will not run properly, you may have to erase the program and reload it from tape.

To reload the program:

1. Insert program tape.

2. Turn computer on and select "BASIC" from the main menu (type 2).

3. Type LOGIN 2, then hit RETURN key; type TITLE"", then hit RETURN key; type NEW, then hit RETURN key.

4. Type WIND, then hit RETURN; after cursor reappears, type LOAD, then hit RETURN.

5. After the tape stops running (cursor reappears) and no errors occurred, type TITLE "FORM" then hit RETURN. If an 10 ERROR" occurs, repeat steps 4 and 5.

6. Type CLEAR 350,120 then hit RETURN. Now hit the MENU key and select "FORM". The program should now run normally.

If the program still will not run properly or the computer malfunctions, you may have to press the RESET key, the red one on the right side of the box. This erases the program and any data not saved. Then repeat the last six steps to reload the program.