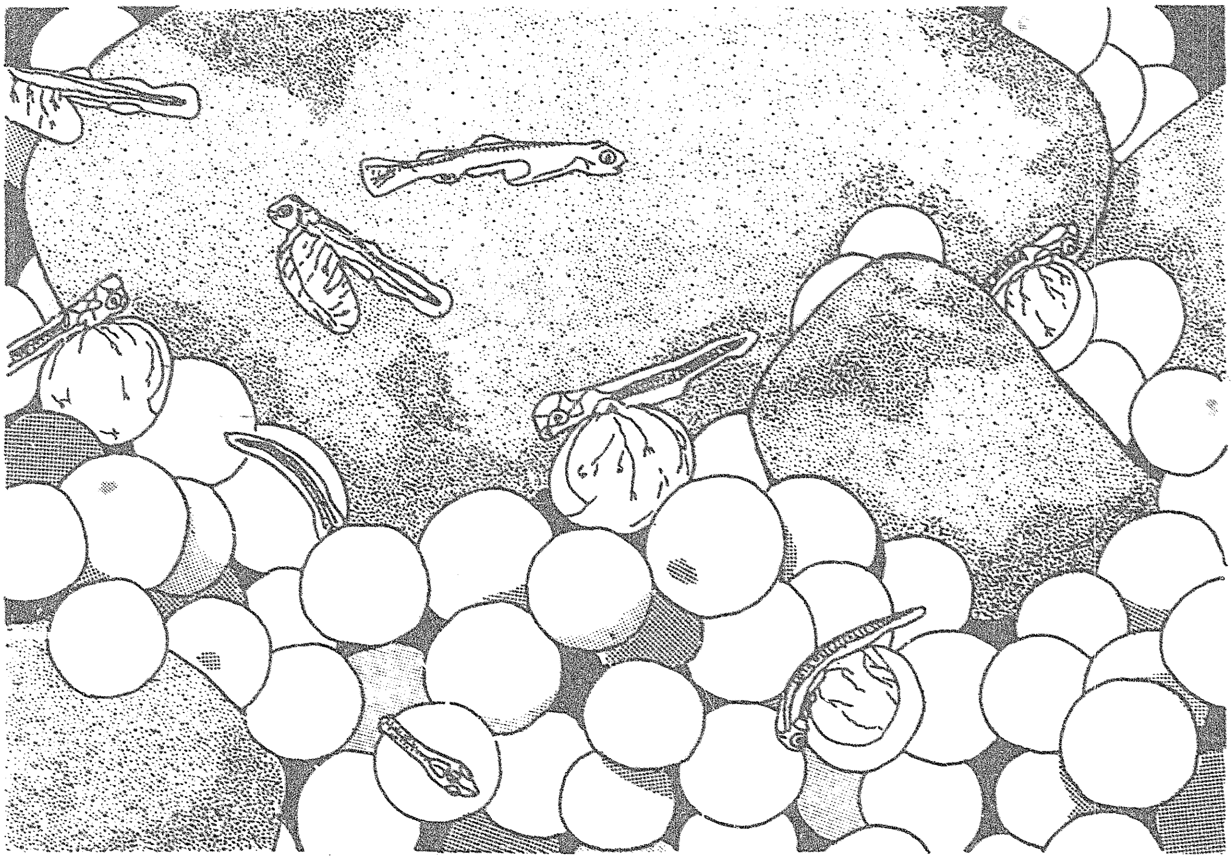
DRAFT



DRAFT

SUSITNA HYDRO AQUATIC STUDIES
DRAFT PHASE II DATA REPORT

WINTER AQUATIC STUDIES
(October 1982 - May 1983)

ALASKA DEPARTMENT OF FISH AND GAME
Susitna Hydro Aquatic Studies
2207 Spenard Road
Anchorage, Alaska 99503
1983

DRAFT
WINTER REPORT
10/20/83

PREFACE

This report was prepared by the Alaska Department of Fish and Game (ADF&G) for the Alaska Power Authority (APA) and its principal contractor, Harza-Ebasco Susitna Joint Venture. It is a product of the five year study plan initiated by ADF&G in November, 1980 to assess the feasibility of the proposed two dam Susitna Hydroelectric project. Basic goals of the five year plan (Acres 1980) are as follows:

1) describe the fishery and aquatic habitat resources of the Susitna River;

2) assess the impacts of development and operation of the Su-Hydro project on these resources; and

3) propose mitigation measures to minimize adverse impacts.

Item 1 is entirely the responsibility of the ADF&G aquatic studies program while items 2 and 3 are primarily the responsibilities of other investigators with ADF&G providing most of the field data to address these items. To provide data that will assist in meeting each of the above goals, research responsibilities were subdivided into three major elements: Adult Anadromous Fish Studies (AA); Resident and Juvenile Anadromous Fish Studies (RJ) and Aquatic Habitat and Instream Flow Studies (AH). The primary objective for each section is as follows.

1) Adult Anadromous - determine the seasonal distribution and relative abundance of adult anadromous fish populations produced within the study area;

2) Resident/Juvenile - determine the seasonal distribution and relative abundance of selected resident and juvenile anadromous fish populations within the study area; and

3) Aquatic Habitat - characterize the seasonal habitat requirements of selected anadromous and resident fish species within the study area and the relationship between the availability of these habitat conditions and the mainstem discharge of the Susitna River.

This report contains four different types of data collected during the 1982-83 ice-covered season (September through May). The four data sets included are:

1) Continuous surface and intragravel temperature monitoring.

2) Salmon incubation and emergence studies.

3) Timing and habitat conditions of burbot spawning in the lower river.

4) Winter progress report of radio telemetry investigations of resident species.

These data, as well as data from other ADF&G reports and sources are expected to be used ~~summarized and analyzed~~ by the Arctic Environmental Information and Data Center (AEIDC) to evaluate post-project conditions.

Any questions concerning this report should be directed to:

Thomas W. Trent
Alaska Department of Fish and Game
Su Hydro Aquatic Studies Program
2207 Spenard Road
Anchorage, Alaska 99503
Telephone (907) 274-7583

TABLE OF CONTENTS

LIST OF FIGURES

Page

LIST OF TABLES

LIST OF PLATES

1.0 INTRODUCTION

The winter investigations of 1982-1983 include four separate studies: 1) surface and intragravel water temperatures, 2) incubation and emergence of juvenile salmon and incubation habitat, 3) burbot spawning, and 4) radio telemetry investigations of resident fish.

The surface and intragravel water temperature study provided support for the incubation and emergence studies in addition to providing winter water temperatures for the ~~physical~~ temperature and ice modelling studies conducted by other investigators.

The salmon incubation and emergence studies were conducted to determine the timing of embryonic development and emergence of chum and sockeye salmon under natural conditions in the Susitna River and to determine the physical and chemical conditions of the surface and intragravel waters in which they develop. In addition, relationships of surface and intragravel water conditions and importance of upwelling water were considered.

Because burbot are thought to spawn in areas affected by mainstem flows and temperatures, a study of their spawning habitat and timing was initiated in areas where this species concentrates in the Susitna River drainage during the winter months. Prior to this study, little was known about where or when burbot spawn in the Susitna River or the habitat conditions under which spawning takes place.

The radio telemetry studies of rainbow trout, burbot, and Arctic grayling provided information on the location and habitat conditions of overwintering areas, timing of fall redistribution into the overwintering habitat, and the location and habitat of spawning areas.

In general, these studies provide new information on aspects of the biology of anadromous fish and on the important resident species not previously defined in earlier winter reports. These data provide an insight as to possible constraints of the winter habitat conditions on the species investigated.

DRAFT
WINTER REPORT
10/20/83

2.0 CONTINUOUS SURFACE AND INTRAGRAVEL WATER TEMPERATURE STUDY

Continuous monitoring of surface and intragravel water temperature was initiated during the winter of 1981-82. These studies were continued during the winter of 1982-83 to address the following objectives.

2.1 Objectives

Continuous surface and intragravel water temperature data were collected at thirteen sites within the Talkeetna to Devil Canyon reach of the Susitna River (Figure 2-1). These data were collected to accomplish three principal objectives:

intragravel

1) Obtain baseline surface and integral water temperature data in slough and mainstem Susitna River (mainstem) habitats during the ice-covered season.

2) To compare surface and intragravel water temperatures in slough areas used by spawning chum salmon to those not used for spawning, and to provide data for calculating thermal [illegible] units required in the incubation and emergence studies.

TU's are not "used" in "study"

3) To provide a data base for calibration and evaluation of mainstem temperature modeling studies.

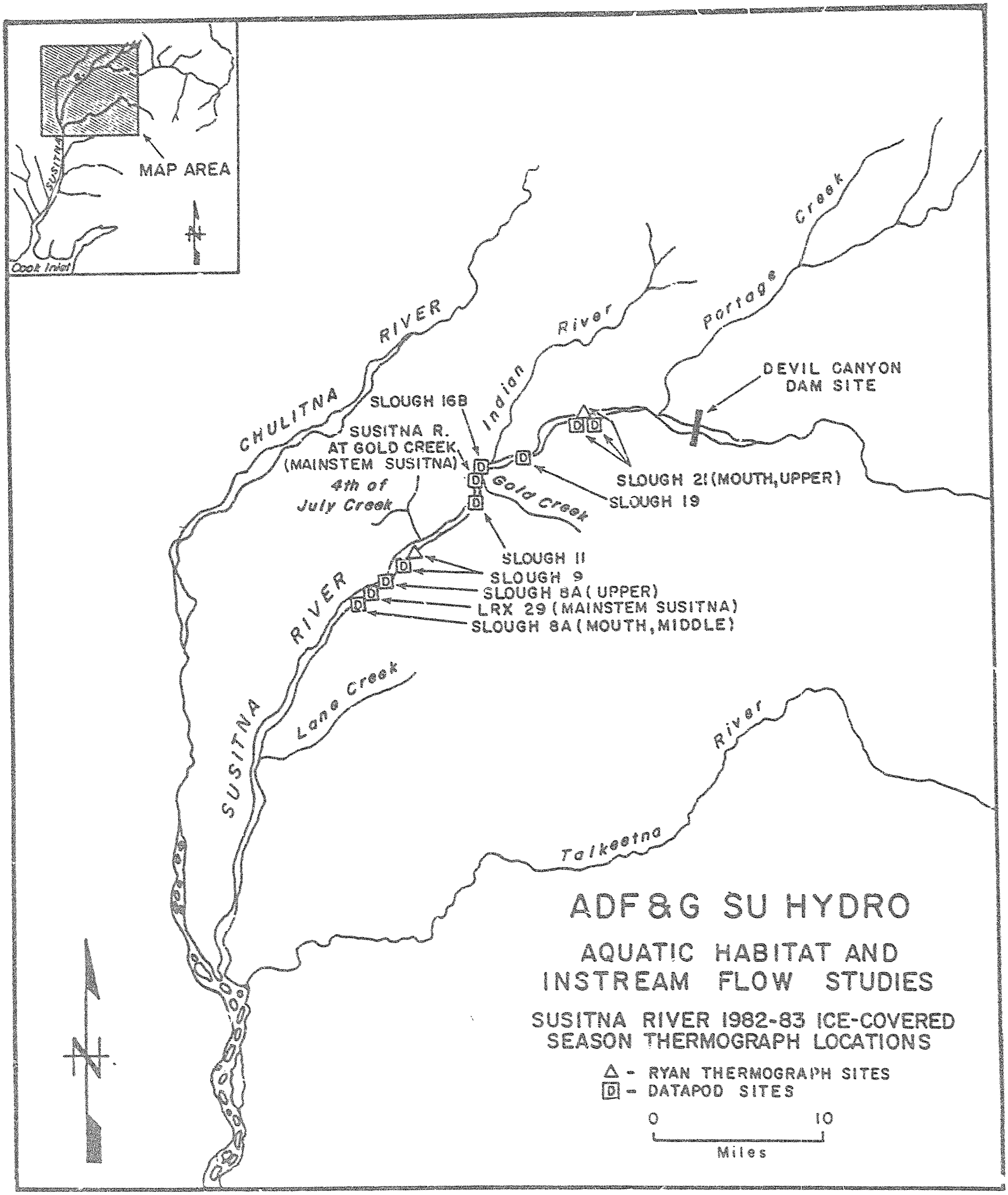


Figure 2-1. Location of Datapod temperature recorders and Ryan thermographs in the Susitna River, Chulitna River confluence to Devil Canyon reach, during the ice-covered season 1982-83.

2.2 Methods

2.2.1 Site selection

[illegible] or solid state temperature recorders

Thermographs were placed within a slough to obtain temperature data from an area (spawning and non-spawning areas) representing typical conditions (substrate, water depth, and velocity) for the study site. Thermographs were also placed along the margin of the mainstem in areas believed to provide representative temperature data. of mainstem thermal conditions?

Slough 21 Mouth, Slough 11, Slough 9, Slough 8A Mouth

define

One set of surface and intragravel datapod temperature probes were placed directly in a chum salmon redd observed in each slough during the fall of 1982.

Middle Slough 8A

The datapod was installed in the middle Slough 8A site in a documented chum salmon spawning area on April 28, 1983 to replace the instrument at the mouth which intruded by lost its probe due to ice shearing.

JWK

Upper Slough 8A, Upper Slough 21, Slough 19

Datapod temperature probes were installed in the approximate area of chum salmon redds observed in 1981. In 1982, salmon had no access to these reaches and no redds were observed.

Slough 19 is the only Upland Slough (ADF&G 1983a) in which continuous intragravel temperatures were obtained -- sloughs 8A, 9, 11, 16B, and 21 are Side Sloughs.

Slough 16B

This slough is representative of those sloughs not used by spawning salmon. Temperature probes were installed midway down the slough, in what appeared to be suitable spawning substrate and where intragravel flow was evident at the time of installation.

how was flow determined?

Mainstem at LRX 29 and Mainstem at Gold Creek

Temperature data from these sites are the first continuous intragravel water temperatures collected in the mainstem Susitna River. Lower river cross section (LRX) 29 is a site adjacent to Slough 8A where continuous surface water temperatures have been monitored since the fall of 1981. The mainstem continuous surface and intragravel water temperature site was selected to obtain intragravel temperatures at this site and to supplement historical surface water temperature data collected by USGS.

influenced by Gold Creek discharge?

When selecting a site, consideration was given to the safety of personnel and the somewhat fragile nature of instruments. Areas characteristic of high water velocity, debris, bank erosion, or shoreline ice action were avoided when possible.

Thermograph locations in Slough 9 and Slough 21

Thermographs were installed in sloughs 9 and 21 to extend the temperature record available from ADF&G's pilot study during the winter of 1981-82.

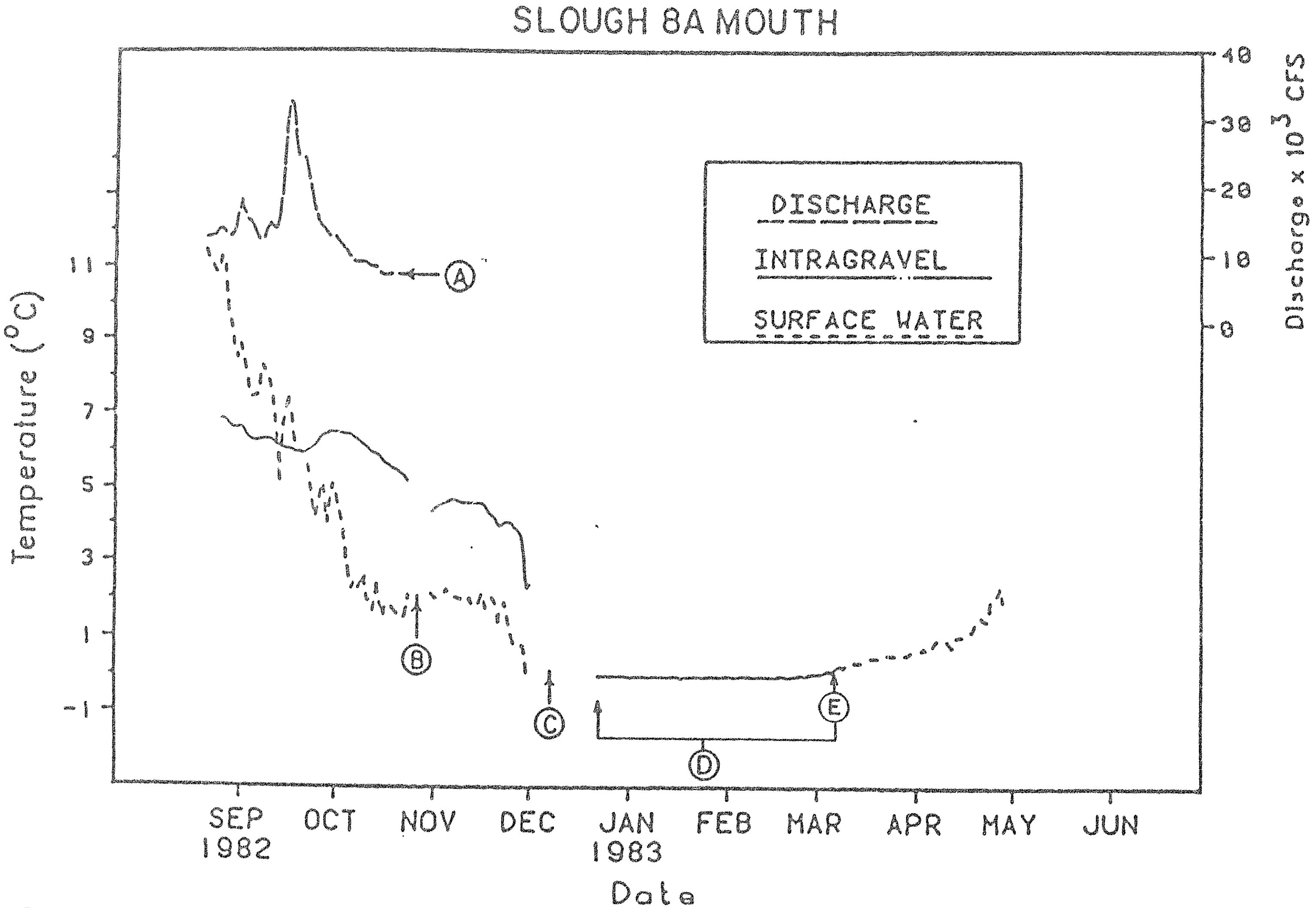
2.2.2 Instrumentation

temperature recorders

★ Two types of thermographs, Omnidata DP2321 (datapods) and Ryan Model J, were used to continuously monitor surface water temperature; only datapods were used to continuously monitor intragravel temperatures. Intragravel datapod probes are installed one foot under the substrate surface using slotted, hollow steel spikes within which the thermister is installed. Detailed procedures are discussed in the ADF&G Phase I and Phase II Procedures Manuals (ADF&G 1981d and 1983e).

2.3 Results

The mean daily intragravel and surface water temperatures collected at the 13 sites during the period of late August, 1982 through early June, 1983 are presented in Figures 2-2 through 2-14. Appendix A of this report tabulates daily and monthly mean, minimum and maximum



Ⓐ Discharge data not available after October 19.

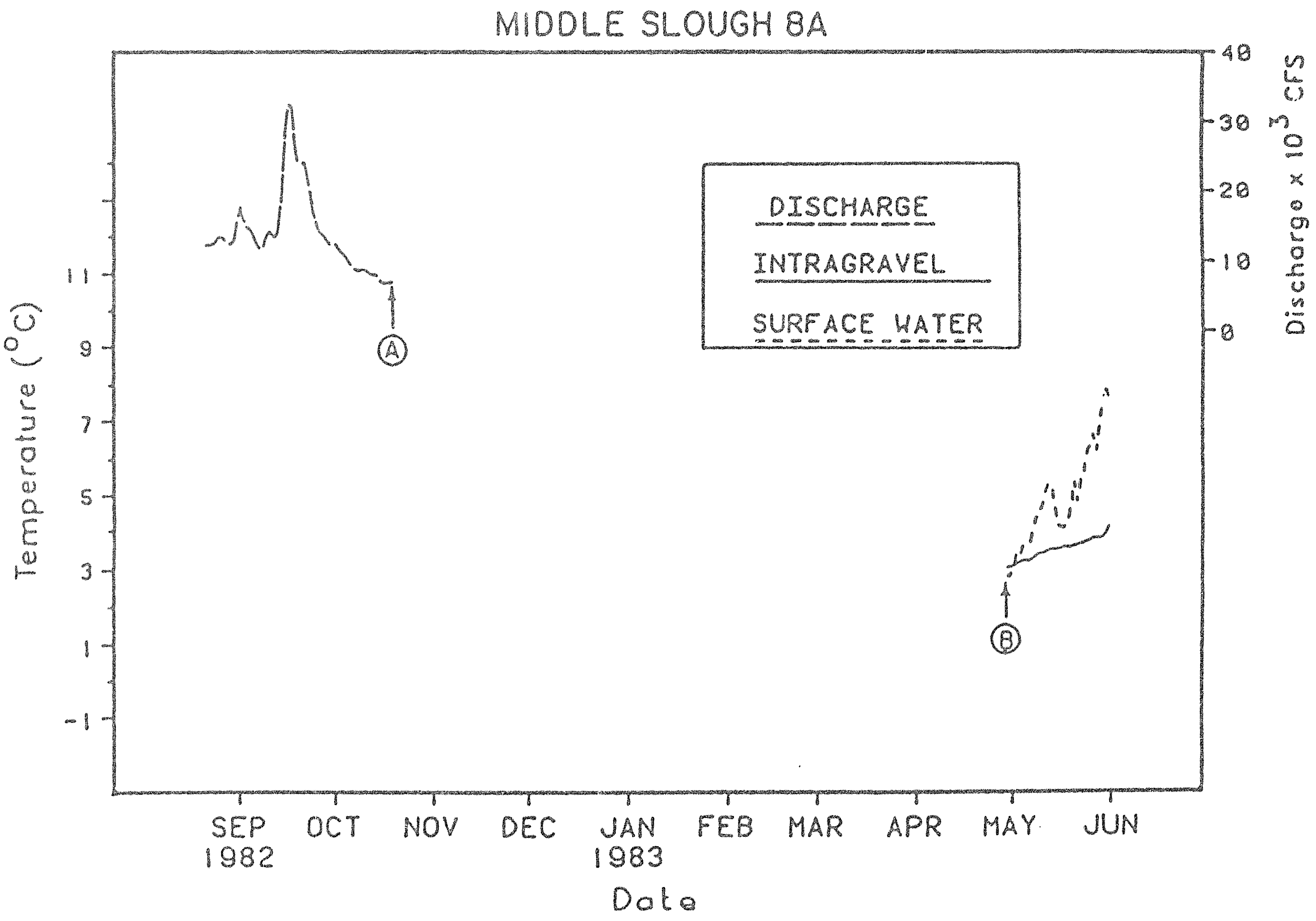
Ⓑ Data gap due to chip change.

Ⓒ Equipment malfunction.

Ⓓ Surface and intragravel temperature superimposed.

Ⓔ Intragravel probe severed by ice movement along bank.

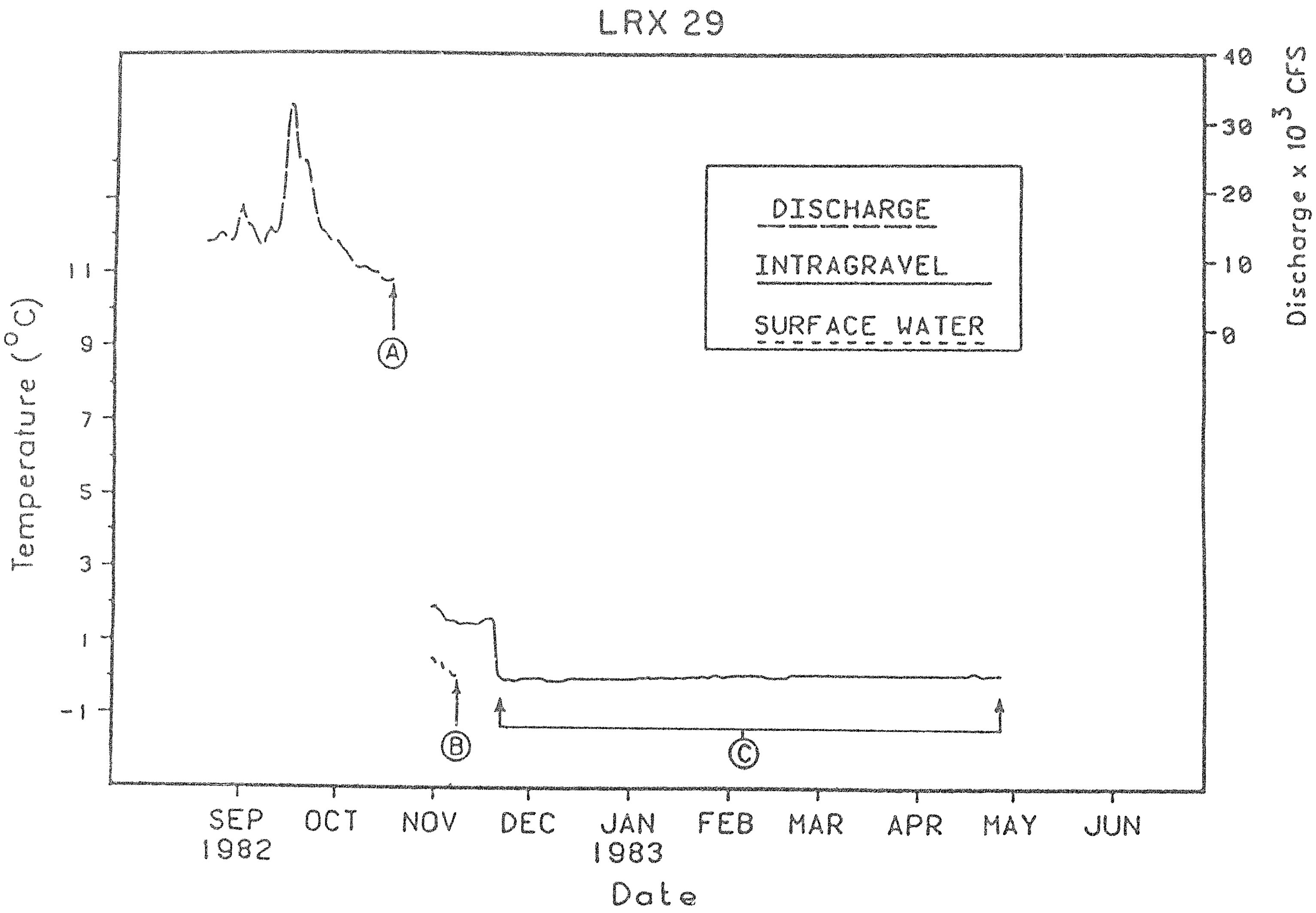
Figure 2-2. Mean daily intragravel and surface water temperatures, collected with Datapod recorders, at the mouth of Slough 8A from August 21, 1982 through March 10, 1982 and provisional Susitna River discharge data from the USGS Gold Creek gage, 15292000 (USGS 1982). Tick marks along the horizontal axis refers to the first day in respective months.



Ⓐ Discharge data not available after October 19.

Ⓑ New site installed 4/28/83, to replace Slough 8A mouth site. Site is located about 75 yards upstream of 8A mouth site.

Figure 2-3. Mean daily intragravel and surface water temperatures, collected with Datapod recorders, at the middle Slough 8A site from April 29 through June 2, 1983 and provisional Susitna River discharge data from the USGS Gold Creek gage, 15292000 (USGS 1982). Tick marks along the horizontal axis refers to the first day in respective months.

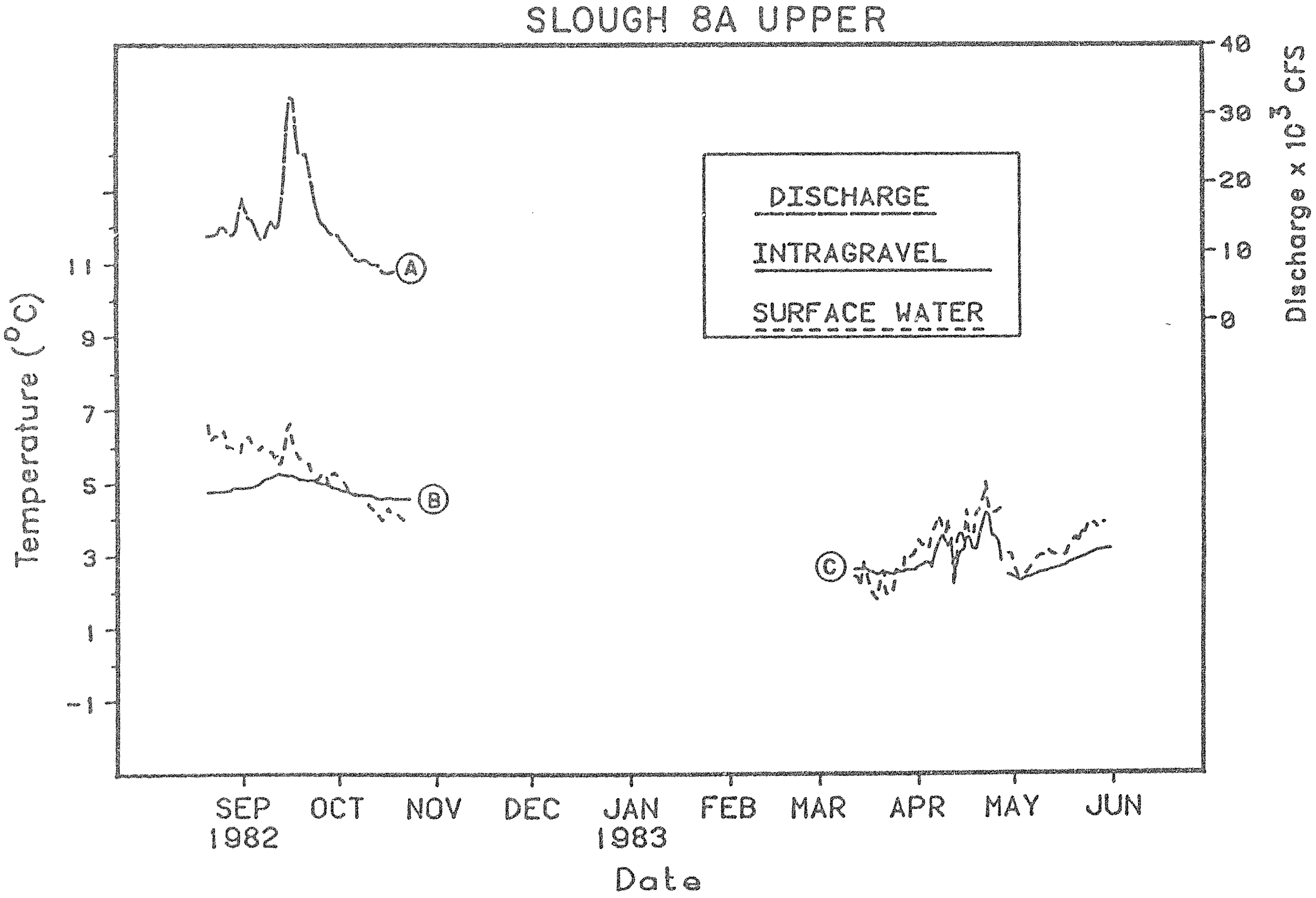


Ⓐ Discharge data not available after October 19.

Ⓑ Probe severed by ice movement along bank.

Ⓒ Intragravel temperature affected by surface water. [illegible]

Figure 2-4. Mean daily intragravel and surface water temperatures, collected with Datapod recorders, at LRX 29 from October 31, 1982 through April 27, 1983 and provisional Susitna River discharge from the USGS Gold Creek gage, 15292000 (USGS 1982). Tick marks along the horizontal axis refers to the first day in respective months.

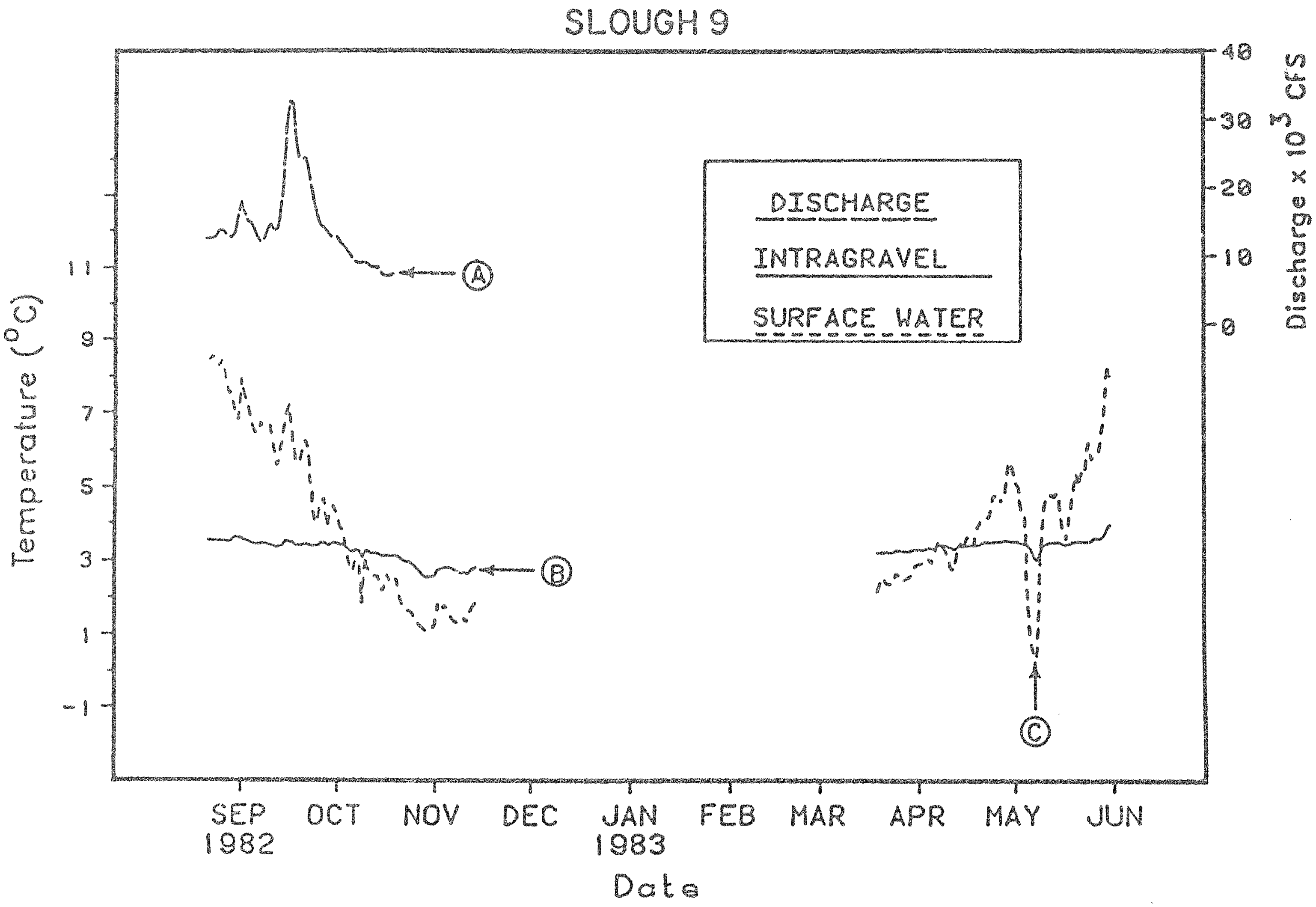


Ⓐ Discharge data not available after October 19.

Ⓑ Probes severed by ice movement along bank edge.

Ⓒ New probes installed approximately 30 yards upstream of old (Aug.-Nov.) site.

Figure 2-5. Mean daily intragravel and surface water temperatures, collected with Datapod recorders, at upper Slough 8A from August 21, 1982 through April 27, 1983, and provisional Susitna River discharge data from the USGS Gold Creek gage, 15292000 (USGS 1982) (Interruption of temperature data due to ice related damage of temperature probe). Tick marks along the horizontal axis refers to the first day in respective months.

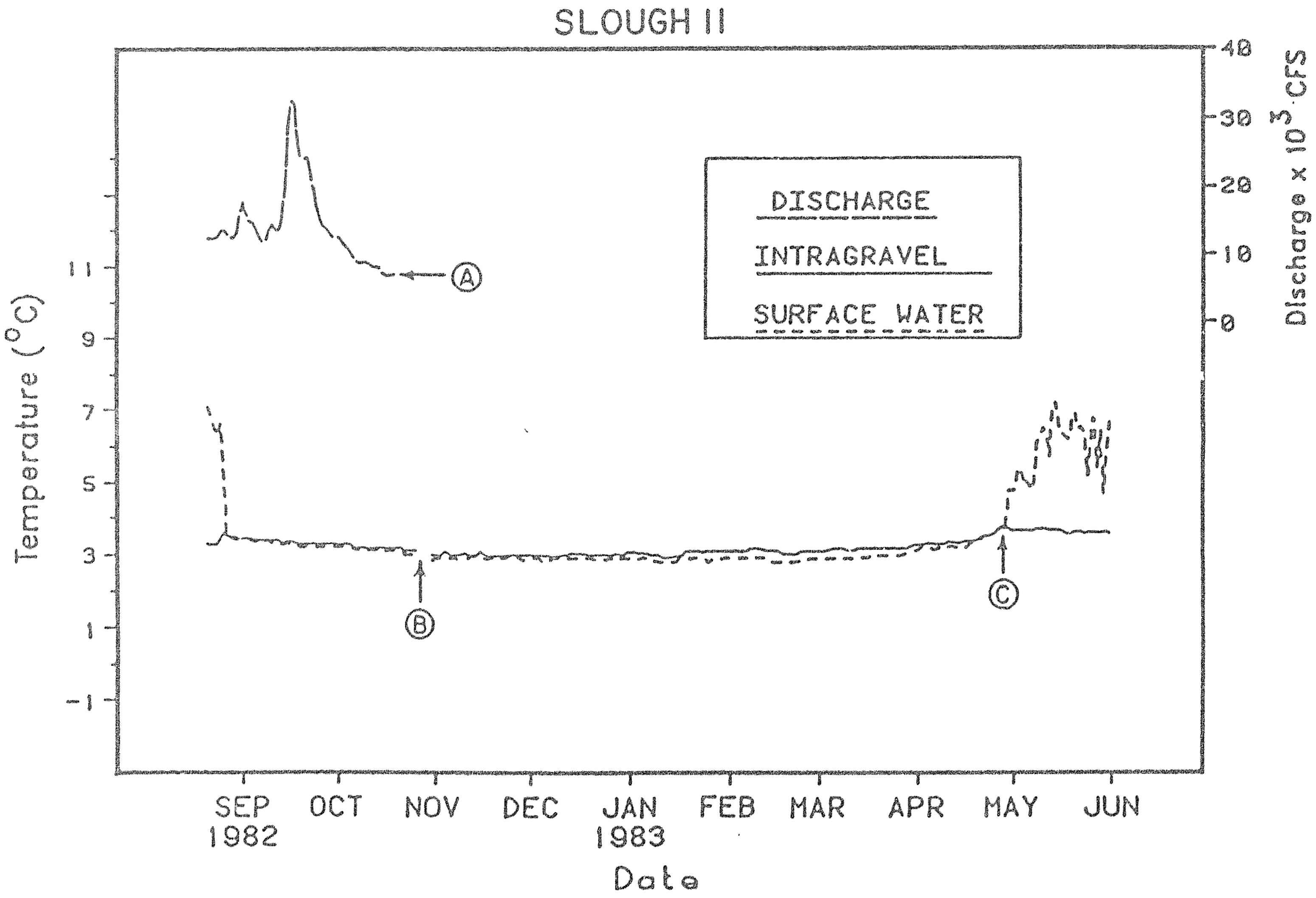


Ⓐ Discharge data not available after October 19.

Ⓑ Equipment malfunctioned.

Ⓒ Slough breached during breakup.

Figure 2-6. Mean daily intragravel and surface water temperatures, collected with Datapod recorders, at Slough 9 from August 22, 1982 through April 28, 1983, and provisional Susitna River discharge data from the USGS Gold Creek gage, 15292000 (USGS 1982). Tick marks along the horizontal axis refers to the first day in respective months.

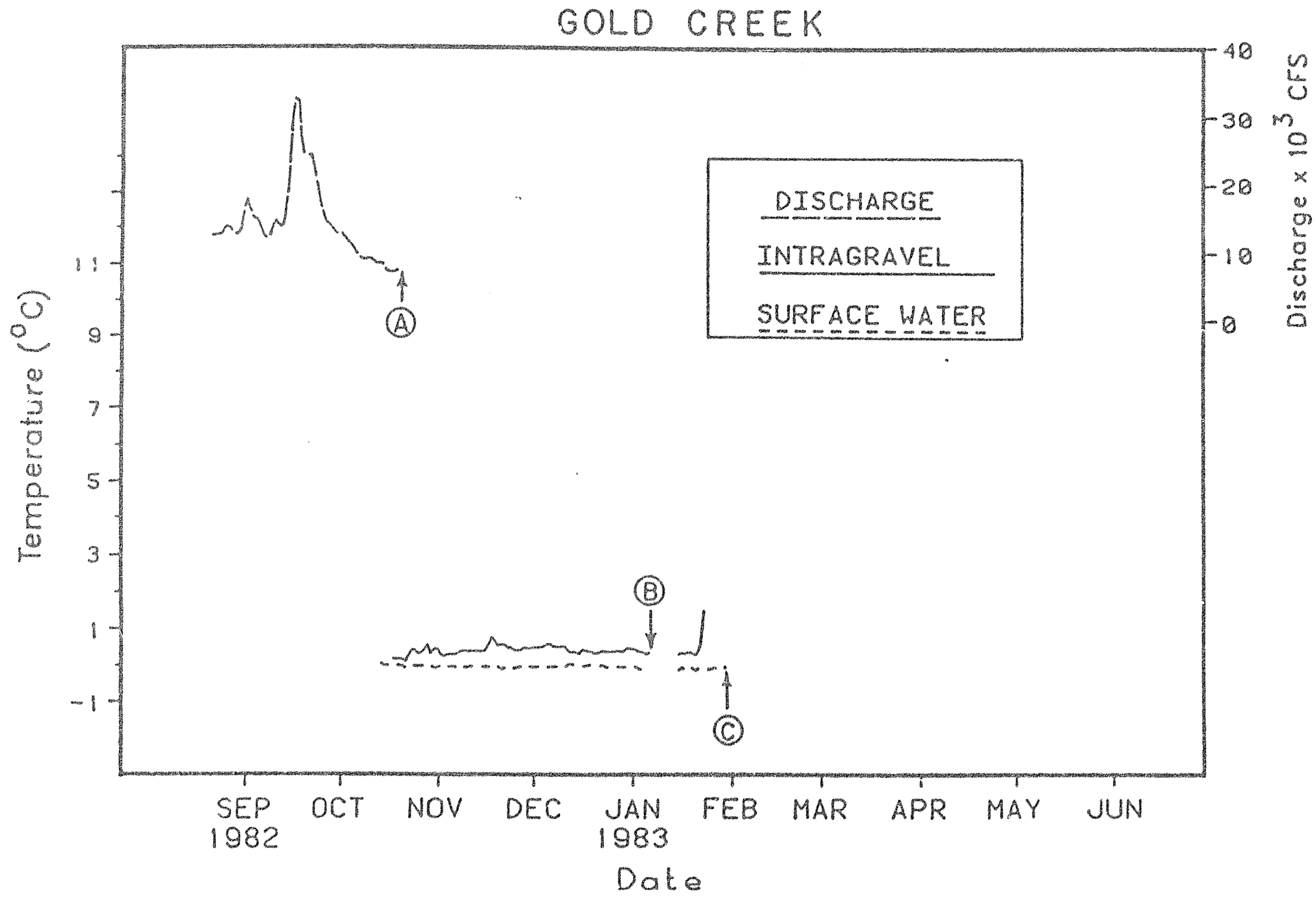


Ⓐ Discharge data not available after October 19.

Ⓑ Data gap due to chip change. - Can we assume surface water probe was not buried here?

Ⓒ April 29,1983 surface water probe found buried in 1" of silt, when uncovered temperature rose to true surface water temperature.

Figure 2-7. Mean daily intragravel and surface water temperatures, collected with Datapod recorders, at Slough 11 from August 21, 1982 through April 28, 1983, and provisional Susitna River discharge data from the USGS Gold Creek gage, 15292000 (USGS 1982). Tick marks along the horizontal axis refers to the first day in respective months.

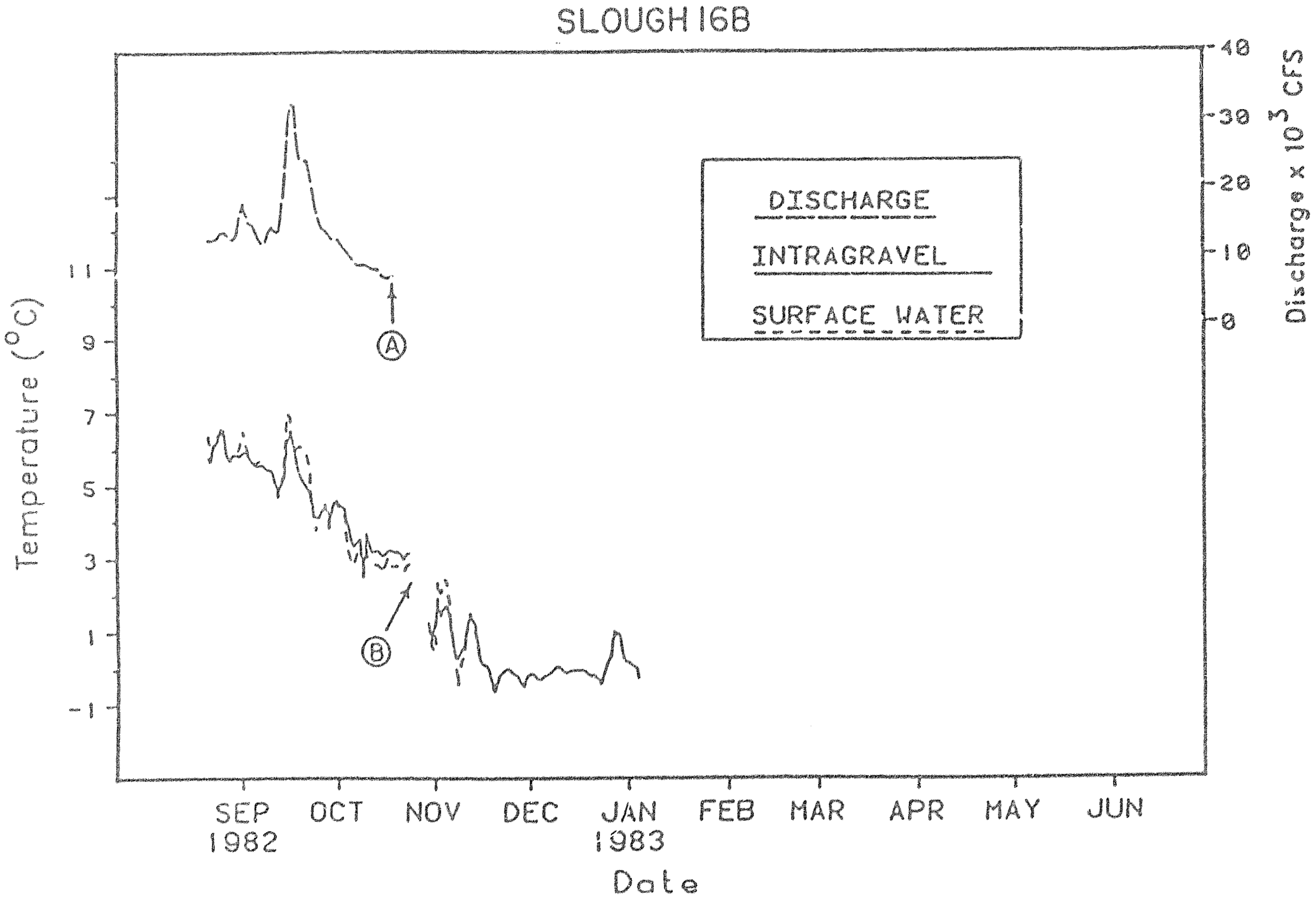

GOLD CREEK

Ⓐ Discharge data not available after October 19.

Ⓑ Data chip (DSM) filled before field crew removal.

Ⓒ Probes severed from ice movement.

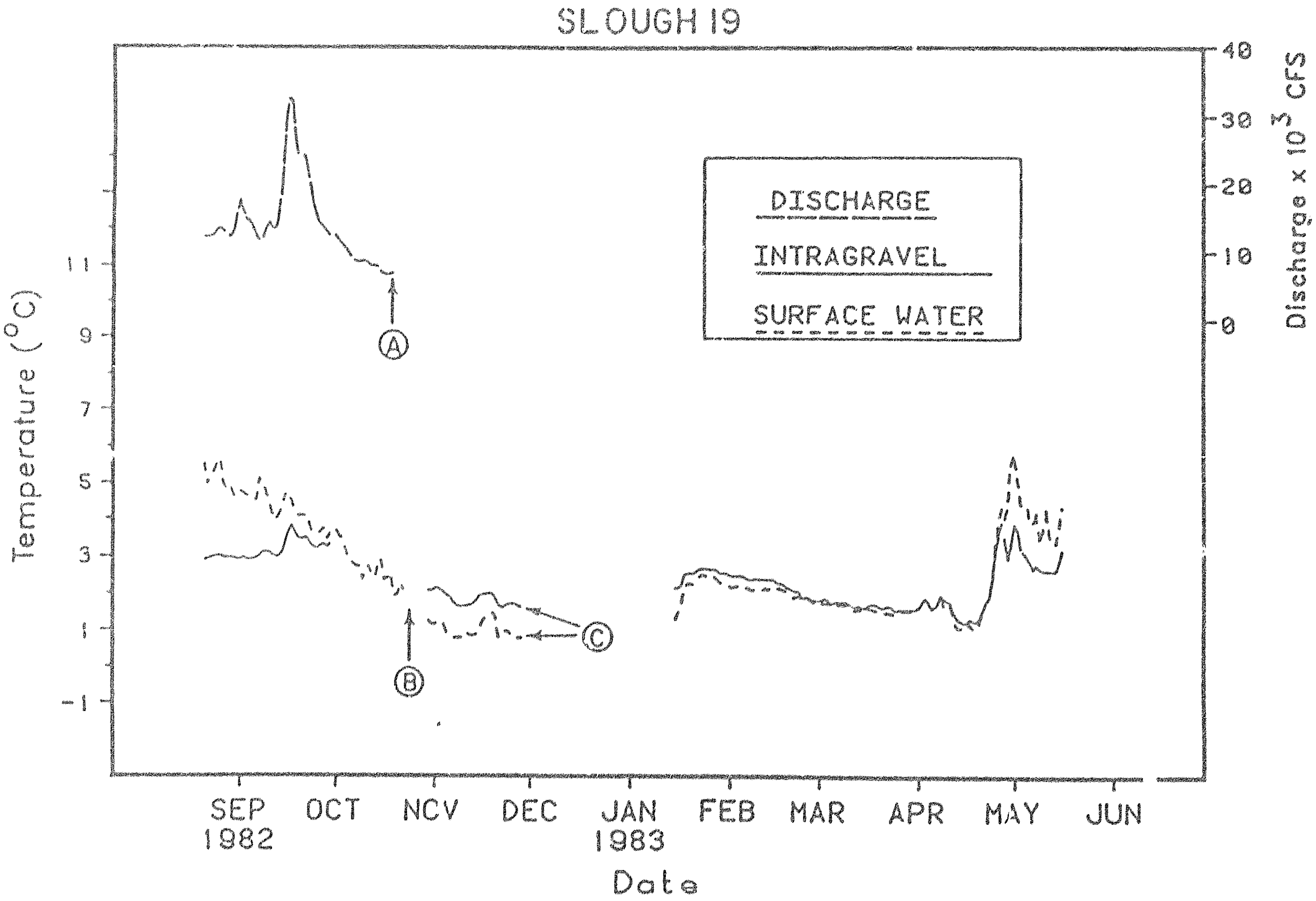
Figure 2-8. Mean daily intragravel and surface water temperatures, collected with Datapod recorders, at Gold Creek from October 18, 1982 through January 30, 1983, and provisional Susitna River discharge data from the USGS Gold Creek gage, 15292000 (USGS 1982). Tick marks along the horizontal axis refers to the first day in respective months.



Ⓐ Discharge data not available after October 19.

Ⓑ Data gap due to chip change.

Figure 2-9. Mean daily intragravel and surface water temperatures, collected with Datapod recorders, at Slough 16B from August 21, 1982 through January 4, 1983, and provisional Susitna River discharge data from the USGS Gold Creek gage, 15292000 (USGS 1982). Tick marks along the horizontal axis refers to the first day in respective months.

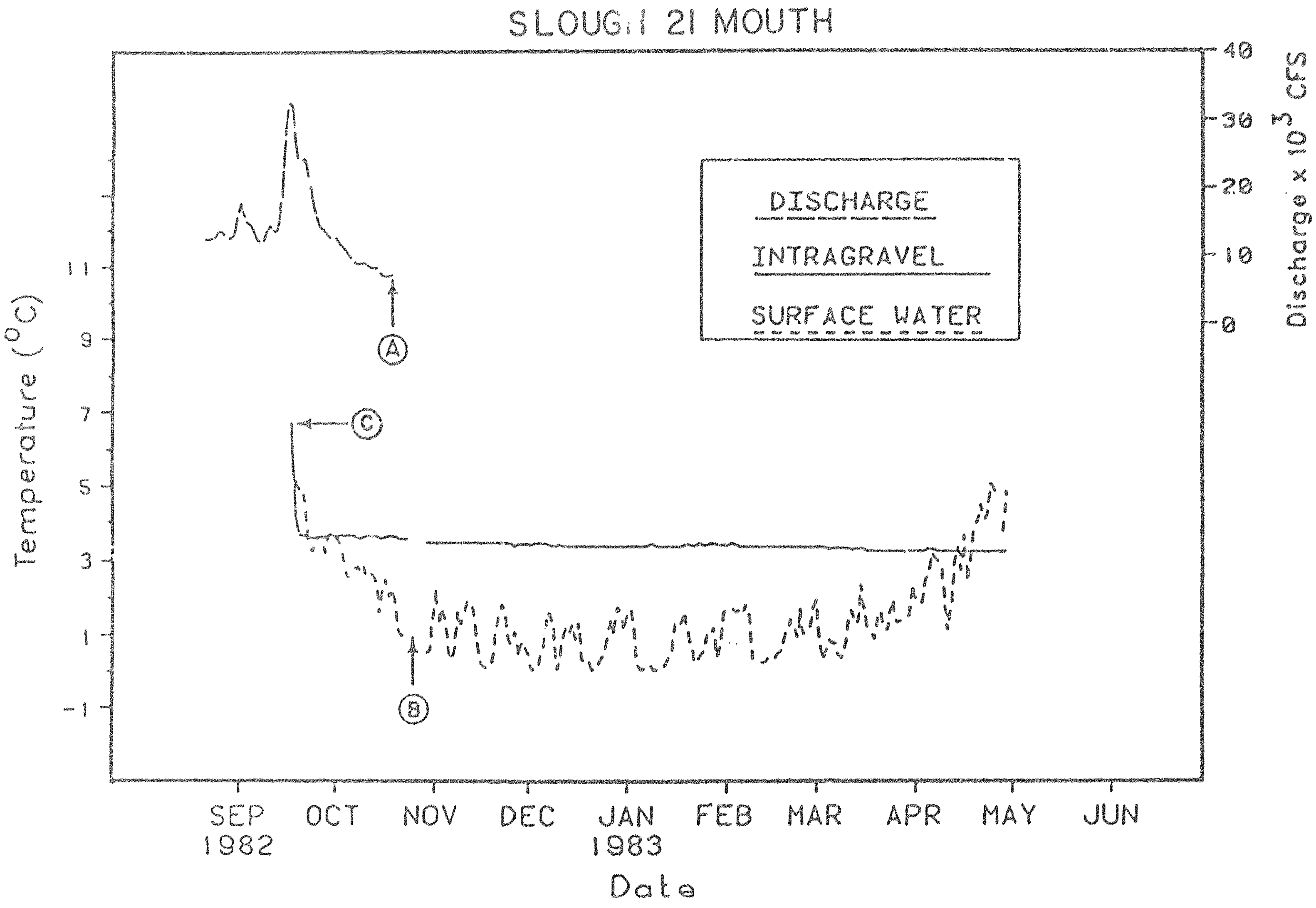


Ⓐ Discharge data not available after October 19.

Ⓑ Data gap due to chip change.

Ⓒ Equipment malfunction.

Figure 2-10. Mean daily intragravel and surface water temperatures, collected with Datapod recorders, at Slough 19 from August 21, 1982 through August 27, 1983, and provisional Susitna River discharge data from the USGS Gold Creek gage, 15292000 (USGS 1982). Tick marks along the horizontal axis refers to the first day in the respective months.

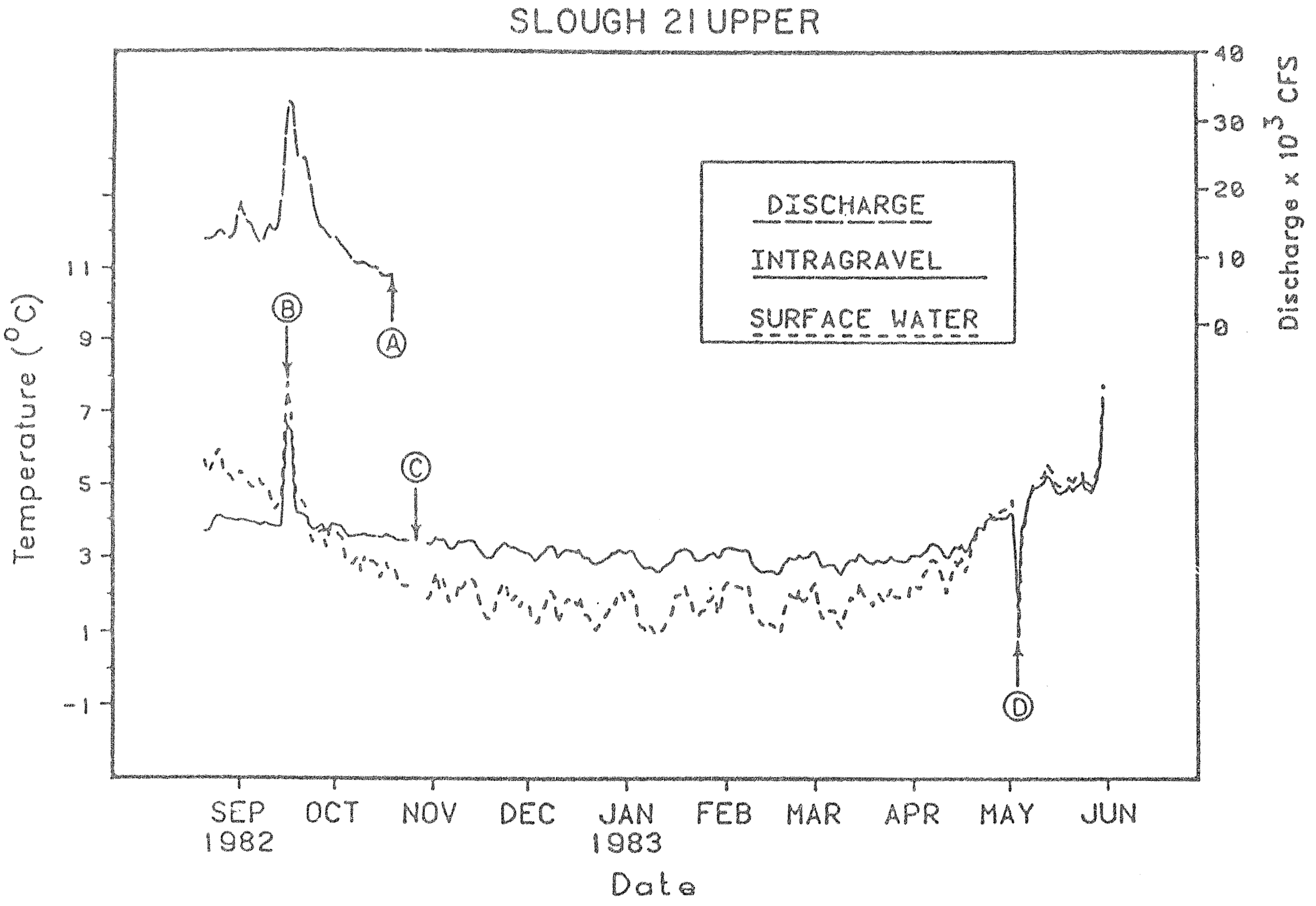


Ⓐ Discharge data not available after October 19.

Ⓑ Data gap due to chip change.

Ⓒ Slough breached in September.

igure 2-11. Mean daily intragravel and surface water temperatures, collected with Data recorders, at the mouth of Slough 21 from September 17, 1982 through April 27, 1983, and provisional Susitna River discharge data from the USGS Gold Creek gage, 15292000 (USGS 1982). Tick marks along the horizontal axis refers to the first day in respective months.



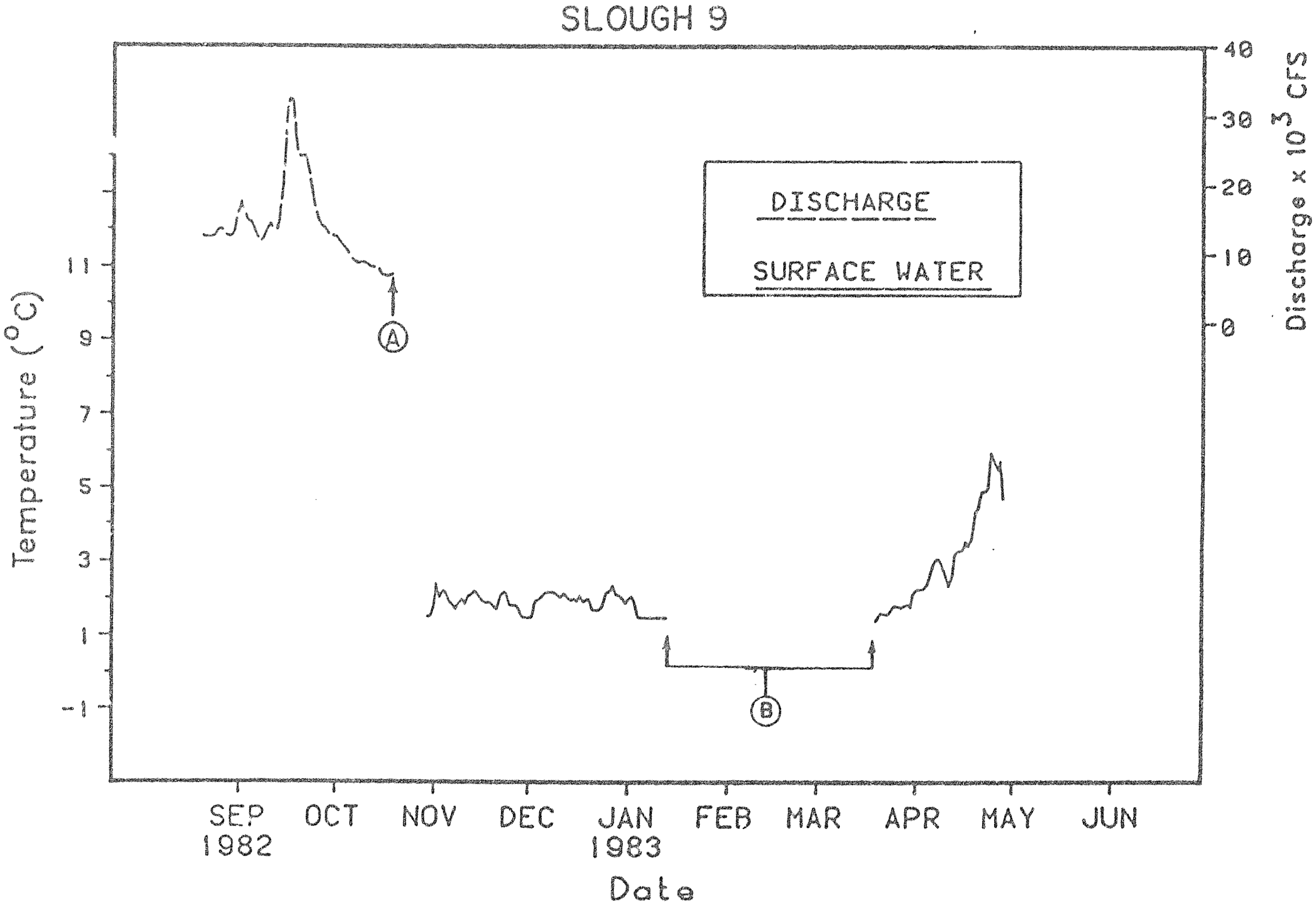
Ⓐ Discharge data not available after October 19.

Ⓑ Slough breached in September 1982.

Ⓒ Data gap due to chip change.

Ⓓ Slough breached during breakup.

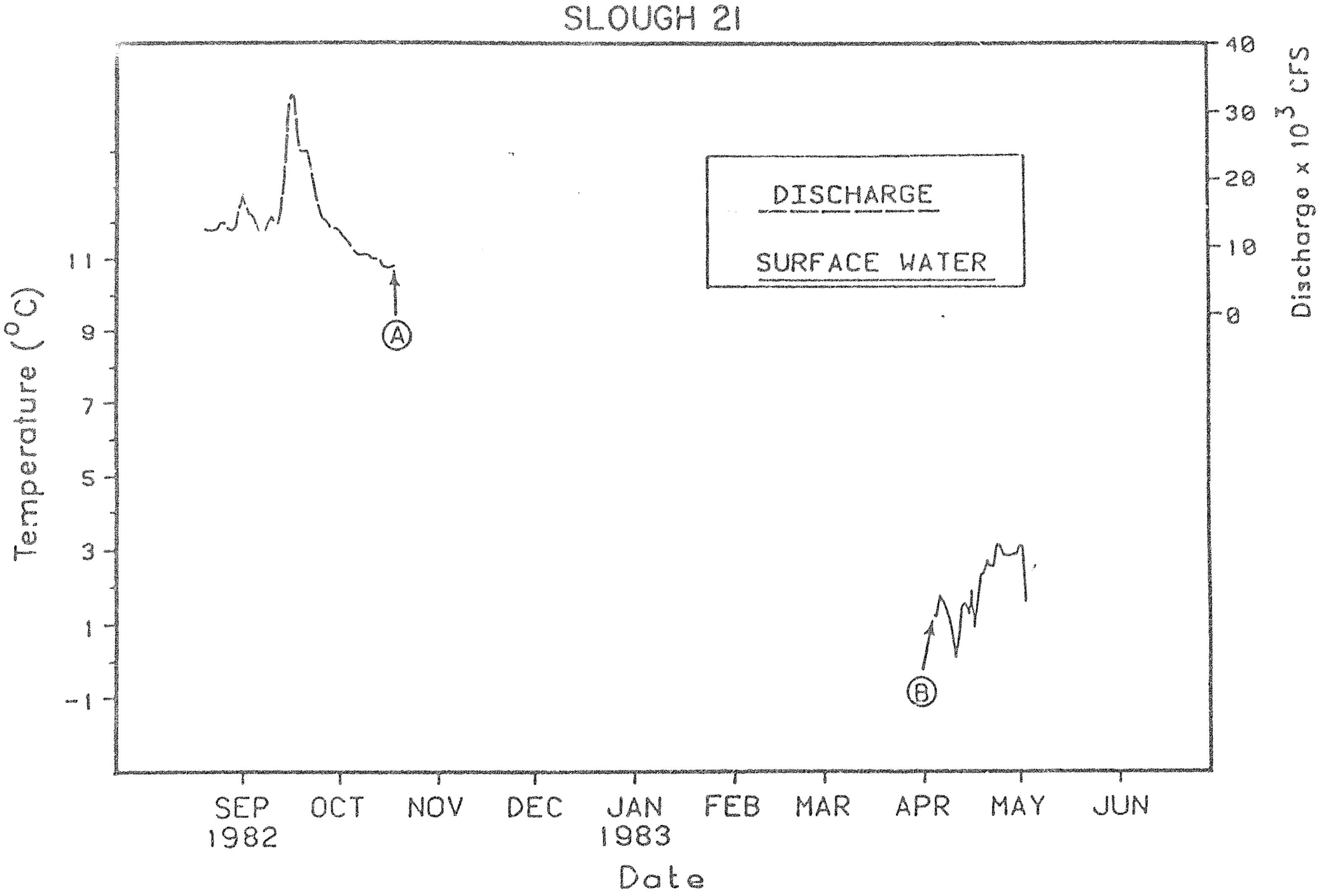
Figure 2-12. Mean daily intragravel and surface water temperatures, collected with Datapod recorders, at upper Slough 21 from August 21, 1982 through April 27, 1983, and provisional Susitna River discharge data from the USGS Gold Creek gage, 15292000 (USGS 1982). Tick marks along the horizontal axis refers to the first day in respective months.



Ⓐ Discharge data not available after October 19.

Ⓑ Equipment malfunction.

Figure 2-13. Mean daily surface water temperatures, collected with Ryan thermograph, in Slough 9 from October 30, 1982 through April 28, 1983, and provisional Susitna River discharge data from the USGS Gold Creek gage, 15292000 (USGS 1982). Tick marks along the horizontal axis refers to the first day in respective months.



Ⓐ Discharge data not available after October 19.

Ⓑ Site established April 3, 1983.

Figure 2-14. Mean daily surface water temperatures, collected with Ryan thermograph, in Slough 21 from April 3 through May 7, 1983, and provisional Susitna River discharge data from the USGS Gold Creek gage, 15292000 (USGS 1982). Tick marks along the horizontal axis refers to the first day in respective months.

temperatures for surface and intragravel water temperatures recorded with datapods. The thermograph data presented in Appendix A include mean, minimum and maximum temperatures for three intervals; six-hour, daily and monthly.

The data indicate that the intragravel temperatures in the sloughs are warmer and more stable during the ice-covered season than the surface water temperatures. The plots for Slough 21 (Figures 2-11 and 2-12) and Slough 9 (Figure 2-6) show this phenomenon well. Figure 2-7 shows that this stabilizing effect is occurring even when only one inch of silt is present. For example, when the surface water probe was silted in, the surface and intragravel temperature are nearly the same, but they changed as soon as the probe was uncovered. The temperature plots for the mainstem site, LRX 29 (Figure 2-4) and Susitna River at Gold Creek (Figure 2-8) illustrate that, at the depths measured, this warming and stabilizing effect is very weak or absent in mainstem intragravel water.

Sediment deposition effects

Although intragravel water temperatures were generally warmer in winter than were surface water temperatures, the relationship between the two water sources varied between sloughs. For example, at the mouth of Slough 21 (Figure 2-11) there was considerable variation in surface water temperatures but relatively little variation in the intragravel water temperatures. In contrast, there was a close correspondence between both the temperature and the pattern of variation in surface and intragravel water temperatures in Slough 8A Upper (Figure 2-5) and Slough 19 (Figure 2-10). Reasons for differences in the relationship of surface to intragravel water temperature in different sloughs may be related to the relative magnitude of, and the proximity of individual datapod probes to upwelling groundwater sources. Probes placed directly in a groundwater upwelling source would undoubtedly be less variable and show a weaker relationship to surface water temperatures than would intragravel temperatures obtained from a datapod located in an area with little or no upwelling groundwater present.

2.4 Discussion

need to relate intragravel [illegible] upwelling

Temperatures monitored at spawning sites within the sloughs were found to have warmer intragravel temperatures than surface water temperatures during the winter. This phenomenon allows more rapid development of alevins and eggs because of the additional available thermal units. Mainstem intragravel temperatures more closely resembled the mainstem surface temperatures with intragravel temperatures near zero during most of the winter. This difference may explain the limited mainstem spawning and the use of sloughs by chum and sockeye salmon although other factors such as substrate stability, velocities, sediment deposition, etc. may also be important factors. Altered post project temperatures need to be evaluated as to their effect on the sloughs (indirect effects) as well as determining their effect on the potential for mainstem spawning of the slough spawning species as well as the tributary spawners. This analysis will aid in determining the extent of the temperature related impacts on each salmon species, both negative and positive.

Seems that [illegible] closer [illegible]

The effect of surface water temperatures on intragravel temperatures during overtopping events is an area that needs to be more rigorously quantified. If cold water from the mainstem Susitna River overtops the heads of sloughs and depresses the temperature of the intragravel water, this could lead to delayed hatching and emergence of alevins. In Sloughs 9 and 21 (upper) (Figures 2-6 and 2-12) the overtopping event in May, 1983 resulted in lowered intragravel temperatures. However, the magnitude of the effect in Slough 9 (Figure 2-6) was relatively small compared to that in Slough 21 (upper).

3.0 SALMON INCUBATION AND EMERGENCE STUDIES

When an adult salmon selects a site for spawning, it is selecting an environment defined by a composite of physical, chemical, and hydraulic variables, each of which may influence the incubation process independently or in combination with other variables. Some primary physical variables known to influence incubation include temperature and dissolved oxygen as well as size composition, permeability, and porosity of the substrate (Reiser and Bjornn 1979). Additional factors such as channel gradient and configuration which affect water depth and velocities may also influence the environments don't incubate incubating environment, depending upon the degree of exchange between surface water and intragravel water (Reiser and Bjornn 1979).

Because chum salmon (*Oncorhynchus keta*) and sockeye salmon (*O. nerka*) generally deposit their eggs less than one foot deep in the substrate, reference? the incubation environment is influenced by both extragravel and intragravel conditions with the relative influence of either set of variables being dependent upon the degree of exchange of water between them. Factors which control the exchange of water include stream surface profile, gravel permeability, gravel bed depth, and irregularity of the streambed surface (Vaux 1962).

Because of the interrelationships of many physical and chemical variables, construction of the Susitna hydroelectric dams may impact spawning, incubation, and overwintering environments of fish indigenous to the Susitna River drainage. Hydrological changes which are expected

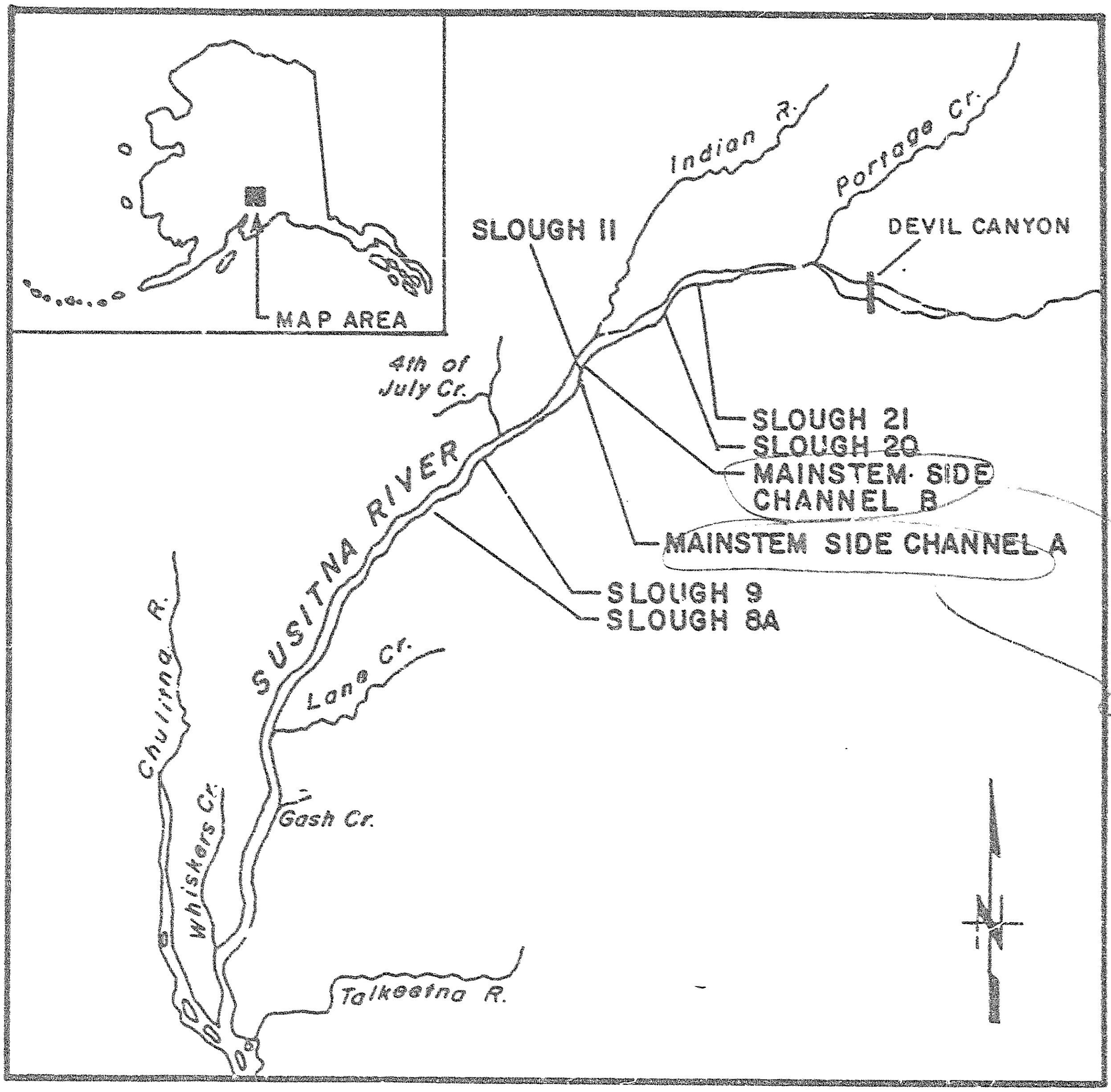
maybe yes
maybe no
it depends

delving into impact assessment w/out substantiation

to result from the proposed project include decreased and stabilized flows during the open water periods, increased flows in the winter, and a marked change in seasonal water temperatures. These alterations could affect sand bar formation, sedimentation layering in sloughs and side channels, and water levels in existing sloughs. Such alterations could potentially destroy spawning sites and/or incubating embryos (Cooper 1965; Baxter and Glaude 1980). In addition, changes in micro-habitat such as lower or higher intragravel temperatures and changes in the concentration of dissolved gases during this incubation life stage could affect development rates (Combs 1965; Childerhose and Trim 1979; Baxter and Glaude 1980; Heming 1982), the amount of time required for completion of incubation of salmon embryos (Velson 1980), and the timing of emergence (Burgner 1958). Increases in post-project water temperatures during winter could accelerate development and cause the emergence of salmon fry before the environment is favorable for their survival. Changes in stage caused by increased discharge or by ice processes may also alter temperatures in slough or side channel spawning grounds by causing mainstem water to breach slough heads.

Kelly - get the references we don't have

Because of these and other potential impacts on the survival of the early life stages of the upper Susitna River salmon stocks, incubation conditions were studied at spawning sites in selected sloughs and side channels of the Susitna River above the Chulitna River confluence (Figure 3-1). Chum and sockeye salmon are the primary users of sloughs for spawning (ADF&G 1983a). Chum salmon are reported to actively select upwelling areas for spawning (Kogl 1965; Bakkala 1970). The 1981-82



[illegible]

Figure 3-1. The location of seven incubation and emergence study sites on the Susitna River between the Chulitna River confluence and Devil Canyon, August 1982 through April 1983.

winter studies provided preliminary data on the emergence time of chum salmon and sockeye salmon. A more detailed study was implemented during the 1982-83 winter program to address the following objectives.

3.1 Objectives

1) Measure levels of intragravel and surface water temperature, dissolved oxygen, pH, and specific conductance at chum and sockeye salmon redds and in upwelling areas of sloughs where chum salmon spawned in 1982.

2) Determine the timing of embryonic development and emergence under natural conditions for chum and sockeye salmon.

In conjunction with this project, the U.S. Fish and Wildlife Service (USFWS) conducted a related study in a laboratory environment to document rates and stages of development of chum and sockeye salmon embryos at four different temperature regimes (Wangaard and Burger 1983). The eggs used in the USFWS lab study were collected from Slough 11 (RM 135.3).

3.2 Methods

Certain environmental variables known to affect salmon incubation were monitored at several spawning sites. Salmon incubation and emergence studies were conducted at some, but not all, of these sites. Analysis of the habitat data with regard to incubation rates was restricted to thermal effects.

3.2.1 Study sites

Sampling sites for incubation and emergence studies were selected during September, 1982, utilizing the following criteria:

all or some of ?

1) documented salmon spawning;

2) site accessibility during the winter survey period;

3) water depth shallow enough for good visibility and for ease of sample collection;

4) areas where open water was present during past winters.

Sites included sloughs 8A (RM 125.3), 9 (RM 129.2), 11 (RM 135.3), 20 (RM 140.1), and 21 (RM 142.0), and Mainstem side channels A (RM 136.2) and B (RM 137.3) (Figures 3-2 to 3-8). Indian River (RM 138.6) was sampled once during the fall, but ice formation and re-channeling prevented further sampling. Four of these sloughs (8A, 9, 11, and 21) have been heavily utilized by spawning chum and sockeye salmon during the last two years.

Standpipes were installed in these same four sloughs to allow sampling of the intragravel environment. Standpipe locations were selected to

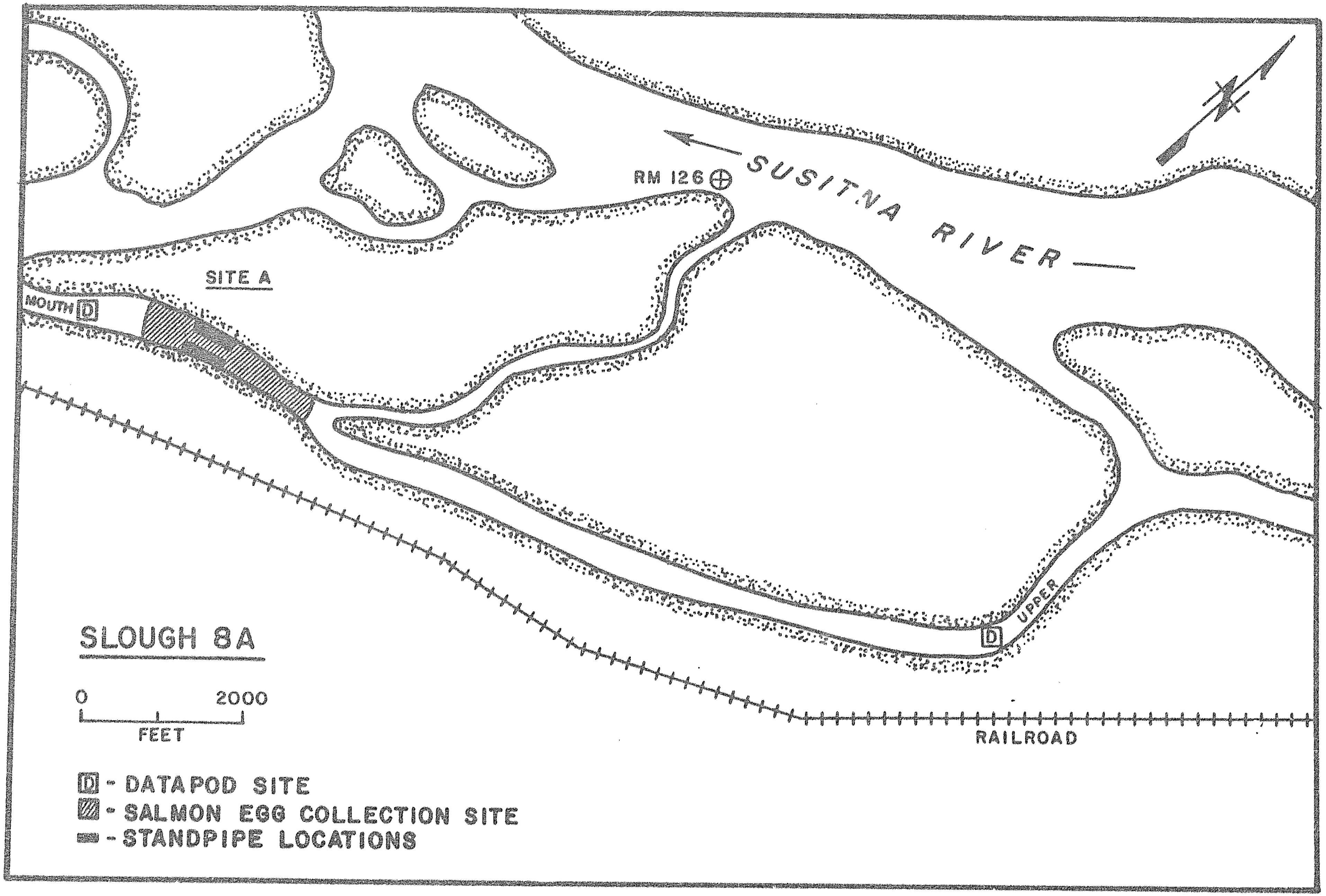


Figure 3-2. Incubation and emergence study site at Slough 8A (RM 125.3).

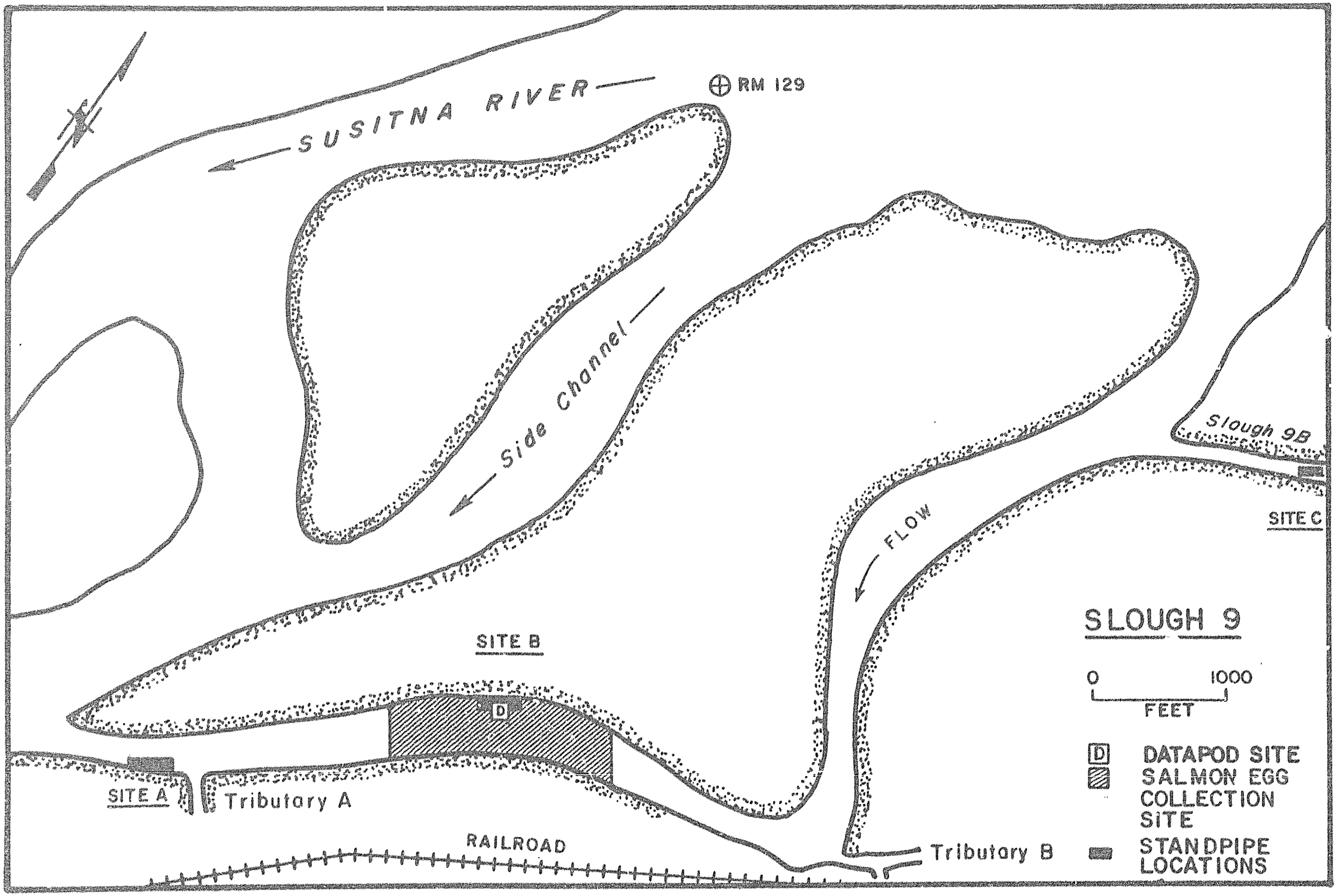


Figure 3-3. Incubation and emergence study site at Slough 9 (RM 129.2).

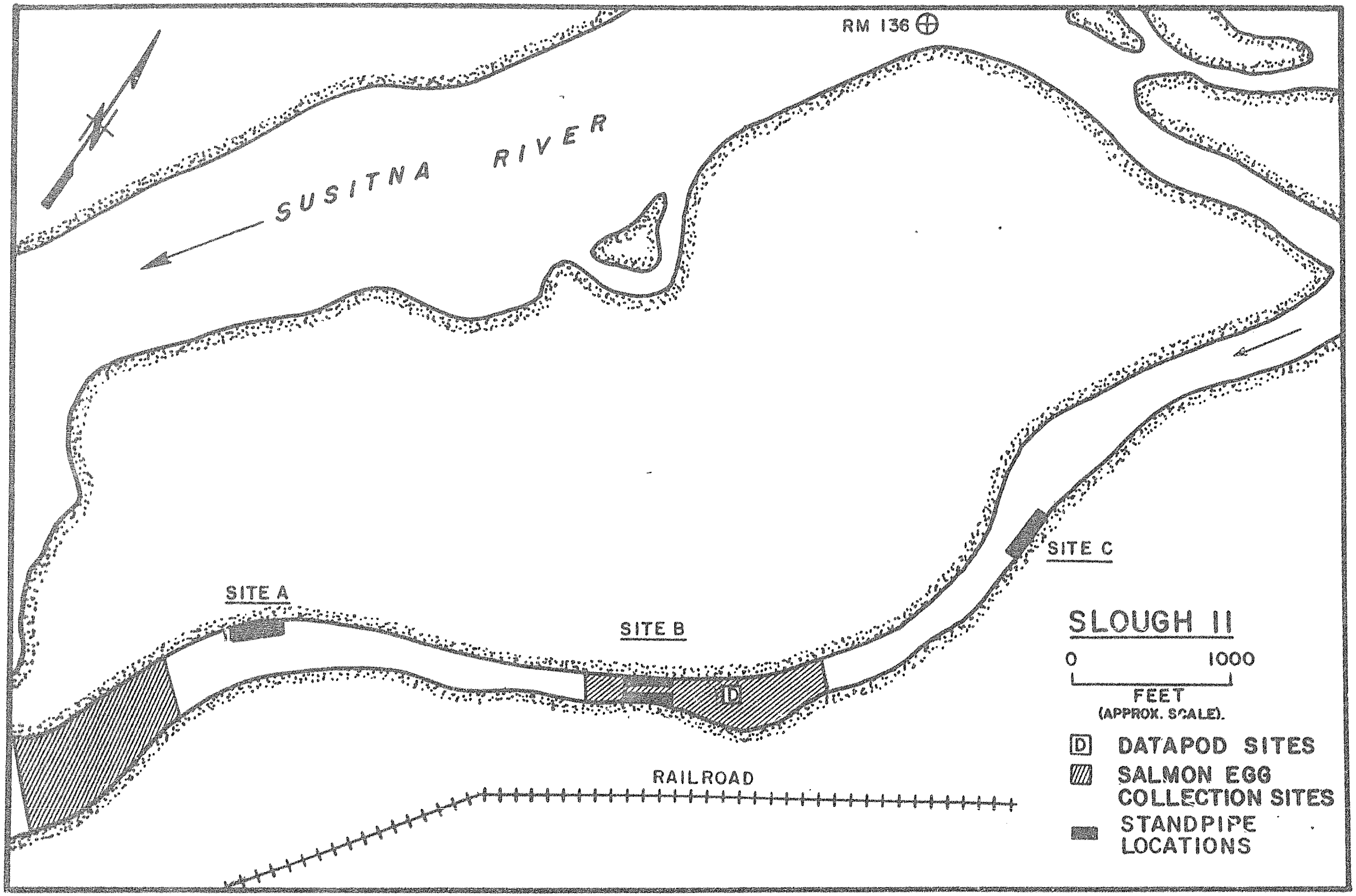


Figure 3-4. Incubation and emergence study site at Slough 11 (RM 135.3).

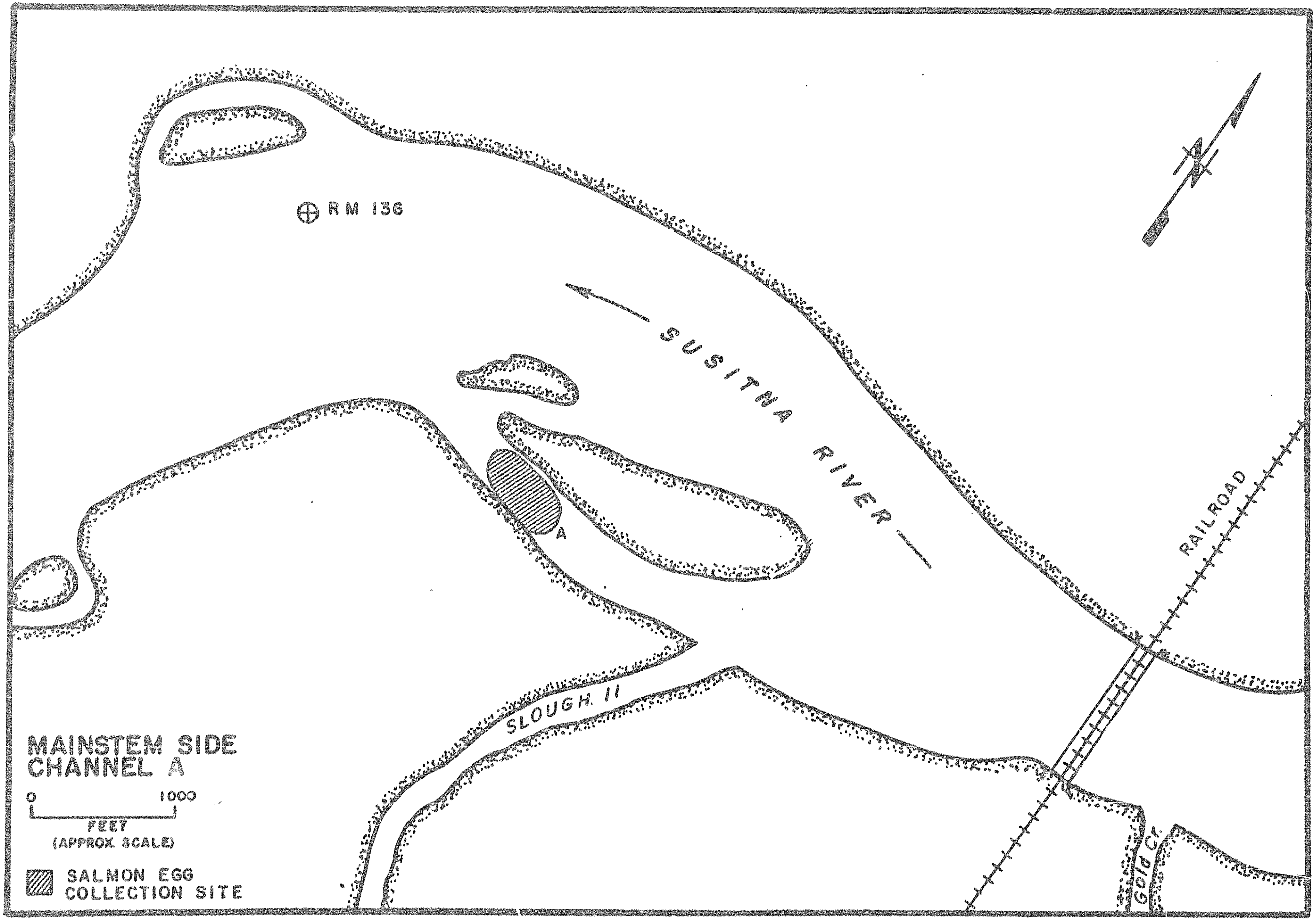
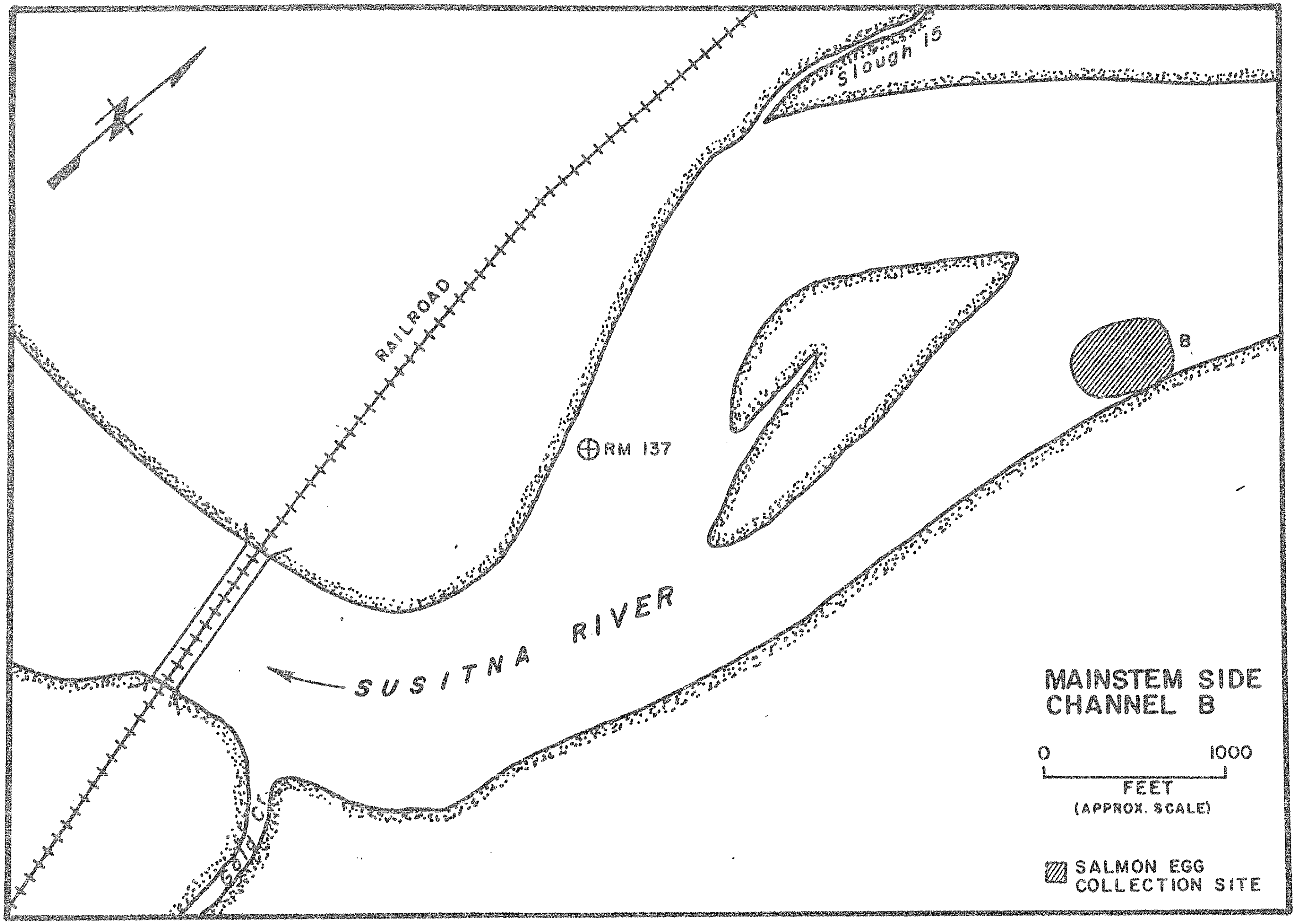


Figure 3-5. Incubation and emergence study site at Mainstem Side Channel A (RM 136.2).



Figuer 3-6. Incubation and emergence study site at Mainstem Side Channel B (RM 137.3).

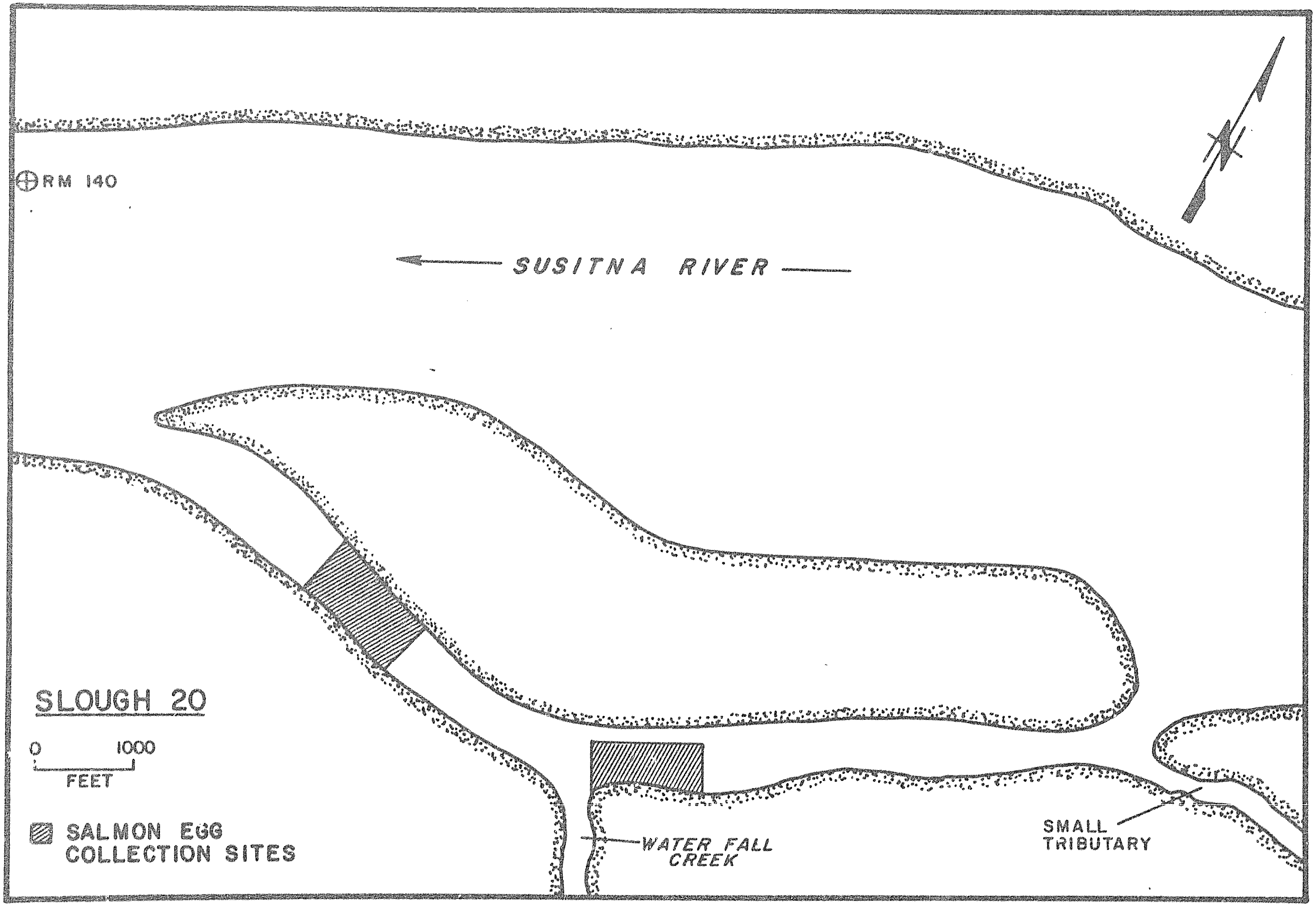


Figure 3-7. Incubation and emergence study sites at Slough 20 (RM 140.1).

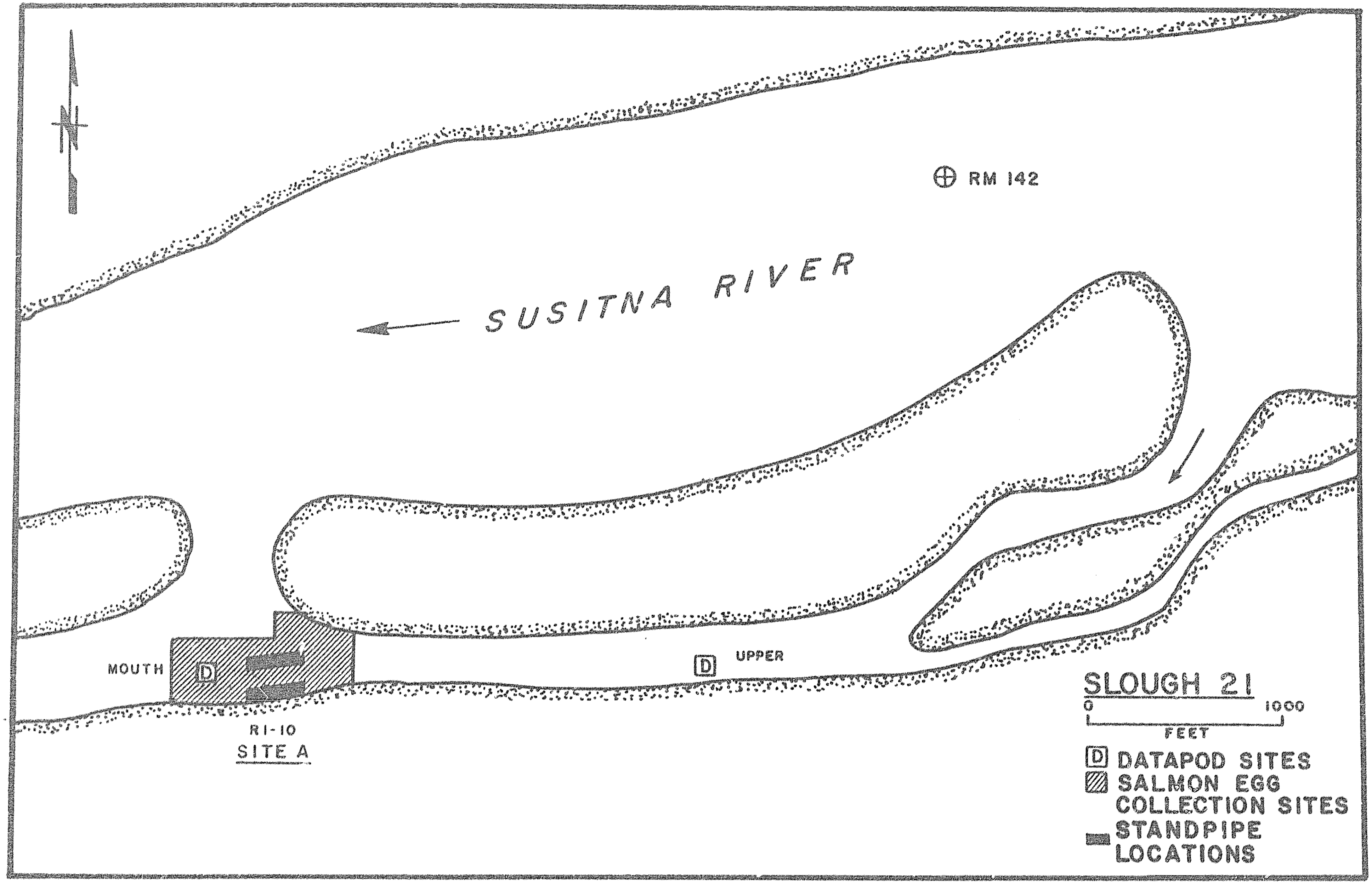


Figure 3-8. Incubation and emergence study site at Slough 21 (RM 142.0).

compare intragravel water quality conditions among study sloughs and between left and right banks within study sloughs. Because the origin of the water upwelling to respective banks of sloughs is presently unknown, standpipes were placed in narrow strips zones (5.0 feet wide) along the banks of each slough to test for water quality differences between the respective banks. Differences in water quality between banks was assumed to represent differences in water sources. Placement of standpipes in this manner allowed data collected to be used to describe fish spawning habitat and to test for differences in water quality between banks. All of these sloughs are located on the right bank (facing upstream) of the mainstem Susitna River. This presents the possibility of slough left bank ground water sources originating from the river and right bank ground water originating from the mountains. ??

What Mountains? I never saw any out there

In March of 1983, 10 standpipes were placed in each of the two sampling locations (one sampling location on each bank) in sloughs 8A, 9, 11, and 21 (Figures 3-2, 3-3, 3-4, and 3-5, respectively). Additional standpipes were later placed in sloughs 11 and 9B. (For purposes of this study, Slough 9B is considered to be a part of Slough 9). Each sampling site was a rectangular area 50 to 100 feet in length (measured along the slough bank) and five feet in width (measured from the water's edge at time of sampling). Pipes were installed at random locations within each designated sampling site, provided that the water depth was within the range of 0.2 - 1.8 ft. The criteria used to select each sampling location within a slough included the above criteria, with the following additions: at least one sampling location per slough was located in a pool habitat where fish had spawned during the fall of

1982, and where upwelling groundwater was known to occur. Generally, these areas were totally free of ice or contained localized patches of open water (Plate 3-1). If upwelling groundwater occurred along both banks of a slough at a single spawning area, a sampling location was established along each bank. If upwelling groundwater did not occur along both banks of a slough at a single spawning area, but was only present along one bank (as in Slough 9, site B), a sampling location was established in the nearest suitable location on the opposite bank where upwelling occurred.

3.2.2 Sampling techniques for habitat measurements

3.2.2.1 Water Temperature

Continuous intragravel and surface water temperatures were recorded in the sloughs from August, 1982 through May, 1983. Locations of the recording instruments and methods are described in Section 2.0.

3.2.2.2 Standpipes

Standpipes were used to sample the intragravel environment during two sampling periods; the first period was April 15-18, and the second period was April 29 - May 2.

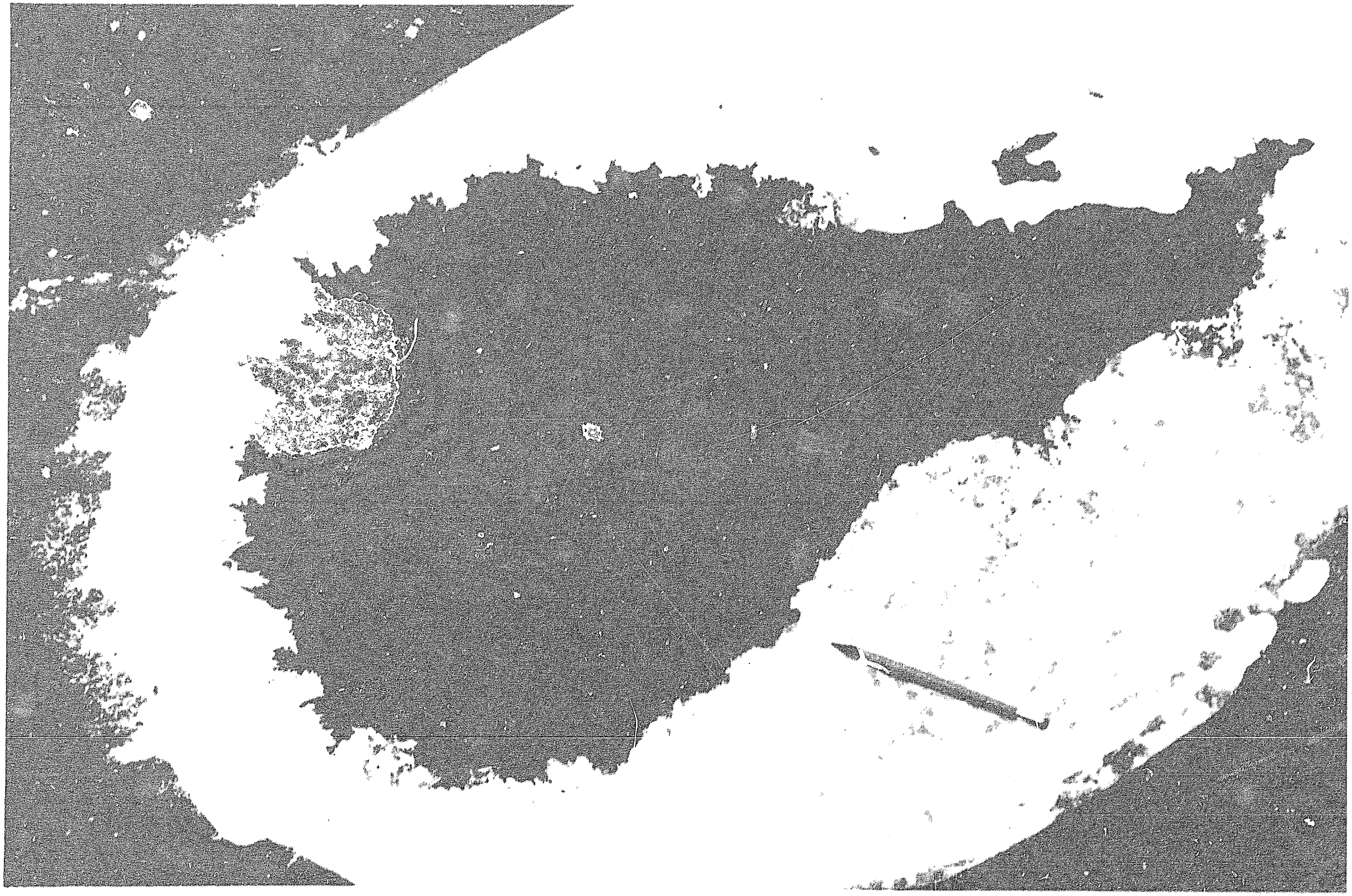


Plate 3-1. Upwelling area in slough. Opening in ice cover indicates higher temperature of upwelling water.

Standpipe design and installation

Measurements of dissolved oxygen, temperature, specific conductance and pH were made inside and outside of plastic polyvinyl chloride (PVC) standpipes that were driven into the streambeds (Plate 3-2). Standpipes were driven into the substrate to a uniform depth of ten inches using a driving rod and sledge hammer (Plate 3-3). The design of the driving rod and standpipe were modified from previous designs (Gangmark and Bakkala 1959; McNeil 1962). The standpipes had the advantages of being relatively inexpensive and easy to install (Figures 3-9 and 3-10). The inside diameter of each standpipe was 1.5 inches (3.8 cm) and contained 48 holes (1/8-inch-diameter; 0.3 cm) that were evenly spaced in four bands (12 holes per band). The four bands were spaced one inch (2.5 cm) apart with the lowest band being placed three inches (7.6 cm) from the bottom of the standpipe.

Each standpipe was pounded into the substrate to a maximum depth of 14.5 inches (36.8 cm), centering the (bands of) holes ten inches (25.4 cm) into the substrate. This depth was selected because ten inches (25 cm) is the estimated mean depth at which chum (Kogl 1965; Merritt and Raymond 1982; Kent Roth pers. comm.) and sockeye salmon (Cooper 1965; Olsen 1968) place their eggs.

After the standpipes were properly installed, a cork/weight assembly was placed inside each standpipe to aid in removal of ice plugs formed during freezing weather conditions (Figure 3-10). This assembly consisted of a weight and cork that was attached by a nylon cord to a

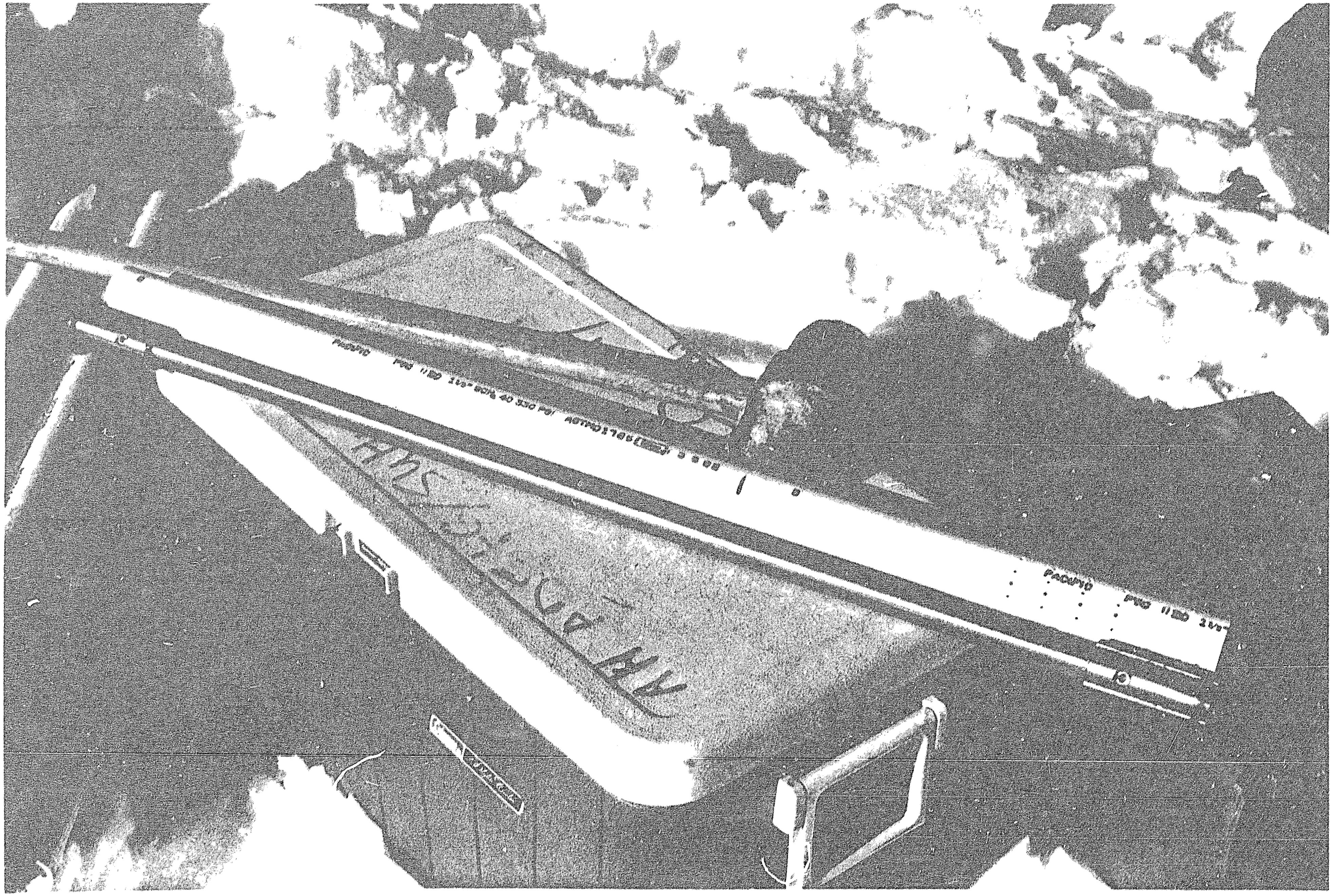


Plate 3-2. Standpipe (with 48 one-eighth inch holes) used for monitoring intragravel water quality and driver used for installation.

Plate 3-3. Installation of standpipes for monitoring of intragravel water quality in Slough 11.

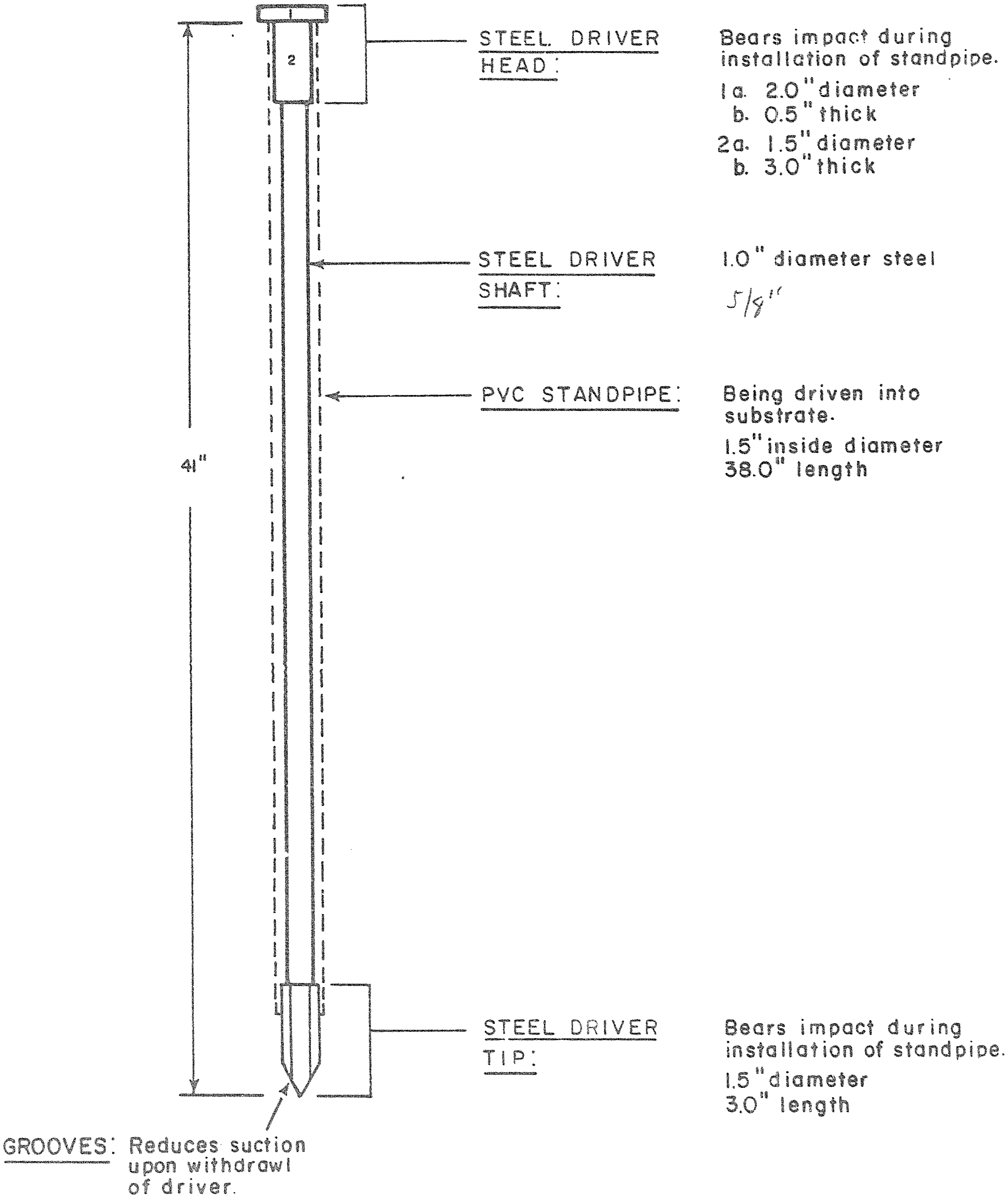


Figure 3-9. Scaled drawing of the steel driver used to install polyvinyl chloride (PVC) standpipes into gravel substrates.

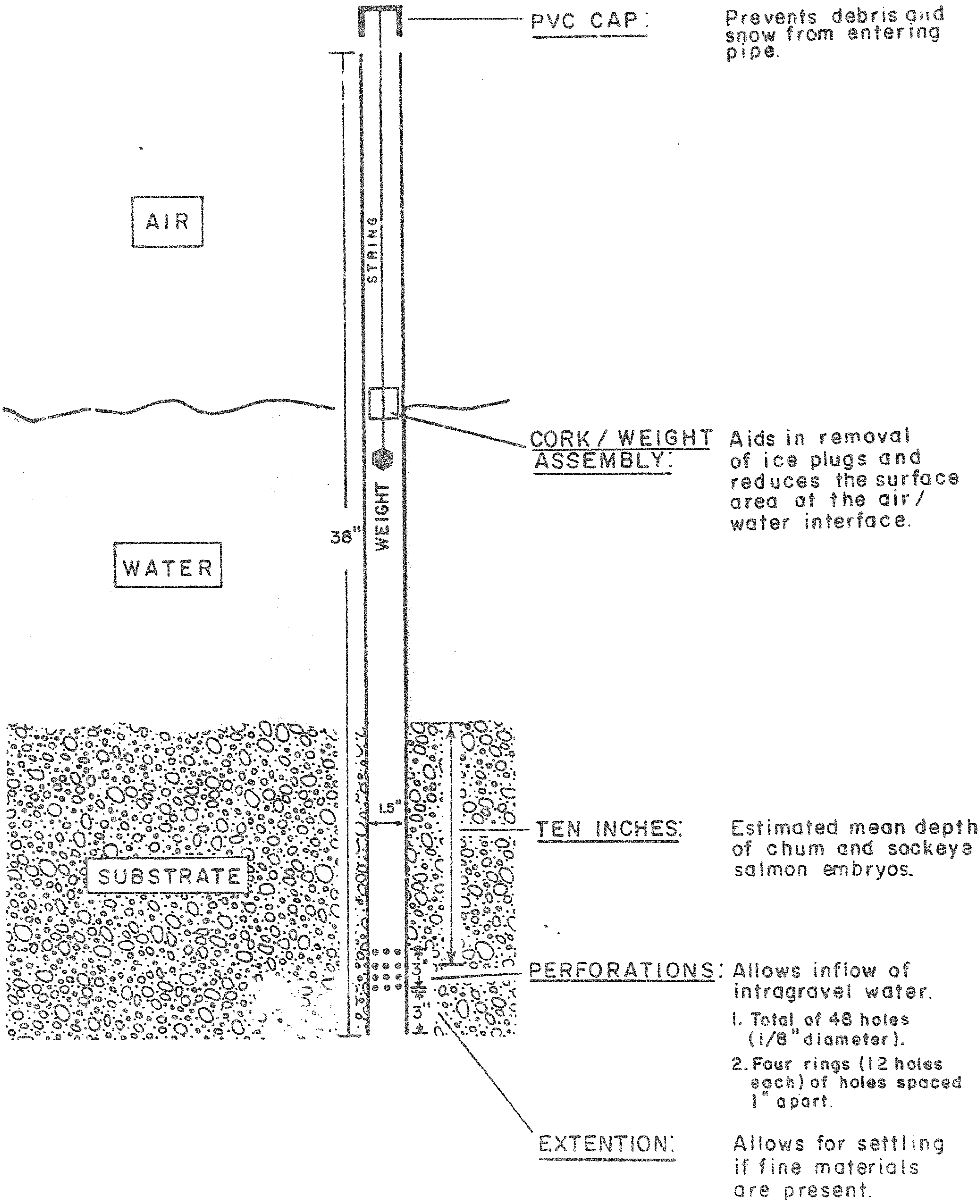


Figure 3-10. Diagram of a polyvinyl chloride (PVC) standpipe installed in substrate.

cap which covered the exposed end of the pipe. The cork floated at the air/water interface and reduced the amount of surface area available for oxygen transfer. It also served to station the weight in a position that caused it to be frozen in the ice plug. Ice plugs were removed by gently heating the exterior of the PVC pipe at the water surface with a propane torch while exerting upward pressure on the pipe cap. After a few minutes of heating the cork/weight assembly and attached ice plug was easily withdrawn.

Can they demonstrate (w/data or literature citations) that the exposed water surface didn't bias DO readings?

Procedures for the measurement of water quality

Following the initial installation of standpipes, sampling was delayed for a minimum of 24 hours. This allowed substrate materials to resettle. Following the resettling period, sampling at each standpipe was conducted after the interior of the standpipe was pumped out using a hand-diaphragm pump (manufactured by PAK of JABSCO; Springfield, Ohio 45501; moc 5800-000) to remove fine sediments that settled inside the standpipe. This procedure ensured that the water that refilled the standpipes was from a fresh source and that the water samples could be obtained at the desired depth in all standpipes.

After water refilled the standpipes and a minimum of one hour had elapsed, measurements of temperature, dissolved oxygen (DO), specific conductance and pH were obtained within each standpipe. In addition, corresponding measurements were obtained approximately halfway between the substrate and water surface beside each standpipe. The minimal elapse time (one hour after pumping standpipes) was allowed to ensure that all standpipes refilled to their original level. Preliminary tests indicated that there were no differences between concentrations of DO collected inside standpipes before pumping and after one, two, and four hours after pumping.

The following procedures were used to obtain measurements of water temperature, DO, specific conductance, and pH.

Temperature

Temperature measurements in standpipes were obtained with the Yellowsprings Instrument (YSI) model 57 dissolved oxygen/temperature meter according to procedures presented in the manufacturer's operations manual.

Dissolved oxygen

Dissolved oxygen measurements were obtained using a YSI model 57 dissolved oxygen/temperature meter. The meter was calibrated following the procedure described in the procedures manual (ADF&G 1983e).

Preliminary data indicated that calibration of the YSI meter was only accurate to ± 0.5 mg/l. This level of accuracy applies to comparisons of data obtained at different sampling locations within a given sampling period and between data sets obtained at the same location during different sampling periods. For a given sampling location and a given sampling period, the error is estimated to be ± 0.1 mg/l. Results should be interpreted accordingly.

is this not on the data sheet itself?

After the meter was calibrated, measurements were collected by lowering the probe inside the standpipe to the desired depth (10.0 inches). After lowering to the proper depth the probe was gently agitated to ensure circulation of water over the membrane and measurements were recorded when the meter indicator stabilized.

The meter and all chemicals were kept inside an ice chest equipped with handwarmers to prevent them from freezing. If movement of the meter was required to sample standpipes at another location, the meter was hand carried by foot or in a helicopter. If transport was required by snowmachine, the instrument was recalibrated upon arrival at the next sampling location.

Specific conductance

Specific conductance ~~were~~ was measured with a YSI model 33 S-C-T meter according to procedures presented in the manufacturer's operations manual. Because factory calibration of this meter was not always reliable or possible prior to field use, a calibration curve was developed over the full range of values expected to be encountered during measurement. The calibration curve was developed by comparing specific conductance values obtained with the YSI meter to those obtained with a calibrated Hydrolab meter, model 4041. All values measured in the field were later adjusted on the basis of the calibration curve.

Why was this the standard? what [illegible] its own [illegible]

Because readings obtained with the YSI meter are not temperature-compensated to 25°C, all readings were temperature-compensated to 25°C using procedures presented in Standard Methods (APHA 198 .

Specific conductance data were used to compare water quality between sloughs and between left and right banks within sloughs. Specific conductance was selected for this purpose because it is generally regarded as an index to total concentration of dissolved ionic matter, which in turn is related to water fertility (Lind 1974). Therefore, it is useful to detect water originating from different sources. In addition, this variable had a much larger range in variation than other variables measured and therefore was expected to be more sensitive to differences in water quality between locations. A two way analysis of variance (ANOVA) was performed on specific conductance data using a statistical program provided by the Statistical Package for Social Sciences (SPSS) (Nie et al. 1975; Hull and Nie 1981). Data collected at different sampling sites within a given slough were merged. Only data obtained from intragravel water was used because the primary interest was to evaluate water sources. Only data from the second sampling period (April 29 - May 2) was used because it was the most complete.

pH

Measurements of pH were obtained at a substrate depth of 10.0 inches with a YSI model 5985-40 pH meter. Standard procedures presented in the manufacturers operations manual were used. The meter was calibrated prior to use using buffer standards of pH 4.0 and 7.0.

3.2.3 Sampling techniques for embryo development study

Egg sampling was conducted once a month, from September, 1982, through May, 1983. A Homelite gas-powered water pump was modified into an egg pump for sampling the redd sites. A two-foot high by two-foot diameter circular screen, open on both ends with an attached ¼-inch mesh catch sack, was used to collect the eggs and alevins during the pumping operation (Plate 3-4). A shovel was used in addition to the egg pump to collect samples at some sites. Samples were preserved in five percent formalin for later visual determination of developmental stages through use of a dissecting scope.

Intragravel and surface water temperatures were also measured at salmon redds, beginning in December, using a YSI 400 series semi-solid insertion probe (3.0 feet in length) attached to a hand-held Digi-Sense thermometer which enables a temperature measurement at the precise location of the tip of the probe. Each intragravel temperature was obtained by inserting the probe tip approximately six inches into the substrate (at the point where embryos were sampled) and noting the displayed temperature. Three to five readings were taken and the mean reading recorded.

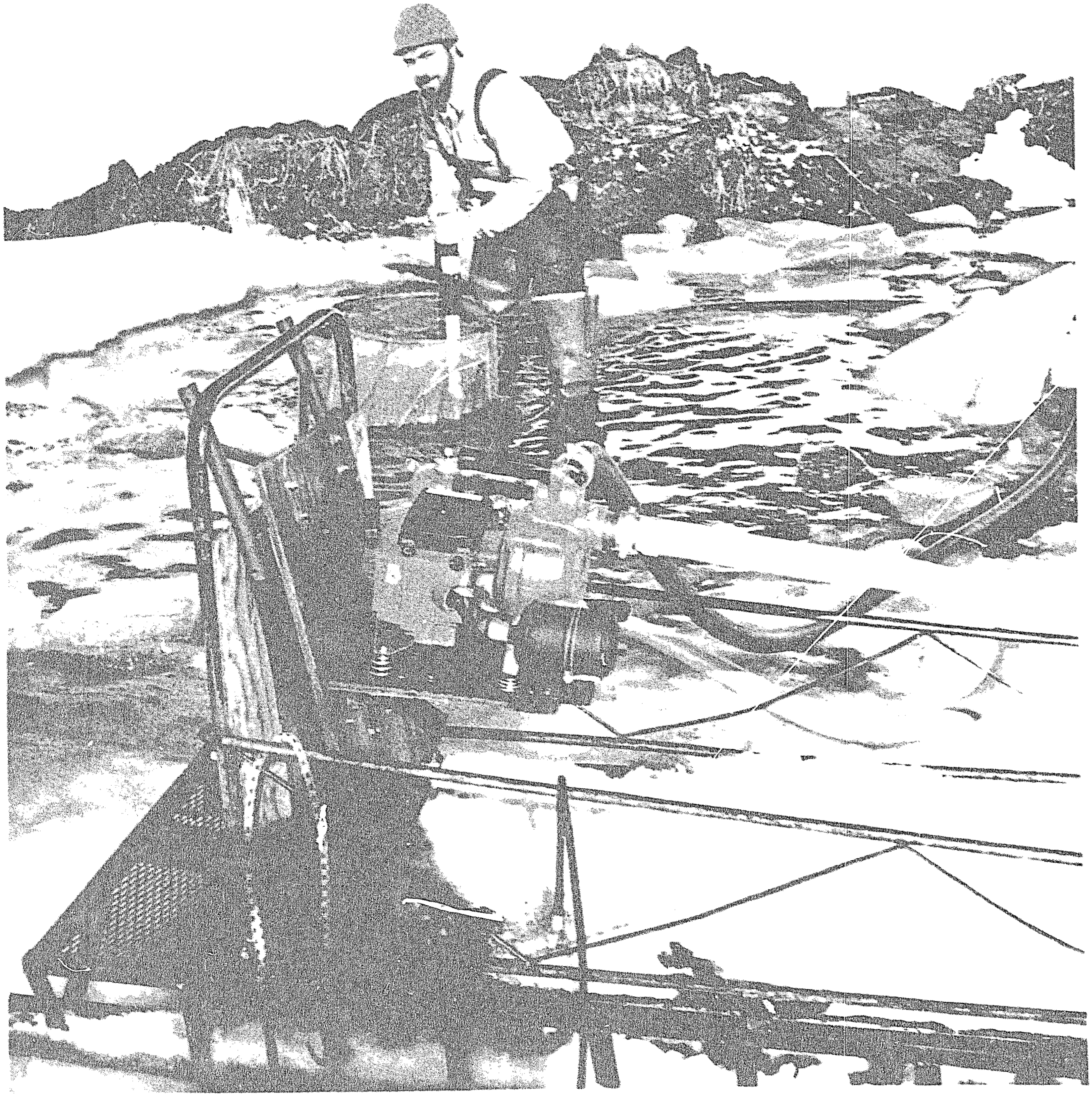


Plate 3-4. Egg pumping for chum and sockeye salmon eggs during the winter studies at Slough 21 (RM 142.0).

3.3 Results

3.3.1 Temperature and other habitat data

Continuous surface and intragravel temperature data from the Datapod recorders were presented in Section 2.

Preliminary scatter plots were made to allow preliminary comparison of data obtained within standpipes to data obtained from corresponding surface water samples. Comparisons were made for each variable by slough and sampling period. These plots were used to determine if a relationship existed between the two water sources. Although a clear relationship could not be demonstrated in every plot, in several instances there appeared to be a direct relationship between the two water sources. These plots have not been presented in this document due to their preliminary nature, but are available upon request from the ADF&G Su Hydro Office, Anchorage, AK.

Mike K lets ask for them

The strength of the various relationships are undoubtedly influenced by the magnitude of water exchange between the surface and intragravel environments. This in turn is influenced by the relative amount of downwelling or upwelling at the specific sampling sites. For the purposes of this report, it is sufficient to note that the two water sources are related to varying degrees, and that the placement of standpipes in future studies should take this into account.

how can we judge this without having the plots

3.3.1.1 Temperature

In each of the four sloughs, mean intragravel temperatures collected in standpipes during a given sampling period, were consistently lower than means of surface water. Considering all sloughs for both sampling periods (first sampling period was April 15-18 and second sampling period was April 29 - May 2) (Appendix Table B-4), mean values for intragravel waters ranged from a low of 2.0°C (first period; Slough 8A) to a high of 4.3°C (second period; Slough 11). Corresponding surface water temperatures were higher, ranging from a low of 3.0°C (first period; Slough 8A) to a high of 8.2°C (second period; Slough 11). This relationship is inverse to the general winter trend of intragravel water temperatures being higher than surface water temperatures. This is because these data were collected during late April and early May when surface water temperatures were beginning to increase, see Figures 2-2 through 2-14 for graphic illustrations of this.

Relatively large differences between early and late sampling periods for both surface and intragravel water are undoubtedly related to the variable environmental conditions at the time these data were collected. Spring thaw conditions were beginning during the first period and were well advanced during the second sampling period. The ranges of intragravel temperatures are much greater than the ranges of surface water temperatures as well as being lower as seen in Figures 3-11 and 3-12. This indicates that water inside the standpipes contained a mixture of ground water and surface water.

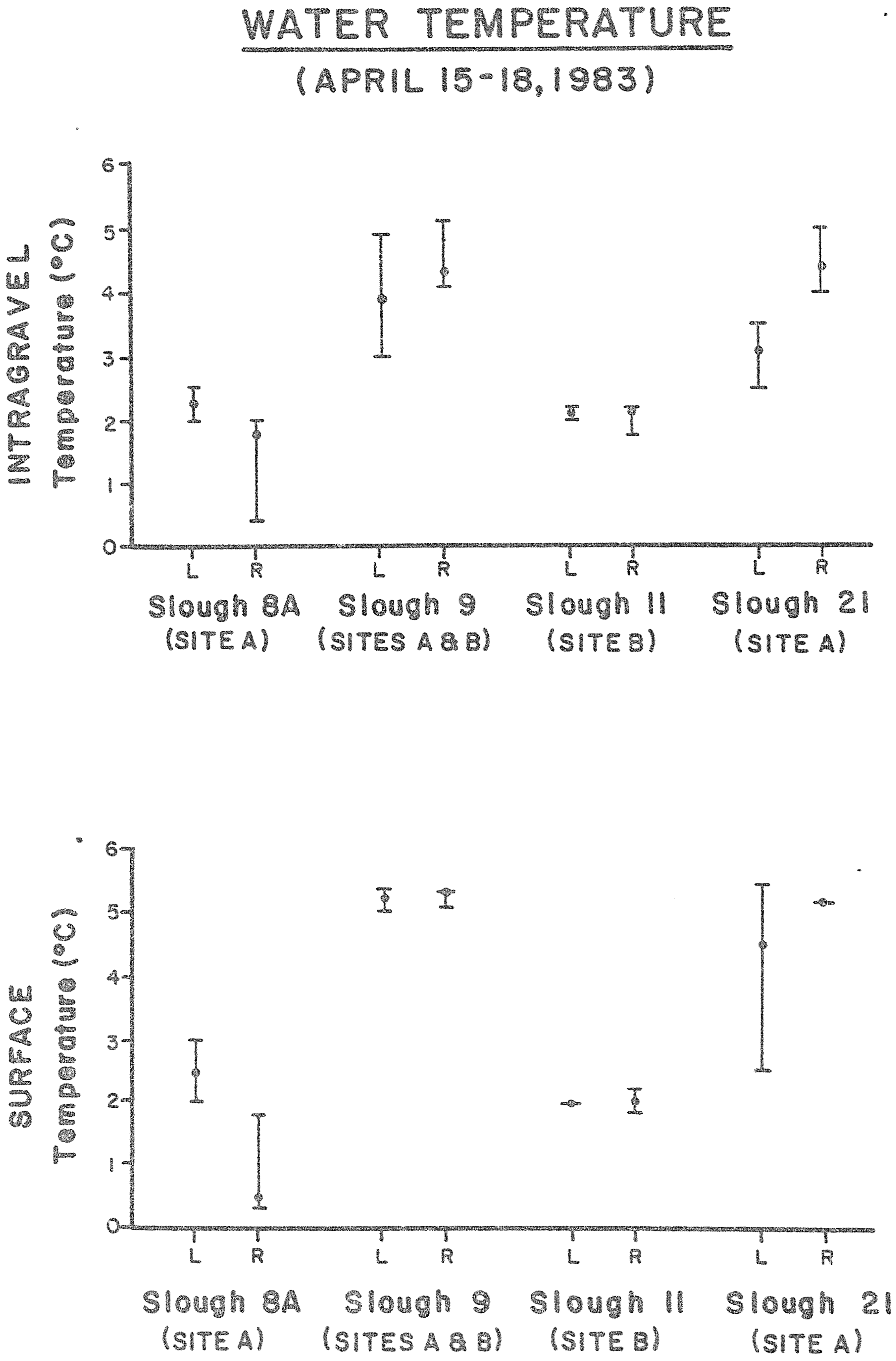


Figure 3-11. Summary (mean and range; n=10) of intragravel and corresponding surface water temperature data collected along left (L) and right (R) banks (looking upstream) of sloughs 8A, 9, 11 and 21, Susitna River, Alaska, spring (April 15-18), 1983.

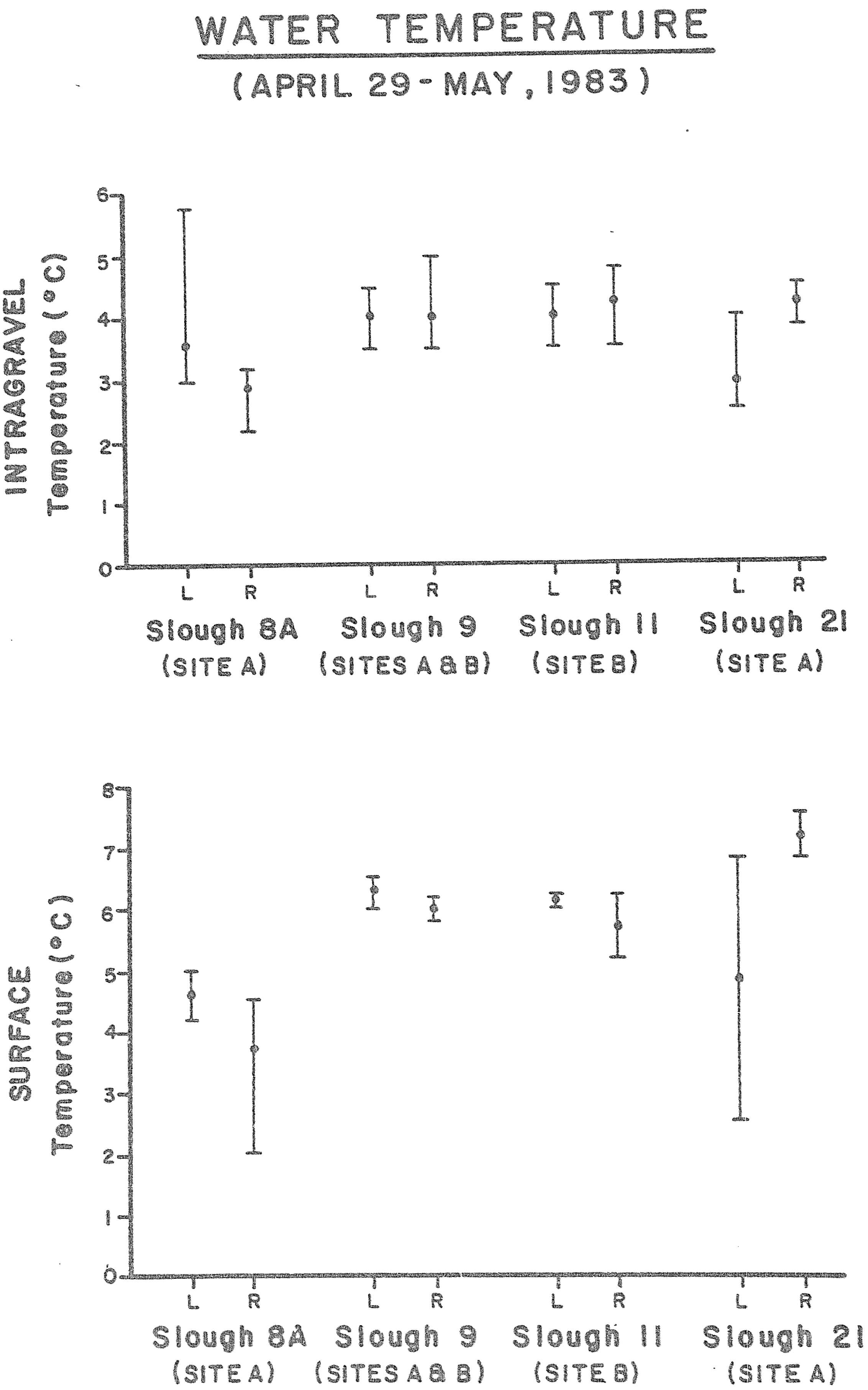


Figure 3-12. Summary (mean and range) of intragravel and corresponding surface water temperature data collected along left (L) and right (R) banks (looking upstream) of sloughs 8A, 9, 11 and 21, Susitna River, Alaska, spring (April 29- May 2), 1983. (n=10 for each mean except for Slough 21, left bank, where n=9).

Summaries of the mean water temperature data for the two sampling periods are presented in Figures 3-11 and 3-12. There appears to be no consistent relationship between the mean temperatures obtained at left bank sites compared to right bank sites. In some instances means for right bank sites were higher (e.g. Figure 3-12; Slough 21) and in other sloughs the reverse was true (e.g. Figure 3-12; Slough 8A). However, with the exception of Slough 11 during the second sampling period (Figure 3-12) the relative positions (higher or lower) of mean temperatures for both banks within a given slough remained the same for both intragravel and surface waters and between sampling periods.

With the possible exception of the mean temperature for the right bank site in Slough 8A during the first sampling period (Figure 3-11), all remaining temperature values are within acceptable ranges for salmonid incubation. The atypical temperatures at the Slough 8A site were probably due to the influence of melting ice. Standpipes in Slough 8A were located along the edge of a thick (12-18 inches) ice sheet that was thawing at the time of sampling.

Which are? How attained?

3.3.1.2 Dissolved oxygen

In each of the four sloughs, mean concentrations of intragravel dissolved oxygen (DO) collected within a given sampling period were consistently lower than mean concentrations for surface water (Appendix Table B-4). Considering all sloughs for both sampling periods, DO concentrations in surface waters in each slough ranged from a low of 9.1 mg/l (April 15-18 period; Slough 21) to a high of 11.2 mg/l (April 29 -

May 2 period; Slough 8A). Means for intragravel measurements ranged from a low of 4.6 mg/l (first and second periods; Slough 8A) to a high of 8.5 mg/l (first period; Slough 11). In each case, the difference in mean DO concentrations between the first and second periods was much less than the difference between means for intragravel and surface waters. These trends are summarized in Figures 3-13 and 3-14 for the first and second sampling periods, respectively.

In Figures 3-13 and 3-14, DO levels are shown for left and right banks within each slough. With the exception of Slough 9 (refer to Figure 3-14) mean values for intragravel water collected along the right bank, were consistently higher than those collected along the left bank.

Mean concentrations of DO for surface water were nearly the same between all sloughs and between sampling periods (Figures 3-13 and 3-14). In contrast, mean intragravel water DO concentrations were variable between sloughs, being lowest in Slough 8A and highest in Slough 11. Intragravel DO concentrations were also more variable at a given location than those of the corresponding surface water. Intragravel DO levels in sloughs 9 (left bank) and 21 appear to be adequate for successful incubation of salmonids according to the threshold of 6.0 mg/l recommended by McNeil and Bailey (1975) for artificial incubation conditions. However, DO concentrations in Slough 8A and at the right bank site in Slough 9 are below this recommended level.

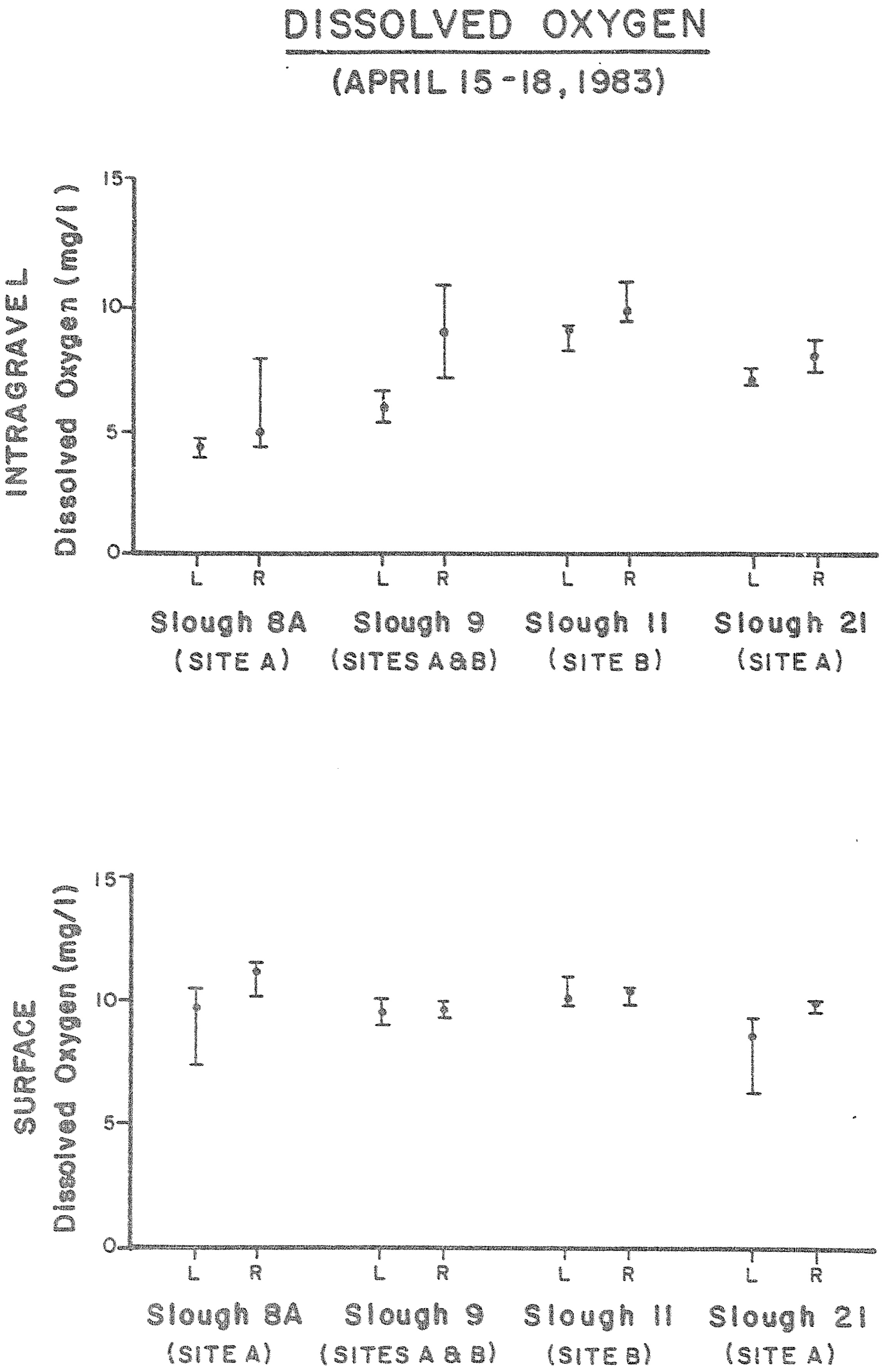


Figure 3-13. Summary (mean and range; n=10) of intragravel and corresponding surface water dissolved oxygen data collected along left (L) and right (R) banks (looking upstream) of sloughs 8A, 9, 11 and 21, Susitna River, Alaska, spring (April 15-18), 1983.

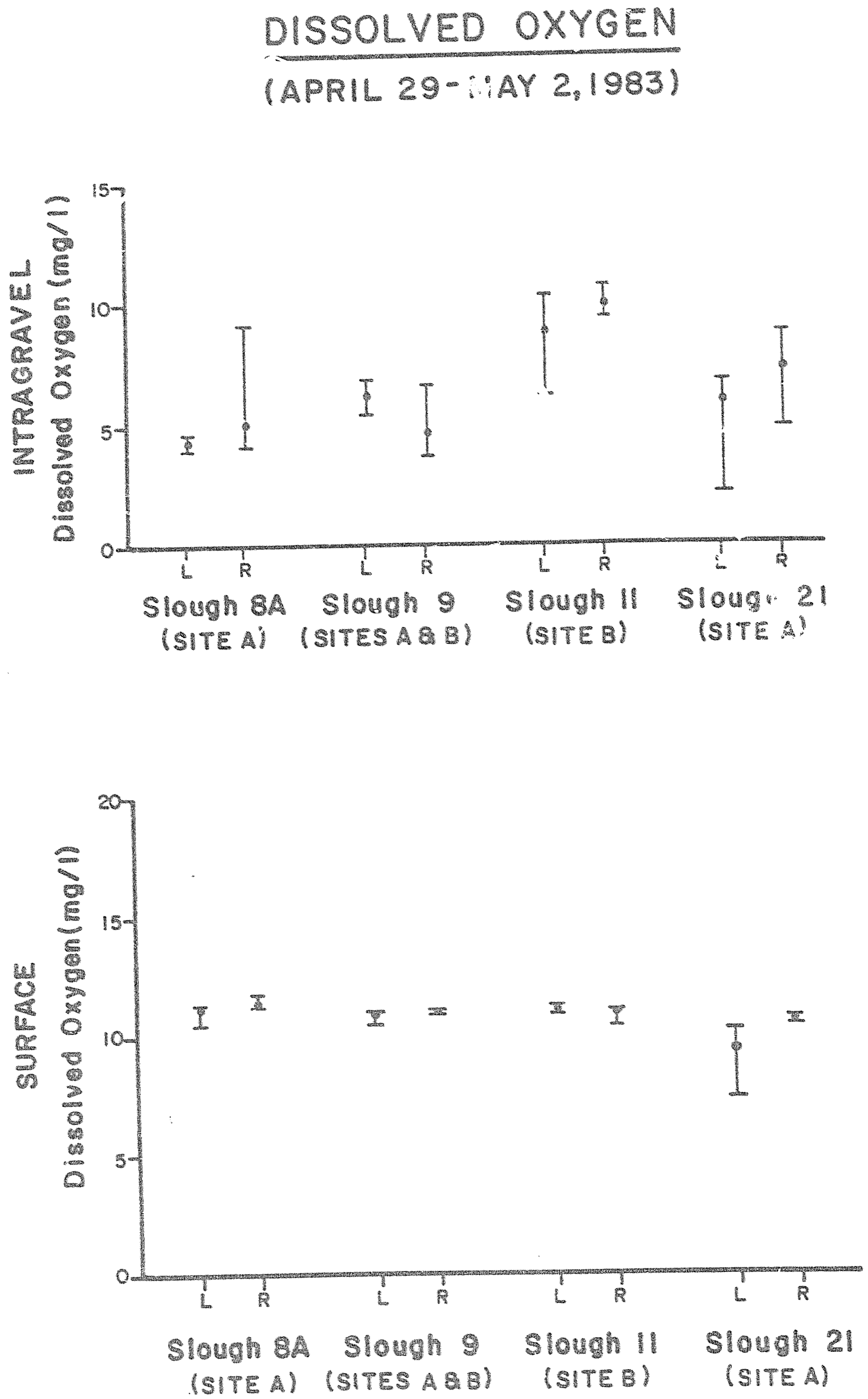


Figure 3-14. Summary (mean and range) of intragravel and corresponding surface water dissolved oxygen data collected along left (L) and right (R) banks (looking upstream) of sloughs 8A, 9, 11 and 21, Susitna River, Alaska, spring (April 29- May 2), 1983. (n=10 for each mean except for Slough 21, left bank, where n=9).

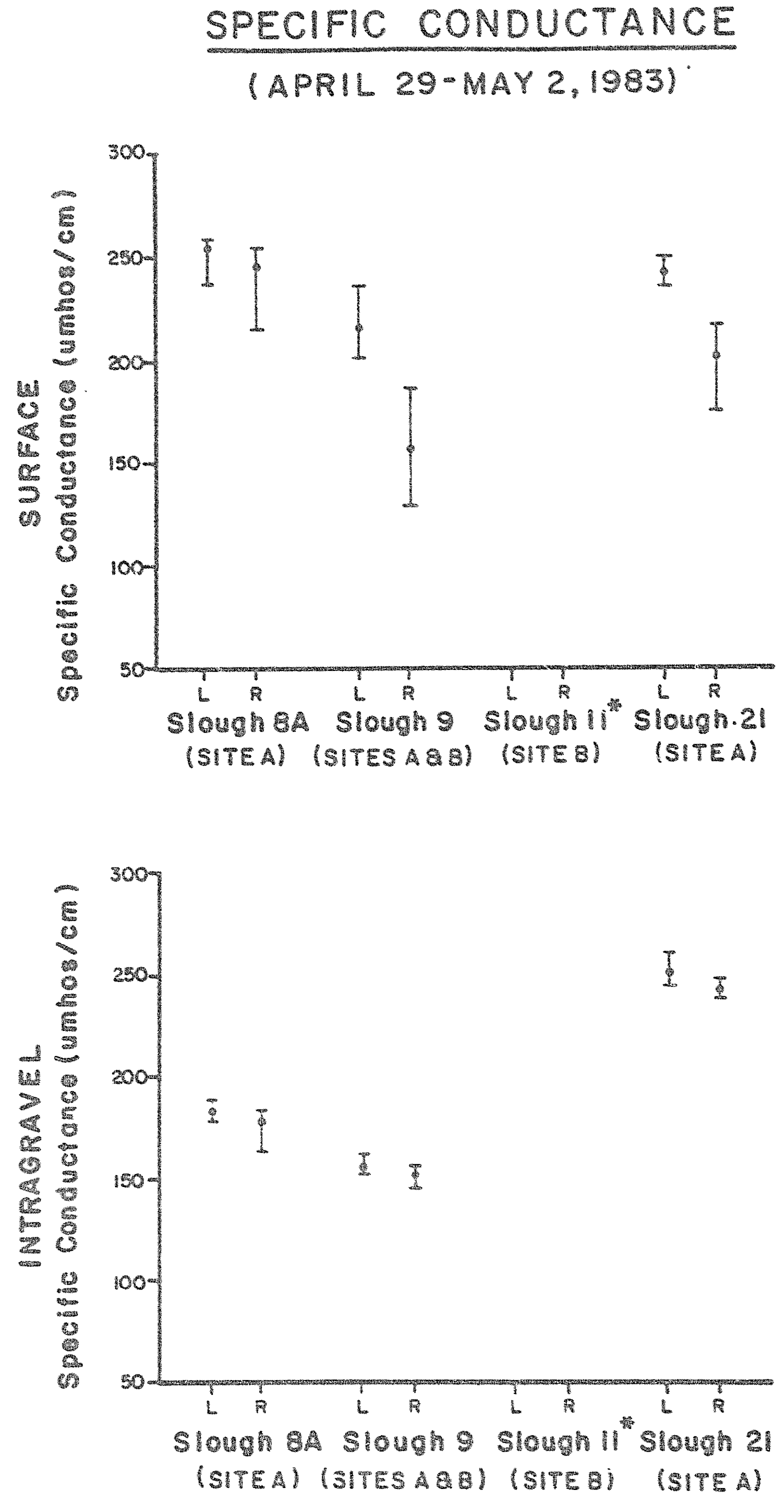
3.3.1.3 pH

Mean pH values for all sites ranged within one pH unit, from approximately 6.5 to 7.5 (Appendix B). These values are within acceptable limits for successful salmonid incubation. which are ?

3.3.1.4 Specific Conductance

Due to meter malfunction, complete data sets for the two sampling periods were not possible. However, from the available data base for three sloughs, the following patterns emerged. Mean values of specific conductance for sloughs (Appendix Table B-4) ranged from a low of 160 umhos/cm (April 15-18 period; Slough 9) to a high of 270 umhos/cm (April 29 - May 2 period; Slough 11). high There did not appear to be a consistent relationship between mean values of intragravel and surface water samples. For both sampling periods in sloughs 8A and 9 and the first sample period in Slough 11, means for specific conductance were lower for surface water samples than for intragravel samples. However, the reverse was true for the second sample period in Slough 11 and for both periods in Sloughs 21. There was a consistent pattern between means of left and right banks (Figure 3-15) with right bank means being consistently lower than left bank means. This was true for both surface and intragravel samples.

Specific conductance data were used to compare water quality between sloughs and between left and right banks within sloughs. Specific conductance was selected for this purpose because it is generally



*Data not available for Site B in Slough 11.

Figure 3-15. Summary (mean and range) of intragravel and corresponding surface specific conductance data collected along left (L) and right(R) banks (looking upstream) of sloughs 8A, 9, 11 and 21, Susitna River, Alaska, spring (April 29 - May 2), 1983. (n=10 for each mean except for Slough 21, left bank, where n=9).

How

regarded as an index to total concentration of dissolved ionic matter, which in turn is related to water fertility (Lind 1974). Therefore, it is useful to detect water originating from different sources. In addition, this variable had a much larger range in variation than other variables measured and therefore was expected to be more sensitive to differences in water quality between locations. Specifically, the following hypotheses were tested.

1. H_o: Specific conductance values are the same in sloughs 8A, 9, 11 and 21; while controlling for bank effects.

   H_a: Not equal.

2. H_o: Specific conductance values are the same at left and right bank sites of sloughs; while controlling for slough effects.

   H_a: Not equal

Table 3-1 is a summary of a two way analysis of variance (ANOVA) testing the above hypotheses. There were significant difference at the $p < 0.001$ level for main effects, bank, slough and interaction effects. Therefore, the null hypotheses of equality are rejected. This suggests that there was more than one source of water contributing to intragravel water in sloughs. However, the significant difference for the interaction effect indicates that the individual effects of slough and bank are not independent. These differences are shown in Table 3-2. The magnitude of the bank effect depends upon which slough is

Table 3-1. Summary of two-way analysis of variance (ANOVA) on specific conductance data obtained inside standpipes located along left and right banks of sloughs 8A, 9, 11 and 21, Susitna River Alaska, April 29 - May 2, 1983.

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F	Significance of F
Model	85394.4	7	12199.2	52.47	0.001
Main Effects	74214.6	4	18553.6	79.79	0.001
Bank	35757.1	1	35757.1	153.77	0.001
Slough	38968.7	3	12989.6	55.86	0.001
Interactions Bank X Slough	11179.8	3	3726.6	16.03	0.001
Residual	15812.1	68	232.5		
Total	101201.4	75			

Table 3-2. Summary of mean specific conductance values obtained inside standpipes in sloughs 8A, 9, 11 and 21, Susitna River Alaska, April 29 - May 2, 1983.

	Means for specific conductance (umhos/ln) in sloughs				
Slough Bank	8A	9	11	21	Total
Left	254 (N=10) (Site A)	223 (N=13) (Site B and C)	260 (N=10) (Site A)	242 (N=9) (Site A)	243 (N=42)
Right	246 (N=10) (Site A)	156 (N=10) (Site A)	191 N=4) (Site C)	201 (N=10) (Site A)	200 (N=34)
Left + Right					
Mean	250	194	240	221	224
Difference	8	67	69	41	43
	(N=20)	(N=23)	(N=14)	(N=19)	(N=76)

considered. For example, the difference between mean specific conductance values in Slough 8A are very slight compared to those in Slough 9. Also, the variation between mean specific conductance values for left bank of sloughs is much less than for right banks. This pattern would be expected if water entering the left bank of sloughs is originating from a common source (i.e., the Susitna River). Therefore, it is not possible to make simple statements regarding the effects of either factor (slough or bank) without considering the effects of the other. It is noteworthy that means for specific conductance are consistently higher at left bank sites in each slough than at right bank sites. (Table 3-2). This suggests that the contribution of water into sloughs by the different sources follows a consistent left bank/right bank trend. This pattern is likely to be related to different hydraulic relationships governing the drainage patterns of water into the left (Susitna River side) and right (mountainous side) side of sloughs.

3.3.2 Development and emergence data

Peak spawning for chum and sockeye salmon occurred in late August and early September of 1982 (ADF&G 1983a). The embryonic developmental stages following this spawning period consists of three phases: cleavage, gastrulation, and organogenesis. The cleavage phase begins after fertilization and ends with the proliferation of cells. In the gastrulation phase, the cells develop into tissues to produce the basic structure of the embryo. Organogenesis is characterized by the appearance of fins and formation of the internal organs and circulatory system. The eyed stage develops during the early portion of the organogenesis phase. Hatching occurs about two weeks after organogenesis is completed. These phases are described in detail by Velsen (1980). In this report, post-hatching stages of embryonic development are evaluated in terms of percent yolk sac absorption and time of emergence. Plate 3-5 shows several stages of salmon development from the beginning of fertilization to just before emergence.

Temperatures recorded within the redds by the intragravel probes are listed in Table 3-3.

3.3.2.1 Chum salmon

Table 3-4 contains the development and emergence data for chum salmon on the Susitna River between the Chulitna River confluence and Devil Canyon. The data for three of the sloughs are also presented graphically in Figure 3-16. Chum salmon egg fertilization occurred in late August and early September at all sampling sites. Chum embryos were developing from the cleavage phase into the early gastrulation stage through September. By November, eggs collected at all sites except Slough 20 were well into organogenesis and had reached the eyed stage. The embryos in Slough 20 at this time were just beginning early organogenesis. Eyes were not noticeable in chum salmon embryos at Slough 20 until mid December.

The first hatching observed at the study sites occurred at Sloughs 11 and 21 during late January. In February, alevins with up to 25 percent yolk sac absorption were present at all the sites sampled; unhatched

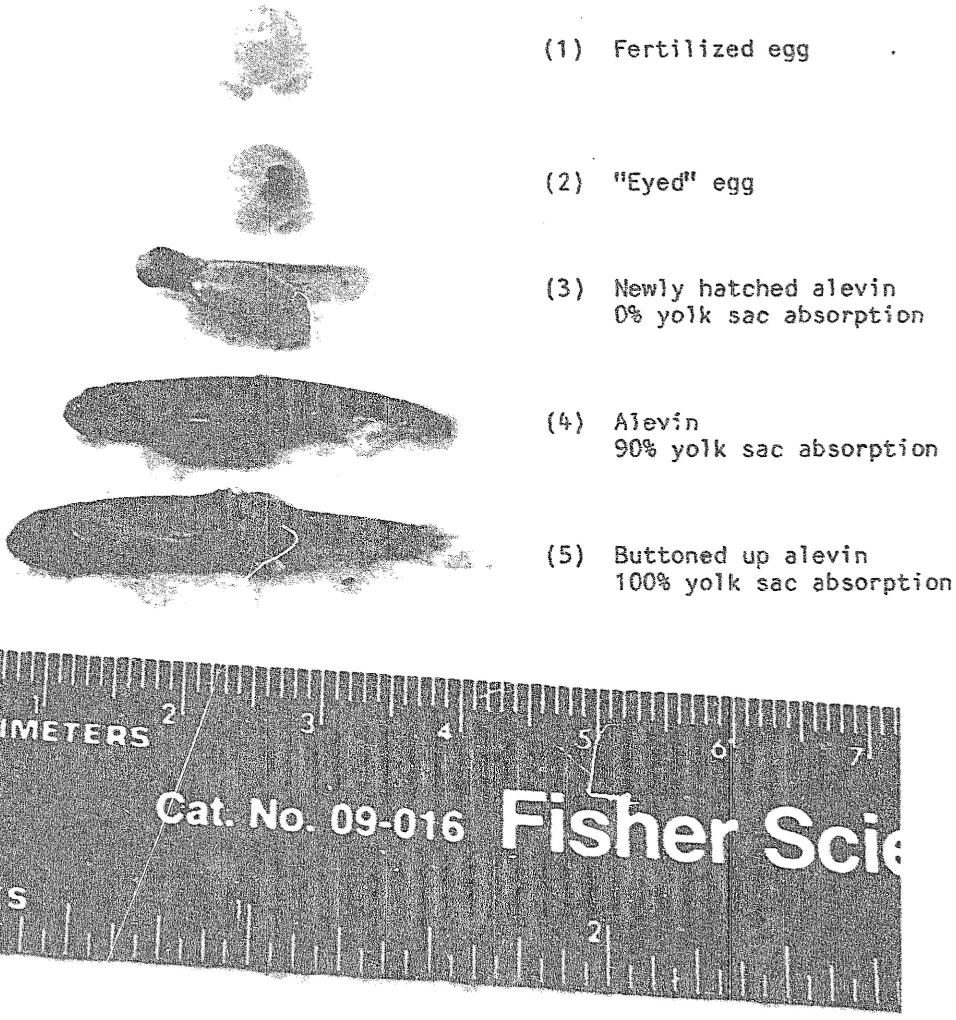


Plate 3-5. Stages of salmon egg and alevin development from beginning of fertilization to just before emergence.

Table 3-3. Temperatures (°C) recorded within chum and sockeye salmon redds by YSI intragravel probe and Digi-Sense thermometer from December 1982, through April, 1983.

Date	Slough 8A	Slough 9	Slough 11	Mainstem Sidechannel A	Mainstem Sidechannel B	Slough 20	Slough 21
Chum Redds							
December 16-21			3.0	3.1		0.3	2.0
January 26			3.1				
February 22-23		2.0	1.4	2.1			2.1
March 24	0.9	2.4	2.4				2.2
April 20-21	1.1	3.1	3.4	3.0	2.7		2.5
Sockeye Redds							
December 16-18			3.2	3.1		0.3	2.0
January 26			3.1				
February 22-23			1.9				2.2
March 24	0.1		2.0				2.6
April 20-21	4.4		2.9				2.5

↑ ↑

Average T ?
for time period
listed

Table 3-4. Development and emergence data for chum salmon on the Susitna River between the Chulitna River confluence and Devil Canyon, August 1982 to April 1983.

	Sloughs & Mainstem Side Channels						
Sampling Date	Slough 8A	Slough 9	Slough 11	Sidechannel A	Sidechannel B	Slough 20	Slough 21
August 1982	Adults Spawning	Adults Spawning	Adults Spawning	-	-	-	-
September 6-7, 1982	Adults Spawning	Adults Spawning	Adults Spawning	N = 3 100% end of cleavage	N = 5 100% early gastrulation	N = 5 100% gastrulation	N = 10 100% end of cleavage
October 22, 1982	-	-	N = 9 100% final stage gastrulation	-	-	-	N = 18 100% early Organogenesis
November 17-18, 1982	N = 33 100% Organogenesis Eyed	N = 12 100% Organogenesis Eyed	N = 9 100% Organogenesis Eyed	-	-	N = 2 100% early Organogenesis	N = 4 100% Organogenesis All Eyed
December 16-21, 1982	-	-	N = 4 100% Final Stage Organogenesis	N = 3 100% Organogenesis Eyed	-	N = 10 100% Organogenesis Eyed	N = 11 100% Late Organogenesis
January 26-30, 1983	-	N = 5 100% Late Organogenesis	N = 15 100% Close to hatching	-	-	-	N = 12 50% Late Organogenesis 50% hatched zero % Yolk Sac Absor.
February 21-23, 1983	-	N = 35 94% at 25% Yolk Sac Absorption 6% Late Organogenesis	N = 14 100% at 25% Yolk Sac Absorption	N = 10 100% at 10% Yolk Sac Absorption	-	-	N = 37 22% at 25% Yolk Sac Absorption 78% at 10% Yolk Sac Absorption

- no data

Table 3-4 (Continued)

	Sloughs & Mainstem Side Channels						
Sampling Date	Slough 8A	Slough 9	Slough 11	Sidechannel A	Sidechannel B	Slough 20	Slough 21
March 22-25, 1983	N = 26 50% Zero Yolk Sac Absorption 50% Late Organogenesis	N = 25 52% at 90% Yolk Sac Absorption 48% at 50% Yolk Sac Absorption	N = 12 100% at 50% Yolk Sac Absorption	-	-	-	N = 35 49 at 75% Yolk Sac Absorption 51% at 50% Yolk Sac Absorption
April 20-23, 1983	N = 31 100% hatched 52% at 50% Yolk Sac Absorption 48% at 25% Yolk Sac Absorption	N = 43 75-90% Yolk Sac Absorption	N = 39 57% free Swimming 43% at 62% Yolk Sac Absorption	N = 2 100% Free Swimming	N = 25 75-90% Yolk Sac Absorption Beginning Emergence	-	N = 65 53% free Swimming 47% at 85% Yolk Sac Absorption

- no data

N ? # of redds

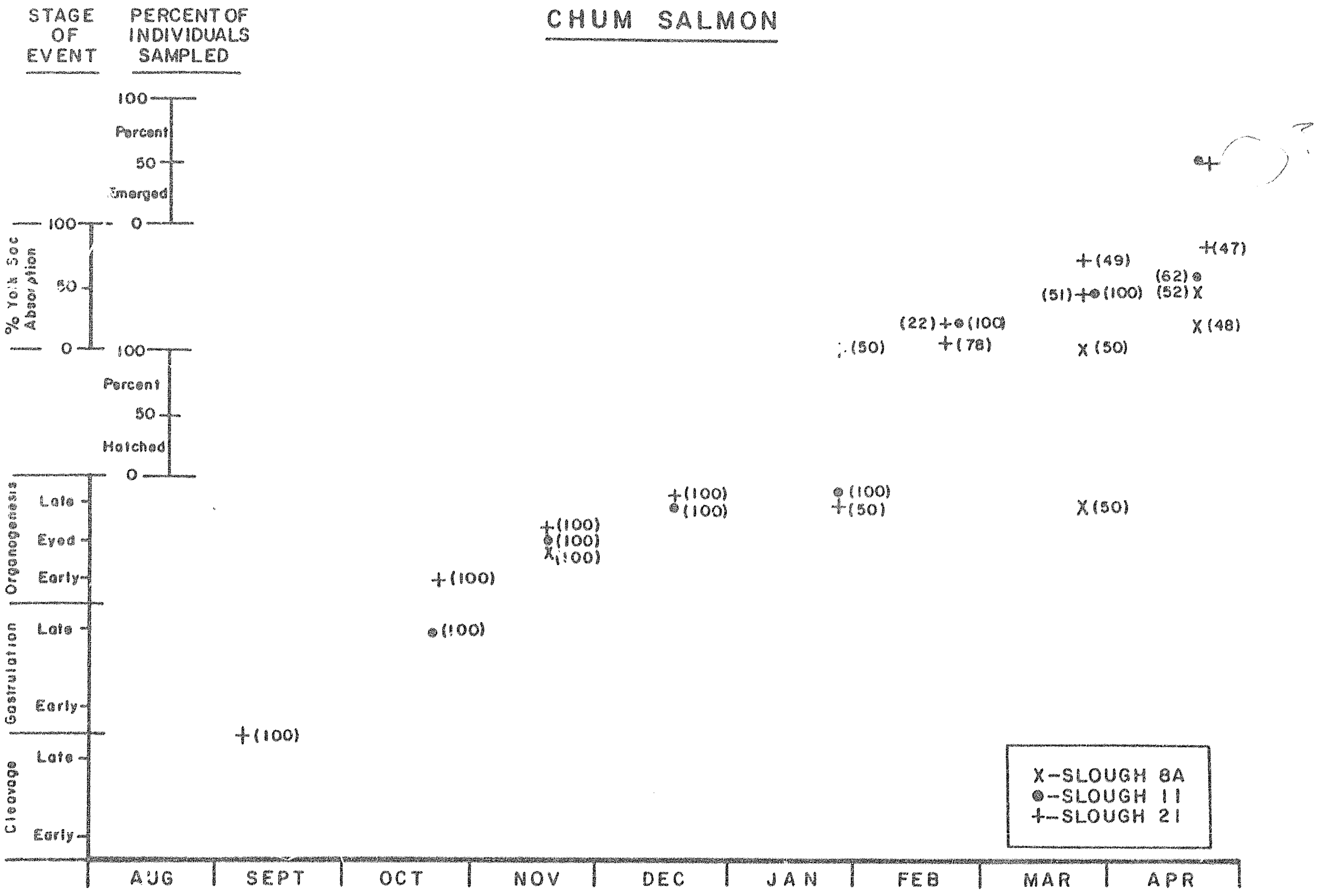


Figure 3-16. Embryonic development, hatching, yolk sac absorption, and emergence data for chum salmon at three sloughs, winter, 1982-1983. Numbers in parentheses are the percentages of individuals sampled which were at the indicated stage.

embryos were also present. Sampling in March revealed a wide range in development. Slough 8A had individuals ranging in developmental stages from late organogenesis to newly hatched alevins, while samples collected from sloughs 9, 11, and 21 showed alevins ranging from 50 to 90 percent yolk sac absorption. Emergence for chum salmon began in early April and continued through the end of May.

3.3.2.2 Sockeye salmon

Development and emergence data for sockeye salmon on the Susitna River between the Chulitna River confluence and Devil Canyon are presented in Table 3-5. Data from three of the sloughs are presented graphically in Figure 3-17. Egg fertilization occurred for sockeye salmon in late August and early September. By late October, collected embryos were already developing from late gastrulation to early organogenesis. The first eyed embryos were found in November at Slough 11. By December, all sites sampled had eyed embryos which were well into organogenesis. Hatching sockeye salmon embryos were first observed at Slough 11 in late February. Sampling in March showed a wide range of embryo development from organogenesis at Slough 8A to 100 percent hatched and 25 percent yolk sac absorption at Slough 21. Emergence for sockeye salmon began in early April and continued through the end of May.

3.4 Discussion

From the onset of incubation to the time of emergence, there are several major factors affecting development rates. These environmental vari-

Table 3-5. Development and emergence data for sockeye salmon on the Susitna River between the Chulitna River confluence and Devil Canyon, August 1982 to April 1983.

	Sloughs & Mainstem Side Channels				
Sampling Date	Slough 8A	Slough 11	Sidechannel A	Slough 20	Slough 21
August 1982	-	-	-	-	-
September 6-7, 1982	Adults Spawning	Adults Spawning	-	-	Adults Spawning
October 22, 1982	-	N = 56 100% Final Stage Gastrulation	-	-	N = 4 100% Early Organogenesis
November 17-18, 1982	-	N = 13 100% Organogenesis 54% Eyed	-	-	-
December 16-21, 1982	-	N = 5 100% Organogenesis All Eyed	N = 3 100% Organogenesis All Eyed	Organogenesis Eyed Eggs	N = 4 100% at Organogenesis All Eyed
January 26-30, 1983	-	N = 4 100% Late Organogenesis	-	-	-
February 21-23, 1983	-	N = 61 18% at zero % Yolk Sac Absorption 82% Late Organogenesis	-	-	N = 17 100% End Organogenesis All Near Hatching

- no data.

Table 3-5 (Continued).

	Sloughs & Mainstem Side Channels				
Sampling Date	Slough 8A	Slough 11	Sidechannel A	Slough 20	Slough 21
March 22-25, 1983	N = 14 100% Organogenesis	N = 23 52% Newly Hatched 48% Late Organogenesis	-	-	N = 12 100% Hatched 25% Yolk Sac Absorption
April 20-23, 1983	N = 13 100% Late Organogenesis	N = 77 38% Free Swimming 62% at 90% Yolk Sac Absorption	-	-	N - 32 100% Free Swimming

\- no data

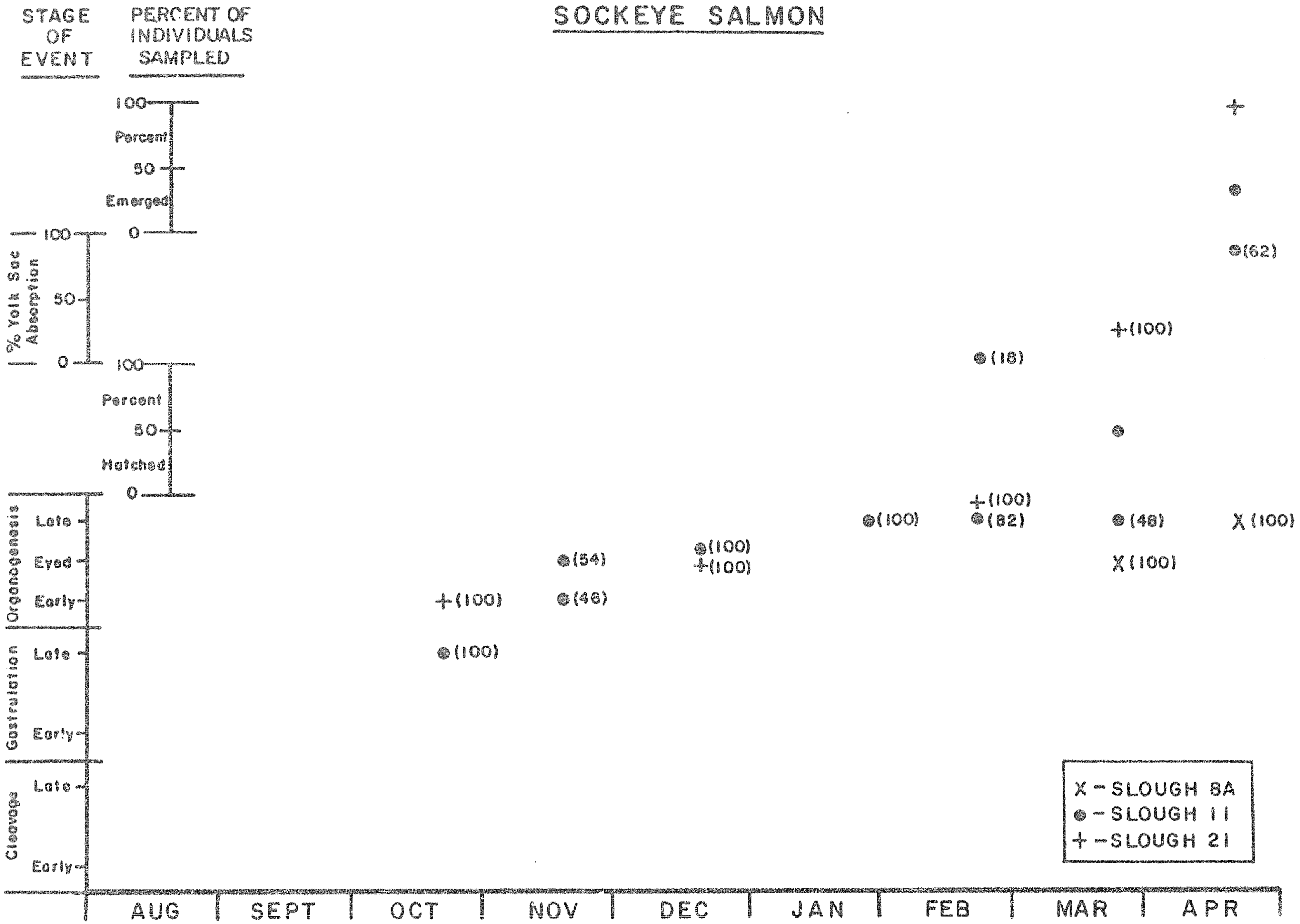


Figure 3-17. Embryonic development, hatching, yolk sac absorption, and emergence data for sockeye salmon at three sloughs, winter, 1982-1983. Numbers in parentheses are the percentages of individuals sampled which were at the indicated stage.

ables include: temperature, dissolved oxygen, water velocity, and siltation (Reiser and Bjornn 1979; Stikini 1979).

?. air temperature

Atlant
Salm

Temperature is a critical component in embryo incubation. From fertilization to the development of the eyed stage, salmon embryos require ambient temperatures greater than four degrees centigrade (Peterson et al. 1977). Temperatures below this point can cause high mortality (Combs and Burrows 1957). Once the eyed stage of development is reached, low temperature is not such a limiting factor, but it will still slow down the development rate (Velsen 1980). In contrast, high temperatures can increase development rates and alter the order of morphological events. This can result in smaller alevins being produced because differentiation and the increased metabolism at higher temperatures takes precedence over growth (Hayes 1949; Bams 1969). The upper temperature limit for incubation of salmon embryos is around 14 degrees centigrade (Reiser and Bjornn 1979).

Another important factor during the entire incubation period is dissolved oxygen. Oxygen is most critical during hatching and for a short time thereafter (Cooper 1965). Low levels of dissolved oxygen can reduce growth and survival rates; survivors could be reduced in size or result in an abnormal alevins (Silver et al. 1963). Optimum development during incubation occurs at concentrations of dissolved oxygen near saturation. There may be temporary reductions, but to a level no lower than five mg/l, for best survival rates (Reiser and Bjornn 1979). In this study, measurements of dissolved oxygen concentrations below this value were made in both Slough 8A and Slough 21 (Figures 3-13 and 3-14).

The interchange of surface and intragravel water is important in conducting dissolved oxygen to salmon embryos and alevins (Vaux 1962; Sheridan 1968; Reiser and Bjornn 1979). Fluctuation in flow may cause silt and stream sediment to be deposited over redds. Sediment deposited over incubating salmon eggs inhibits the exchange of oxygen-carrying surface water with intragravel water and lowers survival rates of embryos and alevins (Cooper 1965; Reiser and Bjornn 1979). An increase in water temperature also increases the amount of oxygen consumed. Thus, the factors affecting survival of developing embryos and newly hatched alevins to time of emergence are often interrelated (Alderdice et al. 1958).

Time and temperature are directly related during salmon embryo incubation. The measure used when computing the length of time for each phase of embryonic development is the temperature unit (TU). This is the number of days incubated multiplied by the mean daily temperature above 0°C. Temperature units for the study sites were calculated from the continuous intragravel temperature data which were presented in Section 2.0.

The theory on development rate has been that development of the salmon egg stops at zero degrees centigrade. However, according to Seymour (1956, as cited by Raymond 1981), development does not stop at zero degrees centigrade, but at some other temperature, c. As the average temperature approaches c, development time becomes infinite. The equation is:

$$t_h = \frac{k}{T-c}$$ where:

t_h = time to 50% hatching (days)

k = a calculated constant.

T = mean temperature in degrees centigrade,

c = temperature at which development ceases.

This equation can be re-written as:

$$\frac{1}{t_h} = \frac{1}{k} T - \frac{c}{k}$$

The constants c and k can then be determined from the data t_h and T by linear regression. Raymond (1981) obtained values of 628.4 for k and -1.53 for c using data from nine different incubation studies of northern chum stocks. Using the same equation to predict the time to 50 percent emergence (t_e), Raymond calculated a value of 683.8 for k and -3.32 for c. Raymond obtained a weaker correlation between t_e and T than between t_h and T and suggested that alevins are exposed to, and affected by, more variables which are not accounted for by the formula than are embryos.

The interchange of surface and intragravel water is important in conducting dissolved oxygen to salmon embryos and alevins (Vaux 1962; Sheridan 1968; Reiser and Bjornn 1979). Fluctuation in flow may cause silt and stream sediment to be deposited over redds. Sediment deposited over incubating salmon eggs inhibits the exchange of oxygen-carrying surface water with intragravel water and lowers survival rates of embryos and alevins (Cooper 1965; Reiser and Bjornn 1979). An increase in water temperature also increases the amount of oxygen consumed. Thus, the factors affecting survival of developing embryos and newly hatched alevins to time of emergence are often interrelated (Alderdice et al. 1958).

Time and temperature are directly related during salmon embryo incubation. The measure used when computing the length of time for each phase of embryonic development is the temperature unit (TU). This is the number of days incubated multiplied by the mean daily temperature above 0°C. Temperature units for the study sites were calculated from the continuous intragravel temperature data which were presented in Section 2.0.

The theory on development rate has been that development of the salmon egg stops at zero degrees centigrade. However, according to Seymour (1956, as cited by Raymond 1981), development does not stop at zero degrees centigrade, but at some other temperature, c. As the average temperature approaches c, development time becomes infinite. The equation is:

$$t_h = \frac{k}{T-c}$$

where:

t_h = time to 50% hatching (days)

k = a calculated constant.

T = mean temperature in degrees centigrade,

c = temperature at which development ceases.

This equation can be re-written as:

$$\frac{1}{t_h} = \frac{1}{k} T - \frac{c}{k}$$

The constants c and k can then be determined from the data t_h and T by linear regression. Raymond (1981) obtained values of 628.4 for k and -1.53 for c using data from nine different incubation studies of northern chum stocks. Using the same equation to predict the time to 50 percent emergence (t_e), Raymond calculated a value of 683.8 for k and -3.32 for c. Raymond obtained a weaker correlation between t_e and T than between t_h and T and suggested that alevins are exposed to, and affected by, more variables which are not accounted for by the formula than are embryos.

Two assumptions were made in this study when discussing development rates of chum and sockeye salmon embryos. The first is that salmon embryos and alevins were actually incubated at the temperatures recorded by the Datapod recorders (Appendix A). This is not a bad assumption, as the limited temperature readings actually taken within the redds (Table 3-3) were fairly close to those intragravel temperatures recorded by the Datapod recorders. The second assumption is that the embryos began incubation on the first of September. This date was chosen after reviewing the timing of the 1982 spawning data (ADF&G 1983a) and actual observations of incubating embryos.

Accumulated thermal units derived from the intragravel Datapod temperature recorders for three of the sites (the same sites plotted in Figures 3-16 and 3-17) are plotted in Figure 3-18. Slough 8A started to accumulate thermal units at a greater rate than the other two sites until an ice jam occurring in early December caused a large mainstem flow through Slough 8A. The cold mainstem water depressed the temperature of the intragravel water in this slough and there was little further accumulation of thermal units. The effect of this phenomenon on developing chum and sockeye embryos can be seen in Figure 3-16 and Figure 3-17, where salmon development and emergence in Slough 8A was delayed in comparison to the other two sloughs.

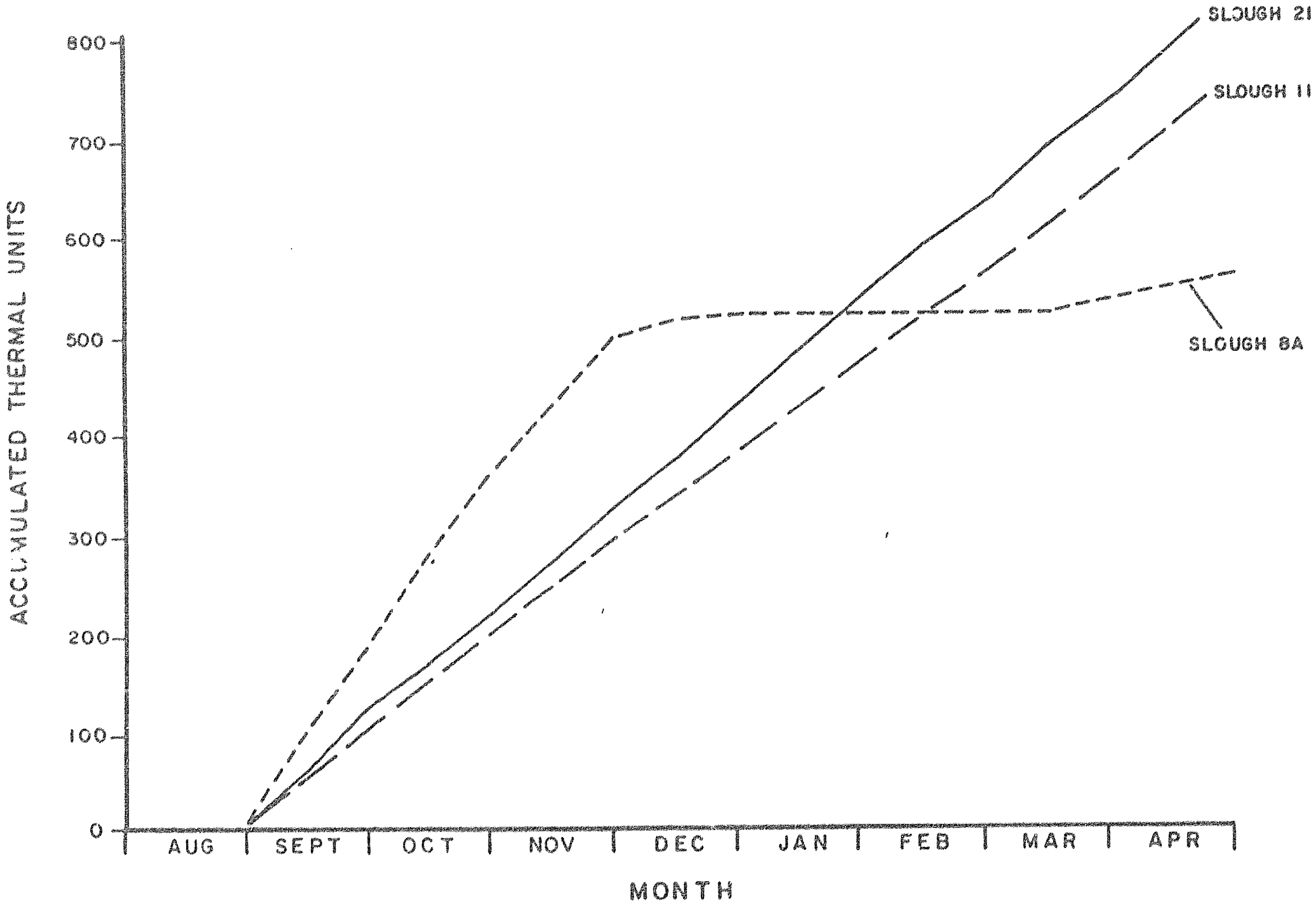


Figure 3-18. Accumulated temperature units for intragravel water at three sloughs, winter, 1982- 1983. For both Slough 8A and Slough 21, the values were interpolated using data from two different Datapod recorders in these sloughs. Because of equipment loss or malfunction, a continuous record for any one of these recorders was not obtained.

3.4.1 Chum salmon

The development of chum salmon embryos and alevins was uniform at all sampling sites except for Slough 8A. Embryo development at Slough 8A was retarded by low intragravel water temperatures which resulted from the ice jam in the mainstem diverting cold Susitna water through the head of Slough 8A from mid-December through mid-February. It is also possible that some incubation delay was caused by low levels of dissolved oxygen (DO) in the intragravel water of Slough 8A (see Figures 3-13 and 3-14). However, DO was not actually measured in the redds, so we do not know this to be the case.

Table 3-6 presents a comparison of accumulated TU's needed to produce 50 percent hatching of chum salmon embryos and 50 percent emergence of chum salmon alevins at selected sites on the Susitna River with other areas in Alaska. It appears that the TU's required by chum salmon on the Susitna River are comparable to values required in the other areas.

The times to 50 percent hatching for chum salmon from the three sloughs plotted in Figure 3-18 (Slough 8A, Slough 9, Slough 21) as a function of mean incubation temperature fall slightly above the regression line calculated by Raymond (1981) (Figure 3-19), but are essentially comparable to the other stocks used by Raymond in his regression. The dates for 50 percent hatching and 50 percent emergence were determined by extrapolating from one period of observation to the next period and taking the mean of the two (see Tables 3-4 and 3-5).

Table 3-6. Comparision of accumulated temperature units (TU's) and days needed to produce fifty percent hatching of chum salmon eggs and fifty percent emergence of chum salmon alevins at selected sites on the Susitna River with other areas in Alaska.

Location	Brood Year	Temp.(°C) min-max (mean)	TU's and (days) required for 50% hatching	Temp.(°C) min-max (mean)	TU's and (days) required for 50% emergence[4]
Clear Hatchery[1]	1977	-- (3.0)	420 (140)	-- (3.0)	313 (108)
Clear Hatchery[1]	1978	-- (3.8)	455 (120)	-- (4.1)	393 (95)
Eklutna Hatchery[2]	1981	-- (5.0)	802 (160)	-- (4.5)	209 (46)
USFWS Laboratory[3] Anchorage	1982	0.5-8.0 (1.8)	306 (170)	--	--
USFWS Laboratory[3] Anchorage	1982	2.0-6.5 (3.6)	448 (124)	--	--
USFWS Laboratory[3] Anchorage	1982	3.0-5.9 (4.6)	489 (106)	--	--
USFWS Laboratory[3] Anchorage	1982	4.0-4.0 (4.0)	472 (118)	--	--
Susitna River - Slough 8A	1982	0.0-6.8 (2.5)	539 (218)	0.0-6.8 (1.4)	Footnote #5
Susitna River - Slough 11	1982	2.9-3.5 (3.1)	501 (162)	2.9-3.6 (3.2)	232 (73)
Susitna River - Slough 21 Mouth	1982	3.4-7.4 (3.6)	534 (148)	3.3-7.4 (3.4)	283 (84)

[1] Raymond (1981)

[2] Loran Waldron, Eklutna Hatchery, personal communication

[3] Adapted from Waangard and Burger (1983)

[4] Calculated from the time of 50 percent hatching to the time of 50 percent emergence

[5] No emergence had occurred as of April 20.

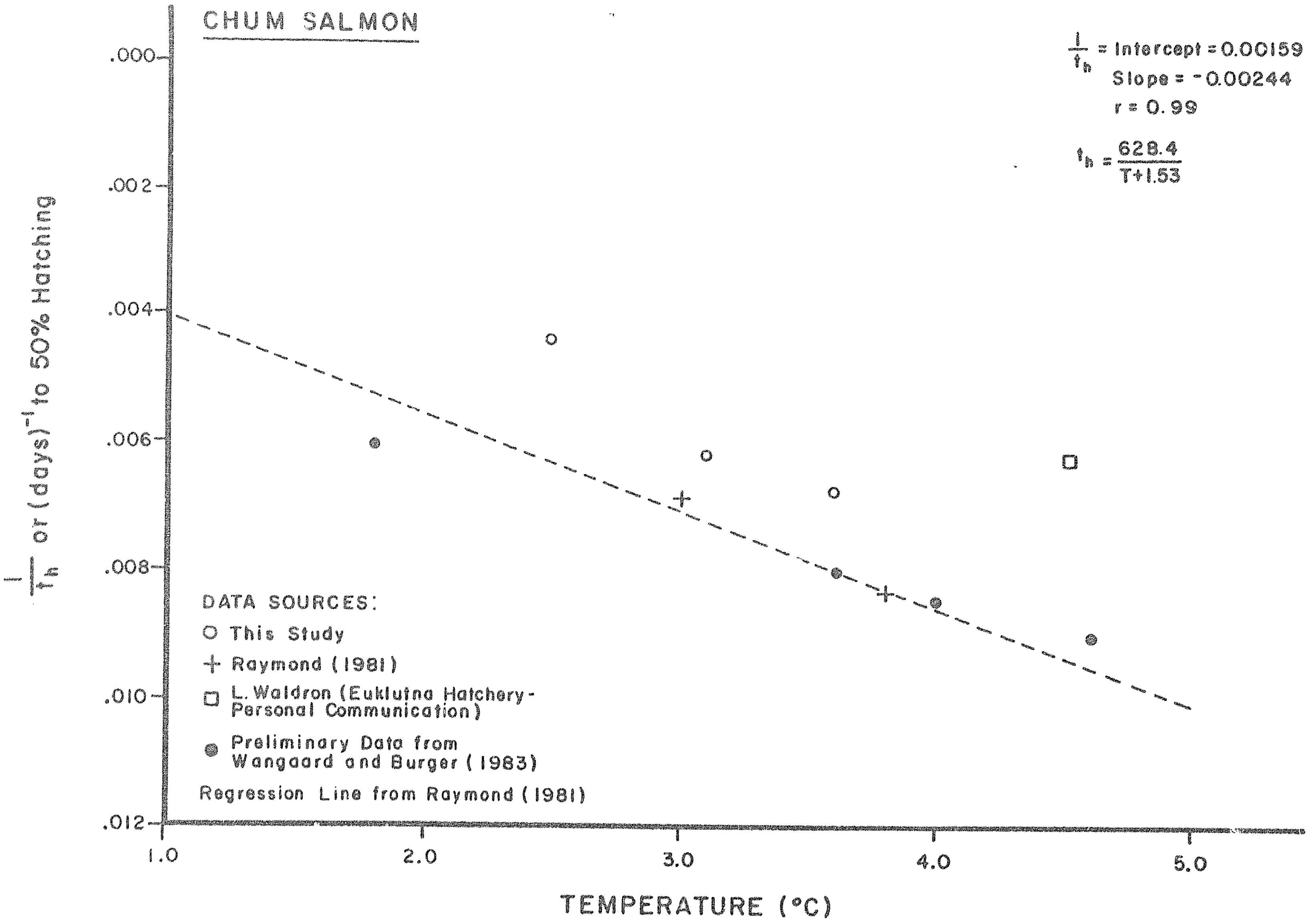


Figure 3-19. Effect of mean incubation temperature on time to 50 percent hatching for chum salmon. The regression line was calculated from several sources by Raymond (1981) and does not include the data plotted on this figure (except for the two Raymond, 1981 points).

3.4.2 Sockeye salmon

As with chum salmon, all sites where sockeye salmon embryos and alevins were collected showed uniform development except Slough 8A. Development rates at Slough 8A were retarded because of low intragravel temperature. Up to hatching, sockeye salmon embryo development lagged behind chum salmon embryo development. This difference in maturation rate is similar to that found by other studies (Velsen 1980; Raymond 1981).

The TU's and time required for 50 percent hatching and 50 percent emergence of the Susitna River sockeye salmon and some other stocks are shown in Table 3-7. The times to 50 percent hatching for sockeye salmon as a function of mean incubation temperature in this study (Slough 11 and Slough 21) and from other studies are plotted in Figure 3-20. All of the data fall close to the regression line (r = 0.99), so there is apparently no essential difference between the development of Susitna River sockeye salmon and the development of sockeye salmon elsewhere. The value for k (649.4) in the equation on this figure is greater than the k value for chum salmon (628.4) on Figure 3-19, which is in accordance with the literature (Velson 1980; Raymond 1981) stating that chum salmon development occurs at a greater rate than sockeye salmon development. These equations suggest that sockeye development ceases around 0°C (c = -0.25), while chum development will occur down to minus 1.5°C (c = -1.52).

Table 3-7. Comparision of accumulated temperature units (TU's) and days needed to produce fifty percent hatching of sockeye salmon eggs and fifty percent emergence of sockeye salmon alevins at selected sites on the Susitna River with other areas in Alaska and Canada.

Location	Brood Year	Temp.(°C) min-max (mean)	TU's and (days) required for 50% hatching	Temp.(°C) min-max (mean	TU's and (days) required for 50% emergence[4]
British Columbia[1]	1980	-- (5.0)	595 (119)		
		-- (8.0)	640 (80)		
		-- (11.0)	627 (57)		
Lake Iliamna[2]	1962	-- (9.0)	643 (71)	--	--
USFWS Laboratory[3] Anchorage	1982	2.0-6.5 (3.1)	523 (169)	--	--
USFWS Laboratory[3] Anchorage	1982	3.0-5.9 (4.3)	612 (142)	--	--
USFWS Laboratory[3] Anchorage	1982	4.0-4.0 (4.0)	614 (154)	--	--
Susitna River Slough 11	1982	2.9-3.5 (3.1)	633 (204)	2.9-3.9 (3.3)	123 (37)
Susitna River Slough 21 Mouth	1982	3.3-7.4 (3.5)	678 (194)	3.3-7.4 (3.3)	103 (31)

[1] Velsen (1980)

[2] Olsen (1968)

[3] Adapted from preliminary unpublished report, (Waangard and Burger 1983)

[4] Calculated from the time of 50 percent hatching to the time of 50 percent emergence

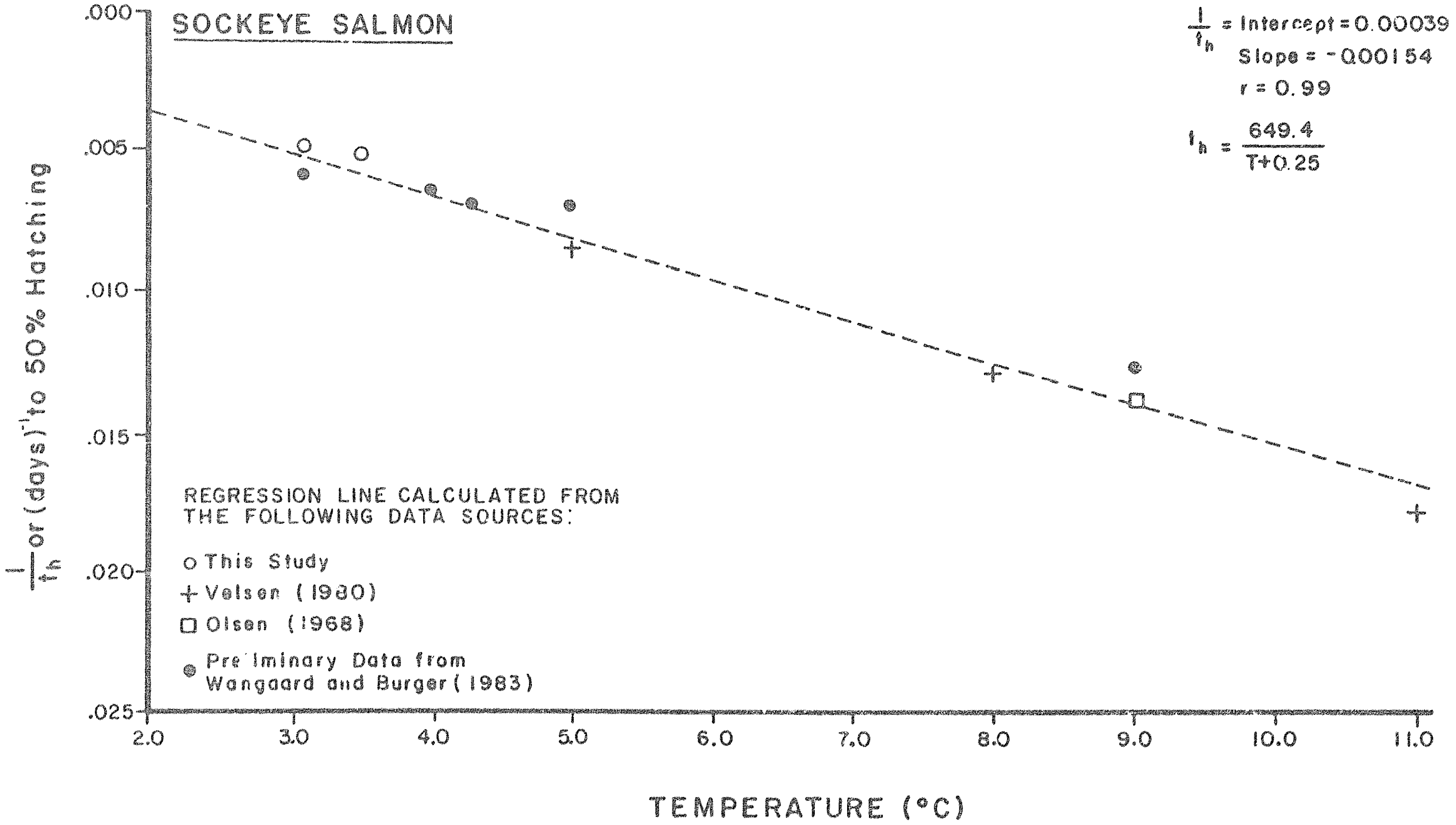


Figure 3-20. Effect of mean incubation temperature on time to 50 percent hatching for sockeye salmon.

3.4.3 Conclusions

The temperature units and times required for 50 percent hatching and 50 percent emergence for chum and sockeye salmon in the Susitna River appear to be basically the same as that required by other stocks of these species. The data provide a basis to compare laboratory incubation studies with the actual rates of development observed in the field that, together, can be used to predict temperature effects on development.

The differences in developmental rates among different sites suggest that the temperature changes which occurred in the system when the mainstem flow overtopped the head of Slough 8A produced substantial changes in developmental rates in the chum embryos incubating at this site. Observations of embryos collected in Slough 8A suggest that an increased mortality may have occurred, as evidenced by larger numbers of dead embryos as compared with other sites that were sampled. We do not have a sufficient sample size to ascertain if this observation reflects actual differences in survival.

The dominant effects of mainstem flows and temperature on development of incubating salmon embryos and alevins in sloughs and sidechannels during the fall and winter occur when high water produced by floods or ice processes causes mainstem water to flow over redds. Otherwise, the intragravel temperatures in the redds are not directly influenced by mainstem flow, but rather by ground water or upwelling water. In this case, the only effect of mainstem water is heat input transferred by upwelling.

interesting concept!
but I don't recall seeing any
substantiating data no
[illegible] discussion

An analysis of impacts of altered flow or thermal regimes should consider these factors as possible components that may alter the natural timing of the incubation and development processes of juvenile sockeye and chum salmon from the sloughs and side channels of the Susitna River.

4.0 BURBOT SPAWNING IN THE SUSITNA RIVER BELOW DEVIL CANYON

Burbot spawn in the winter in areas of the Susitna River which include locations influenced by mainstem flow and temperature. There has been little information available on the locations, timing, or habitat requirements of burbot spawning.

Past studies indicate that burbot spawn in tributaries and sloughs of the Susitna River below Devil Canyon between November and February (ADF&G 1983b). According to residents at Alexander Creek (RM 10.1) and the Deshka River (RM 40.6), burbot migrate enmasse into these tributaries during late November and early December. Catches of burbot by the residents of these areas have reportedly been high during December and January but decrease substantially after January.

4.1 Objectives

The specific objectives of the burbot (Lota lota) spawning studies during the 1982-1983 winter sampling season were:

1) Determine timing of burbot spawning;

2) Describe burbot spawning habitat.

4.2 Methods

Documentation of the exact spawning location and timing of burbot is difficult because they are reported to spawn nocturnally under the ice (Morrow 1980). Therefore, data collected in this study could only be from areas suspected of having burbot spawning. Specimens were collected at these areas during one two-day sampling trip per month from December to February so that the time of spawning (incidence of post-spawning individuals) could be determined.

4.2.1 Study site locations

why so far
downriver, when
project effects
here [illegible]
[illegible] for food
(e.g. often)

The Deshka River was the primary study location (RM 40.6). Two sampling sites on the river were established, one at the mouth (TRM 0.0) and the other at a site two miles upstream (Figures 4-1 and 4-2). These locations had been sampled in previous winters and were chosen for their accessibility and high concentrations of burbot during the winter.

During the winter of 1982-83, a few burbot were also captured at other sites on the Susitna River between the Deshka River and Devil Canyon (Appendix Table C-1). The relative maturity of all burbot captured in this reach of river were examined in order to determine the timing and locations of burbot spawning.

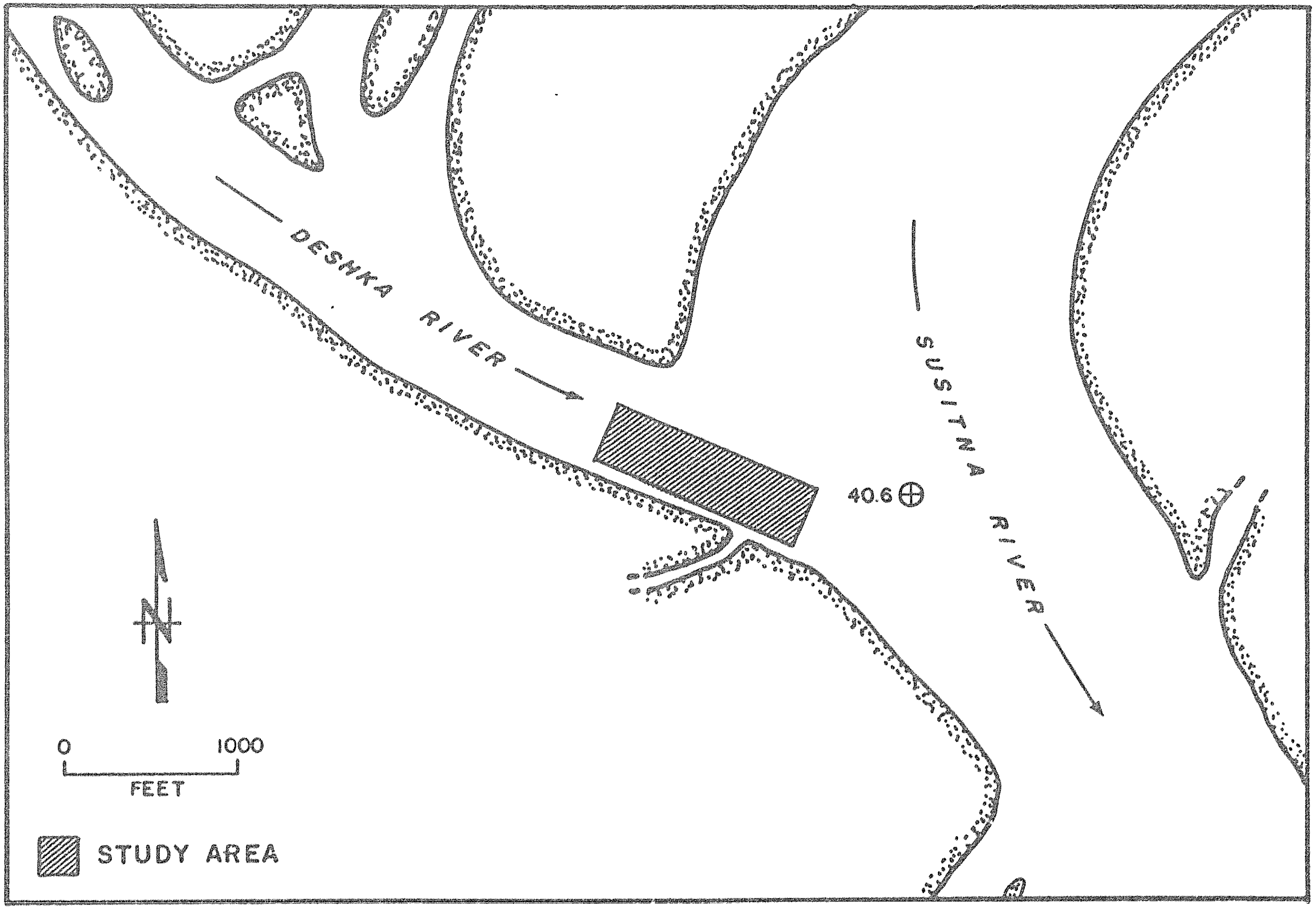


Figure 4-1. Suspected burbot spawning area at the mouth (TRM 0.0) of the Deshka River (RM 40.6).

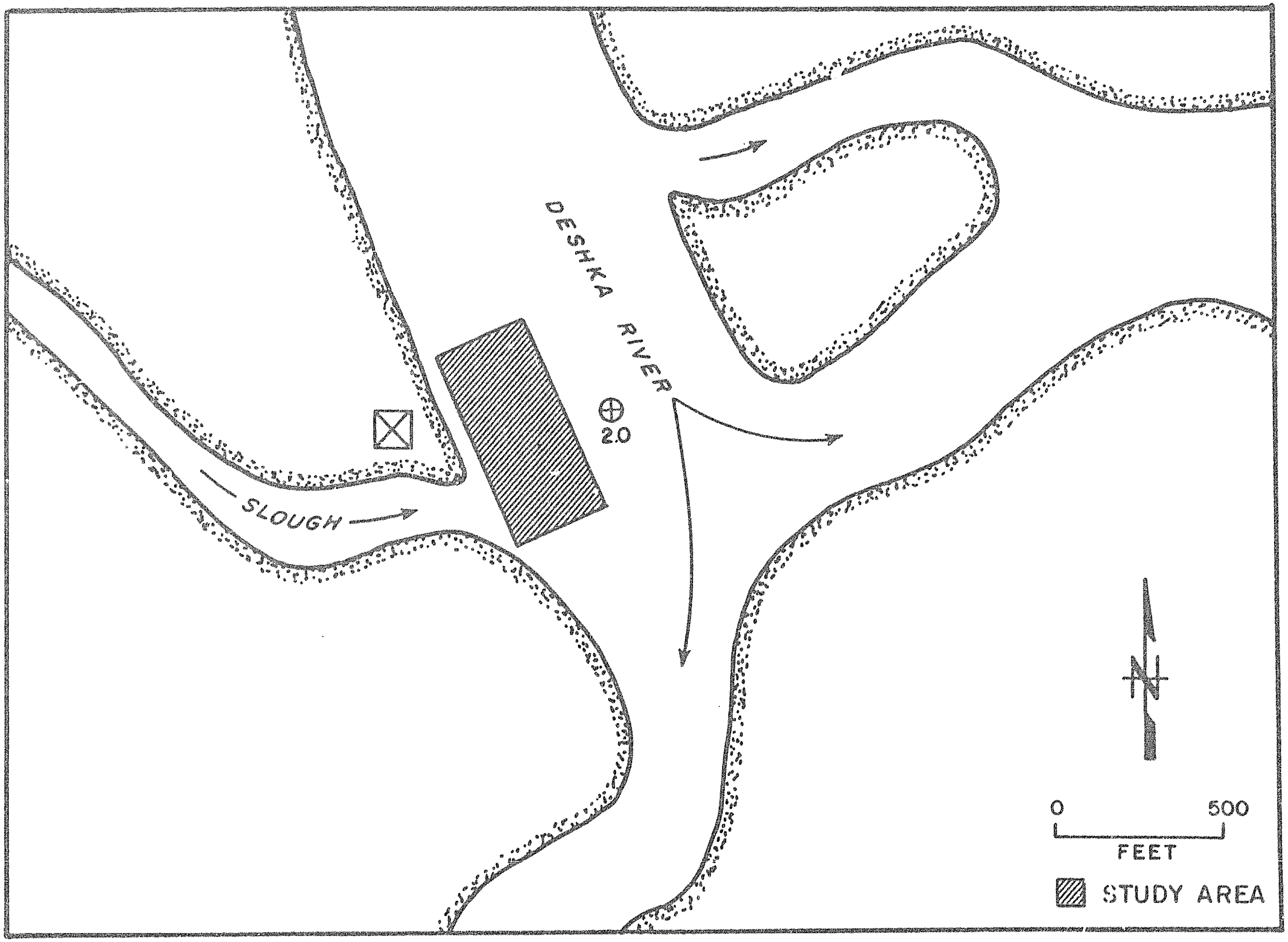


Figure 4-2. Suspected burbot spawning area at TRM 2.0 of the Deshka River (RM 40.6).

4.2.2 Sampling techniques and determination of sexual maturity

Trotlines and burbot sets, baited with fish, were used to capture at all sites according to the FY 1982 procedures manual (ADF&G 1982). All sampling gear was set through the ice; ice drilling was accomplished by use of a two man power auger.

All sampling mortalities during each sampling trip were necropsied to observe the development of gonads. Live fish were sacrificed to obtain a sample size of at least ten fish if there were not enough mortalities. Otoliths were removed for age determination. Sexual maturity or immaturity was determined by the size of the eggs or sperm sacs in comparison to gonads of other fish of similar length. Past data indicated that the majority of adult fish spawn each year and that the gonads noticeably begin to enlarge in August (ADF&G 1983b).

Ripe gonads were examined and then preserved for comparison with gonads collected during later surveys (Plate 4-1). External characteristics of gonads such as size, color and texture of egg and sperm sacs were documented. Internal characteristics, including the size and presence or absence of eggs in the egg sacs, were also recorded.

4.2.3 Habitat measurements

The Deshka River sites (RM 40.6) were sampled once per month to determine physical and chemical characteristics of habitats utilized by

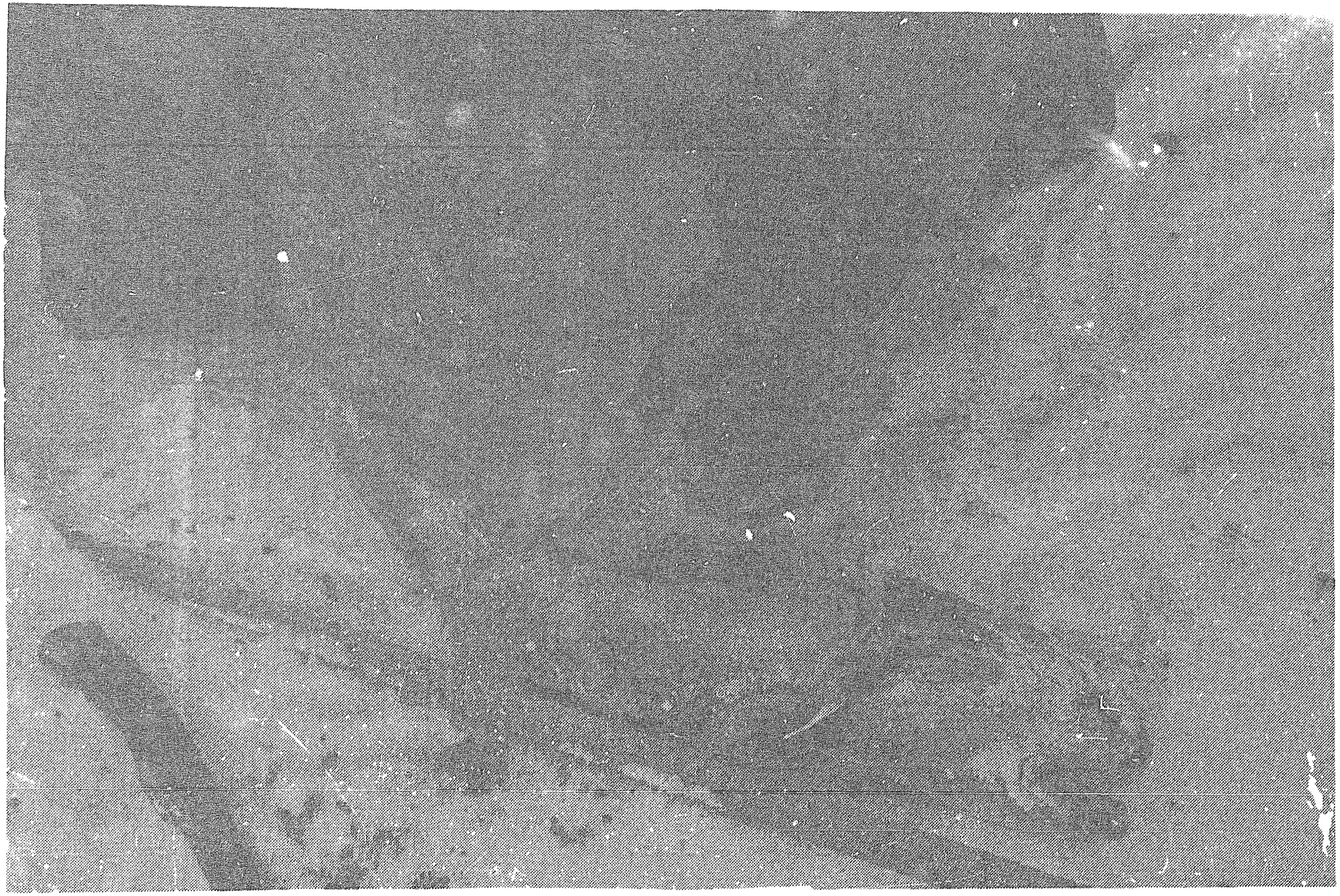


Plate 4-1. Necropsying a burbot to determine sex and relative maturity at the Deshka River (RM 40.6), mid-January, 1983.

burbot for spawning. Habitat parameters measured included ice thickness, water depth, under-ice water velocity, dissolved oxygen, specific conductance, pH, and water temperature. Specific data collection methodology and field experimental designs used in the collection of the above data are summarized in the FY 82 procedures manual (ADF&G 1982).

The sampling sites were also mapped (Figures 4-1 and 4-2).

4.3 Results

4.3.1 Habitat data

Habitat data collected at the above sites are listed in Tables 4-1 and 4-2.

Water depths in the study areas ranged from 2.2 to 9.8 feet ($\bar{x}$ = 6.2 feet, n = 21), with under-ice water velocities ranging from 0.3 to 2.1 ft/sec. ($\bar{x}$ = 0.8 ft/sec., n = 14). Water temperatures measured in the study area ranged from -0.3 to 0.7°C ($\bar{x}$ = 0.1°C, n = 18).

4.3.2 Sexual development

Sexually ripe burbot were captured from early December, 1982 to mid-January, 1983 between Cook Inlet and Devil Canyon. During this time no spent burbot were captured. Spawned out burbot were first captured during a mid-February sampling trip to the Deshka River. All burbot

We can now focus on this period for locating them in next round.

Table 4-1. Physical and chemical characteristics of suspected burbot spawning habitat at the mouth (TRM 0.0) of the Deshka River (RM 40.6).

DATE	SAMPLE	ICE THICKNESS (FT)	WATER DEPTH (FT)	WATER VELOCITY (FT/SEC)	DISSOLVED OXYGEN (MG/L)	SPECIFIC CONDUCTIVITY (UMHOS/CM)	pH	WATER TEMPERATURE (°C)	Notes: Sexual Condition of Burbot
821203	A	1.8	5.9	-	15.6	69	6.3	-0.3	Pre-Spawning Burbot Milling
	B	1.7	7.3	-	14.8	117	6.5	-0.2	
	C	1.8	8.2	-	15.0	79	6.6	-0.3	
	D	1.3	6.5	-	12.2	67	6.7	-0.3	
830112	A	1.5	4.5	0.6	10.6	58	6.3	0.7	Pre-Spawning Burbot Milling
	B	2.0	4.5	1.2	-	-	-	-	
	C	1.8	7.5	0.7	10.2	58	6.1	0.5	
	D	1.8	9.8	0.6	10.1	58	6.1	0.3	
	E	1.8	9.0	0.6	10.2	58	6.1	0.3	
	F	1.9	7.5	0.7	-	-	-	-	
	G	1.9	8.8	0.7	8.5	59	6.4	0.1	
	H	1.7	9.2	0.6	-	-	-	-	
830217	A	1.9	4.7	eddy	-	83	5.8	0.0	Post-spawning
	B	1.9	2.2	2.1	-	84	5.5	0.0	
	C	1.9	5.0	-	-	81	5.1	0.0	
	D	1.9	4.7	-	-	79	4.8	0.0	

- = Not sampled

Table 4-2. Physical and chemical characteristics of suspected burbot spawning habitat at TRM 2.0 of the Deshka River (RM 40.6).

DATE	SAMPLE	ICE THICKNESS (FT)	WATER DEPTH (FT)	WATER VELOCITY (FT/SEC)	DISSOLVED OXYGEN (MG/L)	SPECIFIC CONDUCTIVITY (UMHOS/CM)	pH	WATER TEMPERATURE (°C)	Notes: Sexual Condition of Burbot
821203	A	1.0	-	-	-	-	-	-	Pre-Spawning Burbot Milling
	B	0.7	-	-	-	-	-	-	
	C	1.1	-	-	-	-	-	-	
	D	0.7	-	-	-	-	-	-	
820311	A	1.8	5.2	0.3	11.7	67	6.0	0.1	Post-Spawning
	B	2.0	5.6	0.4	11.9	67	6.0	0.3	
	C	2.2	4.0	0.4	11.4	67	5.5	0.3	
	D	2.2	4.6	0.9	11.6	68	6.0	0.1	
	E	2.0	4.5	1.1	11.4	68	6.1	0.1	

- = Not sampled

captured during this sampling trip and subsequent trips were either post-spawners or sexually immature (non-spawners in 1982-1983). Sampling locations and catch per unit effort of all burbot captured during the winter of 1982-1983 are listed in Appendix Table C-1.

Monthly examinations of sexually ripe burbot gonads showed that the size increased from early December to mid-January, then progressively decreased in size through March. The color of the egg and sperm sacs accordingly increased in intensity up to mid-January. The egg sacs changed from a light yellow color to a dark orange and the sperm sacs changed from a cream to a golden coloration. Similar color changes in egg and sperm sacs have been reported in sexually ripe burbot captured elsewhere in south central Alaska (Mike Stratton pers. comm.).

Egg sacs were examined each month to determine if spawning occurred. Eggs were found in all enlarged (sexually mature) egg sacs examined during December and January. Only residual eggs were found in enlarged egg sacs of fish necropsied in February and March.

4.3.3 Age, length, and sex composition

Analysis of the age composition and total lengths of 69 burbot caught during the winter of 1982-83 yielded the following results. Ages ranged from age IV to age XII with ages V (21.7%) and VI (29.0%) burbot composing the two most frequently sampled age classes (Appendix Table

C-2). Figure 4-3 illustrates the average length and range of lengths for each age class of Susitna River burbot sampled from December, 1982 to March, 1983.

Fifty-nine of the 69 burbot necropsied were sexually ripe or showed signs of having spawned during the winter of 1982-1983. Thirty-nine of the pre- or post-spawners were females, ranging in total length from 430-795 mm and encompassing age classes V to XII. The remaining 20 pre- or post-spawners were males, ranging in length from 424-780 mm and encompassing age classes IV to XI.

Ten sexually immature burbot were also examined. Seven were females ranging in length from 395 mm to 710 mm and age from IV to XII years. The three males ranged in length from 425-585 mm and age from IV to VII years.

4.4 Discussion

4.4.1 Timing and location of spawning

Diff'l site at Deshka R. confluence at [illegible] R where 3 of 89 fish were captured
2 of 12 above (including [illegible]

Studies conducted during the winter of 1982-1983 found that burbot spawn in the Susitna River below Devil Canyon between mid-January and early February. Results from the 1981-1982 studies had shown only that burbot spawn in this reach of the river prior to February (ADF&G 1983b).

Since burbot spawn nocturnally under the ice, exact locations where burbot spawn in the Susitna and Deshka rivers have not been determined.

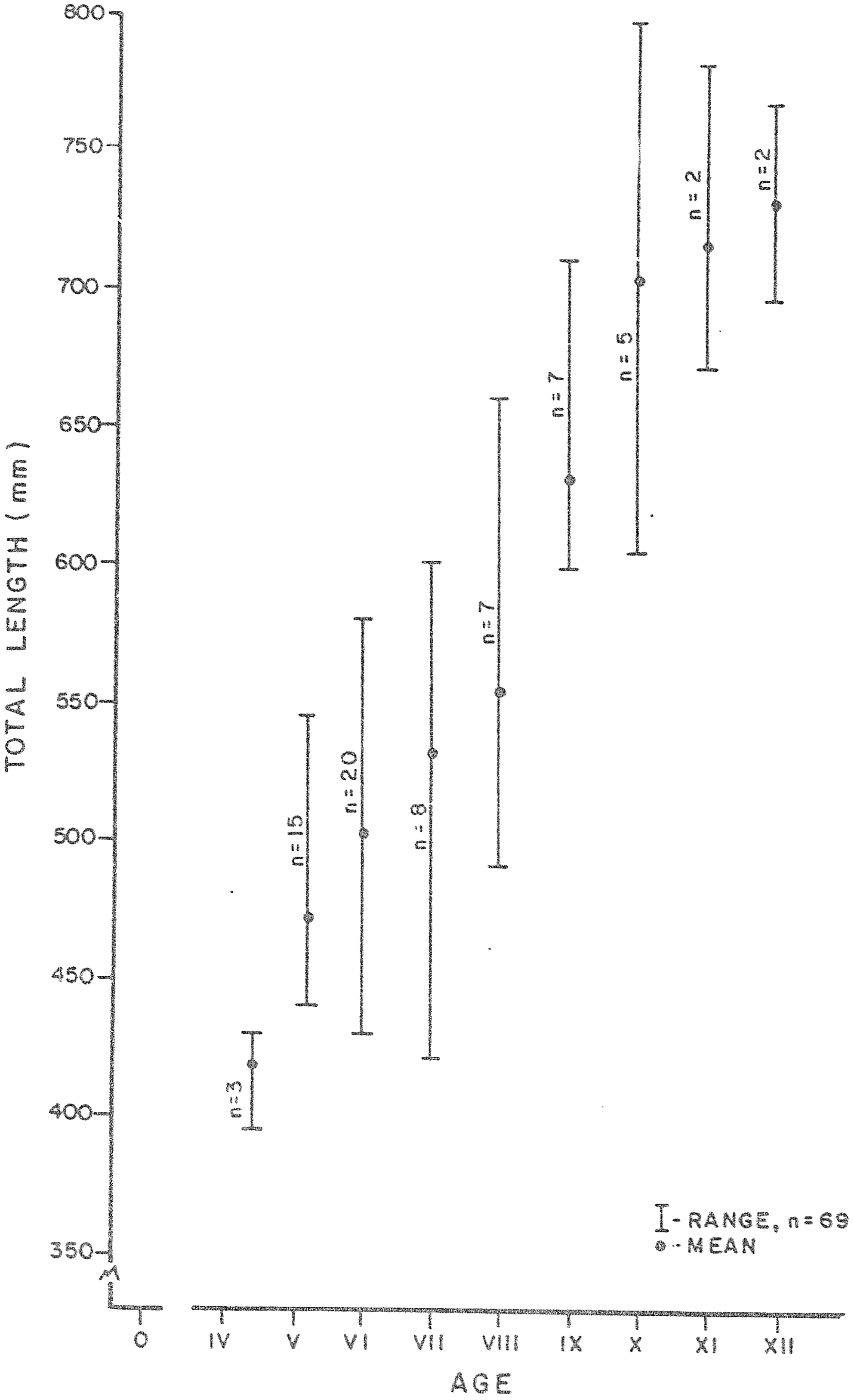


Figure 4-3. Age-length relationship for burbot captured in the Susitna River between Cook Inlet and Devil Canyon, December, 1982 through March, 1983.

However, by systematically sampling at a specific location over the winter (Deshka River), sexually ripe and spent fish were captured. Therefore, although actual spawning was not observed spawning probably did occur between the mouth and at least two miles upriver from the mouth.

The sites on the Deshka River where spawning was suspected is characterized with having slow to moderate flows and medium water depths, 2.2 - 9.8 feet (Tables 4-1 and 4-2). The Deshka River's water is stained with tannins reflecting the source from muskeg areas. Past studies have determined the substrate base at the mouth to be predominantely gravel/ rubble which is often covered by several inches of silt (ADF&G 1981a). Although most data collected to date indicates that burbot spawn at tributary mouths such as the Deshka River and Alexander Creek (RM 10.1), radio telemetry data suggests that burbot may also spawn in the mainstem. Three of the five radio-tagged burbot known to be alive during the monitoring of winter 1981-1982 movements remained in the mainstem from January to February (ADF&G 1983b). Data collected during the 1982-1983 winter radio telemetry study also shows that burbot reside in the mainstem during the determined spawning period (see Section 5.0 of this report).

MacCrimmon (1959) suggests that a post-spawning dispersal occurs for feeding purposes. Substantial decreases in catch rates following spawning in late January indicate that a post-spawning dispersal may also occur in the Susitna River drainage.

Although most of the burbot captured during the winter 1982-1983 were at sites below the Chulitna confluence, several sexually ripe burbot were also caught above the confluence (Appendix Table C-3). No spawning sites have been located above the Chulitna confluence; however, data from 1982 suggests spawning occurs in sloughs (ADF&G 1983b). The sexually ripe fish captured in winter 1982-1983 at mainstem sites suggest that spawning may also occur in the mainstem.

4.4.2 Age, length and sex composition

Although most of the burbot captured during the winter of 1981-1982 and 1982-1983 were sexually mature, several sexually immature adults were also captured (ADF&G 1981b; 1983b). These immature fish were all over 350 mm in length. Data from 1981-1982, however, indicate that male burbot could attain sexual maturity when they reach 310 mm in length and mature females were found that were 330 mm in length. Because the sexually immature fish were over the determined minimum spawning lengths, it appears that some burbot are nonconsecutive spawners in the Susitna River. Since the majority of the fish captured were sexually mature, it further appears that spawning of an individual fish probably occurs for several consecutive years before a non-spawning year.

Burbot have been captured in the Susitna River below Devil Canyon up to 905 mm in length and aged to XV years since the fall of 1981 (ADF&G 1983b, Appendix Table C-4). By pooling the 1981 to 1983 age-length data to increase the sample size, it appears that burbot below Devil Canyon have a rapid growth rate up to age IV. After age IV, mean length data shows that the growth slows to about 40 mm a year.

Age-length data from 1982 suggests that burbot have a higher growth rate in the reach of river below the Chulitna confluence compared to the reach of river between the confluence and Devil Canyon (ADF&G 1983b). For a given age, the average mean lengths of fish below the confluence were consistently 10-15 mm greater than for fish above the confluence.

Using pooled age-length data, age-length relationships can be determined between male and female burbot in the Susitna River. Scott and Crossman (1973) reported females become significantly longer than males after age IV. This is not the case with Susitna River burbot. For the reach of river below the Chulitna River confluence, females tend to be larger than males only at ages IV and V, and then after age X. The same is true for the reach of river above the Chulitna River confluence, at least up to age IX; after this age, the sample size was too small to make any comparisons.

Age-length data findings in the Susitna River concur with Morrow (1980) that female burbot tend to live longer. The three fish aged in the Susitna River which were over 800 mm were females and comprised the three oldest age classes found, ages XIII to XV.

Although 1981 findings found that the sex composition was about 1:1 males to females, since then the ratio has been decreasing (ADF&G 1982). In 1982, the ratio decreased to 1:1.5 males to females and, in the 1982-1983 winter work, the ratio had decreased to a 1:2.0 ratio (ADF&G 1983b, Appendix Table C-3).

Although no reason can be determined for the yearly differences in sex ratios between 1981 and 1982, the higher sex ratio recorded during the winter of 1982-1983 could be related to seasonal sampling. Sampling was conducted monthly from January to October in 1981 and 1982 and only from December to March in 1982-1983, which is the period of spawning.

Although Chen (1969, as cited by Morrow, 1980) indicated that males arrive at the spawning grounds first, the 1982-1983 Susitna River data suggests that females arrive first. Sex ratios at the Deshka River in December were 1:5.0, in January 1:1.5 and by February were 1:1.2 males to females. This ratio could explain the higher male to females ratio in comparison to 1981 and 1982.

4.4.3 Conclusions

The data presented provide information on the types of habitat conditions associated with spawning and provide information on the timing of burbot spawning in the Susitna drainage. Limited information on the burbot spawning in the reach of river above the Chulitna confluence suggests spawning may occur in areas directly affected by mainstem flow of the Susitna River. Substantial changes in discharge caused by the proposed hydro-electric project could affect substrate stability which could influence spawning success in this reach of the river. Further data on the precise locations and substrate used for spawning by this

I don't recall any data [illegible]

species, and an analysis of winter velocities and effects on substrate under incremental winter flow conditions, would provide the data needed for determining the probable effects of flow regulation on burbot reproduction.

another
study
needed

5.0 WINTER RADIO TELEMETRY INVESTIGATIONS OF RESIDENT FISH

5.1 Objectives

In order to evaluate the impacts that may occur from the Susitna hydroelectric project and ultimately to develop mitigation strategies, information on the movements, spawning habitat, and overwintering habitat of important resident fish species is required. Overwintering habitat could be important factor affecting resident fish survival. The following objectives of the radio telemetry studies were set up to meet these requirements.

5.1.1 Radio telemetry studies below Devil Canyon

The specific objectives of the rainbow trout (*Salmo gairdneri*) and burbot (*Lota lota*) radio telemetry studies below Devil Canyon during the 1982-83 winter sampling season were:

1) Identify rainbow trout and burbot overwintering habitat;

2) Determine when rainbow trout return to the tributaries and identify rainbow trout spawning habitat; and

3) Determine burbot spawning habitat and timing.

5.1.2 Radio telemetry studies above Devil Canyon

The specific objectives of the Arctic grayling (*Thymallus arcticus*) radio telemetry studies above Devil Canyon during the 1982-83 winter sampling season were:

1) Identify the overwintering habitat of Arctic grayling within the proposed impoundment areas;

2) Determine Arctic grayling spawning habitat and timing within the proposed impoundment areas;

3) Identify the overwintering habitat of Arctic grayling in the Deadman Lake system; and

4) Determine Arctic grayling spawning habitat and timing in the Deadman Lake system.

To our knowledge, Arctic grayling have never before been radio-tagged.

So this is a first, I [illegible]

5.2 Methods

5.2.1 Radio Tags

Radio telemetry equipment used in this study was developed by the Smith Root Corporation in Vancouver, Washington. Equipment consisted of a low frequency (40 MHz) radio tracking receiver (Model RF-40) and scanner

(Model SR-40), a loop antenna (Model LA-40) and 80 transmitters (Model P40-500L 3V). This equipment was also used in the study of adult anadromous species (ADF&G 1981c).

The transmitters used were cylindrical, encapsulated in plastic, and had a 17-cm external antenna. The transmitters measured 5.3 cm in length and were 1.6 cm in diameter. Each tag weighed approximately 13-gm dry weight. The power source for the transmitter was a three volt, lithium battery which has a life expectancy from 180 to 324 days, depending on the pulse rate. Different frequencies, between 40.600 and 40.750 MHz, and pulse rates, between 0.5 and 3 per second, were used to differentiate between the 80 radio tags. The radio tags were immersed in water for 48 hours and then tested for signal strength and frequency before they were implanted in fish.

5.2.2 Transmitter implantation

Fish were collected by electroshocking, hook and line, trotlines, and hoop nets. No injured or lethargic fish were radio tagged. Each fish determined to be suitable for radio tag implantation was placed in a holding box and anesthetized with MS-222 (tricaine methane-sulfonate). After the fish were anesthetized, their lengths were measured to the nearest millimeter (fork length for rainbow trout and Arctic grayling and total length for burbot). Scales were taken from the rainbow trout for aging purposes. All species were tagged with Floy anchor tags. Based on personal communications with Carl Burger (USFWS) and experience gathered from the 1981-82 radio telemetry studies, a minimum length for radio-tagging was selected for each species. Minimum lengths of rainbow trout, burbot and Arctic grayling to be radio tagged were 390mm fork length, 525mm total length and 370mm fork length, respectively. It was felt that fish smaller than these minimum sizes would not be able to tolerate the radio tags.

A transmitter was surgically implanted in the coelom using a procedure similar to that described by Ziebell (1973) (Plate 5-1). The surgical procedure was similar for all three species. A three to five cm incision was made on the midline of the ventral surface, slightly behind the pectoral fins and antibiotics (ampicillin and terramycin) sprinkled into the body cavity. The radio tags were inserted with the antenna toward the posterior end of the rainbow trout and burbot and toward the anterior end of the Arctic grayling. Care was taken to make sure the antennae were fully extended. Each incision was then closed with five to eight individual sutures of commercial silk, monofilament nylon, or monofilament fishing line. Burbot were implanted with 6-month tags, Arctic grayling with 9-month tags and rainbow trout with one or the other. Each fish was then placed into a live box and held upright until it regained its equilibrium. The fish were held overnight for observation. The sutures were then checked and the implanted transmitter's signal was tested. Each fish was then released near where it had been captured.

Plate 5-1. Surgical implantation of a radio transmitter into a burbot at Mainstem Susitna (RM 84.1).

DRAFT
WINTER REPORT
10/20/83

5.2.3 Tracking

The fish were then radio tracked by boat, aircraft and snowmobile. Boat tracking proved adequate until mid October, when the formation of slush ice in the river prevented further boating. Winter aerial tracking was conducted from September 16, 1982 to April 30, 1983. Aerial tracking procedures were identical to the methods used and described by Adult Anadromous Investigations (ADF&G 1981c). Tracking was generally done twice per month during the fall and once per month during the winter. Depending on the weather, radio tracking flights covered the entire Susitna River from its mouth upstream to the confluence of the Oshetna River (RM 233.4). Selected tributaries were also periodically searched (Appendix Table D-1).

The following assumptions were made regarding radio-tagged fish which were suspected of having tag implantation injuries or a radio tag failure. A radio tagged fish was presumed injured if it exihibited rapid downstream movement shortly after tagging; or in the case of Arctic grayling if they passed over Deadman Creek Falls or were located downstream of Devil Canyon (RM 151.0). A radio tag failure in a fish was assumed if there was a sudden loss of the radio signal and no further reception was made thoughout the study area (RM 0.0 - RM 233.4).

not a bad assum[illegible] for

Snowmobile tracking was conducted in March to pinpoint the exact location of radio tagged fish, to determine the fate of the fish, and to find out if the areas where the radio tagged fish were located in areas where large concentrations of resident fish had gathered to overwinter (or in the case of burbot, to spawn).

5.2.4 Habitat data collection

Data recorded during aerial radio tracking surveys included the date, location of the fish (to the nearest 0.1 mile) and general habitat characteristics (i.e., open lead, riffle, pool). During subsequent ground surveys in March, fish were located to within 30 square feet, and additional habitat data was recorded. These data included ice thickness, presence or absence of slush ice, water depth, water velocity, substrate types, and general water quality.

Maps were drawn and photographs were taken of the area where each radio-tagged fish was located.

5.3 Results

5.3.1 Rainbow trout below Devil Canyon

Between September 8 and October 15, 1982, 18 rainbow trout were captured and radio-tagged in the Susitna River downstream of Devil Canyon. Five were captured at the mouth of Indian River (RM 138.6), one in Slough 15 (RM 137.3), 10 at the mouth of Fourth of July Creek (RM 131.1), one in Slough 8A (RM 125.3), and one in the mainstem at RM 75.6. The fork lengths of the radio-tagged rainbow trout ranged from 410 to 550 millimeters.

Ten of the radio-tagged rainbow trout were implanted with 9-month transmitters in order to obtain information on pre-spawning behavior during the spring of 1983. However, the majority of the 9-month transmitters failed to function. The signals of seven 9-month tags terminated in less than two weeks and the eighth stopped transmitting within 30 days.

A summary of tracking data from the 10 remaining radio-tagged rainbow trout in the Susitna River between Cook Inlet and Devil Canyon from September, 1982 to April, 1983 is presented in Appendix Table D-3. Individual fish movements are plotted in Figures 5-1 and 5-2.

Throughout their reception life, four radio-tagged rainbow trout (numbers 600-.5, 600-1, 670-3, 680-1) exhibited minimal movements ranging

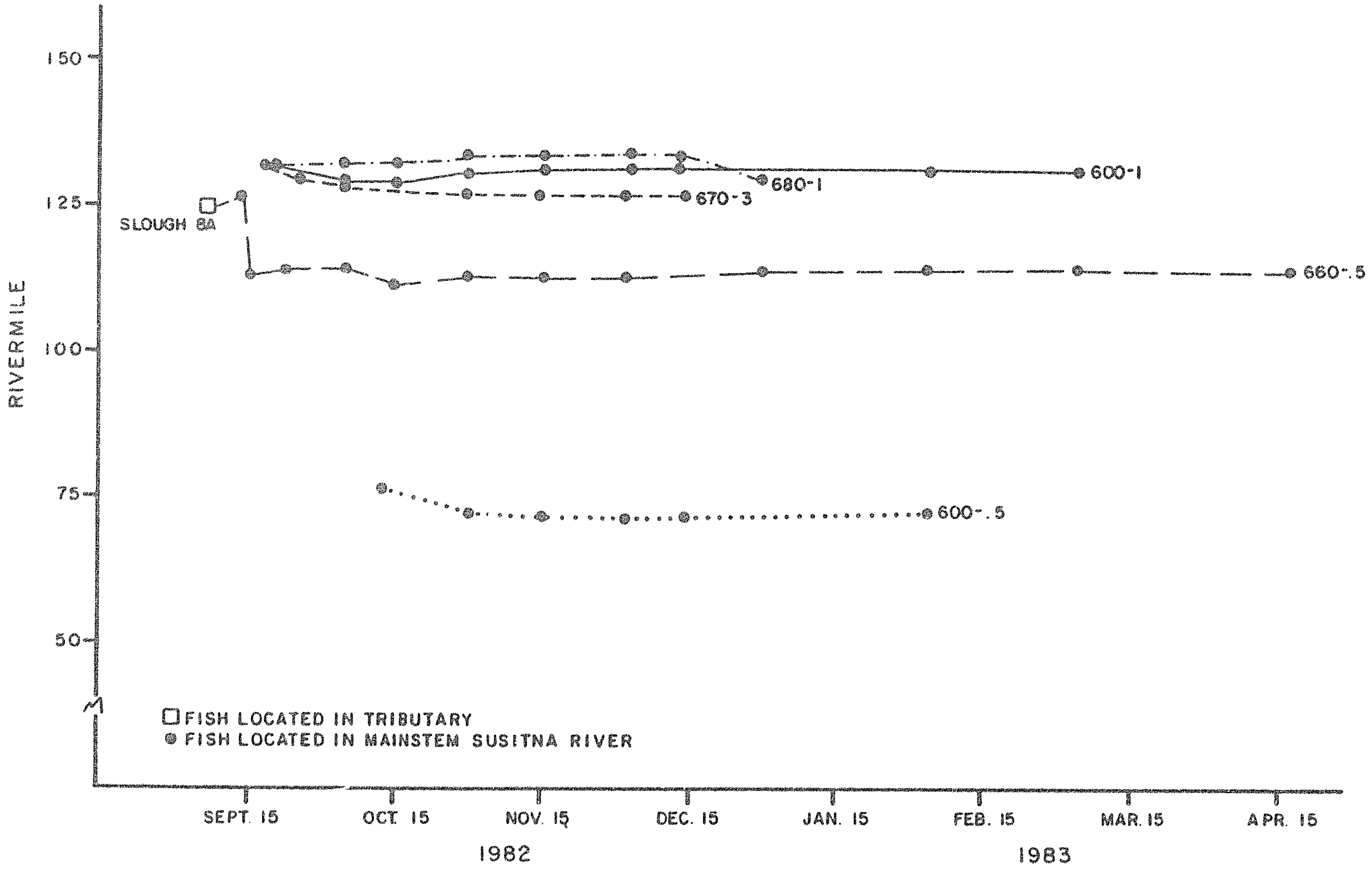


Figure 5-1. Movement of five radio-tagged rainbow trout in the Susitna River drainage below Devil Canyon, September, 1982 through April, 1983.

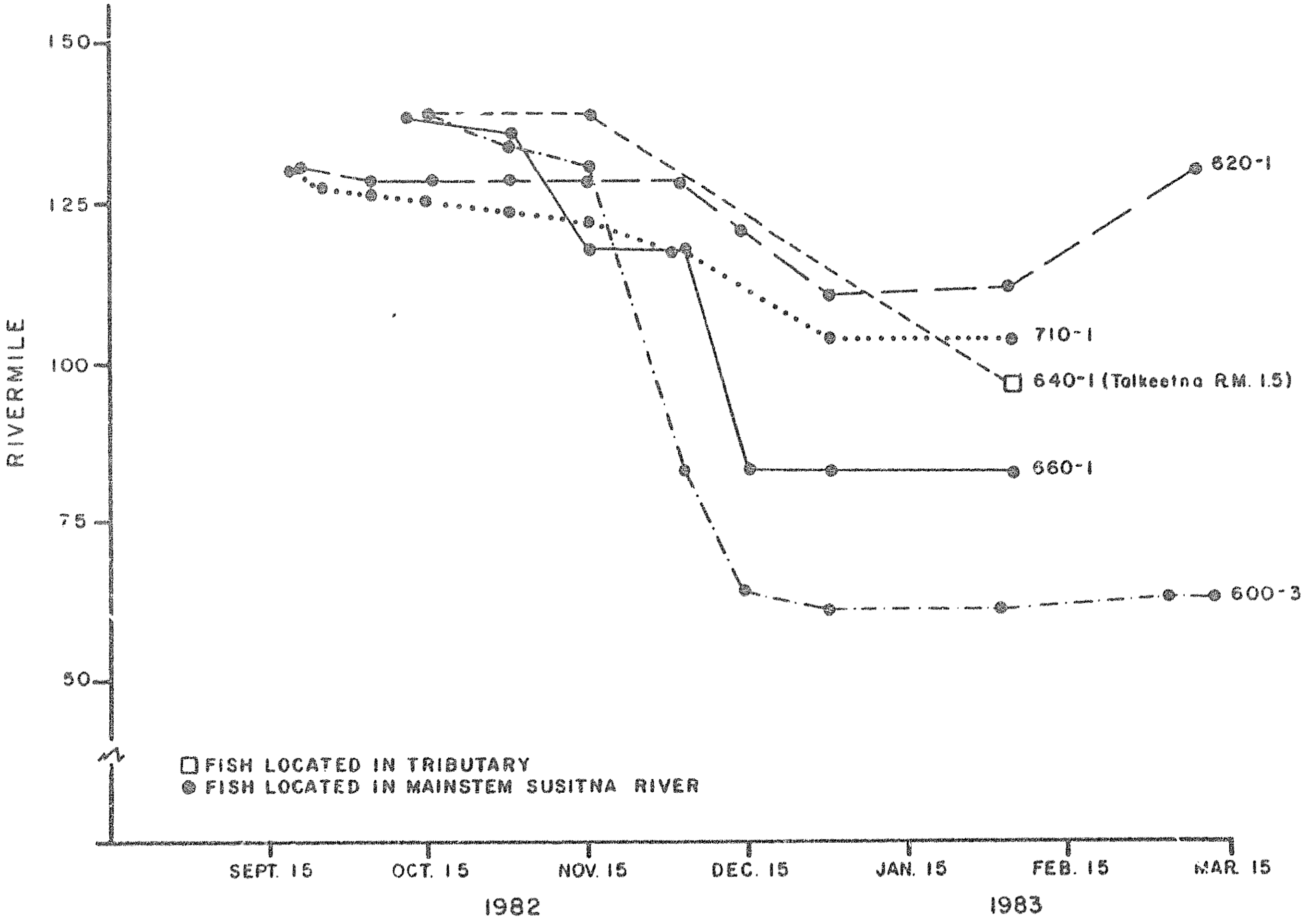


Figure 5-2. Movements of five radio-tagged rainbow trout in the Susitna River drainage below Devil Canyon, September, 1982 through March, 1983.

from 4.5 miles downstream to 1.6 miles upstream from their release sites (Figure 5-1).

Rainbow trout 620-1 remained within 3 miles of its tagging site (Fourth of July Creek, RM 131.1) for 2.5 months before migrating 20.1 miles downstream. After spending over one month in the vicinity of Gash Creek (RM 111.5), it moved upstream to RM 131.5 where it was last located on March 6, 1983 (Figure 5-2).

The remaining five radio-tagged rainbow trout (600-3, 640-1, 660-1, 660-.5, 710-1) migrated distances of 14.0 to 76.6 miles downstream from their release sites (Figure 5-1 and 5-2). All but one of these fish (640-1) overwintered in the mainstem Susitna River at their furthest downstream location.

Rainbow trout 640-1, located at the mouth of Indian River (RM 138.6) on November 15, 1982, was not re-located until February 4, 1983. This rainbow trout had migrated a minimum of 41.6 miles downriver and gone up the Talkeetna River to tributary river mile (TRM) 1.5.

On March 4 and from March 9 to 12, 1983, ground surveys were conducted to determine the status of four radio-tagged rainbow trout (600-1, 600-3, 620-1, 660-.5). No movement of these radio-tagged fish was detected during drilling with an ice auger in the vicinity of their strongest transmitter signal; therefore, their fate was not certain. However, rainbow trout 600-1 and 620-1 were located at RM 131.5 in 4.5 feet of water with an estimated velocity of 1 to 2 feet per second. It is believed that rainbow trout 620-1 was alive at that time since it had recently moved upstream 20.1 miles. The other two rainbow trout (660-.5 and 600-3) were both located under ice and slush ice in 4 to 6 inches of water.

5.3.2 Burbot below Devil Canyon

Eleven burbot were captured and radio-tagged at seven sites in the Susitna River below Devil Canyon between August 20 and October 15, 1982. Seven burbot were captured, radio-tagged, and released at slough and mainstem sites between RM 101.2 and RM 139.5. Three burbot were radio-tagged and released at Sunshine Slough (RM 84.0). The remaining burbot was captured at Birch Creek Slough (RM 88.4); it was tagged and released at RM 84.1 due to unnavigable river conditions caused by newly formed slush ice which prevented return to Birch Creek Slough. Lengths of radio-tagged burbot ranged from 535 to 865 millimeters.

A summary of tagging and tracking data for all radio-tagged burbot are presented in Appendix Table D-3.

Winter movements of six radio-tagged burbot were monitored between December, 1982 and March, 1983. Limited data was collected on the remaining five burbot due to tagging injuries or radio tag failures.

Two of the six burbot that were tracked successfully during the winter of 1982-83 (600-1, 670-1) moved less than one mile from their release sites. The other four burbot (710-3, 680-2, 640-2, 660-2) moved downriver 7.3, 11.4, 37.1, and 113.6 miles, respectively (Figure 5-3).

[illegible]

During a sampling trip conducted between March 9 and March 12, 1983, it was determined that burbot 670-1, 710-3, and 680-2 were alive. Ice augering in the vicinity of these radio-tagged fish at RM 82.5, 76.1, and 72.0 caused the radio-tagged burbot to move from 20 to 50 feet.

Burbot 670-1 and 680-2 were located in less than one foot of water with little or no velocity (Table 5-1). Burbot 710-3 was found in 15 feet of water with moderate velocity. Trotlines set in the vicinity of these radio-tagged burbot failed to recover the radio-tagged fish; however, 11 untagged burbot were captured at these sites.

5.3.3 Arctic grayling above Devil Canyon

From late August through early October, 1982, thirty-seven Arctic grayling in the tributaries of the Susitna River above Devil Canyon were implanted with radio transmitters. Eight grayling were radio-tagged in Tsusena Creek (RM 181.3), 4 in Deadman Creek (RM 186.7), 6 in Watana Creek (RM 194.1), 13 in Kosina Creek (RM 206.8), and 6 in the Oshetna River (RM 233.4). Lengths of Arctic grayling selected for radio-tagging ranged from 370 to 415 millimeters.

A summary of tracking data for 15 radio-tagged Arctic grayling in the Susitna River drainage above Devil Canyon is presented in Appendix Table D-4. Individual fish movements are presented in Figures 5-4 to 5-6.

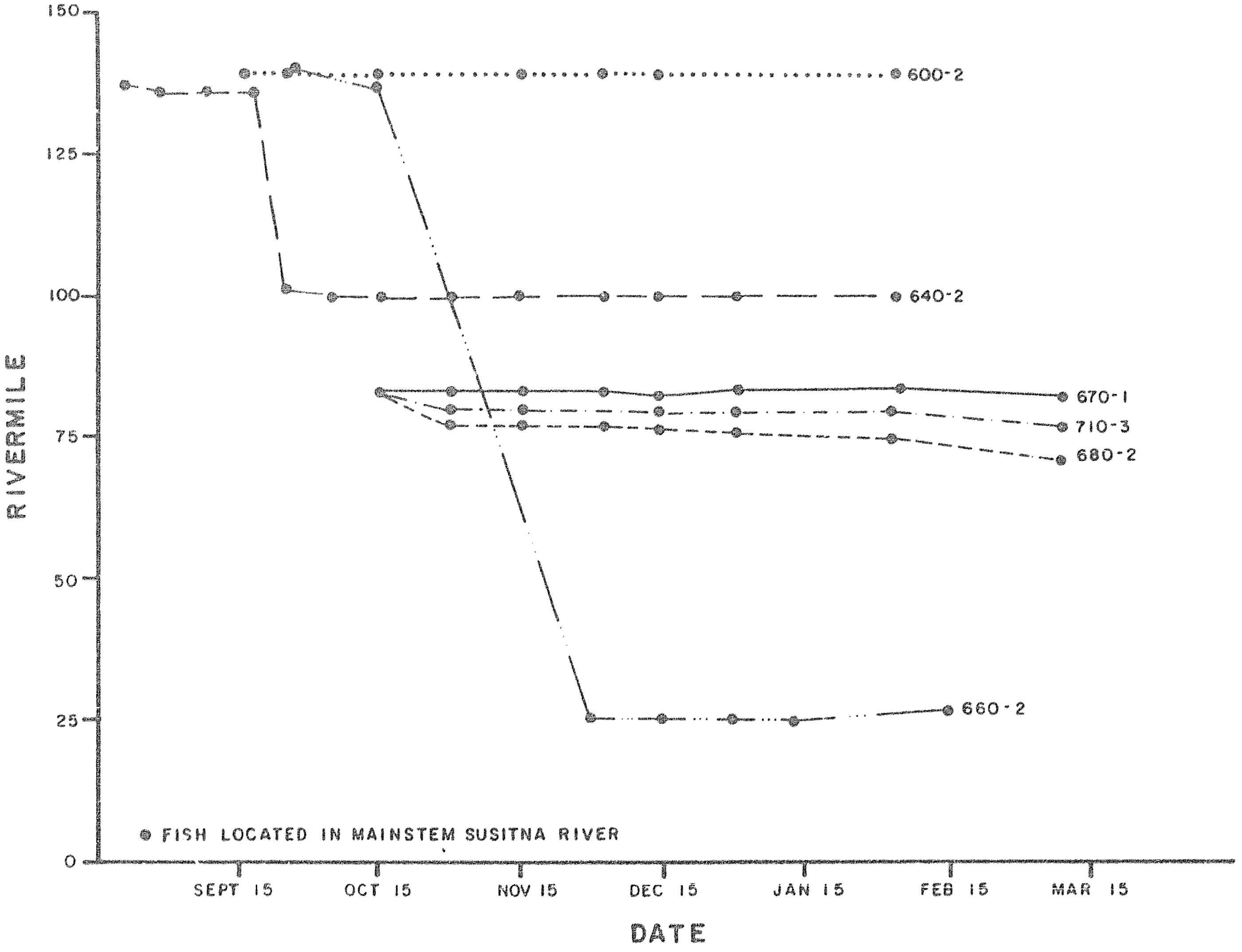


Figure 5-3. Movements of six radio tagged burbot in the Susitna River below Devil Canyon, September, 1982 through March, 1983.

Table 5-1 Physical and chemical habitat characteristics measured in the vicinity of radio-tagged burbot in the Susitna River during March, 1983.

R.M.	Geographic Code	Date	Ice Thickness (ft)	Water Depth (ft)	Water Velocity (ft/sec)	Dissolved Oxygen (mg/l)	Specific Cond. (umhos/cm)	pH	Water Temperature (°C)	Comments
72.0	S23N05W35ACC	83/03/11	4.2	4.4	0.3	--	223	7.2	-0.3	Location of radio-tagged burbot 680-2
76.1	S23N04W07ACC	83/03/11	3.0	15.0	2.5	12.1	206	7.4	-0.3	Location of radio-tagged burbot 710-3
82.5	S24N05W22BBA	83/03/11	3.5	Approx. 1.0	No specific habitat measurements taken due to three feet of slush ice under the ice.					Location of radio-tagged burbot 670-1

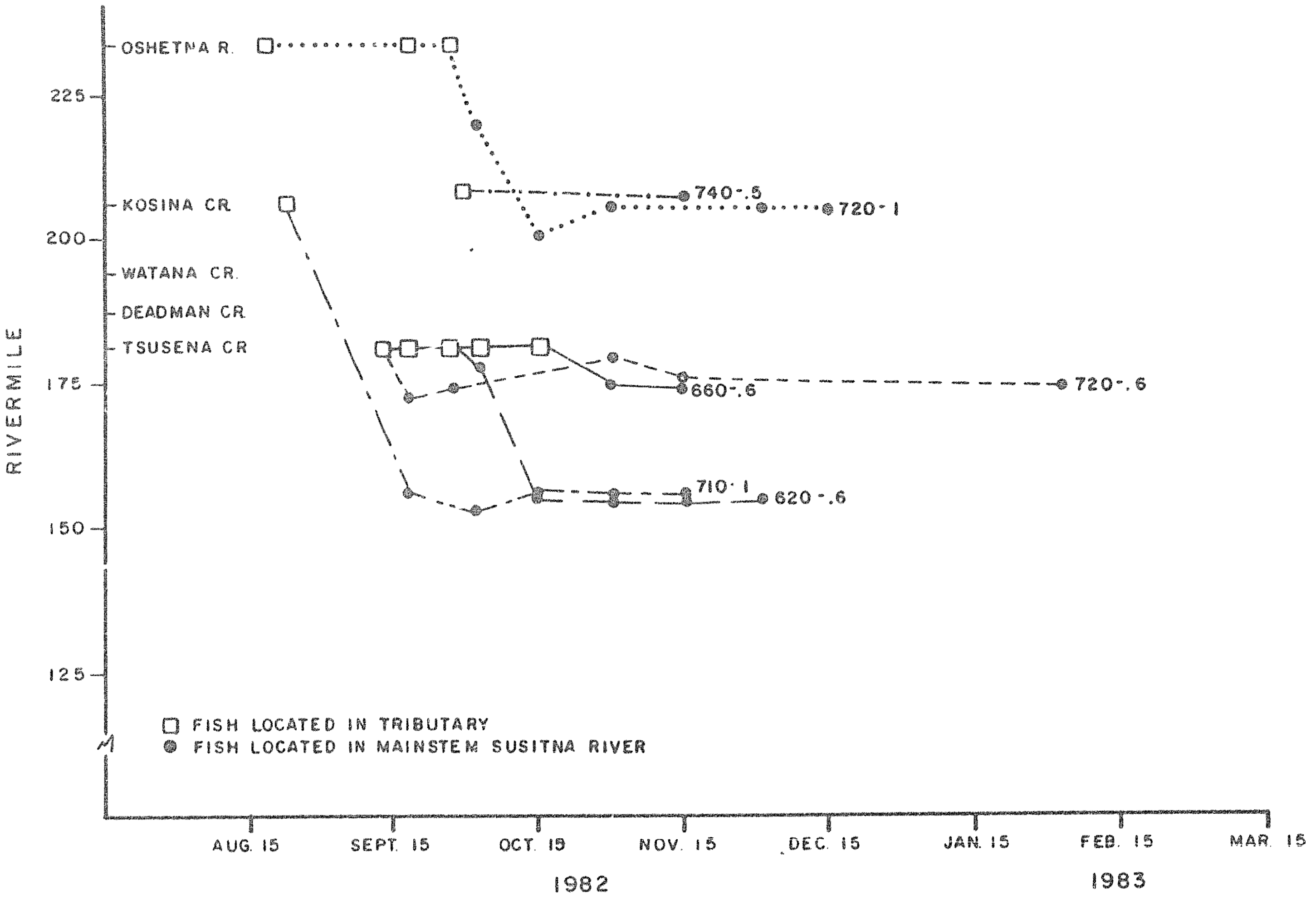


Figure 5-4. Movement of six radio-tagged Arctic grayling in the Susitna River drainage, Devil Canyon and above, August, 1982 through January, 1983.

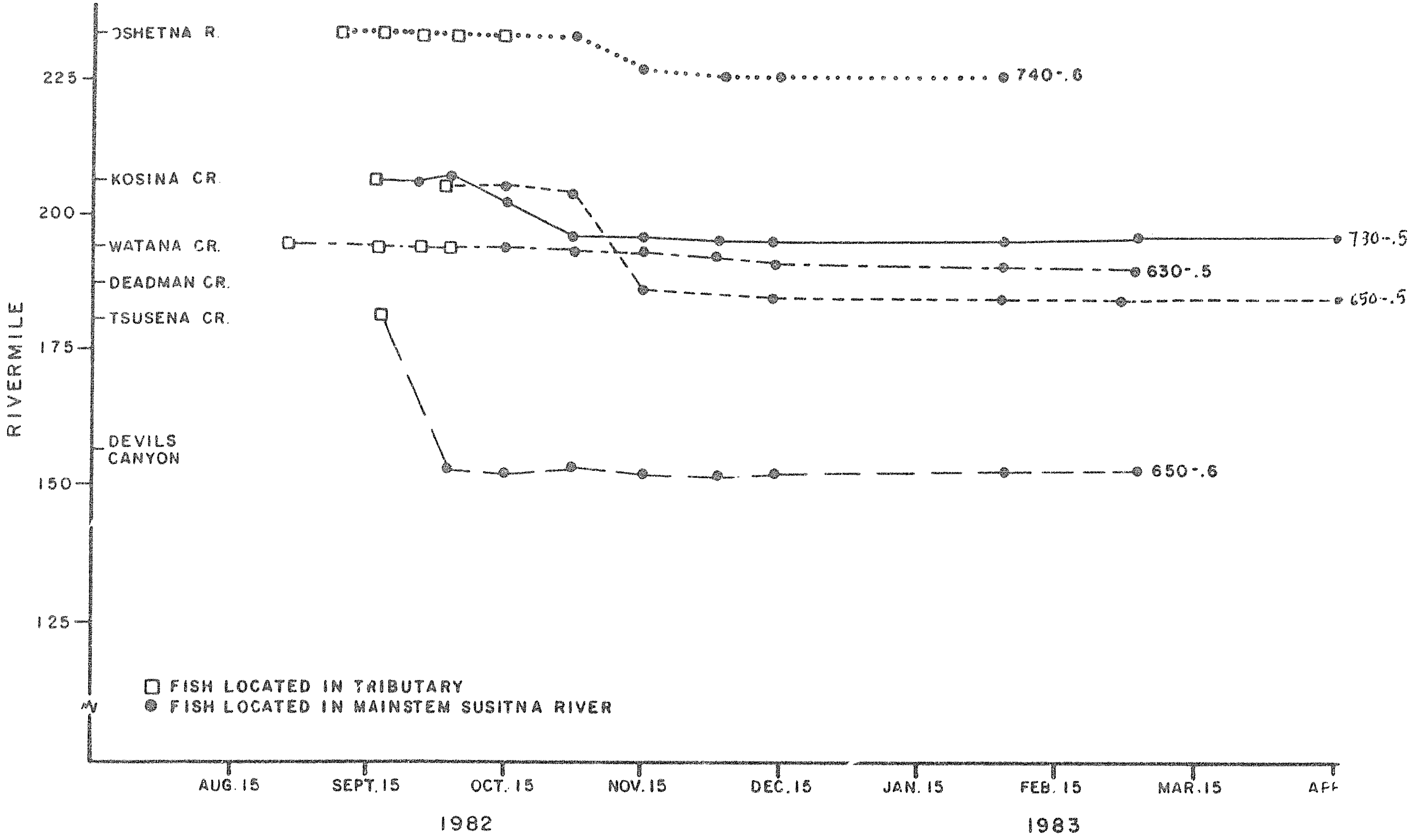


Figure 5-5. Movements of five radio-tagged Arctic grayling in the Susitna River drainage, Devil Canyon and above, August, 1982 through March, 1983.

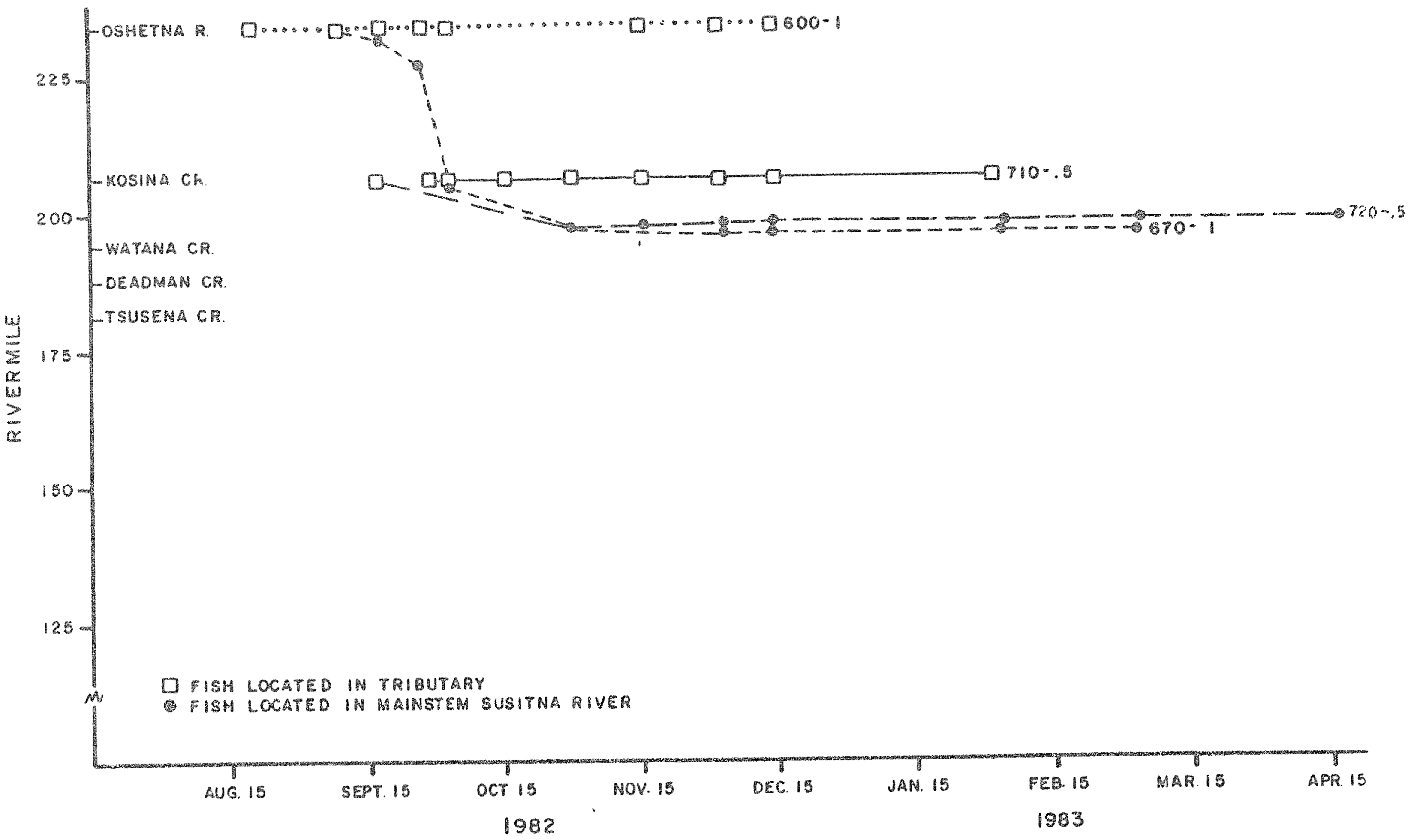


Figure 5-6. Movement of four radio-tagged Arctic grayling in the Susitna River drainage, Devil Canyon and above, August, 1982 through April, 1983.

Little or no data were obtained from the remaining 22 radio-tagged grayling due to an unexpected high rate of radio-tag failures (12) and assumed mortalities of radio-tagged fish (10).

Table 5-2 presents the timing of the Arctic grayling outmigration from tributaries above Devil Canyon into the mainstem Susitna. Based on the incidence of radio-tagged grayling located in tributaries during weekly and bi-monthly aerial surveys, most radio-tagged Arctic grayling entered the mainstem Susitna River in late September and early October. However, two radio-tagged grayling remained in the lower 0.5 miles of tributaries (600-1 in Oshetna River and 710-.5 in Kosina Creek) until December 14, 1982 and February 4, 1983, respectively.

After the radio-tagged grayling dropped out of the tributaries into the mainstem Susitna, most migrated downstream and overwintered in the mainstem. Downstream migrations in the mainstem Susitna ranged from 2.1 to 50.8 miles, with an average movement of 19.8 miles. Most fish reached their overwintering areas within 30 days and exhibited minimal movements during the winter months. However, three radio-tagged Arctic grayling (650-6, 710-1, and 720-1) did move upstream 1.0 to 5.5 miles to reach their overwintering areas during the early months of the winter.

A ground survey was conducted between March 1 and March 4, 1983 to determine the fate of six radio-tagged Arctic grayling whose signals were still being received (Appendix Table D-4). Five were located between RM 187.0 and RM 198.0 and the last was found in Devil Canyon at RM 153.1. By ice augering in the vicinity of the radio-tagged fish and

Table 5-2 Timing of radio-tagged Arctic grayling outmigration from tributaries into the mainstem Susitna River above Devil Canyon.

Tracking date	Total number radio-tagged	Number in tributaries	Percent in tributaries
9/18	12	12	100
9/27	12	10	83
10/2	15	7	47
10/15	15	5	33
10/30	15	2	13

observing habitat conditions, it was determined that two of the six fish were alive. Grayling 650-.6 was located at RM 153.1 in approximately two feet of water with an estimated velocity of 2 to 4 feet per second. The second live grayling was overwintering at RM 187.0 in a pool six feet deep with an estimated water velocity of less than 1 foot per second. The remaining four grayling were located in unfavorable habitats and presumed dead.

5.4 Discussion

5.4.1 Rainbow trout below Devil Canyon

Movements by 10 radio-tagged rainbow trout over the winter of 1982-83, were variable, ranging from 20.1 miles upriver to 76.6 miles downriver. Locations of radio-tagged rainbow trout throughout the winter suggests that mainstem reaches influenced by tributaries may be important overwintering areas for rainbow trout. Tributaries where radio-tagged rainbow trout resided for extended periods were Fourth of July Creek (RM 131.1), Lane Creek (RM 113.6), Gash Creek (RM 111.5), and Kashwitna River (RM 61.0). The location of rainbow trout 640-1 in the Talkeetna River indicates that overwintering may occur in the larger Susitna River tributaries as well.

Movements by both radio-tagged rainbow trout and Floy anchor tag rainbow recaptures during 1981-1982, indicated that rainbow trout inhabit relatively short reaches of the Susitna River. Localized migrations throughout winter 1982-1983 by four radio-tagged rainbow trout supports

1982 observations. Movements of less than 4.5 miles from release sites by these four rainbow trout (three near Fourth of July Creek and one near Montana Creek, RM 77.0) suggests that these fish tended to remain near the tributaries where they were originally tagged. Likewise, the radio-tagged rainbow trout that returned to the mouth of Fourth of July Creek, from a distance of 20.1 miles downriver, also exhibited homing behavior. In contrast, the other five radio-tagged rainbow trout migrated extensively downriver from their release sites. These rainbow trout were most active between mid-November and mid-January. This time period corresponds with the peak activity period of three radio-tagged rainbow trout in winter 1981-1982. After these five radio-tagged rainbow trout reached their downriver locations, their movements were localized. Termination of radio signals in February and March prevented determining whether these fish returned up-river prior to spawning.

5.4.2 Burbot below Devil Canyon

By monitoring radio tagged burbot over the winters 1981-1982 and 1982-1983, it has been found that burbot concentrate in certain areas and migrate little during the winter in the Susitna River. Since burbot are winter spawners, and winter monitoring data has also shown that burbot utilize the mainstem Susitna more than was formerly believed during the assumed spawning period, it may be assumed that burbot probably spawn in the mainstem as well as tributaries and sloughs.

Although (Morrow 1980) indicates that burbot are generally sedentary, our monitoring data from the past two winters indicate that burbot

[illegible]

sometimes migrate to and from spawning grounds. Results from burbot catch data indicates similar finding and that the spawning movement is thought to begin during September in the Susitna River (ADF&G, 1983b).

Until this winter, the duration of the migration and the timing of spawning was not known. Monthly surveys conducted during the winter of 1982-1983 however, have since determined that burbot spawn between mid-January and early February.

Monitored radio-tagged burbot over winter has shown that the pre-spawning migration apparently begins in mid-September and lasts to mid-January. Movement, that may be attributed to post-spawning behavior, begins in early February and lasts until mid-March.

Three of the six radio-tagged burbot in 1982-1983 and all four of the burbot in 1981-1982 showed a post-spawning movement. Although in both years the movement was slight (0.5 - 7.0 miles), in all cases but one, the movement was downriver. MacCrimmon (1959) reported that burbot in Lake Sincoe, Ontario, after sapwning in the lake, moved up into tributaries.

[illegible]

Ground surveys conducted after the spawning period (late February to mid-March) found that burbot inhabit areas of different depths and water velocities. In areas where the radio-tagged burbot were located, water depths ranged from only one foot to 15 feet and water velocities were as high as 2.5 feet per second (ADF&G 1983c). Although radio-tagged burbot inhabited areas of different flows and depths, it appeared that during both years they were in areas of high conductivity. Since high conductivities often indicate areas of upwelling, it suggests that burbot prefer these areas.

The high catches of incidental burbot in areas where radio-tagged fish were over wintering, also suggests that burbot concentrate in specific areas to overwinter.

5.4.3 Arctic grayling above Devil Canyon

Results obtained from radio-tagged Arctic grayling were extremely variable due to the high incidence of radio-tag implantation injuries and radio-tag failures. Since no previous Arctic grayling radio telemetry studies were known to have been undertaken, it was decided that only the largest grayling (greater than 370 mm) would be selected for radio-tagging. It appears that even with this size restriction that radio implantation was too stressful for some Arctic grayling. In future radio-tagging programs of Arctic grayling, it is recommended that a smaller diameter tag (maximum - 12mm) be used for implantation.

The high incidence of radio-tag failures (32 percent) that occurred within 15 days of the date that they were implanted was not anticipated. Field tests in which transmitters were immersed in water for 48 hours proved to be insufficient to determine whether transmitters would perform in the field. Decreasing water temperatures in September from 6°C to 0°C appear to be responsible for radio-tag failures. Future tagging programs should subject transmitters to both water immersion and temperature tests.

Information on Arctic grayling movements and overwintering behavior were obtained from 15 radio-tagged Arctic grayling. The timing of downstream movement from tributaries into overwintering areas of the mainstem Susitna by radio-tagged Arctic grayling (late September - early October) was slightly later than the peak movement of the Arctic grayling into the Susitna, as indicated by a decline in hook and line catch per unit effort in tributaries during September (ADF&G 1983d). Likewise, the majority of Arctic grayling in the Chena, Goodpaster and Chatanika River systems migrate from tributaries in September (Armstrong 1982). Since 12 of the 15 successfully radio-tagged grayling were tagged in mid-September or later, it appears that these fish represented the end of Arctic grayling migration from tributaries to the mainstem.

The fall movement of all but two radio-tagged Arctic grayling into the Susitna River support the findings of 1981 and 1982 grayling sampling which showed a fall outmigration from tributaries to the mainstem (ADF&G 1983d). It appears that most Arctic grayling overwinter in the mainstem Susitna River, downstream of their respective tributaries. Once reaching the extent of their downstream migration, movements by radio-tagged grayling were minimal. Radio-tagged Arctic grayling overwintered between rivermile 153.0 and 226.0 with two apparent areas of concentration, one being a 20 mile reach between Deadman Creek (RM 186.7) and Kosina Creek (RM 206.8) and the other between rivermiles

153.0 and 156.0 in Devil Canyon. During low flows in March, Arctic grayling were also utilizing areas within Devil Canyon for overwintering habitat. It is questionable whether the presence of a radio-tagged Arctic grayling in Kosina Creek and the Oshetna River well into the winter indicates overwintering in tributaries. These fish may have been dead or injured. Winter water levels in these tributaries are low and probably do not provide suitable overwintering habitat. Information concerning the overwintering habitat of Arctic graying in the Deadman Lake system is lacking due to tag failures and tagging injuries of the four grayling radio-tagged in Deadman Creek.

6.0 CONTRIBUTORS

PROJECT LEADERS

Resident and Juvenile Anadromous Fisheries Project	Dana Schmidt
Aquatic Habitat and Instream Flow Project	Christopher Estes

PRIMARY AUTHORS

(1) Text

1.0 Introduction	Staff
2.0 Continuous Surface and Intragravel Water Temperature Study	d Ancrew Hoffmann
3.0 Salmon Incubation and Emergence Studies	
- Habitat Component	Leonard Vining
- Fisheries Component	James Quinn and Staff
4.0 Burbot Spawning in the Susitna Below Devil Canyon	Rich Sundet
5.0 Winter Radio Telemetry Investigations of Selected Resident Fish	Mark Wenger Rich Sundet Mike Stratton

he has is own Staff? wow!

(2) Appendices

Appendix A	Andrew Hoffmann
Appendix B	Leonard Vining
Appendix C	Rich Sundet
Appendix D	Mark Wenger

REPORT COORDINATORS	Dana Schmidt James Quinn Drew Crawford Stephen Hale Andrew Hoffmann
EDITORS	Larry Bartlett Allen Bingham Drew Crawford Christopher Estes Stephen Hale Andrew Hoffmann Dana Schmidt Leonard Vining

DATA PROCESSING	Allen Bingham Kathrin Zosel
DATA COLLECTORS - by sections in the text	
2.0 Continuous Surface and Intragravel Water Temperature Study	Tim Quane E. Woody Trihey Jody Miller Pat Morrow Tommy Withrow
3.0 Salmon Incubation and Emergence Studies	
- Habitat Component	Leonard Vining Kathy Sheehan Don Seagren Rick Sinnott Katrine Zosel
- Fisheries Component	Kent Roth Mike Stratton Dan Gray James Quinn Paul Suchanek
4.0 Burbot Spawning in the Susitna Below Devil Canyon	Rich Sundet Doug Lang Paul Suchanek
5.0 Winter Radio Telemetry Investigations of Selected Resident Fish	Rich Sundet Mark Wenger Mike Stratton James Mauney Doug Lang James Quinn
DRAFTING	Sally Donovan Ann Reilly
TYPING	Peggy Skeers Lynne Watson

7.0 ACKNOWLEDGEMENTS

Funding for this study was provided by the State of Alaska, Alaska Power Authority.

8.0 LITERATURE CITED

Acres American, Inc. 1980. Susitna Hydroelectric Project Plan of Study. Prepared for Alaska Power Authority, Anchorage, Alaska.

Alaska Department of Fish and Game (ADF&G). 1981a. Aquatic habitat and instream flow project. Phase I. Final Draft. Prepared for Acres American Inc., by the Alaska Department of Fish and Game/Su Hydro. Anchorage, Alaska 234 pp.

______. 1981b. Resident fish investigations on the lower Susitna River. Phase I. Final Draft. Prepared for Acres American, Inc., by Alaska Department of Fish and Game/Su Hydro. Anchorage, Alaska. 138 pp.

______. 1981c. Adult anadromous fisheries project. Phase I. Final Draft. Subtask 7.10. Prepared for Acres American, Inc., by the Alaska Department of Fish and Game/Su Hydro. Anchorage, Alaska. 145 pp.

______. 1981d. Aquatic Studies Procedures Manual. Phase I. Final Draft. Alaska Department of Fish and Game Susitna Hydro Aquatic Studies Program. Anchorage, Alaska. 107 pp.

______. 1982. Aquatic Studies Procedures Manual. Phase II Final Draft. Alaska Department of Fish and Game/Su Hydro Aquatic Studies Program. Anchorage, Alaska 191 pp.

______. 1983a. Adult anadromous fish studies, 1982. Volume 2 of Phase II Final Report. ADF&G Su Hydro Aquatic Studies Program, Anchorage, Alaska. 627 pp.

______. 1983b. Resident and juvenile anadromous fish studies on the Susitna River below Devil Canyon, 1982. Volume 3 of Phase II Basic Data Report. ADF&G Su Hydro Aquatic Studies Program. Anchorage, Alaska. 275 pp.

______. 1983c. Aquatic habitat and instream flow studies, 1982. Volume 4 of Phase II Basic Data Report. ADF&G Su Hydro Aquatic Studies Program. Anchorage, Alaska. 398 pp.

______. 1983d. Upper Susitna River impoundment studies, 1982. Volume 5 of Phase I Basic Data Report. ADF&G Su Hydro Aquatic Studies Program. Anchorage, Alaska. 150 pp.

______. 1983e. Aquatic Studies Procedures Manual. Phase II. Alaska Department of Fish and Game. Susitna Hydro Aquatic Studies Program. Anchorage, Alaska.

Alderdice, D.F., W.P. Wickett, and J.R. Brett. 1958. Some effects of temporary exposure to low dissolved oxygen levels on Pacific salmon eggs. J. Fish. Res. Bd. Can. 15:229 - 250.

American Public Health Association (APHA). 1980. Standard methods for the examination of water and wastewater. 15th ed. Amer. Public Health Assoc., Washington, D.C., 1134 pp.

Bakkala, R.G. 1970. Synopsis of biological data on the chum salmon, Oncorhnychus keta (Walbaum) 1792. FAO Species Synopsis No. 41. USFWS, Bureau of Comm. Fish. Circular 315. Washington, D.C. 89 pp.

Bams, R.A. 1969. Adaptations of sockeye salmon associated with incubation in stream gravels. Pages 71-87 in T.G. Northcote (editor). Symposium on Salmon and Trout in Streams. University of British Columbia. Canada.

Baxter, R.M., and P. Glaude. 1980. Environmental effects of dams and impoundment in Canada: experience and prospects. Can. Bull. Fish. Agent. Sci. 205: 34 p.

Burgner, R.L. 1958. A study of fluctuation in abundance, growth, and survival of early life stages of the red salmon Oncorhynchus nerka (Walbaum). PhD thesis. Univ. of Wash. Seattle, Washington.

Childerhose, R.J., and M. Trim. 1979. Pacific salmon. University of Washington Press. Seattle, Washington.

Combs, B.D., and R.E. Burrows. 1957. Threshold temperatures for the normal development of chinook salmon eggs. Prog. Fish-Cult. 19: 3-6.

Combs, B.D. 1965. Effect of temperature on the development of salmon eggs. Prog. Fish-Cult. 27:134-137.

Cooper, A.C. 1965. The effects of transported stream sediments on the survival of sockeye and pink salmon eggs and alevins. International Pacific Salmon Fisheries Commission. Bull XVIII. New Westinstar, British Columbia, Canada. 71 p.

Gangmark, H.A., and R.G. Bakkala. 1959. Plastic standpipe for sampling streambed environment of salmon spawn. U.S. Fish and Wild. Serv. Special Scientific Rpt. - Fisheries No. 261. 20 pp.

Hayes, F.R. 1949. The growth, general chemistry and temperature relations of salmonid eggs. The Quarterly Review of Biology. Vol. 24: 281-308.

Heming, T.A. 1982. Effects of temperature on utilization of yolk by chinook salmon (Oncorhynchus tshawytscha) eggs and alevins. Canadian Journal of Fisheries and Aquatic Sciences 39: 184-190.

Hull, C.H., and N.H. Nie (eds). 1981. SPSS update 7-9: New procedures and facilities for releases 7-9. McGraw-Hill, Inc., New York, New York.

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

Lind, O.T. 1974. Handbook of common methods in limnology. C.V. Mosby Co., Saint Louis, Mo.

MacCrimmon, H.R. 1959. Observations on spawning of burbot in Lake Simcoe, Ontario. J. Wildl. Mgt. 23(4):447-449.

McNeil, W.J. 1962. Variations in the dissolved oxygen content of intragravel water in four spawning streams of southeastern Alaska. US Fish and Wild. Serv. Special Scientific Rpt. - Fisheries No. 402.

McNeil, W.J., and J.E. Bailey. 1975. Salmon rancher's manual. Northwest Fisheries Center, Auke Bay Fisheries Lab., National Marine Fisheries Service, NOAA. Processed Report. 95 pp.

Merritt, M.F., and J.A. Raymond. 1982. Early life history of chum salmon in the Noatak River and Kotzebue Sound. Alaska Dept Fish and Game, FRED Rpt. No. 1. 56 pp.

Morrow, J.E. 1980. The freshwater fishes of Alaska. Alaska Northwest Publishing Co., Anchorage, Alaska. 248 pp.

Nie, N.H., C.H. Hull, J.G. Jenkins, K. Steinbrenner, and D.H. Bent. 1975. SPSS: Statistical package for the social sciences. Second edition, McGraw-Hill, Inc. New York, New York.

Olsen, J.C. 1968. Physical environment and egg development in a mainland beach area and an island beach area of Iliamna Lake. pp. 171-197. In: Further Studies of Alaska Sockeye Salmon. Univ. Wash. Publ. in Fisheries. New Series, Vol. III. R.L. Burgner (ed).

Peterson, R.H., H.C.E. Spinney, and A. Sreepharan. 1977. Development of Atlantic salmon (Salmo salar) eggs and alevins under varied temperature regimes. J. Fish. Res. Board Can. 34: 32-43.

Raymond, J.A. 1981. Incubation of fall chum salmon Oncorhynchus keta (Walbaum) at Clear Air Force Station, Alaska. Alaska Department of Fish and Game, Division of Fisheries Rehabilitation Enhancement and Development, Juneau, Alaska.

Reiser, D.W., and T.C. Bjornn. 1979. Influence of forest and rangeland management fish habitat requirments of anadromous salmonids. U.S. Department of Agriculture. Forest Service. Pacific Northwest Forest and Range Experiment Station. PNW-96:54. Portland, Or.

Scott, W.B., and E.J. Crossman. 1973. Freshwater fishes of Canada. Fish. Res. Bd. Canada Bull. 184. Ottawa. 966 pp.

Sheridan, W.L. 1968. Land use and sediment. Pages 62-80 in Forum on the Relation Between Logging and Salmon. Alaska Dept. Fish and Game, Juneau, Alaska.

Silver, S.J., C.E. Warren, and P. Doudoroff. 1963. Dissolved oxygen requirements of developing steelhead trout and chinook salmon embryos at different water velocities. Transactions of the American Fisheries Society. V. 92: 327-343.

Stikini, I. 1979. A report to British Columbia Hydro and Power Authority April 1980. P. McCart Biological Consultants L.T.D. Fisheries Studies.

U.S. Geological Survey (USGS). 1982. Provisional summary of 1982 water resources data for Alaska.

Vaux, W.G. 1962. Interchange of Stream and Intragravel Water in a Salmon Spawning Riffle. U.S. Fish and Wildlife Service. No. 405: 1-11.

Velsen, F.P.J. 1980. Embryonic development in eggs of sockeye salmon _Oncorhynchus nerka_. Can. Spec. Publ. Fish Aquat. Sci. 49: 19 p.

Wangaard, D.B., and C.V. Burger. 1983. Effects of various temperature regimes on the incubation of Susitna River chum and sockeye salmon. Draft report. U.S. Fish and Wildlife Service. National Fishery Research Center, Anchorage, Alaska.

Zeibell, C.D. 1973. Ultrasonic transmittor for tracking channel catfish. The Progressive Fish Culturist. 35 (1): 28-31.

DRAFT
WINTER REPORT
10/20/83

APPENDIX A

Continuous Surface and Intragravel Temperatures

DRAFT
WINTER REPORT
10/20/83

Appendix A consists of continuous temperature data collected by ADF&G for winter studies from August 1982 through May 1983. The data was collected using two different instruments, Omnidata DP212 recorders (datapods) and Ryan model J-90 thermographs. Datapods record both surface and intragravel temperatures while thermographs measure only surface water temperatures. Data from datapods are in Appendix tables A-1 through A-11 Ryan thermograph data are in Tables A-12 and A-13.

LIST OF APPENDIX A TABLES

Appendix Table A-1 Datapod intragravel and surface water temperature (C) data summary, at Slough 8A - Mouth, RM 125.4, Geocode S30N03W30BCD.

- AUGUST 1982 -

DATE	INTRAGRAVEL			SURFACE WATER		
	MIN	MEAN	MAX	MIN	MEAN	MAX
820821	6.4	6.6	6.7	7.8	10.7	14.7
820822	6.5	6.7	6.8	8.0	11.1	14.8
820823	6.6	6.7	6.8	9.8	11.2	13.8
820824	6.5	6.7	6.8	9.1	10.8	12.9
820825	6.7	6.8	6.8	9.4	10.8	13.2
820826	6.7	6.8	7.0	9.3	11.2	14.8
820827	6.6	6.8	7.1	7.8	11.1	14.6
820828	6.5	6.7	6.8	8.2	10.0	13.0
820829	6.5	6.6	6.7	8.6	9.6	11.2
820830	6.5	6.6	6.6	8.3	8.8	9.9
820831	6.5	6.6	6.7	7.7	8.5	9.7
MONTHLY VALUE	6.4	-----	7.1	7.7	-----	14.8

Appendix Table A-1 (Continued).

- SEPTEMBER 1982 -

DATE	INTRAGRAVEL			SURFACE WATER		
	MIN	MEAN	MAX	MIN	MEAN	MAX
820901	6.5	6.7	6.7	7.7	8.9	10.4
820902	6.4	6.5	6.8	7.1	8.4	9.9
820903	6.2	6.3	6.4	7.3	8.0	8.9
820904	6.2	6.3	6.4	6.4	7.5	9.0
820905	6.1	6.2	6.3	6.3	7.4	8.4
820906	6.2	6.2	6.3	6.5	7.4	7.9
820907	6.2	6.3	6.3	6.8	8.0	9.8
820908	6.2	6.3	6.4	7.5	8.2	8.9
820909	6.3	6.3	6.4	7.3	8.0	9.1
820910	6.2	6.3	6.4	6.9	7.8	8.9
820911	6.1	6.2	6.3	6.3	7.0	7.5
820912	6.0	6.1	6.2	5.3	6.6	8.5
820913	6.0	6.1	6.2	5.8	6.2	6.6
820914	6.0	6.0	6.1	6.1	6.4	6.8
820915	6.0	6.0	6.1	6.3	7.0	8.4
820916	5.9	6.0	6.1	7.3	7.6	8.1
820917	5.9	6.0	6.0	6.6	6.9	7.6
820918	5.8	6.0	6.0	5.5	6.2	6.8
820919	5.8	5.9	6.0	5.6	6.0	6.6
820920	5.9	5.9	6.0	5.6	6.0	6.5
820921	5.9	5.9	6.0	5.4	5.8	6.3
820922	5.9	6.0	6.0	5.3	5.7	6.5
820923	5.9	6.0	6.1	3.9	4.9	5.9
820924	6.0	6.1	6.1	2.9	4.2	5.4
820925	6.1	6.2	6.3	3.4	4.4	5.1
820926	6.3	6.3	6.4	4.6	5.0	5.4
820927	6.3	6.4	6.4	4.8	5.2	6.1
820928	6.3	6.4	6.5	2.9	3.9	4.9
820929	6.4	6.5	6.6	4.1	4.7	5.6
820930	6.4	6.5	6.5	4.5	5.2	6.0
MONTHLY VALUE	5.8	6.2	6.8	2.9	6.5	10.4

Appendix Table A-1 (Continued).

- OCTOBER 1982 -

DATE	INTRAGRAVEL			SURFACE WATER		
	MIN	MEAN	MAX	MIN	MEAN	MAX
821001	6.4	6.5	6.5	4.4	4.8	5.3
821002	6.4	6.5	6.5	3.5	4.4	5.6
821003	6.4	6.5	6.5	3.1	4.0	5.2
821004	6.4	6.4	6.5	2.1	3.1	4.6
821005	6.3	6.4	6.5	1.8	2.5	4.2
821006	6.3	6.4	6.4	1.4	2.3	3.3
821007	6.3	6.3	6.4	1.7	2.3	2.7
821008	6.2	6.3	6.3	1.5	2.3	3.5
821009	6.1	6.2	6.3	1.2	2.3	3.7
821010	6.1	6.2	6.2	2.4	2.8	3.3
821011	6.0	6.1	6.1	.7	2.0	2.7
821012	6.0	6.0	6.1	.8	1.9	2.9
821013	5.9	6.0	6.1	.9	1.7	2.9
821014	5.8	5.9	6.0	1.5	2.5	4.9
821015	5.8	5.9	5.9	1.3	2.0	3.[illegible]
821016	5.6	5.8	5.8	1.0	1.5	1.9
821017	5.6	5.7	5.7	1.1	1.9	2.9
821018	5.5	5.6	5.6	.9	1.9	3.2
821019	5.4	5.5	5.6	1.0	1.7	2.2
821020	5.4	5.5	5.6	1.2	1.9	2.6
821021	5.3	5.4	5.5	1.2	1.5	2.0
821022	5.2	5.4	5.4	1.2	1.5	2.1
821023	5.2	5.3	5.4	1.2	1.6	2.2
821024	5.1	5.2	5.2	1.7	2.2	2.8
821025	5.0	—	5.1	2.2	—	2.8
821030	4.2	—	4.3	2.0	—	2.4
821031	4.3	4.4	4.5	1.9	2.2	2.5
MONTHLY VALUE	4.2	5.8	6.5	.7	2.4	5.6

Appendix Table A-1 (Continued).

- NOVEMBER 1982 -

DATE	INTRAGRAVEL			SURFACE WATER		
	MIN	MEAN	MAX	MIN	MEAN	MAX
821101	4.4	4.4	4.5	1.7	2.0	2.2
821102	4.4	4.5	4.6	1.9	2.0	2.3
821103	4.5	4.6	4.6	2.0	2.1	2.3
821104	4.5	4.6	4.6	2.0	2.2	2.5
821105	4.6	4.6	4.7	2.1	2.3	2.6
821106	4.6	4.7	4.7	1.9	2.2	2.4
821107	4.6	4.7	4.7	1.9	2.0	2.2
821108	4.6	4.7	4.7	1.9	2.1	2.4
821109	4.6	4.6	4.7	1.7	2.0	2.3
821110	4.6	4.6	4.7	1.9	2.0	2.2
821111	4.6	4.6	4.7	1.7	2.0	2.1
821112	4.6	4.6	4.7	1.8	2.1	2.3
821113	4.6	4.6	4.6	1.6	1.9	2.1
821114	4.6	4.6	4.6	1.7	1.8	2.2
821115	4.6	4.6	4.6	1.7	1.9	2.4
821116	4.5	4.6	4.6	1.8	2.2	2.6
821117	4.4	4.5	4.6	1.6	1.8	2.1
821118	4.3	4.4	4.5	1.7	1.9	2.3
821119	4.2	4.3	4.3	1.7	2.1	2.4
821120	4.0	4.2	4.3	.2	2.0	2.6
821121	2.6	4.0	4.3	0.0	1.3	2.7
821122	3.9	4.0	4.2	1.0	1.8	2.7
821123	4.0	4.1	4.1	.8	2.0	2.8
821124	4.0	4.1	4.2	1.0	1.5	2.5
821125	4.0	4.1	4.1	.6	1.1	1.6
821126	3.9	4.0	4.0	.6	.8	1.0
821127	3.8	3.9	4.0	.6	.8	1.0
821128	3.6	3.7	3.8	.7	.8	.9
821129	2.5	3.2	3.7	0.0	.8	2.6
821130	1.7	2.3	2.9	0.0	0.0	.1
MONTHLY VALUE	1.7	4.3	4.7	0.0	1.7	2.8

Appendix Table A-1 (Continued).

- DECEMBER 1982 -

DATE	INTRAGRAVEL			SURFACE WATER		
	MIN	MEAN	MAX	MIN	MEAN	MAX
821201	2.1	2.4	2.6	0.0	0.0	.1
821202	1.8	------	2.1	0.0	------	.1
821221	-.1	------	0.0	0.0	------	0.0
821222	-.1	0.0	.1	-.1	0.0	.1
821223	-.1	0.0	0.0	-.1	0.0	0.0
821224	-.1	0.0	.1	-.1	0.0	0.0
821225	0.0	0.0	0.0	-.1	0.0	0.0
821226	-.1	0.0	.1	0.0	0.0	0.0
821227	-.1	0.0	0.0	0.0	0.0	.1
821228	0.0	0.0	0.0	0.0	0.0	0.0
821229	0.0	0.0	0.0	0.0	0.0	0.0
821230	0.0	0.0	0.0	0.0	0.0	.1
821231	-.1	0.0	0.0	0.0	0.0	.1
MONTHLY VALUE	-.1	------	2.6	-.1	------	.1

Appendix Table A-1 (Continued).

- JANUARY 1983 -

DATE	INTRAGRAVEL			SURFACE WATER		
	MIN	MEAN	MAX	MIN	MEAN	MAX
830101	-.1	0.0	0.0	0.0	0.0	.1
830102	-.1	0.0	0.0	0.0	<.05	.1
830103	-.1	0.0	0.0	0.0	0.0	0.0
830104	-.1	0.0	0.0	-.1	0.0	0.0
830105	-.1	0.0	0.0	-.1	0.0	0.0
830106	-.1	0.0	0.0	-.1	0.0	0.0
830107	-.1	0.0	0.0	-.1	0.0	.1
830108	-.1	0.0	0.0	-.1	0.0	.1
830109	-.1	0.0	0.0	-.1	0.0	.1
830110	-.1	0.0	0.0	-.1	0.0	.1
830111	-.1	0.0	0.0	-.1	0.0	.1
830112	-.1	0.0	0.0	-.1	0.0	0.0
830113	-.1	0.0	0.0	-.1	0.0	0.0
830114	-.1	0.0	0.0	-.1	0.0	.1
830115	-.1	0.0	0.0	-.1	0.0	.1
830116	-.1	0.0	0.0	0.0	0.0	.1
830117	-.1	-.1	0.0	0.0	0.0	.1
830118	-.1	0.0	0.0	0.0	0.0	.1
830119	-.1	0.0	0.0	0.0	0.0	.1
830120	-.1	0.0	0.0	-.1	0.0	0.0
830121	-.1	0.0	0.0	-.1	0.0	.1
830122	-.1	0.0	0.0	-.1	0.0	.1
830123	-.1	0.0	0.0	-.1	0.0	.1
830124	-.1	0.0	0.0	-.1	0.0	0.0
830125	-.1	0.0	0.0	0.0	0.0	0.0
830126	-.1	0.0	0.0	0.0	0.0	.1
830127	-.1	0.0	0.0	0.0	0.0	.1
830128	-.1	0.0	0.0	0.0	0.0	.1
830129	-.1	0.0	0.0	0.0	0.0	.1
830130	-.1	0.0	0.0	0.0	0.0	.1
830131	-.1	0.0	0.0	0.0	<.05	.1
MONTHLY VALUE	-.1	0.0	0.0	-.1	<.05	.1

Appendix Table A-1 (Continued).

- FEBRUARY 1983 -

DATE	INTRAGRAVEL			SURFACE WATER		
	MIN	MEAN	MAX	MIN	MEAN	MAX
830201	-.1	0.0	0.0	0.0	0.0	.1
830202	-.1	0.0	0.0	0.0	0.0	.1
830203	-.1	0.0	0.0	0.0	<.05	.1
830204	-.1	0.0	0.0	0.0	<.05	.1
830205	-.1	0.0	0.0	0.0	<.05	.1
830206	-.1	0.0	0.0	0.0	0.0	.1
830207	-.1	0.0	0.0	0.0	<.05	.1
830208	-.1	0.0	0.0	0.0	0.0	.1
830209	-.1	0.0	0.0	0.0	0.0	.1
830210	-.1	0.0	0.0	0.0	0.0	.1
830211	-.1	0.0	0.0	0.0	0.0	.1
830212	-.1	0.0	0.0	0.0	0.0	.1
830213	-.1	0.0	0.0	0.0	0.0	.1
830214	-.1	0.0	0.0	0.0	<.05	.1
830215	-.1	0.0	0.0	0.0	0.0	.1
830216	-.1	0.0	.1	0.0	0.0	.1
830217	-.1	0.0	.1	0.0	<.05	.1
830218	0.0	0.0	.1	0.0	<.05	.1
830219	-.1	0.0	.1	0.0	0.0	.1
830220	0.0	0.0	.1	0.0	<.05	.1
830221	0.0	0.0	.1	0.0	0.0	.1
830222	0.0	0.0	.1	0.0	<.05	.1
830223	0.0	0.0	.1	0.0	.1	.1
830224	0.0	<.05	.1	0.0	.1	.1
830225	0.0	0.0	.1	0.0	<.05	.1
830226	0.0	<.05	.1	0.0	.1	.1
830227	0.0	<.05	.1	0.0	.1	.1
830228	0.0	.1	.1	0.0	.1	.1
MONTHLY VALUE	-.1	<.05	.1	0.0	<.05	.1

Appendix Table A-1 (Continued).

- MARCH 1983 -

DATE	INTRAGRAVEL			SURFACE WATER		
	MIN	MEAN	MAX	MIN	MEAN	MAX
830301	0.0	.1	.2	0.0	.1	.1
830302	.1	.1	.2	0.0	.1	.1
830303	.1	.1	.2	.1	.1	.2
830304	.1	.2	.2	.1	.1	.2
830305	.1	.2	.3	0.0	.1	.2
830306	.1	.2	.3	.1	.1	.2
830307	.2	.3	.3	.1	.2	.3
830308	.2	.3	.4	.1	.2	.3
830309	.3	-----	.4	.2	.3	.3
830310	-----	-----	-----	.2	.3	.3
830311	-----	-----	-----	.3	-----	.4
830312	-----	-----	-----	.3	.4	.4
830313	-----	-----	-----	.3	.3	.5
830314	-----	-----	-----	.3	.4	.5
830315	-----	-----	-----	.4	.4	.5
830316	-----	-----	-----	.4	.4	.5
830317	-----	-----	-----	.4	.5	.6
830318	-----	-----	-----	.4	.5	.6
830319	-----	-----	-----	.5	.5	.6
830320	-----	-----	-----	.5	.5	.6
830321	-----	-----	-----	.5	.6	.6
830322	-----	-----	-----	.5	.6	.6
830323	-----	-----	-----	.5	.6	.7
830324	-----	-----	-----	.5	.6	.7
830325	-----	-----	-----	.6	.6	.7
830326	-----	-----	-----	.6	.6	.7
830327	-----	-----	-----	.6	.6	.7
830328	-----	-----	-----	.6	.6	.8
830329	-----	-----	-----	.6	.6	.8
830330	-----	-----	-----	.6	.6	.8
830331	-----	-----	-----	.6	.6	.8
MONTHLY VALUE	0.0	-----	.4	0.0	.4	.8

Appendix Table A-1 (Continued).

- APRIL 1983 -

DATE	INTRAGRAVEL			SURFACE WATER		
	MIN	MEAN	MAX	MIN	MEAN	MAX
830401	------	------	------	.6	.7	.9
830402	------	------	------	.6	.7	.9
830403	------	------	------	.6	.8	1.0
830404	------	------	------	.7	.7	.9
830405	------	------	------	.7	.7	.9
830406	------	------	------	.7	.9	1.2
830407	------	------	------	.7	1.0	1.5
830408	------	------	------	.7	1.0	1.5
830409	------	------	------	.8	1.0	1.4
830410	------	------	------	.7	1.0	1.6
830411	------	------	------	.7	.9	1.2
830412	------	------	------	.7	.8	1.0
830413	------	------	------	.8	1.0	1.6
830414	------	------	------	.9	1.1	1.5
830415	------	------	------	.8	1.0	1.4
830416	------	------	------	.8	1.1	1.6
830417	------	------	------	.9	1.2	1.7
830418	------	------	------	.9	1.2	1.8
830419	------	------	------	1.0	1.4	2.1
830420	------	------	------	.8	1.5	2.5
830421	------	------	------	.9	1.6	2.9
830422	------	------	------	1.0	1.5	2.4
830423	------	------	------	1.1	1.4	2.1
830424	------	------	------	1.2	2.0	3.5
830425	------	------	------	1.2	2.2	3.8
830426	------	------	------	1.2	2.2	4.0
830427	------	------	------	1.3	2.4	4.3
830428	------	------	------	1.6	2.1	4.2
MONTHLY VALUE	------	------	------	.6	1.3	4.3

Appendix Table A-2 Datapod intragravel and surface water temperature (C) data summary, at Slough 8A - Middle, RM 125.6, Geocode S30N03W30BCD.

- APRIL 1983 -

DATE	INTRAGRAVEL			SURFACE WATER		
	MIN	MEAN	MAX	MIN	MEAN	MAX
830429	3.0	3.1	3.1	1.8	2.9	4.1
830430	3.1	3.1	3.2	1.7	2.8	4.5
MONTHLY VALUE	3.0	———	3.2	1.7	———	4.5

Appendix Table A-2 (Continued).

- MAY 1983 -

DATE	INTRAGRAVEL			SURFACE WATER		
	MIN	MEAN	MAX	MIN	MEAN	MAX
830501	3.2	——	3.2	4.4	——	4.9
830502	3.1	3.2	3.3	2.5	3.5	4.5
830503	3.2	3.2	3.3	2.3	3.4	4.7
830504	3.2	3.3	3.4	2.0	3.7	5.7
830505	3.3	3.3	3.4	1.8	3.7	6.1
830506	3.3	3.3	3.4	1.4	3.7	6.5
830507	3.3	3.3	3.4	1.3	4.0	7.2
830508	3.3	3.4	3.5	1.8	4.5	7.4
830509	3.4	3.5	3.5	2.1	4.5	7.2
830510	3.4	3.5	3.6	2.5	4.8	7.0
830511	3.5	3.5	3.6	2.7	5.2	8.0
830512	3.5	3.6	3.7	3.4	5.4	7.4
830513	3.6	3.6	3.7	3.0	5.2	7.6
830514	3.6	3.6	3.7	2.8	4.7	7.1
830515	3.6	3.6	3.7	2.5	4.2	6.0
830516	3.6	3.6	3.7	2.4	4.2	5.7
830517	3.6	3.7	3.7	2.7	4.2	5.9
830518	3.6	3.7	3.7	2.5	4.3	6.5
830519	3.6	3.6	3.7	2.9	4.8	6.6
830520	3.6	3.7	3.7	3.0	5.5	8.0
830521	3.6	3.7	3.8	3.4	4.9	7.0
830522	3.7	3.7	3.8	3.7	5.6	8.5
830523	3.7	3.7	3.8	3.7	5.7	7.8
830524	3.8	3.8	3.9	4.1	6.3	9.2
830525	3.8	3.8	3.9	3.8	6.5	9.2
830526	3.8	3.9	3.9	5.1	6.7	8.4
830527	3.8	3.9	4.0	4.4	6.3	8.3
830528	3.8	3.9	4.0	4.5	7.0	9.8
830529	3.8	3.9	4.0	5.6	7.5	9.3
830530	3.9	4.0	4.2	6.7	8.3	9.7
830531	4.1	4.2	4.2	6.2	7.6	8.7
MONTHLY VALUE	3.1	3.6	4.2	1.3	5.2	9.8

Appendix Table A-2 (Continued).

- JUNE 1983 -

DATE	INTRAGRAVEL			SURFACE WATER		
	MIN	MEAN	MAX	MIN	MEAN	MAX
830601	4.0	4.1	4.2	6.5	7.9	9.9
830602	4.0	———	4.1	5.9	———	9.1
MONTHLY VALUE	4.0	———	4.2	5.9	———	9.9

Appendix Table A-3 Datapod intragravel and surface water temperature (C) data summary, at LRX 29, RM 126.1, Geocode S30N03W19DCA

- OCTOBER 1982 -

DATE	INTRAGRAVEL			SURFACE WATER		
	MIN	MEAN	MAX	MIN	MEAN	MAX
821030	1.7	-----	1.9	.2	-----	.6
821031	1.8	1.9	2.1	.2	.5	.7
MONTHLY VALUE	1.7	-----	2.1	.2	-----	.7

Appendix Table A-3 (Continued).

- NOVEMBER 1982 -

DATE	INTRAGRAVEL			SURFACE WATER		
	MIN	MEAN	MAX	MIN	MEAN	MAX
821101	1.9	2.0	2.1	.4	.5	.7
821102	1.7	1.9	2.0	.3	.4	.5
821103	1.7	1.8	1.9	.3	.5	.7
821104	1.5	1.7	1.8	0.0	.2	.3
821105	1.5	1.5	1.6	.2	.3	.4
821106	1.5	1.6	1.6	0.0	.2	.4
821107	1.5	1.5	1.6	-.1	<.05	.1
821108	1.4	1.5	1.6	-.1	.1	.3
821109	1.4	1.5	1.6	-.1	<.05	.3
821110	1.4	1.5	1.5	.2	------	.3
821111	1.5	1.5	1.6	------	------	------
821112	1.5	1.5	1.5	------	------	------
821113	1.5	1.5	1.5	------	------	------
821114	1.4	1.5	1.5	------	------	------
821115	1.4	1.5	1.5	------	------	------
821116	1.5	1.5	1.6	------	------	------
821117	1.6	1.6	1.7	------	------	------
821118	1.6	1.6	1.7	------	------	------
821119	1.6	1.6	1.7	------	------	------
821120	-.1	1.5	1.7	------	------	------
821121	0.0	.1	.4	------	------	------
821122	-.1	0.0	.2	------	------	------
821123	-.1	-.1	0.0	------	------	------
821124	-.1	0.0	0.0	------	------	------
821125	-.1	0.0	0.0	------	------	------
821126	-.1	-.1	0.0	------	------	------
821127	-.1	-.1	0.0	------	------	------
821128	-.1	0.0	0.0	------	------	------
821129	-.1	0.0	0.0	------	------	------
821130	-.1	0.0	0.0	------	------	------
MONTHLY VALUE	-.1	1.1	2.1	-.1	------	.7

Appendix Table A-3 (Continued).

- DECEMBER 1982 -

DATE	INTRAGRAVEL			SURFACE WATER		
	MIN	MEAN	MAX	MIN	MEAN	MAX
821201	-.1	0.0	0.0	----	----	----
821202	-.1	0.0	0.0	----	----	----
821203	-.1	0.0	0.0	----	----	----
821204	-.1	0.0	0.0	----	----	----
821205	-.1	0.0	0.0	----	----	----
821206	-.1	-.1	0.0	----	----	----
821207	-.1	-.1	0.0	----	----	----
821208	-.1	-.1	0.0	----	----	----
821209	-.1	-.1	0.0	----	----	----
821210	-.1	-.1	0.0	----	----	----
821211	-.1	-.1	-.1	----	----	----
821212	-.1	0.0	0.0	----	----	----
821213	-.1	0.0	0.0	----	----	----
821214	-.1	0.0	0.0	----	----	----
821215	-.1	0.0	0.0	----	----	----
821216	-.1	0.0	0.0	----	----	----
821217	0.0	0.0	0.0	----	----	----
821218	-.1	0.0	0.0	----	----	----
821219	-.1	0.0	0.0	----	----	----
821220	0.0	0.0	0.0	----	----	----
821221	-.1	0.0	0.0	----	----	----
821222	-.1	0.0	0.0	----	----	----
821223	0.0	0.0	0.0	----	----	----
821224	0.0	0.0	0.0	----	----	----
821225	0.0	0.0	0.0	----	----	----
821226	-.1	0.0	0.0	----	----	----
821227	0.0	0.0	0.0	----	----	----
821228	0.0	0.0	0.0	----	----	----
821229	0.0	0.0	.1	----	----	----
821230	0.0	0.0	0.0	----	----	----
821231	0.0	0.0	0.0	----	----	----
MONTHLY VALUE	-.1	0.0	.1	----	----	----

Appendix Table A-3 (Continued).

- JANUARY 1983 -

DATE	INTRAGRAVEL			SURFACE WATER		
	MIN	MEAN	MAX	MIN	MEAN	MAX
830101	-.1	0.0	0.0	------	------	------
830102	0.0	0.0	0.0	------	------	------
830103	0.0	0.0	0.0	------	------	------
830104	0.0	<.05	.1	------	------	------
830105	0.0	0.0	.1	------	------	------
830106	0.0	<.05	.1	------	------	------
830107	0.0	<.05	.1	------	------	------
830108	0.0	0.0	0.0	------	------	------
830109	-.1	0.0	.1	------	------	------
830110	0.0	<.05	.1	------	------	------
830111	0.0	<.05	.1	------	------	------
830112	0.0	0.0	0.0	------	------	------
830113	0.0	------	0.0	------	------	------
830114	0.0	------	0.0	------	------	------
830115	-.1	0.0	.1	------	------	------
830116	-.1	<.05	.1	------	------	------
830117	0.0	0.0	.1	------	------	------
830118	0.0	0.0	.1	------	------	------
830119	0.0	<.05	.1	------	------	------
830120	0.0	<.05	.1	------	------	------
830121	0.0	<.05	.1	------	------	------
830122	0.0	0.0	0.0	------	------	------
830123	0.0	.1	.1	------	------	------
830124	0.0	<.05	.1	------	------	------
830125	0.0	0.0	.1	------	------	------
830126	0.0	<.05	.1	------	------	------
830127	0.0	.1	.1	------	------	------
830128	0.0	.1	.1	------	------	------
830129	0.0	<.05	.1	------	------	------
830130	0.0	0.0	0.0	------	------	------
830131	0.0	<.05	.1	------	------	------
MONTHLY VALUE	-.1	<.05	.1	------	------	------

Appendix Table A-3 (Continued).

- FEBRUARY 1983 -

DATE	INTRAGRAVEL			SURFACE WATER		
	MIN	MEAN	MAX	MIN	MEAN	MAX
830201	0.0	.1	.1	——	——	——
830202	0.0	<.05	.1	——	——	——
830203	0.0	.1	.1	——	——	——
830204	0.0	.1	.1	——	——	——
830205	0.0	<.05	.1	——	——	——
830206	0.0	.1	.1	——	——	——
830207	.1	.1	.1	——	——	——
830208	.1	.1	.1	——	——	——
830209	0.0	.1	.1	——	——	——
830210	0.0	<.05	.1	——	——	——
830211	0.0	.1	.1	——	——	——
830212	0.0	<.05	.1	——	——	——
830213	0.0	0.0	0.0	——	——	——
830214	0.0	0.0	0.0	——	——	——
830215	0.0	0.0	0.0	——	——	——
830216	0.0	0.0	0.0	——	——	——
830217	0.0	0.0	0.0	——	——	——
830218	0.0	0.0	0.0	——	——	——
830219	0.0	0.0	0.0	——	——	——
830220	0.0	.1	.1	——	——	——
830221	0.0	.1	.1	——	——	——
830222	0.0	.1	.1	——	——	——
830223	.1	.1	.1	——	——	——
830224	0.0	.1	.1	——	——	——
830225	.1	.1	.1	——	——	——
830226	.1	.1	.1	——	——	——
830227	.1	.1	.1	——	——	——
830228	.1	.1	.1	——	——	——
MONTHLY VALUE	0.0	.1	.1	——	——	——

Appendix Table A-3 (Continued).

- MARCH 1983 -

DATE	INTRAGRAVEL			SURFACE WATER		
	MIN	MEAN	MAX	MIN	MEAN	MAX
830301	.1	.1	.1	-----	-----	-----
830302	.1	.1	.1	-----	-----	-----
830303	.1	.1	.1	-----	-----	-----
830304	.1	.1	.1	-----	-----	-----
830305	.1	.1	.1	-----	-----	-----
830306	.1	.1	.1	-----	-----	-----
830307	.1	.1	.1	-----	-----	-----
830308	.1	.1	.1	-----	-----	-----
830309	.1	.1	.1	-----	-----	-----
830310	.1	.1	.1	-----	-----	-----
830311	.1	.1	.1	-----	-----	-----
830312	.1	.1	.1	-----	-----	-----
830313	.1	.1	.1	-----	-----	-----
830314	.1	.1	.1	-----	-----	-----
830315	.1	.1	.1	-----	-----	-----
830316	.1	.1	.1	-----	-----	-----
830317	.1	.1	.1	-----	-----	-----
830318	0.0	.1	.1	-----	-----	-----
830319	.1	.1	.1	-----	-----	-----
830320	.1	.1	.1	-----	-----	-----
830321	.1	.1	.1	-----	-----	-----
830322	0.0	.1	.1	-----	-----	-----
830323	.1	.1	.1	-----	-----	-----
830324	.1	.1	.1	-----	-----	-----
830325	.1	.1	.1	-----	-----	-----
830326	.1	.1	.1	-----	-----	-----
830327	.1	.1	.1	-----	-----	-----
830328	.1	.1	.1	-----	-----	-----
830329	.1	.1	.1	-----	-----	-----
830330	.1	.1	.1	-----	-----	-----
830331	0.0	.1	.1	-----	-----	-----
MONTHLY VALUE	0.0	.1	.1	-----	-----	-----

Appendix Table A-3 (Continued).

- APRIL 1983 -

DATE	INTRAGRAVEL			SURFACE WATER		
	MIN	MEAN	MAX	MIN	MEAN	MAX
830401	0.0	.1	.1	-----	-----	-----
830402	0.0	.1	.1	-----	-----	-----
830403	0.0	.1	.2	-----	-----	-----
830404	.1	.1	.1	-----	-----	-----
830405	.1	.1	.1	-----	-----	-----
830406	.1	.1	.1	-----	-----	-----
830407	.1	.1	.1	-----	-----	-----
830408	.1	.1	.1	-----	-----	-----
830409	.1	.1	.1	-----	-----	-----
830410	.1	.1	.1	-----	-----	-----
830411	.1	.1	.1	-----	-----	-----
830412	.1	.1	.1	-----	-----	-----
830413	.1	.1	.1	-----	-----	-----
830414	.1	.1	.1	-----	-----	-----
830415	.1	.1	.1	-----	-----	-----
830416	.1	.1	.1	-----	-----	-----
830417	.1	.1	.2	-----	-----	-----
830418	.1	.2	.2	-----	-----	-----
830419	.1	.1	.2	-----	-----	-----
830420	0.0	.1	.1	-----	-----	-----
830421	0.0	<.05	.1	-----	-----	-----
830422	0.0	.1	.1	-----	-----	-----
830423	0.0	.1	.1	-----	-----	-----
830424	.1	.1	.1	-----	-----	-----
830425	0.0	.1	.1	-----	-----	-----
830426	0.0	.1	.1	-----	-----	-----
830427	.1	.1	.2	-----	-----	-----
830428	.1	-----	.1	-----	-----	-----
MONTHLY VALUE	0.0	.1	.2	-----	-----	-----

Appendix Table A-4 Datapod intragravel and surface water temperature (C) data summary, at Slough 8A - Upper, RM 126.4, Geocode S30N03W20CDD.

- AUGUST 1982 -

DATE	INTRAGRAVEL			SURFACE WATER		
	MIN	MEAN	MAX	MIN	MEAN	MAX
820821	4.7	4.7	4.8	5.0	6.3	9.4
820822	4.7	4.8	4.8	4.9	6.1	9.3
820823	4.7	4.8	4.8	5.6	6.4	7.7
820824	4.7	4.8	4.8	5.4	6.3	8.5
820825	4.7	4.8	4.8	5.5	6.3	8.6
820826	4.7	4.8	4.9	5.5	6.5	9.7
820827	4.7	4.8	4.9	4.9	6.0	9.2
820828	4.8	4.8	4.9	5.1	6.0	8.2
820829	4.8	4.9	4.9	5.6	6.0	6.5
820830	4.9	4.9	4.9	5.7	5.9	6.4
820831	4.8	4.9	4.9	5.5	5.8	6.7
MONTHLY VALUE	4.7	----	4.9	4.9	----	9.7

Appendix Table A-4 (Continued).

- SEPTEMBER 1982 -

DATE	INTRAGRAVEL			SURFACE WATER		
	MIN	MEAN	MAX	MIN	MEAN	MAX
820901	4.8	4.9	5.0	5.6	6.2	7.1
820902	4.8	4.9	5.0	5.8	6.3	7.6
820903	4.9	4.9	5.0	5.9	6.3	7.0
820904	4.9	4.9	5.0	5.5	6.1	7.1
820905	4.9	5.0	5.0	5.2	6.0	6.8
820906	4.9	5.0	5.1	5.4	5.9	6.4
820907	5.0	5.1	5.1	5.5	6.0	7.3
820908	5.1	5.1	5.2	5.5	5.9	6.5
820909	5.1	5.2	5.2	5.5	5.9	6.7
820910	5.1	5.2	5.3	5.4	5.9	6.5
820911	5.2	5.3	5.3	5.1	5.7	6.2
820912	5.2	5.3	5.3	5.0	5.6	6.8
820913	5.2	5.2	5.3	5.3	5.6	6.2
820914	5.2	5.2	5.3	5.5	5.9	6.3
820915	5.2	5.2	5.3	5.7	6.4	7.7
820916	5.2	5.3	5.3	5.9	6.7	8.3
820917	5.2	5.2	5.3	5.8	6.1	7.0
820918	5.1	5.2	5.2	5.3	5.8	6.5
820919	5.1	5.1	5.2	5.5	5.7	6.1
820920	5.1	5.1	5.2	5.5	5.7	6.2
820921	5.1	5.1	5.2	5.3	5.6	6.0
820922	5.0	5.1	5.1	5.2	5.6	6.5
820923	5.0	5.1	5.1	4.7	5.3	6.8
820924	5.0	5.1	5.1	4.3	5.1	6.2
820925	5.0	5.0	5.1	4.7	5.2	5.8
820926	5.0	5.0	5.1	5.2	5.3	5.8
820927	4.9	5.0	5.0	4.9	5.3	6.0
820928	4.9	4.9	5.0	4.4	5.0	5.5
820929	4.9	4.9	5.0	5.0	5.3	5.9
820930	4.8	4.9	4.9	5.0	5.4	6.0
MONTHLY VALUE	4.8	5.1	5.3	4.3	5.8	8.3

Appendix Table A-4 (Continued).

- OCTOBER 1982 -

DATE	INTRAGRAVEL			SURFACE WATER		
	MIN	MEAN	MAX	MIN	MEAN	MAX
821001	4.8	4.9	4.9	4.9	5.2	5.6
821002	4.8	4.8	4.9	4.7	5.2	5.9
821003	4.7	4.8	4.8	4.7	5.1	5.3
821004	4.7	4.8	4.8	4.4	4.9	6.0
821005	4.7	4.7	4.8	4.3	4.8	5.8
821006	4.6	4.7	4.8	4.3	4.8	5.4
821007	4.7	4.7	4.7	4.5	4.7	5.1
821008	4.7	4.7	4.7	3.9	4.6	5.5
821009	4.7	4.7	4.7	4.0	4.7	5.4
821010	4.7	4.7	4.7	4.4	4.7	5.1
821011	4.6	4.7	4.7	3.5	4.5	4.9
821012	4.6	4.7	4.7	3.6	4.3	4.8
821013	4.6	4.6	4.7	3.6	4.2	4.6
821014	4.6	4.6	4.7	3.5	4.2	5.2
821015	4.6	4.6	4.7	3.5	4.0	4.8
821016	4.6	4.6	4.7	3.9	4.1	4.3
821017	4.6	4.7	4.7	3.9	4.4	5.3
821018	4.6	4.6	4.7	3.9	4.2	4.8
821019	4.6	4.6	4.6	3.8	4.2	4.5
821020	4.6	4.6	4.7	3.9	4.2	4.7
821021	4.6	4.6	4.7	3.8	4.1	4.4
821022	4.6	4.6	4.6	3.8	4.1	4.4
821023	4.6	4.6	4.6	3.8	4.0	4.3
821024	4.5	4.6	4.6	3.7	3.9	4.3
821025	4.5	—	4.6	3.6	—	3.8
MONTHLY VALUE	4.5	4.7	4.9	3.5	4.4	6.0

Appendix Table A-4 (Continued).

- MARCH 1983 -

DATE	INTRAGRAVEL			SURFACE WATER		
	MIN	MEAN	MAX	MIN	MEAN	MAX
830311	2.7	—	2.7	2.4	—	2.7
830312	2.6	2.7	2.7	2.3	2.5	4.2
830313	2.6	2.7	2.7	1.4	2.4	4.6
830314	2.5	2.6	2.7	1.3	2.2	4.0
830315	2.6	2.6	2.7	1.3	2.9	4.6
830316	2.5	2.6	2.7	1.4	2.5	4.5
830317	2.4	2.6	2.7	1.2	2.2	4.5
830318	2.4	2.5	2.7	1.0	1.9	4.6
830319	2.4	2.5	2.7	1.0	1.8	4.6
830320	2.4	2.6	2.7	1.3	2.3	4.3
830321	2.4	2.6	2.8	1.3	2.6	4.6
830322	2.4	2.5	2.7	1.0	2.0	4.3
830323	2.5	2.5	2.7	1.0	2.0	4.4
830324	2.5	2.5	2.7	1.0	2.0	4.6
830325	2.4	2.6	2.8	1.2	2.7	5.5
830326	2.4	2.6	2.8	1.2	2.5	4.6
830327	2.4	2.6	2.8	1.0	2.6	5.7
830328	2.4	2.6	2.9	1.3	3.1	6.0
830329	2.4	2.6	2.9	1.1	3.0	6.0
830330	2.4	2.6	2.9	1.1	3.0	6.0
830331	2.4	2.7	3.1	1.3	3.2	6.0
MONTHLY VALUE	2.4	2.6	3.1	1.0	2.5	6.0

Appendix Table A-4 (Continued).

- APRIL 1983 -

DATE	INTRAGRAVEL			SURFACE WATER		
	MIN	MEAN	MAX	MIN	MEAN	MAX
830401	2.5	2.7	3.1	2.3	3.5	6.0
830402	2.5	2.8	3.1	1.1	3.3	6.0
830403	2.6	2.9	4.1	2.3	3.4	6.2
830404	2.6	2.8	3.1	2.6	3.2	4.5
830405	2.5	2.7	3.0	2.6	3.7	5.5
830406	2.7	3.1	4.2	2.3	3.8	7.5
830407	2.8	3.3	4.4	2.4	4.1	7.6
830408	2.8	3.6	4.3	2.3	4.0	7.5
830409	2.7	3.5	4.2	2.9	3.4	5.9
830410	2.7	3.2	4.3	2.7	4.1	7.2
830411	2.7	3.5	4.2	2.7	3.6	5.6
830412	2.4	2.7	4.0	1.1	2.2	4.3
830413	2.4	2.7	4.0	1.4	3.5	6.1
830414	2.7	3.2	4.1	2.3	3.7	6.1
830415	2.7	3.2	4.1	2.8	3.4	5.9
830416	2.8	3.5	4.4	2.3	4.3	6.1
830417	2.8	3.5	4.3	2.5	3.6	5.8
830418	2.7	3.2	4.1	2.6	3.5	5.6
830419	2.7	3.2	4.3	2.6	4.2	7.6
830420	2.8	3.6	4.5	2.4	4.3	7.8
830421	2.9	4.0	4.7	2.4	4.6	9.0
830422	3.1	4.3	4.6	2.7	5.1	7.6
830423	3.0	4.1	4.4	2.5	4.2	6.1
830424	2.8	3.6	4.5	2.3	4.2	9.4
830425	2.8	3.5	4.4	2.3	4.2	8.9
830426	2.6	3.4	4.3	2.4	4.3	7.6
830427	2.5	2.9	4.1	2.4	4.4	7.3
830428	2.5	----	3.1	2.5	----	3.9
830429	2.4	2.5	2.7	1.8	3.1	5.6
830430	2.3	2.5	2.7	1.5	3.0	6.5
MONTHLY VALUE	2.3	3.2	4.7	1.1	3.8	9.4

Appendix Table A-4 (Continued).

- MAY 1983 -

DATE	INTRAGRAVEL			SURFACE WATER		
	MIN	MEAN	MAX	MIN	MEAN	MAX
830501	2.3	2.4	2.6	1.3	2.7	5.7
830502	2.2	2.4	2.5	1.7	2.5	4.0
830503	2.2	2.3	2.5	1.6	2.4	3.6
830504	2.2	2.4	2.5	1.6	2.5	4.6
830505	2.3	2.4	2.5	1.7	2.6	4.8
830506	2.4	2.5	2.6	1.7	2.7	5.0
830507	2.4	2.5	2.7	1.7	2.8	5.2
830508	2.5	2.5	2.7	1.8	3.0	5.3
830509	2.4	2.5	2.7	2.0	3.1	5.4
830510	2.5	2.6	2.7	2.0	3.0	5.3
830511	2.5	2.6	2.8	2.0	3.2	5.5
830512	2.5	2.7	2.8	2.2	3.1	4.8
830513	2.6	2.7	2.8	2.2	3.1	5.4
830514	2.6	2.7	2.8	2.3	3.0	4.6
830515	2.6	2.7	2.8	2.2	3.0	4.2
830516	2.6	2.7	2.9	2.2	3.0	4.3
830517	2.7	2.8	2.9	2.4	3.1	4.1
830518	2.7	2.8	2.9	2.4	3.3	4.7
830519	2.8	2.9	3.0	2.4	3.4	4.9
830520	2.8	2.9	3.0	2.4	3.6	5.7
830521	2.9	3.0	3.1	2.6	3.3	4.4
830522	2.9	3.0	3.1	2.8	3.8	5.9
830523	2.9	3.0	3.2	2.8	3.7	6.0
830524	2.9	3.1	3.3	2.8	3.9	6.5
830525	3.0	3.1	3.3	2.6	3.9	6.2
830526	3.0	3.1	3.3	3.1	4.0	6.4
830527	3.0	3.2	3.3	2.8	3.8	5.8
830528	3.0	3.2	3.3	2.8	3.9	5.6
830529	3.1	3.2	3.4	2.9	4.0	5.4
830530	3.2	3.2	3.3	3.3	3.9	5.0
830531	3.2	3.2	3.3	3.4	3.9	5.1
MONTHLY VALUE	2.2	2.8	3.4	1.3	3.3	6.5

Appendix Table A-4 (Continued).

- JUNE 1983 -

DATE	INTRAGRAVEL			SURFACE WATER		
	MIN	MEAN	MAX	MIN	MEAN	MAX
830601	3.1	3.3	3.4	3.2	4.3	6.7
830602	3.2	—	3.4	3.2	—	3.9
MONTHLY VALUE	3.1	—	3.4	3.2	—	6.7

Appendix Table A-5 Datapod intragravel and surface water temperature (C) data summary at Slough 9, RM 128.7, Geocode S30N03W09DBC.

- AUGUST 1982 -

DATE	INTRAGRAVEL			SURFACE WATER		
	MIN	MEAN	MAX	MIN	MEAN	MAX
820821	3.4	———	3.7	5.1	———	12.0
820822	3.4	3.5	3.6	5.2	8.4	12.1
820823	3.5	3.5	3.7	6.9	8.7	10.9
820824	3.4	3.5	3.7	6.5	8.5	11.5
820825	3.5	3.5	3.6	6.7	8.4	10.4
820826	3.4	3.5	3.7	6.0	8.4	12.1
820827	3.3	3.5	3.7	4.5	8.1	11.6
820828	3.4	3.5	3.7	5.5	7.5	10.2
820829	3.4	3.5	3.7	6.5	7.6	8.7
820830	3.6	3.6	3.7	6.3	7.1	8.0
820831	3.5	3.6	3.8	5.7	6.8	8.4
MONTHLY VALUE	3.3	———	3.8	4.5	———	12.1

Appendix Table A-5 (Continued).

- SEPTEMBER 1982 -

DATE	INTRAGRAVEL			SURFACE WATER		
	MIN	MEAN	MAX	MIN	MEAN	MAX
820901	3.5	3.6	3.7	6.3	8.0	10.6
820902	3.4	3.5	3.6	6.1	7.5	9.7
820903	3.4	3.5	3.6	6.2	7.1	8.0
820904	3.4	3.5	3.5	5.6	6.9	9.1
820905	3.4	3.5	3.5	5.3	6.4	7.7
820906	3.4	3.4	3.5	5.5	6.4	7.7
820907	3.4	3.5	3.5	5.7	6.8	8.3
820908	3.4	3.5	3.5	5.7	6.6	7.7
820909	3.4	3.4	3.5	5.6	6.6	8.2
820910	3.3	3.4	3.5	5.5	6.6	8.0
820911	3.3	3.4	3.4	5.0	5.9	7.1
820912	3.3	3.3	3.4	4.1	5.7	7.4
820913	3.3	3.4	3.4	4.9	5.7	6.7
820914	3.4	3.4	3.5	5.9	6.4	7.2
820915	3.4	3.5	3.6	6.4	6.8	7.5
820916	3.5	3.5	3.6	7.0	7.3	7.4
820917	3.4	3.5	3.5	6.2	6.6	7.1
820918	3.4	3.4	3.5	5.6	5.9	6.3
820919	3.4	3.4	3.5	5.5	5.6	5.9
820920	3.4	3.4	3.5	5.6	5.9	6.4
820921	3.4	3.5	3.5	6.0	6.3	6.7
820922	3.4	3.4	3.5	5.5	6.1	7.0
820923	3.4	3.4	3.5	4.4	5.1	6.4
820924	3.3	3.4	3.5	2.9	4.0	5.2
820925	3.3	3.4	3.5	3.3	4.2	4.9
820926	3.4	3.5	3.5	4.2	4.6	5.0
820927	3.4	3.5	3.5	4.5	4.8	5.5
820928	3.3	3.4	3.5	3.1	3.8	4.5
820929	3.4	3.5	3.5	4.0	4.4	5.0
820930	3.4	3.5	3.5	4.1	4.5	4.9
MONTHLY VALUE	3.3	3.4	3.7	2.9	5.9	10.6

Appendix Table A-5 (Continued).

- OCTOBER 1982 -

DATE	INTRAGRAVEL			SURFACE WATER		
	MIN	MEAN	MAX	MIN	MEAN	MAX
821001	3.4	3.5	3.5	3.9	4.2	4.5
821002	3.4	3.4	3.5	3.6	3.9	4.5
821003	3.3	3.4	3.5	3.4	3.7	4.1
821004	3.2	3.3	3.4	2.9	3.2	3.8
821005	3.2	3.3	3.3	2.4	2.8	3.2
821006	3.1	3.2	3.3	2.2	2.7	3.2
821007	3.2	3.3	3.3	2.8	3.0	3.1
821008	3.2	3.3	3.3	2.6	3.0	3.4
821009	3.2	3.2	3.3	2.4	2.9	3.6
821010	3.2	3.3	3.3	2.9	3.2	3.5
821011	3.2	3.2	3.3	2.6	2.9	3.2
821012	3.1	3.2	3.2	2.2	2.5	3.0
821013	3.1	3.2	3.2	2.5	2.7	3.0
821014	3.1	3.2	3.2	2.3	2.6	3.1
821015	3.1	3.1	3.2	1.7	2.2	2.8
821016	3.1	3.2	3.2	2.1	2.2	2.4
821017	3.1	3.1	3.2	2.2	2.6	3.3
821018	3.1	3.1	3.2	1.9	2.4	2.8
821019	3.1	3.2	3.2	2.1	2.5	2.7
821020	3.1	3.1	3.2	2.3	2.5	2.9
821021	3.0	3.0	3.2	1.6	1.9	2.3
821022	2.9	3.0	3.1	1.5	1.7	2.1
821023	2.9	3.0	3.0	1.4	1.6	1.8
821024	2.8	3.0	3.0	1.5	1.6	1.9
821025	2.8	2.9	3.0	1.4	1.5	1.7
821026	2.8	2.8	2.9	1.3	1.3	1.5
821027	2.6	2.7	2.8	1.2	1.2	1.3
821028	2.5	2.6	2.7	1.0	1.2	1.2
821029	2.4	2.5	2.6	1.0	1.1	1.1
821030	2.5	2.5	2.6	1.1	1.1	1.2
821031	2.6	2.6	2.6	1.1	1.1	1.2
MONTHLY VALUE	2.4	3.1	3.5	1.0	2.3	4.5

Appendix Table A-5 (Continued).

- NOVEMBER 1982 -

DATE	INTRAGRAVEL			SURFACE WATER		
	MIN	MEAN	MAX	MIN	MEAN	MAX
821101	2.6	2.6	2.7	1.2	1.3	1.6
821102	2.7	2.8	2.8	1.6	1.8	2.1
821103	2.8	2.8	2.8	1.4	1.7	2.1
821104	2.8	2.8	2.9	1.6	1.8	2.1
821105	2.8	2.8	2.9	1.5	1.7	2.0
821106	2.8	2.8	2.9	1.4	1.5	1.8
821107	2.7	2.7	2.8	1.3	1.3	1.4
821108	2.6	2.7	2.7	1.2	1.3	1.3
821109	2.6	2.7	2.7	1.2	1.3	1.4
821110	2.7	2.7	2.7	1.4	1.5	1.5
821111	2.6	2.6	2.7	1.1	1.3	1.5
821112	2.6	2.7	2.8	1.5	1.6	1.9
821113	2.8	2.8	2.8	1.6	1.8	2.0
821114	2.8	2.8	2.9	1.7	1.9	2.2
MONTHLY VALUE	2.6	----	2.9	1.1	----	2.2

Appendix Table A-5 (Continued).

- MARCH 1983 -

DATE	INTRAGRAVEL			SURFACE WATER		
	MIN	MEAN	MAX	MIN	MEAN	MAX
830318	3.2	——	3.3	2.3	——	3.0
830319	3.1	3.2	3.3	1.6	2.2	3.0
830320	3.2	3.2	3.4	1.9	2.4	3.3
830321	3.2	3.3	3.4	1.9	2.5	3.4
830322	3.1	3.2	3.4	1.7	2.4	3.3
830323	3.1	3.2	3.4	1.7	2.3	3.3
830324	3.2	3.2	3.4	1.8	2.4	3.3
830325	3.2	3.3	3.4	2.0	2.7	3.6
830326	3.2	3.3	3.4	1.8	2.6	3.4
830327	3.1	3.3	3.4	1.6	2.4	3.4
830328	3.2	3.3	3.4	1.8	2.5	3.7
830329	3.2	3.3	3.4	1.7	2.6	3.8
830330	3.2	3.3	3.5	1.7	2.7	3.8
830331	3.2	3.4	3.5	1.9	2.9	4.3
MONTHLY VALUE	3.1	——	3.5	1.6	——	4.3

Appendix Table A-5 (Continued).

- APRIL 1983 -

DATE	INTRAGRAVEL			SURFACE WATER		
	MIN	MEAN	MAX	MIN	MEAN	MAX
830401	3.2	3.4	3.5	1.9	3.0	4.3
830402	3.2	3.4	3.5	1.9	3.0	4.4
830403	3.2	3.4	3.5	1.9	3.0	4.4
830404	3.3	3.4	3.5	2.6	3.1	3.8
830405	3.3	3.4	3.4	2.5	3.0	3.6
830406	3.3	3.4	3.5	2.4	3.3	4.5
830407	3.3	3.5	3.6	2.6	3.6	4.9
830408	3.3	3.5	3.6	2.5	3.5	4.6
830409	3.3	3.5	3.5	2.6	3.3	4.3
830410	3.2	3.4	3.5	2.0	3.2	4.7
830411	3.2	3.4	3.5	2.0	2.8	3.5
830412	3.2	3.3	3.5	2.1	2.7	3.5
830413	3.3	3.4	3.5	2.5	3.4	4.7
830414	3.3	3.5	3.5	2.8	3.5	4.5
830415	3.3	3.5	3.5	2.5	3.3	4.1
830416	3.3	3.4	3.6	2.8	3.7	5.0
830417	3.3	3.5	3.6	2.4	3.5	4.5
830418	3.3	3.5	3.5	2.4	3.4	4.9
830419	3.4	3.5	3.6	3.1	3.9	5.1
830420	3.4	3.5	3.6	2.7	4.1	5.7
830421	3.4	3.5	3.6	2.8	4.3	5.9
830422	3.4	3.5	3.6	3.2	4.2	5.3
830423	3.4	3.5	3.6	3.4	4.3	5.0
830424	3.4	3.5	3.7	3.4	4.8	6.7
830425	3.4	3.6	3.7	3.2	4.8	6.6
830426	3.4	3.6	3.7	3.0	4.6	6.3
830427	3.4	3.6	3.7	3.0	4.7	6.6
830428	3.4	3.6	3.7	3.3	4.2	5.9
830429	3.5	3.6	3.7	3.6	5.7	8.8
830430	3.4	3.5	3.7	2.2	5.7	10.4
MONTHLY VALUE	3.2	3.5	3.7	1.9	3.8	10.4

Appendix Table A-5 (Continued).

- MAY 1983 -

DATE	INTRAGRAVEL			SURFACE WATER		
	MIN	MEAN	MAX	MIN	MEAN	MAX
830501	3.4	3.5	3.7	1.9	5.2	9.7
830502	3.4	3.5	3.6	3.4	5.1	7.6
830503	3.4	3.5	3.6	2.8	4.4	6.9
830504	3.4	3.5	3.5	2.1	4.4	7.8
830505	3.4	3.5	3.5	.6	2.1	4.1
830506	3.3	3.3	3.4	.2	.8	3.4
830507	3.1	3.1	3.3	0.0	.3	.9
830508	2.8	3.0	3.1	0.0	.4	.9
830509	2.9	3.3	3.5	.6	3.4	7.1
830510	3.3	3.5	3.7	2.1	4.5	7.7
830511	3.4	3.5	3.7	2.1	4.8	8.5
830512	3.4	3.5	3.8	2.7	4.9	8.0
830513	3.4	3.5	3.7	2.5	4.8	8.5
830514	3.4	3.5	3.7	2.8	4.9	8.5
830515	3.4	3.5	3.7	2.5	4.6	7.2
830516	3.3	3.5	3.7	2.2	3.8	6.0
830517	3.4	3.5	3.5	1.7	3.6	5.9
830518	3.4	3.5	3.6	2.4	4.3	7.1
830519	3.4	3.5	3.7	2.8	4.8	7.1
830520	3.4	3.6	3.8	2.8	5.5	8.7
830521	3.5	3.6	3.8	3.5	5.1	7.2
830522	3.5	3.5	3.7	3.7	5.6	8.2
830523	3.5	3.5	3.7	3.6	5.5	8.1
830524	3.5	3.6	3.8	3.7	6.3	9.6
830525	3.5	3.6	3.8	3.1	5.8	8.3
830526	3.5	3.6	3.8	4.5	6.0	8.0
830527	3.5	3.6	3.8	3.8	6.0	8.8
830528	3.5	3.7	3.9	3.7	6.4	9.0
830529	3.6	3.7	3.9	4.5	6.9	9.3
830530	3.8	4.0	4.2	7.2	8.4	10.0
830531	3.9	4.0	4.2	7.7	8.1	8.5
MONTHLY VALUE	2.8	3.5	4.2	0.0	4.7	10.0

Appendix Table A-5 (Continued).

- JUNE 1983 -

DATE	INTRAGRAVEL			SURFACE WATER		
	MIN	MEAN	MAX	MIN	MEAN	MAX
830601	3.8	3.9	4.0	7.5	8.4	9.6
830602	3.8	———	4.0	8.0	———	8.9
MONTHLY VALUE	3.8	———	4.0	7.5	———	9.6

Appendix Table A-6 Datapod intragravel and surface water temperature (C) data summary, at Slough 11, RM 135.7, Geocode S31N02W30ADC.

- AUGUST 1982 -

DATE	INTRAGRAVEL			SURFACE WATER		
	MIN	MEAN	MAX	MIN	MEAN	MAX
820821	3.2	3.3	3.3	4.7	6.4	9.2
820822	3.2	3.3	3.3	4.9	6.8	9.0
820823	3.2	3.3	3.3	5.9	6.8	8.4
820824	3.2	3.3	3.4	5.5	6.3	8.0
820825	3.2	3.4	3.7	4.3	6.5	8.4
820826	3.6	3.7	4.4	3.5	5.5	7.7
820827	3.4	3.5	3.6	3.4	3.5	3.8
820828	3.4	3.5	3.5	3.4	3.4	3.5
820829	3.5	3.5	3.5	3.4	3.4	3.5
820830	3.4	3.5	3.5	3.3	3.4	3.5
820831	3.4	3.4	3.5	3.3	3.4	3.4
MONTHLY VALUE	3.2	----	4.4	3.3	----	9.2

Appendix Table A-6 (Continued).

- SEPTEMBER 1982 -

DATE	INTRAGRAVEL			SURFACE WATER		
	MIN	MEAN	MAX	MIN	MEAN	MAX
820901	3.4	3.4	3.5	3.3	3.4	3.5
820902	3.4	3.5	3.5	3.3	3.4	3.5
820903	3.4	3.5	3.5	3.3	3.4	3.5
820904	3.3	3.4	3.5	3.3	3.4	3.4
820905	3.3	3.4	3.5	3.3	3.4	3.4
820906	3.4	3.4	3.5	3.3	3.4	3.4
820907	3.3	3.4	3.5	3.3	3.3	3.4
820908	3.4	3.4	3.5	3.3	3.4	3.4
820909	3.3	3.4	3.5	3.3	3.4	3.4
820910	3.3	3.4	3.4	3.3	3.3	3.4
820911	3.3	3.4	3.4	3.2	3.3	3.3
820912	3.3	3.4	3.4	3.2	3.3	3.4
820913	3.3	3.3	3.4	3.2	3.3	3.3
820914	3.3	3.3	3.4	3.2	3.3	3.3
820915	3.3	3.4	3.4	3.2	3.3	3.3
820916	3.3	3.4	3.4	3.2	3.3	3.4
820917	3.3	3.3	3.4	3.2	3.3	3.4
820918	3.2	3.3	3.4	3.2	3.2	3.3
820919	3.3	3.3	3.3	3.2	3.2	3.2
820920	3.3	3.3	3.4	3.2	3.2	3.3
820921	3.3	3.3	3.4	3.2	3.2	3.3
820922	3.2	3.3	3.4	3.2	3.2	3.3
820923	3.2	3.3	3.4	3.2	3.2	3.3
820924	3.2	3.3	3.4	3.1	3.2	3.3
820925	3.2	3.3	3.3	3.1	3.2	3.2
820926	3.2	3.3	3.3	3.1	3.2	3.2
820927	3.2	3.3	3.3	3.1	3.2	3.3
820928	3.2	3.3	3.3	3.1	3.2	3.2
820929	3.2	3.3	3.3	3.1	3.2	3.2
820930	3.2	3.3	3.4	3.1	3.2	3.3
MONTHLY VALUE	3.2	3.4	3.5	3.1	3.3	3.5

Appendix Table A-6 (Continued).

- OCTOBER 1982 -

DATE	INTRAGRAVEL			SURFACE WATER		
	MIN	MEAN	MAX	MIN	MEAN	MAX
821001	3.2	3.3	3.4	3.1	3.2	3.3
821002	3.2	3.3	3.3	3.1	3.2	3.2
821003	3.2	3.3	3.3	3.1	3.2	3.3
821004	3.2	3.3	3.3	3.1	3.2	3.2
821005	3.2	3.2	3.3	3.1	3.2	3.2
821006	3.2	3.2	3.3	3.1	3.1	3.2
821007	3.2	3.2	3.3	3.1	3.1	3.2
821008	3.1	3.2	3.3	3.1	3.1	3.2
821009	3.1	3.2	3.3	3.1	3.1	3.2
821010	3.2	3.2	3.3	3.1	3.1	3.2
821011	3.2	3.2	3.3	3.1	3.1	3.2
821012	3.1	3.2	3.2	3.1	3.1	3.1
821013	3.2	3.2	3.2	3.1	3.1	3.1
821014	3.1	3.2	3.3	3.0	3.1	3.2
821015	3.1	3.2	3.3	3.0	3.1	3.2
821016	3.2	3.2	3.2	3.0	3.1	3.1
821017	3.1	3.2	3.2	3.0	3.1	3.1
821018	3.1	3.2	3.3	3.0	3.1	3.1
821019	3.1	3.2	3.2	3.0	3.1	3.1
821020	3.1	3.2	3.2	3.0	3.1	3.1
821021	3.1	3.2	3.2	3.0	3.1	3.1
821022	3.1	3.1	3.2	2.9	3.0	3.0
821023	3.1	3.1	3.2	2.9	3.0	3.0
821024	3.1	3.1	3.2	2.9	3.0	3.1
821025	3.1	3.1	3.2	2.9	3.0	3.1
821026	3.1	3.1	3.2	2.9	3.0	3.0
821027	3.1	———	3.2	2.9	———	3.0
821030	2.9	———	3.0	2.8	———	2.9
821031	2.9	3.0	3.0	2.8	2.9	2.9
MONTHLY VALUE	2.9	3.2	3.4	2.8	3.1	3.3

Appendix Table A-6 (Continued).

- NOVEMBER 1982 -

DATE	INTRAGRAVEL			SURFACE WATER		
	MIN	MEAN	MAX	MIN	MEAN	MAX
821101	2.9	3.0	3.1	2.8	2.9	3.0
821102	3.0	3.0	3.1	2.9	2.9	3.0
821103	3.0	3.0	3.1	2.8	2.9	3.0
821104	3.0	3.1	3.1	2.9	2.9	3.0
821105	3.0	3.0	3.1	2.9	2.9	3.0
821106	3.0	3.0	3.1	2.8	2.9	3.0
821107	2.9	3.0	3.1	2.8	2.9	2.9
821108	2.9	3.0	3.1	2.8	2.9	2.9
821109	3.0	3.0	3.1	2.9	2.9	3.0
821110	3.0	3.1	3.1	2.9	2.9	3.0
821111	3.0	3.0	3.1	2.9	2.9	3.0
821112	3.0	3.0	3.0	2.9	3.0	3.0
821113	3.0	3.0	3.1	2.9	3.0	3.0
821114	3.0	3.0	3.1	2.9	3.0	3.0
821115	3.0	3.1	3.1	2.9	2.9	3.0
821116	3.0	3.0	3.1	2.8	2.9	3.0
821117	3.0	3.0	3.0	2.8	2.9	2.9
821118	2.9	3.0	3.0	2.8	2.9	2.9
821119	2.9	3.0	3.0	2.8	2.9	2.9
821120	2.9	3.0	3.0	2.8	2.9	2.9
821121	2.9	3.0	3.1	2.8	2.9	2.9
821122	3.0	3.0	3.1	2.9	2.9	2.9
821123	3.0	3.0	3.1	2.9	2.9	2.9
821124	3.0	3.0	3.0	2.9	3.0	3.0
821125	3.0	3.0	3.1	2.9	2.9	2.9
821126	3.0	3.0	3.1	2.9	2.9	2.9
821127	3.0	3.0	3.1	2.9	2.9	2.9
821128	3.0	3.0	3.1	2.8	2.8	2.9
821129	3.0	3.0	3.0	2.8	2.9	2.9
821130	3.0	3.0	3.1	2.9	2.9	2.9
MONTHLY VALUE	2.9	3.0	3.1	2.8	2.9	3.0

Appendix Table A-6 (Continued).

- DECEMBER 1982 -

DATE	INTRAGRAVEL			SURFACE WATER		
	MIN	MEAN	MAX	MIN	MEAN	MAX
821201	3.0	3.0	3.0	2.9	2.9	2.9
821202	3.0	3.0	3.0	2.9	2.9	2.9
821203	3.0	3.0	3.0	2.9	2.9	2.9
821204	2.9	3.0	3.1	2.8	2.8	2.9
821205	2.9	3.0	3.0	2.8	2.8	2.9
821206	2.9	3.0	3.0	2.8	2.8	2.9
821207	3.0	3.0	3.1	2.9	2.9	2.9
821208	3.0	3.0	3.0	2.9	2.9	2.9
821209	3.0	3.0	3.0	2.9	2.9	3.0
821210	3.0	3.0	3.0	2.9	2.9	3.0
821211	3.0	3.0	3.1	2.9	2.9	2.9
821212	3.0	3.0	3.1	2.8	2.9	2.9
821213	3.0	3.1	3.1	2.9	2.9	2.9
821214	3.0	3.0	3.1	2.9	2.9	2.9
821215	3.0	3.0	3.1	2.9	2.9	2.9
821216	3.0	3.1	3.1	2.9	2.9	3.0
821217	3.0	3.0	3.1	2.9	2.9	3.0
821218	3.0	3.0	3.1	2.9	2.9	3.0
821219	3.0	3.0	3.0	2.9	2.9	2.9
821220	3.0	3.0	3.0	2.8	2.9	2.9
821221	3.0	3.0	3.1	2.8	2.9	2.9
821222	3.0	3.0	3.0	2.8	2.9	2.9
821223	2.9	3.0	3.0	2.8	2.9	2.9
821224	2.9	3.0	3.0	2.8	2.9	2.9
821225	3.0	3.0	3.0	2.8	2.9	2.9
821226	3.0	3.0	3.1	2.8	2.9	2.9
821227	3.0	3.0	3.1	2.9	2.9	2.9
821228	3.0	3.0	3.1	2.9	2.9	2.9
821229	3.0	3.0	3.0	2.9	2.9	3.0
821230	3.0	3.0	3.1	2.9	2.9	2.9
821231	3.0	3.1	3.1	2.9	2.9	2.9
MONTHLY VALUE	2.9	3.0	3.1	2.8	2.9	3.0

Appendix Table A-6 (Continued).

- JANUARY 1983 -

DATE	INTRAGRAVEL			SURFACE WATER		
	MIN	MEAN	MAX	MIN	MEAN	MAX
830101	3.0	3.0	3.1	2.9	2.9	2.9
830102	3.0	3.1	3.1	2.9	2.9	2.9
830103	3.0	3.0	3.1	2.9	2.9	2.9
830104	3.0	3.1	3.1	2.9	2.9	3.0
830105	3.0	3.0	3.1	2.9	3.0	3.0
830106	3.0	3.1	3.1	2.8	2.9	3.0
830107	3.0	3.0	3.1	2.8	2.9	2.9
830108	2.9	3.0	3.0	2.8	2.8	2.9
830109	2.9	3.0	3.0	2.8	2.8	2.9
830110	2.9	3.0	3.0	2.8	2.8	2.9
830111	2.9	2.9	2.9	2.8	2.8	2.8
830112	2.9	2.9	3.0	2.8	2.8	2.8
830113	2.9	———	3.0	2.8	———	2.8
830114	3.0	———	3.0	2.8	———	2.8
830115	3.0	3.0	3.0	2.8	2.8	2.9
830116	3.0	3.0	3.1	2.8	2.9	2.9
830117	3.0	3.0	3.1	2.9	2.9	2.9
830118	3.0	3.1	3.1	2.9	2.9	3.0
830119	3.1	3.1	3.1	2.9	2.9	2.9
830120	3.1	3.1	3.1	2.9	2.9	2.9
830121	3.1	3.1	3.1	2.9	3.0	3.0
830122	3.1	3.1	3.1	2.9	2.9	2.9
830123	3.0	3.1	3.1	2.8	2.9	2.9
830124	3.1	3.1	3.1	2.8	2.9	2.9
830125	3.1	3.1	3.1	2.8	2.8	2.9
830126	3.1	3.1	3.1	2.8	2.9	2.9
830127	3.1	3.1	3.1	2.9	2.9	2.9
830128	3.1	3.1	3.1	2.9	2.9	2.9
830129	3.1	3.1	3.2	2.9	2.9	3.0
830130	3.1	3.1	3.2	2.9	2.9	3.0
830131	3.1	3.1	3.2	2.9	3.0	3.0
MONTHLY VALUE	2.9	3.1	3.2	2.8	2.9	3.0

Appendix Table A-6 (Continued).

- FEBRUARY 1983 -

DATE	INTRAGRAVEL			SURFACE WATER		
	MIN	MEAN	MAX	MIN	MEAN	MAX
830201	3.1	3.1	3.2	2.9	2.9	2.9
830202	3.1	3.1	3.2	2.9	2.9	2.9
830203	3.1	3.1	3.2	2.9	2.9	2.9
830204	3.1	3.1	3.2	2.9	2.9	2.9
830205	3.1	3.1	3.1	2.9	2.9	2.9
830206	3.1	3.1	3.1	2.9	2.9	2.9
830207	3.1	3.2	3.2	2.9	2.9	2.9
830208	3.2	3.2	3.2	2.9	2.9	2.9
830209	3.1	3.2	3.2	2.9	3.0	3.0
830210	3.1	3.2	3.2	2.9	3.0	3.0
830211	3.1	3.1	3.2	2.9	2.9	2.9
830212	3.1	3.1	3.1	2.9	2.9	2.9
830213	3.1	3.1	3.1	2.8	2.9	2.9
830214	3.1	3.1	3.1	2.8	2.8	2.9
830215	3.0	3.1	3.1	2.8	2.8	2.8
830216	3.0	3.1	3.1	2.8	2.8	2.8
830217	3.0	3.0	3.1	2.8	2.8	2.8
830218	3.0	3.0	3.1	2.8	2.8	2.8
830219	3.0	3.0	3.1	2.8	2.8	2.8
830220	3.0	3.0	3.1	2.8	2.8	2.8
830221	3.0	3.0	3.1	2.8	2.8	2.9
830222	3.0	3.0	3.1	2.8	2.8	2.9
830223	3.1	3.1	3.1	2.8	2.9	2.9
830224	3.1	3.1	3.1	2.8	2.8	2.9
830225	3.1	3.1	3.1	2.8	2.9	2.9
830226	3.1	3.1	3.1	2.9	2.9	2.9
830227	3.1	3.1	3.1	2.9	2.9	2.9
830228	3.1	3.1	3.2	2.9	2.9	2.9
MONTHLY VALUE	3.0	3.1	3.2	2.8	2.9	3.0

Appendix Table A-6 (Continued).

- MARCH 1983 -

DATE	INTRAGRAVEL			SURFACE WATER		
	MIN	MEAN	MAX	MIN	MEAN	MAX
830301	3.1	3.1	3.1	2.9	2.9	2.9
830302	3.1	3.1	3.1	2.9	2.9	2.9
830303	3.1	3.1	3.2	2.9	2.9	2.9
830304	3.1	3.1	3.2	2.9	2.9	2.9
830305	3.1	3.2	3.2	2.9	2.9	3.0
830306	3.1	3.2	3.2	2.9	2.9	3.0
830307	3.1	3.2	3.2	2.9	2.9	3.0
830308	3.1	3.2	3.2	2.9	2.9	2.9
830309	3.1	3.2	3.2	2.9	2.9	2.9
830310	3.1	3.1	3.2	2.9	2.9	2.9
830311	3.1	3.1	3.2	2.9	2.9	2.9
830312	3.1	3.1	3.2	2.9	2.9	2.9
830313	3.1	3.2	3.2	2.9	2.9	3.0
830314	3.1	3.2	3.2	2.9	3.0	3.0
830315	3.1	3.2	3.2	2.9	2.9	2.9
830316	3.1	3.2	3.2	2.9	2.9	3.0
830317	3.2	3.2	3.2	2.9	3.0	3.0
830318	3.2	3.2	3.2	2.9	3.0	3.0
830319	3.2	3.2	3.2	2.9	3.0	3.0
830320	3.2	3.2	3.2	2.9	3.0	3.0
830321	3.1	3.2	3.2	3.0	3.0	3.0
830322	3.2	3.2	3.3	3.0	3.0	3.0
830323	3.2	3.2	3.3	3.0	3.0	3.0
830324	3.2	3.2	3.2	3.0	3.0	3.0
830325	3.1	3.2	3.2	3.0	3.0	3.0
830326	3.2	3.2	3.2	3.0	3.0	3.1
830327	3.2	3.2	3.3	3.0	3.0	3.1
830328	3.2	3.2	3.3	3.0	3.0	3.1
830329	3.2	3.2	3.3	3.0	3.1	3.1
830330	3.2	3.3	3.3	3.1	3.1	3.2
830331	3.2	3.3	3.3	3.0	3.1	3.2
MONTHLY VALUE	3.1	3.2	3.3	2.9	3.0	3.2

Appendix Table A-6 (Continued).

- APRIL 1983 -

DATE	INTRAGRAVEL			SURFACE WATER		
	MIN	MEAN	MAX	MIN	MEAN	MAX
830401	3.3	3.3	3.4	3.1	3.1	3.3
830402	3.3	3.3	3.4	3.1	3.2	3.3
830403	3.3	3.3	3.4	3.1	3.2	3.3
830404	3.2	3.4	3.4	3.1	3.2	3.3
830405	3.2	3.3	3.3	3.1	3.1	3.2
830406	3.2	3.3	3.4	3.0	3.1	3.2
830407	3.2	3.3	3.4	3.1	3.2	3.3
830408	3.2	3.3	3.4	3.1	3.2	3.3
830409	3.3	3.3	3.4	3.2	3.2	3.3
830410	3.3	3.4	3.4	3.2	3.2	3.3
830411	3.3	3.4	3.4	3.2	3.2	3.3
830412	3.3	3.4	3.4	3.2	3.2	3.3
830413	3.2	3.3	3.4	3.1	3.2	3.3
830414	3.3	3.4	3.4	3.2	3.2	3.3
830415	3.3	3.4	3.4	3.1	3.2	3.3
830416	3.3	3.4	3.5	3.1	3.2	3.4
830417	3.3	3.4	3.5	3.2	3.3	3.4
830418	3.4	3.4	3.5	3.2	3.3	3.4
830419	3.4	3.4	3.5	3.3	3.4	3.5
830420	3.4	3.5	3.6	3.3	3.4	3.5
830421	3.4	3.5	3.6	3.4	3.5	3.6
830422	3.5	3.5	3.6	3.4	3.5	3.6
830423	3.5	3.5	3.7	3.5	3.5	3.6
830424	3.5	3.6	3.8	3.5	3.6	3.8
830425	3.5	3.6	3.8	3.5	3.7	3.9
830426	3.6	3.7	3.9	3.6	3.8	3.9
830427	3.6	3.7	3.9	3.6	3.8	4.0
830428	3.7	3.7	3.9	3.7	3.8	4.0
830429	3.6	3.7	3.8	3.7	4.4	6.4
830430	3.5	3.7	3.8	3.5	4.8	8.2
MONTHLY VALUE	3.2	3.5	3.9	3.0	3.5	8.2

Appendix Table A-6 (Continued).

- MAY 1983 -

DATE	INTRAGRAVEL			SURFACE WATER		
	MIN	MEAN	MAX	MIN	MEAN	MAX
830501	3.6	3.7	3.8	3.5	4.8	7.7
830502	3.6	3.7	3.8	3.7	5.4	7.4
830503	3.6	3.7	3.8	3.7	5.4	7.4
830504	3.6	3.7	3.8	3.8	4.9	6.9
830505	3.6	3.7	3.8	3.6	5.1	8.7
830506	3.6	3.7	3.8	3.7	4.9	8.1
830507	3.6	3.7	3.8	3.7	4.9	8.5
830508	3.6	3.7	3.8	3.8	6.1	9.5
830509	3.6	3.7	3.9	3.8	6.4	8.8
830510	3.7	3.7	3.8	3.8	6.6	9.0
830511	3.6	3.7	3.8	3.8	6.4	9.5
830512	3.7	3.7	3.8	3.9	5.7	8.3
830513	3.6	3.7	3.8	3.7	7.1	9.7
830514	3.6	3.7	3.8	4.7	7.3	9.6
830515	3.6	3.7	3.8	5.3	6.6	8.0
830516	3.6	3.6	3.7	4.6	6.4	8.2
830517	3.6	3.6	3.7	5.3	6.3	7.6
830518	3.6	3.6	3.7	4.9	6.2	7.7
830519	3.5	3.6	3.7	4.1	6.7	9.1
830520	3.6	3.7	3.7	4.5	7.0	9.0
830521	3.6	3.7	3.7	4.1	6.5	7.7
830522	3.6	3.6	3.7	4.4	6.6	8.7
830523	3.6	3.6	3.7	4.0	6.4	8.4
830524	3.6	3.7	3.7	3.8	5.2	7.6
830525	3.6	3.6	3.7	3.6	6.4	8.5
830526	3.6	3.7	3.7	4.2	6.8	8.9
830527	3.6	3.6	3.7	3.9	5.5	8.6
830528	3.6	3.6	3.7	3.9	6.5	9.7
830529	3.6	3.7	3.7	3.8	4.7	7.9
830530	3.6	3.6	3.7	3.9	5.9	8.2
830531	3.5	3.6	3.7	4.1	6.7	8.0
MONTHLY VALUE	3.5	3.7	3.9	3.5	6.0	9.7

Appendix Table A-6 (Continued).

- JUNE 1983 -

DATE	INTRAGRAVEL			SURFACE WATER		
	MIN	MEAN	MAX	MIN	MEAN	MAX
830601	3.5	3.6	3.7	4.0	6.7	10.0
830602	3.5	——	3.6	4.0	——	7.0
MONTHLY VALUE	3.5	——	3.7	4.0	——	10.0

Appendix Table A-7 Datapod intragravel and surface water temperature (C) data summary, at Susitna River at Gold Creek, RM 136.8, Geocode S30N02W17CDD.

- OCTOBER 1982 -

DATE	INTRAGRAVEL			SURFACE WATER		
	MIN	MEAN	MAX	MIN	MEAN	MAX
821013	------	------	------	.5	------	.8
821014	------	------	------	-.1	<.05	.6
821015	------	------	------	-.1	0.0	.1
821016	------	------	------	-.1	0.0	0.0
821017	.1	------	.2	-.1	0.0	0.0
821018	.1	.2	.3	-.1	0.0	0.0
821019	.1	.2	.2	-.1	0.0	0.0
821020	.1	.2	.2	0.0	0.0	0.0
821021	0.0	.2	.3	-.1	0.0	0.0
821022	0.0	.1	.2	-.1	-.1	0.0
821023	.1	.3	.5	-.1	0.0	0.0
821024	.2	.5	.7	-.1	0.0	0.0
821025	.2	.4	.5	-.1	0.0	0.0
821026	.2	.3	.4	-.1	0.0	0.0
821027	.2	.3	.5	-.1	0.0	0.0
821028	.2	.5	.7	-.1	0.0	0.0
821029	.3	.6	.9	-.1	0.0	0.0
821030	.1	.3	.5	-.1	0.0	0.0
821031	.3	.5	.6	-.1	-.1	0.0
MONTHLY VALUE	0.0	------	.9	-.1	------	.8

Appendix Table A-7 (Continued).

- NOVEMBER 1982 -

DATE	INTRAGRAVEL			SURFACE WATER		
	MIN	MEAN	MAX	MIN	MEAN	MAX
821101	.3	.5	.6	-.1	0.0	0.0
821102	.2	.3	.4	-.1	0.0	0.0
821103	.2	.3	.4	-.1	0.0	0.0
821104	.2	.3	.3	-.1	0.0	0.0
821105	.2	.3	.3	-.1	0.0	0.0
821106	.2	.3	.4	-.1	0.0	0.0
821107	.2	.3	.4	-.1	-.1	0.0
821108	.3	.4	.4	-.1	0.0	0.0
821109	.4	.4	.5	-.1	0.0	0.0
821110	.3	.4	.5	-.1	0.0	0.0
821111	.3	.4	.5	-.1	0.0	0.0
821112	.4	.4	.5	-.1	0.0	0.0
821113	.4	.4	.5	-.1	0.0	0.0
821114	.3	.4	.5	-.1	0.0	0.0
821115	.3	.4	.4	-.1	0.0	0.0
821116	.4	.4	.5	-.1	0.0	0.0
821117	.4	.6	.8	-.1	0.0	0.0
821118	.6	.8	1.1	-.1	-.1	0.0
821119	.5	.7	.8	-.1	0.0	0.0
821120	.5	.5	.6	-.1	0.0	0.0
821121	.5	.6	.7	-.1	-.1	0.0
821122	.5	.6	.7	-.1	0.0	0.0
821123	.4	.5	.5	-.1	0.0	0.0
821124	.4	.5	.5	-.1	0.0	0.0
821125	.3	.4	.5	-.1	-.1	0.0
821126	.4	.4	.5	-.1	0.0	0.0
821127	.4	.4	.5	-.1	0.0	0.0
821128	.4	.5	.5	-.1	0.0	0.0
821129	.4	.5	.5	-.1	0.0	0.0
821130	.4	.5	.5	-.1	0.0	0.0
MONTHLY VALUE	.2	.4	1.1	-.1	0.0	0.0

Appendix Table A-7 (Continued).

- DECEMBER 1982 -

DATE	INTRAGRAVEL			SURFACE WATER		
	MIN	MEAN	MAX	MIN	MEAN	MAX
821201	.4	.5	.5	-.1	0.0	0.0
821202	.4	.5	.5	-.1	0.0	0.0
821203	.4	.5	.5	-.1	0.0	0.0
821204	.5	.5	.7	-.1	0.0	0.0
821205	.5	.6	.7	-.1	0.0	0.0
821206	.5	.6	.8	-.1	0.0	.1
821207	.4	.5	.5	-.1	0.0	.1
821208	.5	.5	.6	0.0	0.0	0.0
821209	.4	.5	.6	-.1	0.0	.1
821210	.4	.5	.6	-.1	0.0	.1
821211	.3	.5	.6	-.1	0.0	.1
821212	.3	.4	.4	-.1	.1	.1
821213	.3	.4	.5	0.0	<.05	.1
821214	.3	.4	.5	-.1	0.0	.1
821215	.3	.3	.4	-.1	<.05	.1
821216	.3	.5	.6	-.1	0.0	.1
821217	.3	.4	.5	-.1	0.0	.1
821218	.4	.4	.5	0.0	<.05	.1
821219	.3	.4	.5	-.1	<.05	.1
821220	.3	.3	.4	0.0	<.05	.1
821221	.3	.3	.5	0.0	0.0	.1
821222	.3	.4	.5	-.1	<.05	.1
821223	.4	.4	.5	-.1	0.0	.1
821224	.4	.4	.5	-.1	0.0	0.0
821225	.3	.4	.5	-.1	0.0	.1
821226	.3	.4	.5	-.1	0.0	.1
821227	.4	.5	.5	-.1	0.0	.1
821228	.3	.4	.4	0.0	0.0	0.0
821229	.4	.4	.5	0.0	0.0	0.0
821230	.4	.5	.5	-.1	0.0	.1
821231	.4	.5	.5	-.1	0.0	0.0
MONTHLY VALUE	.3	.5	.8	-.1	<.05	.1

Appendix Table A-7 (Continued).

- JANUARY 1983 -

DATE	INTRAGRAVEL			SURFACE WATER		
	MIN	MEAN	MAX	MIN	MEAN	MAX
830101	.4	.5	.5	-.1	0.0	0.0
830102	.4	.4	.5	-.1	0.0	.1
830103	.3	.4	.5	-.1	-.1	0.0
830104	.3	.4	.4	-.1	-.1	0.0
830105	.2	.3	.4	-.1	-.1	0.0
830106	.3	.4	.4	-.1	-.1	0.0
830114	.3	------	.4	-.1	------	0.0
830115	.3	.3	.4	-.1	-.1	0.0
830116	.3	.4	.4	-.1	0.0	0.0
830117	.3	.3	.4	-.1	-.1	0.0
830118	.3	.4	.4	-.1	0.0	0.0
830119	.3	.4	.4	-.1	0.0	0.0
830120	.3	.3	.4	-.1	-.1	0.0
830121	.3	.3	.4	-.1	-.1	0.0
830122	.3	.6	2.0	-.1	0.0	0.0
830123	1.1	1.6	2.8	-.1	0.0	0.0
830124	.5	------	3.9	-.1	-.1	0.0
830125	------	------	------	-.1	-.1	0.0
830126	------	------	------	-.1	0.0	0.0
830127	------	------	------	-.1	0.0	0.0
830128	------	------	------	-.1	0.0	0.0
830129	------	------	------	-.1	0.0	0.0
830130	------	------	------	-.1	0.0	0.0
830131	------	------	------	0.0	------	0.0
MONTHLY VALUE	.2	------	3.9	-.1	0.0	.1

Appendix Table A-8 Datapod intragravel and surface water temperature (C) data summary, at Slough 16B, RM 138.0, Geocode S31N02W17AAA.

- AUGUST 1982 -

DATE	INTRAGRAVEL			SURFACE WATER		
	MIN	MEAN	MAX	MIN	MEAN	MAX
820821	4.8	5.5	6.7	4.3	5.9	9 2
820822	4.7	5.7	6.9	4.2	5.9	9.0
820823	5.6	6.2	6.8	5.5	6.4	8.0
820824	5.4	6.2	7.4	5.1	6.3	8.7
820825	5.9	6.5	7.5	5.5	6.7	9.0
820826	5.9	6.5	7.6	5.5	6.8	9.1
820827	4.6	5.9	7.4	3.9	5.7	8.7
820828	4.7	5.6	7.0	4.5	5.6	7.8
820829	5.3	5.9	6.7	5.0	6.0	7.1
820830	5.5	5.8	6.2	5.3	5.9	6.7
820831	5.6	5.8	6.3	5.2	6.2	8.0
MONTHLY VALUE	4.6	-----	7.6	3.9	-----	9.2

Appendix Table A-8 (Continued).

- SEPTEMBER 1982 -

DATE	INTRAGRAVEL			SURFACE WATER		
	MIN	MEAN	MAX	MIN	MEAN	MAX
820901	5.7	6.0	6.4	5.4	6.6	8.6
820902	5.5	5.9	6.4	4.9	6.1	8.6
820903	5.5	5.8	6.2	5.0	5.9	7.7
820904	5.2	5.6	6.0	4.6	5.7	7.9
820905	5.1	5.6	5.9	4.6	5.6	7.6
820906	5.3	5.6	6.0	5.0	5.7	6.6
820907	5.0	5.7	6.7	4.8	5.8	7.6
820908	5.1	5.5	5.9	4.8	5.4	6.2
820909	5.0	5.5	6.0	4.8	5.5	7.0
820910	5.0	5.5	6.0	4.6	5.5	6.9
820911	5.0	5.2	5.5	4.5	5.0	5.6
820912	4.4	4.9	5.4	3.9	4.8	6.3
820913	4.8	5.0	5.2	4.5	5.1	6.1
820914	5.0	5.2	5.3	5.0	5.5	6.4
820915	5.3	5.8	6.6	6.1	6.7	8.0
820916	6.4	6.6	6.8	6.7	7.2	7.9
820917	5.9	6.2	6.6	5.7	6.2	6.9
820918	5.5	5.7	6.0	5.5	6.1	6.6
820919	5.2	5.4	5.6	5.9	6.2	6.5
820920	5.0	5.2	5.3	5.7	6.1	6.5
820921	4.9	5.0	5.1	5.5	6.0	6.4
820922	4.7	4.9	5.1	4.7	5.8	6.5
820923	4.1	4.5	4.9	3.2	4.3	5.8
820924	3.8	4.2	4.6	2.3	3.7	5.7
820925	3.7	4.2	4.5	2.7	4.2	5.8
820926	4.2	4.4	4.6	4.0	4.6	5.5
820927	4.3	4.5	4.8	3.6	4.6	6.3
820928	3.7	4.1	4.7	2.6	3.7	5.0
820929	4.1	4.3	4.7	3.9	4.6	6.0
820930	4.4	4.6	4.9	4.0	4.8	6.1
MONTHLY VALUE	3.7	5.2	6.8	2.3	5.4	8.6

Appendix Table A-8 (Continued).

- OCTOBER 1982 -

DATE	INTRAGRAVEL			SURFACE WATER		
	MIN	MEAN	MAX	MIN	MEAN	MAX
821001	4.4	4.6	4.8	3.7	4.4	5.4
821002	4.1	4.5	4.8	3.6	4.3	5.6
821003	4.1	4.4	4.7	3.4	4.1	5.3
821004	3.5	3.9	4.5	2.3	3.2	4.7
821005	3.3	3.6	3.9	2.2	2.9	4.1
821006	2.9	3.3	3.7	2.0	3.0	4.4
821007	3.3	3.5	3.7	2.7	3.2	4.1
821008	3.4	3.6	3.9	2.0	3.3	4.5
821009	3.2	3.4	3.8	2.1	3.2	4.3
821010	3.5	3.7	4.0	3.1	3.5	4.2
821011	3.3	3.5	3.9	1.9	3.0	3.7
821012	2.9	3.2	3.5	2.0	2.8	3.5
821013	3.1	3.3	3.5	2.4	2.9	3.4
821014	3.0	3.2	3.5	2.4	2.9	3.8
821015	3.0	3.1	3.5	2.3	2.6	3.3
821016	3.0	3.1	3.2	2.4	2.8	3.1
821017	3.0	3.2	3.6	2.2	3.0	3.8
821018	3.0	3.2	3.5	2.3	2.8	3.4
821019	2.9	3.2	3.3	2.1	2.8	3.3
821020	3.1	3.2	3.4	2.5	2.8	3.5
821021	3.0	3.1	3.3	2.3	2.7	3.2
821022	2.6	3.0	3.4	2.0	2.7	3.4
821023	2.9	3.1	3.3	2.4	2.8	3.2
821024	3.0	3.2	3.5	2.5	2.9	3.6
821025	2.7	—	3.4	2.2	—	3.0
MONTHLY VALUE	2.6	3.5	4.8	1.9	3.1	5.6

Appendix Table A-9 Datapod intragravel and surface water temperature (C) data summary, at Slough 19, RM 140.0, Geocode S. [illegible] 10DBA.

- AUGUST 1982 -

DATE	INTRAGRAVEL			SURFACE WATER		
	MIN	MEAN	MAX	MIN	MEAN	MAX
820821	2.8	2.9	3.0	3.5	4.9	7.9
820822	2.8	3.0	3.1	3.5	5.0	7.4
820823	2.9	3.0	3.1	4.3	5.3	6.7
820824	2.9	3.0	3.1	4.0	5.2	7.5
820825	3.0	3.0	3.1	4.3	5.6	7.9
820826	2.9	3.0	3.1	4.2	5.7	8.2
820827	2.9	3.0	3.1	3.2	4.9	7.8
820828	2.9	3.0	3.1	3.6	4.8	6.6
820829	2.9	3.0	3.0	4.1	4.9	5.9
820830	2.9	3.0	3.0	4.3	4.6	5.2
820831	2.8	2.9	3.0	3.9	4.6	6.1
MONTHLY VALUE	2.8	----	3.1	3.2	----	8.2

Appendix Table A-9 (Continued).

- SEPTEMBER 1982 -

DATE	INTRAGRAVEL			SURFACE WATER		
	MIN	MEAN	MAX	MIN	MEAN	MAX
820901	2.8	3.0	3.2	3.8	4.8	6.2
820902	2.8	3.0	3.1	3.6	4.7	6.8
820903	2.9	2.9	3.0	3.9	4.6	5.9
820904	2.9	2.9	3.0	3.8	4.6	6.3
820905	2.9	3.0	3.0	3.6	4.5	6.0
820906	2.9	3.0	3.1	3.8	4.5	5.3
820907	2.9	3.0	3.2	4.0	5.2	7.4
820908	3.1	3.1	3.2	4.2	4.9	5.8
820909	3.0	3.1	3.2	4.1	4.7	6.4
820910	3.0	3.1	3.1	3.8	4.4	5.5
820911	3.0	3.0	3.1	3.6	4.1	4.7
820912	2.9	3.0	3.1	3.4	4.0	5.3
820913	2.9	3.0	3.1	3.8	4.1	5.2
820914	3.1	3.1	3.2	3.7	4.3	4.9
820915	3.2	3.3	3.5	4.1	4.6	5.5
820916	3.5	3.6	4.2	4.3	4.7	5.6
820917	3.7	3.9	4.2	4.2	4.6	5.1
820918	3.5	3.7	3.9	3.9	4.3	4.8
820919	3.5	3.5	3.7	3.9	4.1	4.4
820920	3.4	3.5	3.6	3.8	4.1	4.6
820921	3.4	3.5	3.6	3.7	4.1	4.6
820922	3.4	3.5	3.7	3.7	4.2	5.1
820923	3.2	3.4	3.6	3.4	3.8	4.7
820924	3.1	3.3	3.4	3.1	3.6	4.5
820925	3.1	3.2	3.5	3.1	3.6	4.2
820926	3.2	3.3	3.4	3.4	3.7	4.1
820927	3.2	3.4	3.6	3.5	3.8	4.6
820928	3.0	3.2	3.4	3.0	3.4	4.0
820929	3.2	3.4	3.6	3.4	3.7	4.3
820930	3.2	3.4	3.6	3.4	3.7	4.3
MONTHLY VALUE	2.8	3.2	4.2	3.0	4.2	7.4

Appendix Table A-9 (Continued).

- OCTOBER 1982 -

DATE	INTRAGRAVEL			SURFACE WATER		
	MIN	MEAN	MAX	MIN	MEAN	MAX
821001	——	——	——	3.4	3.7	4.4
821002	——	——	——	3.1	3.5	4.4
821003	——	——	——	2.9	3.5	4.4
821004	——	——	——	2.6	3.1	4.0
821005	——	——	——	2.5	2.8	3.5
821006	——	——	——	2.4	2.8	3.6
821007	——	——	——	2.5	2.7	3.2
821008	——	——	——	2.0	2.7	3.6
821009	——	——	——	2.4	2.8	3.4
821010	——	——	——	2.4	2.7	3.1
821011	——	——	——	2.5	2.8	3.4
821012	——	——	——	2.2	2.5	2.9
821013	——	——	——	1.7	2.5	3.2
821014	——	——	——	2.2	2.7	4.0
821015	——	——	——	2.6	3.0	3.5
821016	——	——	——	2.0	2.4	2.9
821017	——	——	——	2.0	2.4	3.3
821018	——	——	——	2.2	2.6	3.1
821019	——	——	——	1.6	2.0	2.4
821020	——	——	——	1.6	2.0	2.5
821021	——	——	——	1.9	2.3	2.6
821022	——	——	——	1.9	2.1	2.5
821023	——	——	——	2.1	2.2	2.4
821024	——	——	——	2.2	2.3	2.6
821025	——	——	——	2.2	——	2.6
821029	2.0	——	2.1	1.2	——	1.4
821030	2.0	2.1	2.1	1.1	1.2	1.4
821031	2.0	2.1	2.2	1.0	1.2	1.2
MONTHLY VALUE	2.0	——	2.2	1.0	2.5	4.4

Appendix Table A-9 (Continued).

- NOVEMBER 1982 -

DATE	INTRAGRAVEL			SURFACE WATER		
	MIN	MEAN	MAX	MIN	MEAN	MAX
821101	2.1	2.2	2.2	1.1	1.2	1.3
821102	2.1	2.2	2.3	1.1	1.2	1.3
821103	2.1	2.1	2.2	1.1	1.2	1.3
821104	2.0	2.0	2.1	1.0	1.2	1.3
821105	1.9	2.0	2.1	.9	<.05	1.1
821106	1.8	1.9	2.0	.7	.8	.9
821107	1.7	1.8	1.9	.7	.8	.9
821108	1.6	1.7	1.8	.7	.8	.9
821109	1.6	1.6	1.7	.8	.8	.9
821110	1.6	1.7	1.7	.7	.8	.9
821111	1.6	1.7	1.7	.9	<.05	1.0
821112	1.7	1.7	1.8	.7	.9	1.0
821113	1.7	1.7	1.8	.7	.9	1.0
821114	1.8	1.8	1.8	.8	.9	.9
821115	1.8	2.0	2.1	.9	1.1	1.1
821116	2.0	2.0	2.1	1.1	1.3	1.4
821117	2.0	2.0	2.1	1.3	1.4	1.6
821118	2.0	2.0	2.1	1.3	1.5	1.6
821119	2.0	2.0	2.1	1.4	1.5	1.6
821120	1.8	1.9	2.0	.9	1.4	1.6
821121	1.6	1.7	1.8	.7	.8	1.0
821122	1.6	1.6	1.6	.7	.9	1.0
821123	1.6	1.7	1.7	.9	1.0	1.1
821124	1.7	1.7	1.8	.9	1.0	1.1
821125	1.7	1.8	1.8	.8	.9	1.0
821126	1.7	1.7	1.8	.8	.8	.9
821127	1.6	1.7	1.7	.7	.8	.8
821128	1.6	1.6	1.7	.7	.8	.9
MONTHLY VALUE	1.6	1.8	2.3	.7	1.0	1.6

Appendix Table A-9 (Continued).

- JANUARY 1983 -

DATE	INTRAGRAVEL			SURFACE WATER		
	MIN	MEAN	MAX	MIN	MEAN	MAX
830114	2.1	———	2.2	1.2	———	1.3
830115	2.0	2.2	2.3	1.2	1.3	1.5
830116	2.1	2.2	2.3	1.4	1.5	1.6
830117	2.1	2.3	2.5	1.5	1.8	2.2
830118	2.4	2.6	2.6	2.1	2.2	2.3
830119	2.5	2.6	2.6	2.1	2.3	2.4
830120	2.5	2.6	2.6	2.1	2.3	2.4
830121	2.6	2.6	2.7	2.2	2.3	2.4
830122	2.6	2.7	2.8	2.3	2.5	2.6
830123	2.6	2.7	2.8	2.4	2.6	2.6
830124	2.6	2.7	2.8	2.4	2.5	2.6
830125	2.6	2.7	2.8	2.4	2.5	2.5
830126	2.6	2.7	2.7	2.4	2.5	2.5
830127	2.6	2.7	2.8	2.4	2.5	2.6
830128	2.5	2.7	2.8	2.0	2.4	2.6
830129	2.5	2.6	2.6	2.2	2.3	2.5
830130	2.5	2.6	2.6	2.2	2.3	2.4
830131	2.5	2.6	2.6	2.1	2.3	2.4
MONTHLY VALUE	2.0	———	2.8	1.2	———	2.6

Appendix Table A-9 (Continued).

- FEBRUARY 1983 -

DATE	INTRAGRAVEL			SURFACE WATER		
	MIN	MEAN	MAX	MIN	MEAN	MAX
830201	2.4	2.5	2.6	2.0	2.2	2.3
830202	2.4	2.5	2.6	2.0	2.2	2.3
830203	2.4	2.5	2.6	2.1	2.2	2.4
830204	2.4	2.5	2.6	2.1	2.2	2.4
830205	2.4	2.5	2.6	2.1	2.2	2.3
830206	2.4	2.5	2.5	2.1	2.2	2.3
830207	2.3	2.4	2.5	1.9	2.2	2.3
830208	2.3	2.4	2.5	2.0	2.1	2.2
830209	2.3	2.4	2.5	2.0	2.2	2.3
830210	2.3	2.4	2.5	2.0	2.1	2.2
830211	2.3	2.4	2.5	2.0	2.1	2.3
830212	2.3	2.4	2.5	2.1	2.2	2.3
830213	2.3	2.4	2.5	2.0	2.1	2.3
830214	2.3	2.4	2.5	2.1	2.2	2.3
830215	2.3	2.4	2.4	2.1	2.2	2.3
830216	2.2	2.3	2.4	2.1	2.2	2.3
830217	2.2	2.3	2.4	2.0	2.2	2.3
830218	2.1	2.3	2.4	2.0	2.1	2.2
830219	2.1	2.2	2.3	1.9	2.0	2.1
830220	2.1	2.2	2.3	1.8	2.0	2.0
830221	2.0	2.1	2.1	1.8	1.9	2.0
830222	2.0	2.1	2.1	1.8	2.0	2.0
830223	1.9	2.0	2.1	1.8	1.9	2.0
830224	1.8	1.9	2.0	1.8	1.8	1.9
830225	1.8	2.0	2.0	1.8	1.9	1.9
830226	1.8	1.9	2.0	1.7	1.9	1.9
830227	1.8	1.9	2.0	1.7	1.8	1.8
830228	1.7	1.9	1.9	1.7	1.8	1.8
MONTHLY VALUE	1.7	2.3	2.6	1.7	2.1	2.4

Appendix Table A-9 (Continued).

- MARCH 1983 -

DATE	INTRAGRAVEL			SURFACE WATER		
	MIN	MEAN	MAX	MIN	MEAN	MAX
830301	1.7	1.8	1.9	1.6	1.7	1.8
830302	1.6	1.9	2.0	1.5	1.8	1.9
830303	1.6	1.9	2.0	1.6	1.7	2.0
830304	1.7	1.9	2.1	1.6	1.7	2.0
830305	1.6	1.7	1.9	1.6	1.6	1.8
830306	1.6	1.8	2.0	1.5	1.6	1.8
830307	1.6	1.8	2.0	1.5	1.7	1.8
830308	1.6	1.8	2.0	1.5	1.7	1.9
830309	1.5	1.8	2.0	1.5	1.7	1.9
830310	1.6	1.8	2.0	1.5	1.7	1.8
830311	1.5	1.7	1.8	1.4	1.6	1.7
830312	1.5	1.6	1.8	1.4	1.5	1.7
830313	1.5	1.7	1.9	1.4	1.6	1.8
830314	1.5	1.7	1.9	1.4	1.6	1.7
830315	1.5	1.6	1.8	1.3	1.5	1.6
830316	1.5	1.7	1.9	1.4	1.6	1.7
830317	1.5	1.7	2.0	1.4	1.6	1.8
830318	1.5	1.7	1.9	1.4	1.6	1.7
830319	1.4	1.7	1.9	1.3	1.5	1.7
830320	1.4	1.6	1.9	1.3	1.5	1.7
830321	1.4	1.6	1.7	1.3	1.5	1.6
830322	1.4	1.7	1.8	1.3	1.5	1.6
830323	1.4	1.7	1.8	1.3	1.5	1.6
830324	1.3	1.6	1.8	1.2	1.5	1.6
830325	1.3	1.5	1.8	1.3	1.4	1.7
830326	1.3	1.5	1.8	1.3	1.5	1.6
830327	1.3	1.6	1.7	1.3	1.5	1.6
830328	1.3	1.6	1.8	1.3	1.5	1.7
830329	1.3	1.6	1.8	1.3	1.5	1.7
830330	1.3	1.6	1.8	1.3	1.5	1.8
830331	1.3	1.6	1.8	1.2	1.6	1.9
MONTHLY VALUE	1.3	1.7	2.1	1.2	1.6	2.0

Appendix Table A-9 (Continued).

- APRIL 1983 -

DATE	INTRAGRAVEL			SURFACE WATER		
	MIN	MEAN	MAX	MIN	MEAN	MAX
830401	1.4	1.7	1.9	1.3	1.6	2.1
830402	1.4	1.7	2.0	1.5	1.8	2.4
830403	1.7	1.9	2.1	1.6	1.9	2.6
830404	1.6	1.8	2.1	1.4	1.8	2.1
830405	1.5	1.7	1.9	1.4	1.6	1.8
830406	1.4	1.6	1.8	1.3	1.6	1.9
830407	1.5	1.8	2.1	1.4	1.8	2.6
830408	1.6	2.0	2.5	1.5	2.1	3.1
830409	1.6	1.9	2.4	1.4	1.6	2.1
830410	1.5	1.8	2.1	1.4	1.7	2.0
830411	1.6	1.9	2.2	1.5	1.7	2.0
830412	1.3	1.6	1.8	1.1	1.3	1.6
830413	1.2	1.3	1.5	1.0	1.1	1.2
830414	1.1	1.3	1.4	.9	1.1	1.2
830415	1.1	1.2	1.4	.9	1.1	1.2
830416	1.1	1.2	1.4	.9	1.1	1.4
830417	1.2	1.4	1.5	1.1	1.2	1.4
830418	1.1	1.3	1.5	.9	1.1	1.3
830419	1.1	1.2	1.4	.9	1.1	1.3
830420	1.1	1.4	1.6	.9	1.3	1.8
830421	1.3	1.6	2.1	1.1	1.6	2.4
830422	1.6	1.9	2.2	1.4	1.8	2.3
830423	1.7	1.9	2.2	1.6	1.9	2.3
830424	1.8	2.3	3.4	1.6	2.5	4.2
830425	2.5	3.2	4.2	2.5	3.5	5.0
830426	3.0	3.7	4.4	3.0	4.1	5.6
830427	3.4	4.0	4.6	3.4	4.4	5.8
830428	2.8	3.5	4.2	3.5	4.1	5.0
830429	2.7	3.0	3.4	3.1	4.5	6.8
830430	3.2	3.5	4.0	4.2	5.7	7.9
MONTHLY VALUE	1.1	2.0	4.6	.9	2.1	7.9

Appendix Table A-9 (Continued).

- MAY 1983 -

DATE	INTRAGRAVEL			SURFACE WATER		
	MIN	MEAN	MAX	MIN	MEAN	MAX
830501	3.6	4.0	4.2	4.7	5.9	8.5
830502	3.5	3.7	4.2	4.0	5.1	6.6
830503	2.9	3.3	3.7	2.8	4.5	6.4
830504	2.8	3.1	3.4	2.9	4.5	6.5
830505	2.6	3.0	3.3	2.7	4.4	6.7
830506	2.5	2.9	3.2	2.5	4.0	7.0
830507	2.3	2.7	3.0	2.2	4.0	6.7
830508	2.5	[illegible]	3.1	2.6	4.4	6.7
830509	2.3	2.7	3.1	1.6	3.4	5.3
830510	2.3	2.6	2.8	2.1	3.8	6.1
830511	2.3	2.7	2.9	2.5	4.4	6.4
830512	2.4	2.7	2.9	2.0	3.6	5.7
830513	2.5	2.7	2.9	2.1	3.4	5.7
830514	2.4	2.7	2.9	2.0	3.4	5.6
830515	2.5	2.8	3.2	2.3	3.8	5.7
830516	3.0	3.2	3.5	3.4	4.4	6.1
830517	3.1	—	3.5	2.9	—	4.2
MONTHLY VALUE	2.3	—	4.2	1.6	—	8.5

Appendix Table A-10 Datapod intragravel and surface water temperature (C) data summary, at Slough 21 - Mouth, RM 141.8, Geocode S31N02W02AAB.

- SEPTEMBER 1982 -

DATE	INTRAGRAVEL			SURFACE WATER		
	MIN	MEAN	MAX	MIN	MEAN	MAX
820917	3.7	6.7	7.4	6.6	6.9	7.5
820918	5.2	5.8	6.8	4.7	5.7	6.6
820919	3.6	4.4	5.4	4.3	5.0	7.1
820920	3.6	3.7	3.7	4.5	5.0	5.6
820921	3.6	3.7	3.7	4.4	4.9	5.8
820922	3.6	3.7	3.7	3.5	4.4	5.3
820923	3.6	3.6	3.7	2.6	3.4	5.2
820924	3.6	3.6	3.7	2.3	3.2	4.9
820925	3.6	3.6	3.7	2.6	3.4	4.7
820926	3.6	3.7	3.7	3.2	3.6	4.3
820927	3.6	3.6	3.7	3.0	3.8	5.0
820928	3.6	3.7	3.7	2.4	3.1	4.2
820929	3.6	3.7	3.7	3.3	3.7	4.8
820930	3.6	3.7	3.7	3.4	3.8	5.1
MONTHLY VALUE	3.6	------	7.4	2.3	------	7.5

Appendix Table A-10 (Continued).

- OCTOBER 1982 -

DATE	INTRAGRAVEL			SURFACE WATER		
	MIN	MEAN	MAX	MIN	MEAN	MAX
821001	3.6	3.7	3.7	3.1	3.6	4.3
821002	3.6	3.7	3.7	3.0	3.6	4.6
821003	3.6	3.7	3.7	2.8	3.4	4.5
821004	3.6	3.7	3.7	2.2	2.8	4.3
821005	3.6	3.7	3.7	2.1	2.5	3.5
821006	3.6	3.7	3.7	2.0	2.7	3.7
821007	3.6	3.7	3.7	2.3	2.7	3.6
821008	3.6	3.6	3.7	1.5	2.8	3.9
821009	3.6	3.6	3.7	1.5	2.8	3.7
821010	3.6	3.7	3.7	2.5	2.8	3.5
821011	3.6	3.7	3.7	1.2	2.6	3.3
821012	3.6	3.7	3.7	1.6	2.6	3.3
821013	3.6	3.7	3.7	1.7	2.7	3.1
821014	3.6	3.7	3.7	1.8	2.6	3.7
821015	3.6	3.7	3.7	1.1	1.6	2.4
821016	3.6	3.6	3.7	1.5	2.0	2.5
821017	3.6	3.6	3.7	1.9	2.6	3.6
821018	3.6	3.7	3.7	1.5	2.0	2.8
821019	3.6	3.7	3.7	1.3	2.3	3.0
821020	3.6	3.7	3.7	1.3	2.0	2.5
821021	3.6	3.6	3.7	.6	1.0	1.5
821022	3.6	3.6	3.7	.6	1.0	1.5
821023	3.6	3.6	3.7	.6	<.05	1.2
821024	3.6	3.6	3.7	.3	1.1	1.9
821025	3.6	—	3.7	.7	—	1.3
821029	3.5	—	3.6	.5	—	1.5
821030	3.5	3.5	3.6	.3	.5	.9
821031	3.5	3.5	3.5	.2	.6	1.4
MONTHLY VALUE	3.5	3.6	3.7	.2	2.2	4.6

Appendix Table A-10 (Continued).

- NOVEMBER 1982 -

DATE	INTRAGRAVEL			SURFACE WATER		
	MIN	MEAN	MAX	MIN	MEAN	MAX
821101	3.5	3.5	3.5	1.0	1.7	2.4
821102	3.5	3.5	3.5	1.8	2.3	3.0
821103	3.5	3.5	3.5	.5	1.2	2.0
821104	3.5	3.5	3.5	1.4	1.8	2.6
821105	3.5	3.5	3.5	.8	1.5	2.1
821106	3.5	3.5	3.6	.2	.5	.8
821107	3.5	3.5	3.5	.1	.3	.6
821108	3.5	3.5	3.5	.3	.7	1.3
821109	3.5	3.5	3.5	1.1	1.6	2.0
821110	3.5	3.5	3.5	.6	1.3	1.9
821111	3.5	3.5	3.5	.8	1.6	2.4
821112	3.5	3.5	3.5	1.6	1.9	2.5
821113	3.5	3.5	3.5	1.3	1.9	2.2
821114	3.4	3.5	3.5	.4	1.6	2.2
821115	3.4	3.5	3.5	.3	.8	1.2
821116	3.5	3.5	3.5	.1	.3	.5
821117	3.5	3.5	3.5	-.1	.1	.4
821118	3.5	3.5	3.5	0.0	.1	.2
821119	3.5	3.5	3.5	0.0	.1	.3
821120	3.5	3.5	3.5	.3	.4	.8
821121	3.5	3.5	3.5	.7	1.1	1.5
821122	3.5	3.5	3.5	1.3	1.5	1.7
821123	3.4	3.5	3.5	1.4	1.9	2.2
821124	3.4	3.5	3.5	.7	1.6	2.2
821125	3.4	3.5	3.5	.6	.9	1.3
821126	3.4	3.5	3.5	.5	.8	1.2
821127	3.4	3.4	3.5	.6	1.1	1.6
821128	3.4	3.5	3.5	.1	.4	.7
821129	3.4	3.5	3.5	.4	.8	1.2
821130	3.4	3.5	3.5	.2	.7	1.1
MONTHLY VALUE	3.4	3.5	3.6	-.1	1.1	3.0

Appendix Table A-10 (Continued).

- DECEMBER 1982 -

DATE	INTRAGRAVEL			SURFACE WATER		
	MIN	MEAN	MAX	MIN	MEAN	MAX
821201	3.4	3.5	3.5	.1	.5	.9
821202	3.4	3.4	3.5	-.1	<.05	.2
821203	3.4	3.5	3.5	-.1	<.05	.1
821204	3.4	3.5	3.5	0.0	<.05	.2
821205	3.5	3.5	3.5	.1	.4	.9
821206	3.4	3.5	3.5	.5	.8	1.1
821207	3.4	3.5	3.5	1.1	1.6	2.1
821208	3.4	3.4	3.5	.7	1.6	2.1
821209	3.4	3.4	3.5	.2	1.2	2.1
821210	3.4	3.4	3.5	-.2	<.05	.3
821211	3.4	3.5	3.5	.1	.4	.8
821212	3.4	3.4	3.5	.3	<.05	1.4
821213	3.4	3.4	3.5	.8	1.2	1.6
821214	3.4	3.4	3.5	.5	1.0	1.6
821215	3.4	3.4	3.4	.6	1.3	1.9
821216	3.4	3.4	3.4	.4	.9	1.3
821217	3.4	3.4	3.4	1.0	1.3	1.7
821218	3.4	3.4	3.4	0.0	.3	1.2
821219	3.4	3.4	3.4	.1	.3	.6
821220	3.4	3.4	3.4	.1	.3	.6
821221	3.4	3.4	3.4	-.1	<.05	.2
821222	3.4	3.4	3.4	-.1	<.05	.1
821223	3.4	3.4	3.4	0.0	.1	.3
821224	3.4	3.4	3.5	.1	.4	.6
821225	3.4	3.4	3.4	.4	.6	.8
821226	3.4	3.4	3.4	.6	1.0	1.3
821227	3.4	3.4	3.4	1.2	1.5	1.7
821228	3.4	3.4	3.4	.6	1.0	1.7
821229	3.4	3.4	3.4	1.5	1.8	2.0
821230	3.4	3.4	3.4	.9	1.6	1.9
821231	3.4	3.4	3.4	.7	1.1	1.5
MONTHLY VALUE	3.4	3.4	3.5	-.2	.8	2.1

Appendix Table A-10 (Continued).

- JANUARY 1983 -

DATE	INTRAGRAVEL			SURFACE WATER		
	MIN	MEAN	MAX	MIN	MEAN	MAX
830101	3.4	3.4	3.4	1.2	1.5	1.8
830102	3.4	3.4	3.4	1.5	1.7	2.0
830103	3.4	3.4	3.4	1.0	1.4	1.8
830104	3.4	3.4	3.4	-.1	.2	1.0
830105	3.4	3.4	3.4	-.1	<.05	.1
830106	3.4	3.4	3.4	0.0	.1	.3
830107	3.4	3.4	3.4	-.1	.1	.2
830108	3.4	3.5	3.5	0.0	.2	.4
830109	3.4	3.5	3.5	0.0	<.05	.1
830110	3.4	3.4	3.5	0.0	<.05	.1
830111	3.4	3.4	3.4	0.0	<.05	.1
830112	3.4	3.4	3.5	0.0	.1	.2
830113	3.4	—	3.4	0.0	—	.2
830114	3.4	—	3.5	.4	—	.6
830115	3.4	3.4	3.5	.4	.6	1.1
830116	3.4	3.4	3.5	1.1	1.3	1.6
830117	3.4	3.4	3.5	.6	1.2	1.6
830118	3.4	3.4	3.4	.6	1.4	1.8
830119	3.4	3.5	3.5	1.4	1.7	1.9
830120	3.4	3.5	3.5	.6	1.0	1.5
830121	3.4	3.4	3.5	.6	.8	1.0
830122	3.4	3.4	3.5	-.3	.3	.7
830123	3.4	3.5	3.5	-.1	.3	.6
830124	3.4	3.5	3.5	.1	.5	.8
830125	3.4	3.4	3.5	.3	.6	.9
830126	3.4	3.5	3.5	.5	1.0	1.6
830127	3.4	3.5	3.5	.5	<.05	1.3
830128	3.4	3.5	3.5	.8	1.2	1.7
830129	3.4	3.5	3.5	0.0	.4	.9
830130	3.4	3.4	3.5	.1	.7	1.5
830131	3.4	3.5	3.5	1.3	1.6	2.3
MONTHLY VALUE	3.4	3.4	3.5	-.3	.7	2.3

Appendix Table A-10 (Continued).

- FEBRUARY 1983 -

DATE	INTRAGRAVEL			SURFACE WATER		
	MIN	MEAN	MAX	MIN	MEAN	MAX
830201	3.4	3.4	3.5	1.3	1.7	2.3
830202	3.4	3.5	3.5	1.1	1.7	2.3
830203	3.4	3.5	3.5	1.4	1.7	2.1
830204	3.4	3.5	3.5	1.3	1.6	2.0
830205	3.4	3.4	3.5	1.3	1.7	2.4
830206	3.4	3.4	3.5	.8	1.5	2.4
830207	3.4	3.4	3.5	1.0	1.9	2.8
830208	3.4	3.4	3.5	1.1	1.5	2.4
830209	3.4	3.4	3.5	.1	.4	1.4
830210	3.4	3.4	3.5	0.0	.3	.8
830211	3.4	3.4	3.5	0.0	.2	.5
830212	3.4	3.4	3.4	0.0	.2	.4
830213	3.4	3.4	3.5	.1	.2	.4
830214	3.4	3.4	3.5	.2	.4	.5
830215	3.4	3.4	3.4	.1	.3	.6
830216	3.4	3.4	3.4	.2	.4	.5
830217	3.4	3.4	3.4	.1	.5	.8
830218	3.4	3.4	3.4	.4	.6	.8
830219	3.4	3.4	3.4	.7	1.0	1.3
830220	3.4	3.4	3.4	.5	1.1	1.7
830221	3.4	3.4	3.4	.9	1.4	2.2
830222	3.4	3.4	3.4	.6	1.2	1.8
830223	3.4	3.4	3.4	.4	<.05	1.8
830224	3.4	3.4	3.4	1.1	1.7	2.6
830225	3.3	3.4	3.4	.4	1.0	1.7
830226	3.3	3.4	3.4	.4	1.1	2.0
830227	3.3	3.4	3.4	.5	1.2	2.7
830228	3.3	3.4	3.4	.8	1.8	3.0
MONTHLY VALUE	3.3	3.4	3.5	0.0	1.1	3.0

Appendix Table A-10 (Continued).

- MARCH 1983 -

DATE	INTRAGRAVEL			SURFACE WATER		
	MIN	MEAN	MAX	MIN	MEAN	MAX
830301	3.3	3.4	3.4	1.2	2.0	2.6
830302	3.3	3.4	3.4	.1	.9	1.5
830303	3.3	3.4	3.4	0.0	.3	.8
830304	3.3	3.4	3.4	.1	.5	1.1
830305	3.3	3.4	3.4	.3	.9	1.5
830306	3.3	3.4	3.4	.1	.8	1.6
830307	3.4	3.4	3.4	.3	.8	1.8
830308	3.3	3.4	3.4	0.0	.4	1.3
830309	3.3	3.4	3.4	.1	.4	1.0
830310	3.3	3.4	3.4	.1	.7	1.5
830311	3.3	3.4	3.4	.9	1.5	2.5
830312	3.3	3.3	3.4	.7	1.7	3.3
830313	3.3	3.4	3.4	.5	1.3	3.3
830314	3.3	3.4	3.4	.4	1.3	3.2
830315	3.3	3.4	3.4	1.5	2.4	4.3
830316	3.3	3.4	3.4	.5	1.6	3.8
830317	3.3	3.3	3.4	.3	1.2	3.6
830318	3.3	3.3	3.4	.1	1.0	3.4
830319	3.3	3.3	3.4	.1	.9	3.0
830320	3.3	3.3	3.4	.5	1.5	3.8
830321	3.3	3.3	3.4	.4	1.7	4.3
830322	3.3	3.3	3.4	0.0	1.2	4.0
830323	3.3	3.3	3.4	.1	1.1	3.7
830324	3.3	3.3	3.4	.2	1.7	4.4
830325	3.3	3.3	3.4	.7	2.0	4.6
830326	3.3	3.3	3.4	.2	1.3	3.9
830327	3.3	3.3	3.4	.3	1.4	4.4
830328	3.3	3.3	3.4	.2	1.5	4.8
830329	3.3	3.3	3.4	0.0	1.5	4.9
830330	3.3	3.3	3.4	0.0	1.6	5.1
830331	3.3	3.3	3.3	.3	2.4	6.3
MONTHLY VALUE	3.3	3.3	3.4	0.0	1.3	6.3

Appendix Table A-10 (Continued).

- APRIL 1983 -

DATE	INTRAGRAVEL			SURFACE WATER		
	MIN	MEAN	MAX	MIN	MEAN	MAX
830401	3.3	3.3	3.4	.2	2.0	6.2
830402	3.3	3.3	3.4	.1	1.9	6.0
830403	3.3	3.3	3.4	.1	1.9	6.3
830404	3.3	3.3	3.4	1.3	2.6	4.4
830405	3.3	3.4	3.4	1.2	2.7	5.0
830406	3.3	3.4	3.4	1.3	3.3	7.3
830407	3.3	3.4	3.4	1.1	3.1	8.4
830408	3.3	3.3	3.4	.9	3.0	6.8
830409	3.3	3.3	3.4	1.5	2.8	6.3
830410	3.3	3.3	3.4	.2	1.9	5.7
830411	3.3	3.3	3.4	0.0	1.1	2.7
830412	3.3	3.3	3.4	.3	1.9	4.2
830413	3.3	3.3	3.3	1.3	3.0	6.7
830414	3.3	3.3	3.3	1.6	3.4	6.8
830415	3.3	3.3	3.3	.7	2.8	5.1
830416	3.3	3.3	3.4	2.0	3.8	7.0
830417	3.3	3.3	3.4	.6	2.5	5.3
830418	3.3	3.3	3.3	.8	3.1	6.4
830419	3.3	3.3	3.3	1.8	4.0	8.1
830420	3.3	3.3	3.4	1.5	4.1	8.7
830421	3.3	3.3	3.4	1.3	4.6	10.0
830422	3.3	3.3	3.4	1.7	4.1	7.7
830423	3.3	3.3	3.4	2.5	4.3	7.3
830424	3.3	3.3	3.4	2.5	5.1	10.9
830425	3.3	3.3	3.4	2.0	5.0	10.7
830426	3.3	3.3	3.4	1.5	4.8	10.5
830427	3.3	3.3	3.4	1.5	4.8	10.5
830428	3.3	3.3	3.4	1.9	3.8	8.1
830429	3.3	3.3	3.4	3.0	4.9	8.1
830430	3.3	——	3.4	1.6	——	4.5
MONTHLY VALUE	3.3	3.3	3.4	0.0	3.3	10.9

Appendix Table A-11 Datapod intragravel and surface water temperature (C) data summary, at Slough 21 - Upper, RM 142.0, Geocode S32N02W36CCC.

- AUGUST 1982 -

DATE	INTRAGRAVEL			SURFACE WATER		
	MIN	MEAN	MAX	MIN	MEAN	MAX
820821	3.7	3.7	3.8	4.0	5.4	7.9
820822	3.7	3.7	3.8	3.9	5.2	7.6
820823	3.7	3.7	3.8	4.8	5.5	6.9
820824	3.7	4.0	4.4	4.6	5.6	7.6
820825	3.9	4.1	4.6	4.8	5.9	8.1
820826	3.9	4.2	4.6	4.9	6.0	8.3
820827	3.8	4.1	4.6	3.9	5.4	8.3
820828	3.8	4.0	4.3	4.2	5.2	7.1
820829	3.8	4.0	4.2	4.6	5.2	6.2
820830	3.9	4.0	4.1	4.7	5.1	5.5
820831	3.8	4.0	4.3	4.5	5.2	6.7
MONTHLY VALUE	3.7	----	4.6	3.9	----	8.3

Appendix Table A-11 (Continued).

- SEPTEMBER 1982 -

DATE	INTRAGRAVEL			SURFACE WATER		
	MIN	MEAN	MAX	MIN	MEAN	MAX
820901	3.8	4.0	4.3	4.6	5.4	6.9
820902	3.8	4.0	4.3	4.4	5.3	7.1
820903	3.8	4.0	4.1	4.6	5.1	6.4
820904	3.8	4.0	4.1	4.2	5.0	6.7
820905	3.8	3.9	4.1	4.0	4.9	6.3
820906	3.8	3.9	4.0	4.4	4.9	5.8
820907	3.8	3.9	4.1	4.4	5.2	7.2
820908	3.8	3.9	4.0	4.4	4.9	5.9
820909	3.8	3.9	4.1	4.4	5.0	6.5
820910	3.8	3.9	4.0	4.2	4.9	6.2
820911	3.8	3.8	3.9	4.1	4.4	5.0
820912	3.7	3.8	3.9	3.5	4.3	6.0
820913	3.8	3.8	3.9	4.1	4.5	5.6
820914	3.8	3.8	3.9	4.4	4.8	5.5
820915	3.8	4.6	6.0	4.7	5.9	7.7
820916	5.6	6.4	7.5	7.6	7.9	8.2
820917	5.8	6.8	7.5	6.9	7.3	7.8
820918	4.4	5.0	5.9	5.1	6.0	6.9
820919	4.0	4.2	4.4	4.2	4.7	5.1
820920	4.0	4.2	4.5	4.2	4.6	5.3
820921	3.9	4.2	4.4	4.0	4.5	5.2
820922	3.8	4.1	4.5	3.7	4.4	5.4
820923	3.5	3.8	4.4	2.8	3.7	5.1
820924	3.3	3.7	4.4	2.5	3.4	4.9
820925	3.4	3.8	4.2	2.6	3.5	4.5
820926	3.7	3.9	4.1	3.4	3.7	4.2
820927	3.7	3.9	4.3	3.2	3.8	4.7
820928	3.5	3.7	4.0	2.5	3.2	4.0
820929	3.7	3.9	4.2	3.3	3.7	4.5
820930	3.8	4.0	4.3	3.4	3.9	4.8
MONTHLY VALUE	3.3	4.2	7.5	2.5	4.7	8.2

Appendix Table A-11 (Continued).

- OCTOBER 1982 -

DATE	INTRAGRAVEL			SURFACE WATER		
	MIN	MEAN	MAX	MIN	MEAN	MAX
821001	3.8	3.9	4.1	3.4	3.7	4.2
821002	3.7	3.9	4.2	3.2	3.6	4.5
821003	3.6	3.8	4.2	3.0	3.5	4.5
821004	3.5	3.7	4.1	2.4	3.0	4.3
821005	3.4	3.5	3.9	2.4	2.8	3.8
821006	3.4	3.6	3.9	2.3	2.9	3.8
821007	3.5	3.6	3.8	2.6	2.9	3.5
821008	3.4	3.6	3.9	2.1	3.0	3.8
821009	3.3	3.6	3.9	2.2	3.0	3.7
821010	3.5	3.6	3.9	2.8	3.1	3.5
821011	3.3	3.6	3.8	2.0	2.8	3.4
821012	3.4	3.6	3.8	2.4	2.8	3.3
821013	3.5	3.6	3.7	2.4	2.9	3.2
821014	3.5	3.6	3.9	2.4	2.9	3.6
821015	3.4	3.5	3.7	2.2	2.5	3.1
821016	3.5	3.5	3.7	2.3	2.6	2.9
821017	3.5	3.6	3.9	2.5	2.9	3.6
821018	3.5	3.5	3.7	2.3	2.6	3.2
821019	3.4	3.6	3.8	2.2	2.7	3.1
821020	3.4	3.5	3.6	2.2	2.6	2.9
821021	3.3	3.5	3.5	2.0	2.2	2.5
821022	3.4	3.5	3.6	2.0	2.2	2.6
821023	3.3	3.5	3.5	2.0	2.2	2.4
821024	3.3	3.5	3.6	1.8	2.3	2.6
821025	3.3	——	3.5	1.9	——	2.4
821029	3.3	——	3.5	1.7	——	2.2
821030	3.2	3.4	3.5	1.6	1.9	2.2
821031	3.3	3.4	3.5	1.7	2.0	2.3
MONTHLY VALUE	3.2	3.6	4.2	1.6	2.7	4.5

Appendix Table A-11 (Continued).

- NOVEMBER 1982 -

DATE	INTRAGRAVEL			SURFACE WATER		
	MIN	MEAN	MAX	MIN	MEAN	MAX
821101	3.4	3.5	3.6	1.9	2.3	2.6
821102	3.5	3.6	3.8	2.3	2.6	3.0
821103	3.3	3.5	3.6	1.7	2.2	2.6
821104	3.4	3.5	3.7	2.1	2.5	2.9
821105	3.3	3.5	3.6	1.8	2.2	2.6
821106	3.1	3.2	3.4	1.5	1.8	2.2
821107	3.2	3.2	3.4	1.6	1.9	2.1
821108	3.2	3.3	3.4	1.6	1.9	2.1
821109	3.3	3.5	3.5	2.0	2.3	2.6
821110	3.3	3.4	3.5	1.7	2.2	2.5
821111	3.3	3.5	3.6	1.9	2.3	2.7
821112	3.4	3.5	3.6	2.1	2.5	2.8
821113	3.3	3.5	3.6	2.1	2.5	2.7
821114	3.2	3.5	3.5	1.7	2.4	2.6
821115	3.1	3.3	3.4	1.6	2.0	2.3
821116	3.1	3.2	3.4	1.3	1.7	2.0
821117	2.9	3.0	3.2	1.1	1.5	1.8
821118	2.9	3.0	3.1	1.1	1.4	1.6
821119	2.9	3.0	3.1	1.2	1.4	1.6
821120	3.0	3.1	3.2	1.3	1.5	1.8
821121	3.1	3.2	3.4	1.7	1.9	2.2
821122	3.2	3.3	3.4	1.9	2.2	2.3
821123	3.3	3.4	3.5	2.1	2.4	2.6
821124	3.3	3.4	3.5	1.7	2.2	2.6
821125	3.2	3.3	3.4	1.7	1.9	2.2
821126	3.2	3.3	3.4	1.6	1.9	2.2
821127	3.2	3.3	3.4	1.8	2.0	2.4
821128	3.0	3.2	3.3	1.4	1.7	1.9
821129	3.0	3.2	3.3	1.6	1.9	2.1
821130	3.0	3.1	3.3	1.6	1.8	2.0
MONTHLY VALUE	2.9	3.3	3.8	1.1	2.0	3.0

Appendix Table A-11 (Continued).

- DECEMBER 1982 -

DATE	INTRAGRAVEL			SURFACE WATER		
	MIN	MEAN	MAX	MIN	MEAN	MAX
821201	3.0	3.2	3.3	1.4	1.8	2.0
821202	2.9	3.0	3.2	1.1	1.4	1.6
821203	2.8	2.9	3.1	1.0	1.2	1.5
821204	2.9	3.0	3.1	1.0	1.3	1.5
821205	2.9	3.1	3.2	1.1	1.6	1.9
821206	3.0	3.2	3.3	1.5	1.7	2.0
821207	3.1	3.3	3.5	1.7	2.0	2.3
821208	3.2	3.4	3.5	1.7	2.1	2.4
821209	3.1	3.3	3.5	1.4	2.0	2.4
821210	2.9	3.0	3.2	.8	1.2	1.6
821211	3.0	3.1	3.3	1.1	1.4	1.8
821212	3.0	3.2	3.3	1.4	1.8	2.0
821213	3.1	3.3	3.3	1.6	1.9	2.2
821214	3.0	3.2	3.3	1.5	1.9	2.2
821215	3.1	3.2	3.4	1.6	2.0	2.3
821216	3.0	3.1	3.3	1.4	1.7	2.0
821217	3.1	3.3	3.4	1.7	2.0	2.2
821218	2.9	3.0	3.3	1.2	1.5	2.0
821219	2.9	3.0	3.1	1.2	1.5	1.7
821220	2.9	3.0	3.2	1.1	1.4	1.7
821221	2.7	2.9	3.0	.8	1.1	1.5
821222	2.7	2.9	3.0	.9	1.1	1.3
821223	2.7	2.9	3.0	1.0	1.2	1.4
821224	2.8	2.9	3.0	1.1	1.3	1.6
821225	2.9	3.0	3.1	1.3	1.5	1.6
821226	2.9	3.0	3.2	1.3	1.6	1.9
821227	3.1	3.2	3.3	1.7	1.9	2.2
821228	2.9	3.1	3.3	1.4	1.8	2.1
821229	3.2	3.3	3.3	2.0	2.1	2.3
821230	3.1	3.2	3.3	1.7	2.1	2.3
821231	3.1	3.1	3.2	1.6	1.9	2.2
MONTHLY VALUE	2.7	3.1	3.5	.8	1.6	2.4

Appendix Table A-11 (Continued).

- JANUARY 1983 -

DATE	INTRAGRAVEL			SURFACE WATER		
	MIN	MEAN	MAX	MIN	MEAN	MAX
830101	3.1	3.2	3.3	1.8	2.1	2.3
830102	3.2	3.2	3.4	1.9	2.2	2.3
830103	3.1	3.2	3.3	1.7	2.0	2.3
830104	2.8	3.0	3.2	1.1	1.5	1.9
830105	2.7	2.8	2.9	.9	1.2	1.5
830106	2.6	2.7	2.9	.8	1.1	1.3
830107	2.6	2.8	2.9	.7	1.0	1.2
830108	2.7	2.8	2.9	.9	1.2	1.4
830109	2.6	2.7	2.9	.9	1.0	1.2
830110	2.6	2.7	2.8	.7	<.05	1.2
830111	2.5	2.7	2.8	.8	1.0	1.3
830112	2.7	2.8	2.8	1.0	1.2	1.3
830113	2.7	—	2.9	.9	—	1.2
830114	2.8	—	3.0	1.5	—	1.7
830115	2.7	3.0	3.1	1.4	1.6	1.9
830116	3.0	3.2	3.3	1.8	2.0	2.2
830117	3.1	3.2	3.3	1.7	2.0	2.2
830118	3.1	3.3	3.4	1.7	2.1	2.4
830119	3.2	3.3	3.4	2.1	2.3	2.4
830120	3.1	3.2	3.3	1.7	2.0	2.3
830121	3.1	3.2	3.3	1.6	1.9	2.1
830122	2.7	3.0	3.2	.9	1.5	1.8
830123	2.7	3.0	3.1	.9	1.4	1.8
830124	2.7	3.0	3.2	1.0	1.6	1.9
830125	2.8	3.0	3.2	1.2	1.6	1.9
830126	2.9	3.1	3.3	1.3	1.9	2.1
830127	3.0	3.1	3.3	1.6	1.9	2.1
830128	3.1	3.2	3.3	1.8	2.0	2.3
830129	2.8	3.0	3.2	1.0	1.5	2.0
830130	2.9	3.1	3.2	1.4	1.7	2.1
830131	3.2	3.3	3.4	1.9	2.2	2.6
MONTHLY VALUE	2.5	3.0	3.4	.7	1.6	2.6

Appendix Table A-11 (Continued).

- FEBRUARY 1983 -

DATE	INTRAGRAVEL			SURFACE WATER		
	MIN	MEAN	MAX	MIN	MEAN	MAX
830201	3.2	3.3	3.5	2.1	2.4	2.6
830202	3.2	3.3	3.5	1.9	2.3	2.7
830203	3.2	3.3	3.4	2.0	2.3	2.6
830204	3.2	3.3	3.4	1.9	2.2	2.5
830205	3.1	3.2	3.4	2.0	2.3	2.7
830206	3.0	3.2	3.4	1.8	2.2	2.6
830207	3.1	3.3	3.5	1.7	2.3	2.8
830208	3.1	3.2	3.4	1.8	2.2	2.5
830209	2.7	2.9	3.2	1.1	1.6	2.2
830210	2.6	2.8	3.1	1.0	1.4	2.0
830211	2.6	2.7	2.9	1.1	1.4	1.6
830212	2.6	2.6	2.8	.9	1.2	1.5
830213	2.6	2.7	2.8	1.0	1.2	1.5
830214	2.6	2.7	2.8	1.1	1.3	1.5
830215	2.6	2.7	2.8	.9	1.2	1.5
830216	2.6	2.7	2.8	1.1	1.2	1.4
830217	2.6	2.6	2.7	.9	1.0	1.2
830218	2.6	2.6	2.8	.8	1.0	1.4
830219	2.7	2.9	3.1	1.3	1.6	1.9
830220	2.7	3.0	3.2	1.4	1.9	2.2
830221	2.9	3.1	3.4	1.7	2.1	2.5
830222	2.8	3.0	3.3	1.6	2.0	2.4
830223	2.9	3.0	3.2	1.5	1.8	2.3
830224	2.9	3.1	3.4	1.7	2.2	2.6
830225	2.8	3.0	3.3	1.5	1.9	2.4
830226	2.9	3.1	3.3	1.5	1.9	2.4
830227	2.9	3.1	3.4	1.6	2.0	2.7
830228	3.0	3.2	3.5	1.8	2.3	2.8
MONTHLY VALUE	2.6	3.0	3.5	.8	1.8	2.8

Appendix Table A-11 (Continued).

- MARCH 1983 -

DATE	INTRAGRAVEL			SURFACE WATER		
	MIN	MEAN	MAX	MIN	MEAN	MAX
830301	3.0	3.2	3.4	1.8	2.3	2.7
830302	2.8	3.0	3.3	1.3	1.8	2.3
830303	2.6	2.8	3.0	1.2	1.4	1.8
830304	2.6	2.8	3.0	1.1	1.4	1.8
830305	2.7	2.9	3.1	1.2	1.6	2.0
830306	2.6	2.8	3.1	1.1	1.6	2.1
830307	2.7	2.9	3.2	1.3	1.7	2.2
830308	2.5	2.7	3.0	.9	1.3	1.9
830309	2.3	2.6	3.0	.7	1.1	1.8
830310	2.5	2.7	3.0	1.0	1.4	1.9
830311	2.7	2.9	3.3	1.5	1.8	2.4
830312	2.8	3.0	3.4	1.6	2.0	2.7
830313	2.7	3.0	3.4	1.4	1.9	2.8
830314	2.7	3.0	3.4	1.4	1.9	2.7
830315	2.9	3.2	3.7	1.9	2.4	3.3
830316	2.8	3.1	3.5	1.5	2.1	3.1
830317	2.7	3.0	3.5	1.4	1.9	2.9
830318	2.6	2.9	3.5	1.3	1.9	2.9
830319	2.6	2.9	3.4	1.2	1.7	2.7
830320	2.8	3.0	3.5	1.4	2.0	3.0
830321	2.7	3.0	3.6	1.5	2.1	3.1
830322	2.6	2.9	3.6	1.4	1.9	3.1
830323	2.7	2.9	3.5	1.3	1.8	2.9
830324	2.7	3.0	3.6	1.3	2.1	3.1
830325	2.8	3.1	3.7	1.5	2.2	3.3
830326	2.7	3.0	3.6	1.4	2.0	3.0
830327	2.7	2.9	3.7	1.4	2.0	3.1
830328	2.6	2.9	3.7	1.4	2.0	3.2
830329	2.6	3.0	3.8	1.3	1.9	3.3
830330	2.6	3.0	3.8	1.4	2.0	3.4
830331	2.7	3.1	3.9	1.5	2.3	3.7
MONTHLY VALUE	2.3	2.9	3.9	.7	1.9	3.7

Appendix Table A-11 (Continued).

- APRIL 1983 -

DATE	INTRAGRAVEL			SURFACE WATER		
	MIN	MEAN	MAX	MIN	MEAN	MAX
830401	2.6	3.1	3.9	1.5	2.3	3.7
830402	2.7	3.1	3.9	1.5	2.2	3.7
830403	2.7	3.1	4.0	1.6	2.2	3.7
830404	3.0	3.2	3.6	2.1	2.7	3.2
830405	2.8	3.2	3.8	1.9	2.7	3.6
830406	2.9	3.4	4.6	2.1	3.0	5.1
830407	2.9	3.5	4.8	2.0	3.0	5.4
830408	2.8	3.4	4.3	2.0	3.0	4.5
830409	3.1	3.4	4.2	2.2	2.8	4.4
830410	2.7	3.2	3.9	1.7	2.4	3.7
830411	2.7	3.0	3.5	1.5	2.1	2.7
830412	2.8	3.1	3.6	1.8	2.3	3.0
830413	2.9	3.2	4.0	1.9	2.6	3.9
830414	3.0	3.4	4.4	2.3	3.0	4.7
830415	2.9	3.3	3.8	2.2	2.8	3.6
830416	3.0	3.5	4.3	2.4	3.1	4.4
830417	2.7	3.2	3.9	1.8	2.7	3.8
830418	2.9	3.3	4.0	2.2	2.8	4.0
830419	3.1	3.6	4.7	2.5	3.3	5.5
830420	3.2	3.8	4.6	2.4	3.5	5.1
830421	3.4	4.0	5.2	2.6	3.8	6.0
830422	3.5	3.9	4.7	2.9	3.8	5.2
830423	3.5	3.9	4.6	3.1	3.8	4.8
830424	3.4	4.1	5.7	2.9	4.3	7.2
830425	3.3	4.2	5.6	2.7	4.3	6.9
830426	3.3	4.1	5.5	2.7	4.2	7.0
830427	3.2	4.2	5.6	2.7	4.3	6.9
830428	3.5	3.9	5.0	3.0	4.0	5.8
830429	3.8	4.2	5.0	3.7	4.4	5.8
830430	3.3	4.2	5.7	2.8	4.4	7.1
MONTHLY VALUE	2.6	3.6	5.7	1.5	3.2	7.2

Appendix Table A-11 (Continued).

- MAY 1983 -

DATE	INTRAGRAVEL			SURFACE WATER		
	MIN	MEAN	MAX	MIN	MEAN	MAX
830501	3.2	4.3	5.7	2.8	4.5	7.3
830502	4.0	4.3	5.1	4.1	4.7	5.9
830503	.4	3.2	5.0	.1	3.0	5.7
830504	.5	1.3	3.3	0.0	.8	3.0
830505	2.7	3.8	5.7	2.4	3.6	6.1
830506	3.4	4.2	5.8	3.0	4.1	6.4
830507	3.5	4.7	7.0	3.0	4.7	7.9
830508	3.6	4.8	7.3	3.4	4.9	8.3
830509	4.0	5.0	7.5	3.9	5.2	8.2
830510	4.1	5.0	7.1	4.1	5.2	7.9
830511	3.9	5.1	7.4	3.8	5.3	8.6
830512	4.3	5.2	6.4	4.3	5.4	6.9
830513	4.2	5.4	8.0	4.2	5.7	9.2
830514	4.3	5.3	7.2	4.3	5.6	7.9
830515	4.1	5.1	6.6	4.1	5.4	7.2
830516	3.2	4.9	7.0	2.9	5.1	7.8
830517	4.1	4.8	5.8	4.2	5.0	6.2
830518	3.8	4.9	6.3	3.8	5.1	6.8
830519	3.9	4.9	6.3	3.9	5.2	7.0
830520	3.8	5.1	6.8	3.8	5.3	7.6
830521	3.9	4.9	6.5	3.9	5.1	7.0
830522	4.1	5.1	7.2	4.2	5.3	7.9
830523	4.1	5.1	6.9	4.1	5.3	7.5
830524	3.9	5.3	7.2	3.9	5.5	7.8
830525	3.5	5.0	7.0	3.3	5.1	7.6
830526	4.2	5.0	6.6	4.3	5.2	7.2
830527	3.8	4.9	6.6	3.7	5.0	7.2
830528	3.6	5.1	7.0	3.5	5.4	7.7
830529	3.8	5.3	6.9	3.8	5.5	7.5
830530	4.5	5.8	7.8	4.6	6.2	8.6
830531	7.2	7.5	7.8	7.6	7.9	8.4
MONTHLY VALUE	.4	4.8	8.0	0.0	5.0	9.2

Appendix Table A-12 Thermograph data summary, winter surface water temperature (C), Slough 9, RM 128.7, Geocode S30N03W09DBC.

- OCTOBER 1982 -

TIME PERIOD	DAYS 1 - 8			DAYS 9 - 16			DAYS 17 - 24			DAYS 25 - 31		
	MIN	MEAN	MAX	MIN	MEAN	MAX	MIN	MEAN	MAX	MIN	MEAN	MAX
0001 - 0600	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
0601 - 1200	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
1201 - 1800	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
1801 - 2400	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
DAILY VALUE	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
0001 - 0600	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
0601 - 1200	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
1201 - 1800	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
1801 - 2400	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
DAILY VALUE	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
0001 - 0600	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
0601 - 1200	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
1201 - 1800	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
1801 - 2400	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
DAILY VALUE	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
0001 - 0600	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
0601 - 1200	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
1201 - 1800	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
1801 - 2400	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
DAILY VALUE	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
0001 - 0600	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
0601 - 1200	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
1201 - 1800	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
1801 - 2400	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
DAILY VALUE	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
0001 - 0600	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
0601 - 1200	-----	-----	-----	-----	-----	-----	-----	-----	-----	1.5	-----	1.5
1201 - 1800	-----	-----	-----	-----	-----	-----	-----	-----	-----	1.5	1.5	1.5
1801 - 2400	-----	-----	-----	-----	-----	-----	-----	-----	-----	1.5	1.6	1.7
DAILY VALUE	-----	-----	-----	-----	-----	-----	-----	-----	-----	1.5	-----	1.7
0001 - 0600	-----	-----	-----	-----	-----	-----	-----	-----	-----	1.5	1.5	1.6
0601 - 1200	-----	-----	-----	-----	-----	-----	-----	-----	-----	1.6	1.6	1.6
1201 - 1800	-----	-----	-----	-----	-----	-----	-----	-----	-----	1.5	1.5	1.6
1801 - 2400	-----	-----	-----	-----	-----	-----	-----	-----	-----	1.5	1.5	1.6
DAILY VALUE	-----	-----	-----	-----	-----	-----	-----	-----	-----	1.5	1.5	1.6
0001 - 0600	-----	-----	-----	-----	-----	-----	-----	-----	-----			
0601 - 1200	-----	-----	-----	-----	-----	-----	-----	-----	-----	MONTHLY VALUE		
1201 - 1800	-----	-----	-----	-----	-----	-----	-----	-----	-----			
1801 - 2400	-----	-----	-----	-----	-----	-----	-----	-----	-----	1.5	-----	1.7
DAILY VALUE	-----	-----	-----	-----	-----	-----	-----	-----	-----			

Appendix Table A-12 (Continued).

- NOVEMBER 1982 -

TIME PERIOD	DAYS 1 - 8			DAYS 9 - 16			DAYS 17 - 24			DAYS 25 - 31		
	MIN	MEAN	MAX	MIN	MEAN	MAX	MIN	MEAN	MAX	MIN	MEAN	MAX
0001 - 0600	1.6	1.7	1.7	1.6	1.6	1.7	1.8	1.9	1.9	1.9	2.0	2.0
0601 - 1200	1.6	1.7	1.7	1.7	1.8	1.9	1.8	1.8	1.9	1.8	1.8	1.9
1201 - 1800	1.9	2.0	2.0	2.0	2.0	2.0	1.9	1.9	1.9	1.8	1.8	1.8
1801 - 2400	2.0	2.1	2.2	2.0	2.0	2.1	1.9	1.9	2.0	1.7	1.7	1.8
DAILY VALUE	1.6	1.9	2.2	1.6	1.9	2.1	1.8	1.9	2.0	1.7	1.8	2.0
0001 - 0600	2.3	2.3	2.4	2.1	2.1	2.2	1.9	1.9	2.0	1.7	1.7	1.8
0601 - 1200	2.3	2.4	2.5	2.1	2.2	2.2	1.9	1.9	2.0	1.8	1.8	1.8
1201 - 1800	2.6	2.6	2.7	2.0	2.1	2.1	1.9	1.9	2.0	1.7	1.8	1.9
1801 - 2400	2.2	2.4	2.5	1.7	1.8	1.9	1.8	1.8	1.8	1.7	1.9	2.0
DAILY VALUE	2.2	2.4	2.7	1.7	2.0	2.2	1.8	1.9	2.0	1.7	1.8	2.0
0001 - 0600	1.9	2.0	2.0	1.6	1.7	1.8	1.8	1.8	1.8	1.8	1.9	1.9
0601 - 1200	1.8	1.9	1.9	1.6	1.7	1.7	1.8	1.9	2.0	1.8	1.8	1.9
1201 - 1800	2.0	2.1	2.2	1.8	2.0	2.1	2.0	2.0	2.0	1.8	1.9	1.9
1801 - 2400	2.0	2.1	2.2	2.0	2.0	2.0	2.0	2.0	2.1	1.8	1.8	1.9
DAILY VALUE	1.8	2.0	2.2	1.6	1.8	2.1	1.8	1.9	2.1	1.8	1.8	1.9
0001 - 0600	2.2	2.2	2.2	2.0	2.0	2.0	2.0	2.0	2.0	1.7	1.8	1.8
0601 - 1200	2.2	2.3	2.4	2.0	2.0	2.0	2.0	2.1	2.1	1.8	1.8	1.8
1201 - 1800	2.3	2.4	2.4	2.2	2.2	2.2	1.5	1.6	1.7	1.5	1.6	1.7
1801 - 2400	2.1	2.1	2.2	2.1	2.1	2.2	1.5	1.5	1.5	1.5	1.5	1.5
DAILY VALUE	2.1	2.2	2.4	2.0	2.1	2.2	1.5	1.8	2.1	1.5	1.7	1.8
0001 - 0600	1.9	2.0	2.1	2.0	2.1	2.1	1.5	1.5	1.5	1.5	1.5	1.5
0601 - 1200	2.1	2.1	2.2	2.0	2.0	2.1	1.5	1.6	1.7	1.5	1.5	1.5
1201 - 1800	2.3	2.4	2.4	2.2	2.2	2.2	1.7	1.7	1.8	1.5	1.5	1.5
1801 - 2400	2.0	2.1	2.3	2.0	2.1	2.2	1.9	2.0	2.0	1.5	1.5	1.5
DAILY VALUE	1.9	2.1	2.4	2.0	2.1	2.2	1.5	1.7	2.0	1.5	1.5	1.5
0001 - 0600	1.9	1.9	1.9	2.2	2.2	2.2	1.9	2.0	2.1	1.5	1.5	1.5
0601 - 1200	1.8	1.9	1.9	2.2	2.3	2.4	2.1	2.1	2.2	1.5	1.5	1.5
1201 - 1800	1.9	1.9	1.9	2.4	2.4	2.5	2.1	2.1	2.2	1.5	1.5	1.5
1801 - 2400	1.9	1.9	1.9	2.0	2.1	2.2	2.1	2.1	2.2	1.5	1.5	1.5
DAILY VALUE	1.8	1.9	1.9	2.0	2.2	2.5	1.9	2.1	2.2	1.5	1.5	1.5
0001 - 0600	1.9	1.9	1.9	2.0	2.0	2.0	2.2	2.2	2.2	-----	-----	-----
0601 - 1200	1.9	1.9	1.9	2.0	2.1	2.2	2.2	2.2	2.2	-----	-----	-----
1201 - 1800	1.8	1.8	1.9	2.1	2.1	2.2	2.2	2.2	2.2	-----	-----	-----
1801 - 2400	1.8	1.8	1.8	2.1	2.1	2.1	2.2	2.2	2.2	-----	-----	-----
DAILY VALUE	1.8	1.9	1.9	2.0	2.1	2.2	2.2	2.2	2.2	-----	-----	-----
0001 - 0600	1.7	1.8	1.8	1.9	2.0	2.1	2.2	2.2	2.2			
0601 - 1200	1.6	1.7	1.8	1.9	1.9	2.0	2.2	2.2	2.2	MONTHLY VALUE		
1201 - 1800	1.5	1.6	1.6	1.9	2.0	2.0	2.1	2.1	2.1			
1801 - 2400	1.6	1.7	1.7	2.0	2.0	2.1	2.1	2.1	2.2	1.5	1.9	2.7
DAILY VALUE	1.5	1.7	1.8	1.9	2.0	2.1	2.1	2.2	2.2			

Appendix Table A-12 (Continued).

- DECEMBER 1982 -

TIME PERIOD	DAYS 1 - 8 MIN	MEAN	MAX	DAYS 9 - 16 MIN	MEAN	MAX	DAYS 17 - 24 MIN	MEAN	MAX	DAYS 25 - 31 MIN	MEAN	MAX
0001 - 0600	1.5	1.5	1.5	2.1	2.1	2.1	1.9	2.0	2.1	2.2	2.2	2.2
0601 - 1200	1.5	1.5	1.5	2.1	2.2	2.2	2.2	2.2	2.3	2.2	2.2	2.2
1201 - 1800	1.5	1.5	1.5	2.1	2.2	2.2	2.2	2.3	2.3	2.2	2.2	2.2
1801 - 2400	1.5	1.5	1.5	2.1	2.1	2.1	1.9	2.0	2.1	2.2	2.2	2.2
DAILY VALUE	1.5	1.5	1.5	2.1	2.1	2.2	1.9	2.1	2.3	2.2	2.2	2.2
0001 - 0600	1.5	1.5	1.5	2.1	2.1	2.1	1.8	1.8	1.9	2.2	2.2	2.2
0601 - 1200	1.5	1.5	1.5	2.0	2.1	2.1	1.8	1.9	2.0	2.2	2.2	2.2
1201 - 1800	1.5	1.5	1.5	2.0	2.0	2.1	1.8	1.9	1.9	2.2	2.2	2.2
1801 - 2400	1.5	1.5	1.5	2.0	2.1	2.2	1.9	1.9	1.9	2.2	2.2	2.2
DAILY VALUE	1.5	1.5	1.5	2.0	2.1	2.2	1.8	1.9	2.0	2.2	2.2	2.2
0001 - 0600	1.5	1.8	2.0	1.9	2.0	2.0	2.0	2.0	2.1	2.4	2.4	2.5
0601 - 1200	1.9	2.0	2.1	2.0	2.0	2.0	2.0	2.0	2.0	2.5	2.6	2.6
1201 - 1800	1.9	2.0	2.0	2.0	2.1	2.2	2.0	2.1	2.1	2.2	2.4	2.6
1801 - 2400	2.0	2.0	2.0	2.0	2.0	2.1	2.0	2.0	2.0	2.1	2.1	2.2
DAILY VALUE	1.5	1.9	2.1	1.9	2.0	2.2	2.0	2.0	2.1	2.1	2.4	2.6
0001 - 0600	1.9	2.0	2.0	2.0	2.1	2.1	2.0	2.1	2.1	2.1	2.2	2.2
0601 - 1200	2.0	2.0	2.1	2.2	2.2	2.2	2.0	2.1	2.1	2.1	2.2	2.2
1201 - 1800	1.9	2.0	2.1	2.1	2.2	2.2	2.0	2.0	2.1	2.0	2.1	2.1
1801 - 2400	1.9	2.0	2.0	2.2	2.2	2.2	1.6	1.7	1.9	2.1	2.1	2.1
DAILY VALUE	1.9	2.0	2.1	2.0	2.2	2.2	1.6	2.0	2.1	2.0	2.1	2.2
0001 - 0600	2.0	2.0	2.1	2.1	2.1	2.1	1.6	1.7	1.7	2.2	2.2	2.2
0601 - 1200	2.0	2.1	2.1	2.0	2.0	2.1	1.7	1.7	1.7	2.0	2.1	2.2
1201 - 1800	2.0	2.1	2.1	1.9	2.0	2.1	1.7	1.7	1.7	2.0	2.0	2.0
1801 - 2400	2.1	2.1	2.1	1.8	1.9	2.0	1.7	1.7	1.7	2.0	2.0	2.0
DAILY VALUE	2.0	2.1	2.1	1.8	2.0	2.1	1.6	1.7	1.7	2.0	2.1	2.2
0001 - 0600	2.1	2.1	2.2	1.9	2.0	2.0	1.7	1.7	1.7	2.0	2.0	2.0
0601 - 1200	2.2	2.2	2.2	1.8	1.9	2.0	1.7	1.7	1.7	2.0	2.0	2.0
1201 - 1800	2.2	2.2	2.2	1.9	1.9	2.0	1.7	1.7	1.7	2.0	2.0	2.0
1801 - 2400	2.2	2.2	2.2	1.9	1.9	2.0	1.7	1.7	1.7	2.0	2.0	2.0
DAILY VALUE	2.1	2.2	2.2	1.8	1.9	2.0	1.7	1.7	1.7	2.0	2.0	2.0
0001 - 0600	2.2	2.2	2.2	1.9	2.0	2.1	1.7	1.7	1.7	1.7	1.8	2.0
0601 - 1200	2.2	2.2	2.2	2.0	2.0	2.0	1.7	1.7	1.7	1.7	1.7	1.7
1201 - 1800	2.2	2.2	2.2	2.0	2.1	2.2	1.7	1.7	1.7	1.8	1.9	2.0
1801 - 2400	2.2	2.2	2.2	2.0	2.1	2.1	1.7	1.7	1.7	2.0	2.0	2.0
DAILY VALUE	2.2	2.2	2.2	1.9	2.0	2.2	1.7	1.7	1.7	1.7	1.9	2.0
0001 - 0600	2.2	2.2	2.2	1.8	1.8	1.9	1.7	1.7	1.7			
0601 - 1200	2.2	2.2	2.2	1.8	1.9	1.9	1.7	1.7	1.7	MONTHLY VALUE		
1201 - 1800	2.1	2.2	2.2	1.9	1.9	1.9	1.7	1.8	1.9			
1801 - 2400	2.2	2.2	2.2	1.9	2.0	2.1	2.0	2.0	2.1	1.5	2.0	2.6
DAILY VALUE	2.1	2.2	2.2	1.8	1.9	2.1	1.7	1.8	2.1			

Appendix Table A-12 (Continued).

- JANUARY 1983 -

TIME PERIOD	DAYS 1 - 8			DAYS 9 - 16			DAYS 17 - 24			DAYS 25 - 31		
	MIN	MEAN	MAX	MIN	MEAN	MAX	MIN	MEAN	MAX	MIN	MEAN	MAX
0001 - 0600	2.0	2.0	2.0	1.5	1.5	1.5	-----	-----	-----	-----	-----	-----
0601 - 1200	2.0	2.0	2.0	1.5	1.5	1.5	-----	-----	-----	-----	-----	-----
1201 - 1800	2.0	2.0	2.0	1.5	1.5	1.5	-----	-----	-----	-----	-----	-----
1801 - 2400	2.0	2.0	2.0	1.5	1.5	1.5	-----	-----	-----	-----	-----	-----
DAILY VALUE	2.0	2.0	2.0	1.5	1.5	1.5	-----	-----	-----	-----	-----	-----
0001 - 0600	2.0	2.0	2.0	1.5	1.5	1.5	-----	-----	-----	-----	-----	-----
0601 - 1200	2.2	2.3	2.3	1.5	1.5	1.5	-----	-----	-----	-----	-----	-----
1201 - 1800	2.0	2.1	2.2	1.5	1.5	1.5	-----	-----	-----	-----	-----	-----
1801 - 2400	1.9	2.0	2.1	1.5	1.5	1.5	-----	-----	-----	-----	-----	-----
DAILY VALUE	1.9	2.1	2.3	1.5	1.5	1.5	-----	-----	-----	-----	-----	-----
0001 - 0600	1.8	1.9	2.0	1.5	1.5	1.5	-----	-----	-----	-----	-----	-----
0601 - 1200	1.8	1.9	2.0	1.5	1.5	1.5	-----	-----	-----	-----	-----	-----
1201 - 1800	1.9	2.0	2.0	1.5	1.5	1.5	-----	-----	-----	-----	-----	-----
1801 - 2400	1.5	1.7	1.9	1.5	1.5	1.5	-----	-----	-----	-----	-----	-----
DAILY VALUE	1.5	1.9	2.0	1.5	1.5	1.5	-----	-----	-----	-----	-----	-----
0001 - 0600	1.5	1.5	1.5	1.5	1.5	1.5	-----	-----	-----	-----	-----	-----
0601 - 1200	1.5	1.5	1.5	1.5	1.5	1.5	-----	-----	-----	-----	-----	-----
1201 - 1800	1.5	1.5	1.5	1.5	1.5	1.5	-----	-----	-----	-----	-----	-----
1801 - 2400	1.5	1.5	1.5	1.5	1.5	1.5	-----	-----	-----	-----	-----	-----
DAILY VALUE	1.5	1.5	1.5	1.5	1.5	1.5	-----	-----	-----	-----	-----	-----
0001 - 0600	1.5	1.5	1.5	1.5	1.5	1.5	-----	-----	-----	-----	-----	-----
0601 - 1200	1.5	1.5	1.5	1.5	1.5	1.5	-----	-----	-----	-----	-----	-----
1201 - 1800	1.5	1.5	1.5	1.5	1.5	1.5	-----	-----	-----	-----	-----	-----
1801 - 2400	1.5	1.5	1.5	1.5	1.5	1.5	-----	-----	-----	-----	-----	-----
DAILY VALUE	1.5	1.5	1.5	1.5	1.5	1.5	-----	-----	-----	-----	-----	-----
0001 - 0600	1.5	1.5	1.5	1.5	1.5	1.5	-----	-----	-----	-----	-----	-----
0601 - 1200	1.5	1.5	1.5	1.5	1.5	1.5	-----	-----	-----	-----	-----	-----
1201 - 1800	1.5	1.5	1.5	-----	-----	-----	-----	-----	-----	-----	-----	-----
1801 - 2400	1.5	1.5	1.5	-----	-----	-----	-----	-----	-----	-----	-----	-----
DAILY VALUE	1.5	1.5	1.5	1.5	-----	1.5	-----	-----	-----	-----	-----	-----
0001 - 0600	1.5	1.5	1.5	-----	-----	-----	-----	-----	-----	-----	-----	-----
0601 - 1200	1.5	1.5	1.5	-----	-----	-----	-----	-----	-----	-----	-----	-----
1201 - 1800	1.5	1.5	1.5	-----	-----	-----	-----	-----	-----	-----	-----	-----
1801 - 2400	1.5	1.5	1.5	-----	-----	-----	-----	-----	-----	-----	-----	-----
DAILY VALUE	1.5	1.5	1.5	-----	-----	-----	-----	-----	-----	-----	-----	-----
0001 - 0600	1.5	1.5	1.5	-----	-----	-----	-----	-----	-----			
0601 - 1200	1.5	1.5	1.5	-----	-----	-----	-----	-----	-----	MONTHLY VALUE		
1201 - 1800	1.5	1.5	1.5	-----	-----	-----	-----	-----	-----			
1801 - 2400	1.5	1.5	1.5	-----	-----	-----	-----	-----	-----	1.5	-----	2.3
DAILY VALUE	1.5	1.5	1.5	-----	-----	-----	-----	-----	-----			

Appendix Table A-12 (Continued).

- MARCH 1983 -

TIME PERIOD	DAYS 1 - 8			DAYS 9 - 16			DAYS 17 - 24			DAYS 25 - 31		
	MIN	MEAN	MAX	MIN	MEAN	MAX	MIN	MEAN	MAX	MIN	MEAN	MAX
0001 - 0600	-----	-----	-----	-----	-----	-----	-----	-----	-----	1.6	1.6	1.7
0601 - 1200	-----	-----	-----	-----	-----	-----	-----	-----	-----	1.4	1.6	1.8
1201 - 1800	-----	-----	-----	-----	-----	-----	-----	-----	-----	2.1	2.3	2.5
1801 - 2400	-----	-----	-----	-----	-----	-----	-----	-----	-----	1.7	1.9	2.1
DAILY VALUE	-----	-----	-----	-----	-----	-----	-----	-----	-----	1.4	1.9	2.5
0001 - 0600	-----	-----	-----	-----	-----	-----	-----	-----	-----	1.3	1.4	1.5
0601 - 1200	-----	-----	-----	-----	-----	-----	-----	-----	-----	1.4	1.6	1.9
1201 - 1800	-----	-----	-----	-----	-----	-----	1.9	2.0	2.0	2.1	2.3	2.5
1801 - 2400	-----	-----	-----	-----	-----	-----	1.5	1.6	1.8	1.6	1.8	2.0
DAILY VALUE	-----	-----	-----	-----	-----	-----	1.5	-----	2.0	1.3	1.8	2.5
0001 - 0600	-----	-----	-----	-----	-----	-----	1.2	1.2	1.2	1.4	1.5	1.6
0601 - 1200	-----	-----	-----	-----	-----	-----	1.2	1.3	1.5	1.1	1.4	1.7
1201 - 1800	-----	-----	-----	-----	-----	-----	1.6	1.8	1.9	2.1	2.4	2.6
1801 - 2400	-----	-----	-----	-----	-----	-----	1.2	1.4	1.7	1.6	1.8	2.0
DAILY VALUE	-----	-----	-----	-----	-----	-----	1.2	1.4	1.9	1.1	1.8	2.6
0001 - 0600	-----	-----	-----	-----	-----	-----	1.2	1.2	1.2	1.3	1.3	1.4
0601 - 1200	-----	-----	-----	-----	-----	-----	1.4	1.5	1.6	1.4	1.6	2.0
1201 - 1800	-----	-----	-----	-----	-----	-----	1.9	1.9	1.9	2.4	2.5	2.6
1801 - 2400	-----	-----	-----	-----	-----	-----	1.5	1.6	1.8	1.7	1.9	2.1
DAILY VALUE	-----	-----	-----	-----	-----	-----	1.2	1.6	1.9	1.3	1.8	2.6
0001 - 0600	-----	-----	-----	-----	-----	-----	1.3	1.4	1.4	1.1	1.2	1.4
0601 - 1200	-----	-----	-----	-----	-----	-----	1.2	1.5	1.8	1.4	1.7	2.0
1201 - 1800	-----	-----	-----	-----	-----	-----	2.0	2.0	2.1	2.6	2.7	2.9
1801 - 2400	-----	-----	-----	-----	-----	-----	1.5	1.7	1.9	1.5	1.9	2.3
DAILY VALUE	-----	-----	-----	-----	-----	-----	1.2	1.7	2.1	1.1	1.9	2.9
0001 - 0600	-----	-----	-----	-----	-----	-----	1.2	1.2	1.2	1.0	1.1	1.2
0601 - 1200	-----	-----	-----	-----	-----	-----	1.2	1.4	1.5	1.4	1.6	1.9
1201 - 1800	-----	-----	-----	-----	-----	-----	1.9	2.0	2.1	2.5	2.5	2.5
1801 - 2400	-----	-----	-----	-----	-----	-----	1.6	1.7	1.9	1.5	1.9	2.1
DAILY VALUE	-----	-----	-----	-----	-----	-----	1.2	1.6	2.1	1.0	1.8	2.5
0001 - 0600	-----	-----	-----	-----	-----	-----	1.2	1.2	1.2	1.2	1.2	1.3
0601 - 1200	-----	-----	-----	-----	-----	-----	1.2	1.5	1.7	1.6	2.3	3.0
1201 - 1800	-----	-----	-----	-----	-----	-----	2.0	2.1	2.1	3.0	3.1	3.2
1801 - 2400	-----	-----	-----	-----	-----	-----	1.5	1.7	1.9	1.6	2.0	2.4
DAILY VALUE	-----	-----	-----	-----	-----	-----	1.2	1.6	2.1	1.2	2.2	3.2
0001 - 0600	-----	-----	-----	-----	-----	-----	1.2	1.2	1.2			
0601 - 1200	-----	-----	-----	-----	-----	-----	1.3	1.7	2.0	MONTHLY VALUE		
1201 - 1800	-----	-----	-----	-----	-----	-----	2.0	2.2	2.4			
1801 - 2400	-----	-----	-----	-----	-----	-----	1.7	1.8	2.0	1.0	-----	3.2
DAILY VALUE	-----	-----	-----	-----	-----	-----	1.2	1.7	2.4			

Appendix Table A-12 (Continued).

- APRIL 1983 -

TIME PERIOD	DAYS 1 - 8			DAYS 9 - 16			DAYS 17 - 24			DAYS 25 - 31		
	MIN	MEAN	MAX	MIN	MEAN	MAX	MIN	MEAN	MAX	MIN	MEAN	MAX
0001 - 0600	1.3	1.5	1.7	2.3	2.5	2.7	2.1	2.5	2.8	3.1	3.4	3.8
0601 - 1200	1.5	1.9	2.6	2.2	2.6	3.2	2.9	3.5	4.1	3.6	4.7	5.7
1201 - 1800	3.0	3.2	3.4	3.4	3.5	3.5	4.4	4.6	4.7	8.6	8.9	9.1
1801 - 2400	2.1	2.5	2.9	1.8	2.7	3.2	2.8	3.2	3.5	4.9	6.2	7.7
DAILY VALUE	1.3	2.3	3.4	1.8	2.8	3.5	2.1	3.4	4.7	3.1	5.8	9.1
0001 - 0600	1.2	1.6	1.9	1.3	1.6	2.0	1.9	2.0	2.1	2.3	2.8	3.4
0601 - 1200	1.4	1.9	2.5	2.1	2.5	3.0	2.5	3.3	4.3	3.0	4.4	5.9
1201 - 1800	2.9	3.1	3.2	3.6	3.8	3.9	5.1	5.3	5.5	7.8	8.8	9.5
1801 - 2400	2.2	2.5	2.9	2.0	2.7	3.3	3.8	4.2	4.5	5.0	6.1	7.5
DAILY VALUE	1.2	2.3	3.2	1.3	2.6	3.9	1.9	3.7	5.5	2.3	5.5	9.5
0001 - 0600	1.3	1.5	1.9	1.6	1.7	1.7	3.1	3.3	3.5	2.6	3.0	3.6
0601 - 1200	1.4	2.0	2.7	1.9	2.5	3.1	3.3	4.0	4.8	3.2	4.6	6.5
1201 - 1800	3.0	3.2	3.4	2.9	3.1	3.2	5.5	5.7	5.9	9.0	9.3	9.8
1801 - 2400	2.1	2.4	2.7	1.9	2.1	2.2	4.0	4.6	5.2	5.1	6.3	7.8
DAILY VALUE	1.3	2.3	3.4	1.6	2.3	3.2	3.1	4.4	5.9	2.6	5.8	9.8
0001 - 0600	2.1	2.1	2.1	2.0	2.0	2.0	2.2	2.6	3.3	2.9	3.2	3.6
0601 - 1200	2.2	2.5	2.8	2.3	2.6	3.2	2.7	3.7	4.9	3.6	4.7	6.0
1201 - 1800	2.4	2.8	3.0	3.0	3.1	3.3	6.1	6.3	6.5	6.8	7.1	7.3
1801 - 2400	2.2	2.2	2.3	2.3	2.7	3.0	4.7	5.2	5.7	——	——	——
DAILY VALUE	2.1	2.4	3.0	2.0	2.6	3.3	2.2	4.5	6.5	2.9	——	7.3
0001 - 0600	2.1	2.2	2.2	2.2	2.2	2.3	1.9	2.8	4.0	——	——	——
0601 - 1200	2.2	2.5	3.0	2.4	3.1	4.0	3.2	4.3	5.5	——	——	——
1201 - 1800	3.0	3.1	3.3	4.0	4.3	4.5	6.2	6.9	7.4	——	——	——
1801 - 2400	2.5	2.7	2.8	3.4	3.5	3.6	5.0	5.9	6.7	——	——	——
DAILY VALUE	2.1	2.6	3.3	2.2	3.3	4.5	1.9	5.0	7.4	——	——	——
0001 - 0600	2.0	2.1	2.3	2.4	2.7	3.0	3.0	3.5	4.4	——	——	——
0601 - 1200	2.2	2.7	3.2	2.9	3.3	3.7	3.3	4.2	5.1	——	——	——
1201 - 1800	3.5	3.8	4.0	4.0	4.1	4.3	6.1	6.4	6.6	——	——	——
1801 - 2400	3.0	3.2	3.5	2.9	3.3	3.6	5.2	5.6	6.0	——	——	——
DAILY VALUE	2.0	3.0	4.0	2.4	3.3	4.3	3.0	4.9	6.6	——	——	——
0001 - 0600	2.4	2.5	2.6	2.3	2.5	2.6	3.8	4.1	4.5	——	——	——
0601 - 1200	2.5	3.0	3.5	2.9	3.6	4.2	3.9	4.6	5.3	——	——	——
1201 - 1800	3.6	3.8	4.0	3.7	4.0	4.2	6.0	6.1	6.3	——	——	——
1801 - 2400	2.9	3.2	3.5	3.0	3.3	3.5	4.9	5.3	5.8	——	——	——
DAILY VALUE	2.4	3.1	4.0	2.3	3.3	4.2	3.8	5.1	6.3	——	——	——
0001 - 0600	2.1	2.4	2.8	2.3	2.5	2.7	3.5	4.0	4.5			
0601 - 1200	2.8	3.1	3.5	2.8	3.7	4.7	4.1	5.0	6.0	MONTHLY VALUE		
1201 - 1800	3.6	3.8	4.0	4.6	5.0	5.2	8.3	9.0	9.7			
1801 - 2400	2.9	3.1	3.4	3.1	3.4	3.8	4.8	6.1	7.8	1.2	3.7	9.8
DAILY VALUE	2.1	3.1	4.0	2.3	3.6	5.2	3.5	6.0	9.7			

Appendix Table A-13 Thermograph data summary, winter surface water temperature (C), Slough 21, RM 141.9, Geocode S31N02W02AAA.

- APRIL 1983 -

TIME PERIOD	DAYS 1 - 8			DAYS 9 - 16			DAYS 17 - 24			DAYS 25 - 31		
	MIN	MEAN	MAX	MIN	MEAN	MAX	MIN	MEAN	MAX	MIN	MEAN	MAX
0001 - 0600	----	----	----	.5	.5	.6	-.4	-.2	.1	1.1	1.2	1.3
0601 - 1200	----	----	----	.5	1.1	1.9	-.1	.8	2.3	1.2	3.1	5.6
1201 - 1800	----	----	----	2.4	2.8	3.2	2.0	2.5	2.9	4.9	6.3	7.2
1801 - 2400	----	----	----	-.6	.1	.9	.2	.5	.9	1.3	1.9	2.8
DAILY VALUE	----	----	----	-.6	1.1	3.2	-.4	.9	2.9	1.1	3.1	7.2
0001 - 0600	----	----	----	----	----	----	-.1	-.1	-.1	.6	.7	1.0
0601 - 1200	----	----	----	-.5	.1	.8	.6	1.8	2.8	1.0	2.7	4.9
1201 - 1800	----	----	----	1.4	2.3	2.9	2.9	3.4	3.6	4.7	6.1	6.9
1801 - 2400	----	----	----	-.6	-.3	.1	1.2	1.4	1.8	1.3	1.9	2.8
DAILY VALUE	----	----	----	-.6	.7	2.9	-.1	1.6	3.6	.6	2.9	6.9
0001 - 0600	----	----	----	----	----	----	.9	.9	1.0	.6	.7	.9
0601 - 1200	----	----	----	.0	.3	.6	1.3	2.6	4.3	1.0	2.9	5.3
1201 - 1800	2.7	3.3	3.9	.0	.4	.6	3.4	4.4	5.0	4.7	6.1	6.9
1801 - 2400	1.0	1.2	1.4	-.6	-.5	-.5	.8	1.4	2.2	1.2	1.9	2.8
DAILY VALUE	1.0	----	3.9	-.6	----	.6	.8	2.4	5.0	.6	2.9	6.9
0001 - 0600	.4	.5	.6	-.6	-.6	-.6	.6	.6	.6	1.0	1.0	1.0
0601 - 1200	.8	1.4	1.9	.2	.8	1.5	1.0	2.5	4.2	1.9	3.3	4.5
1201 - 1800	1.6	2.0	2.3	1.2	1.6	1.9	3.8	4.8	5.4	4.0	4.7	5.1
1801 - 2400	1.1	1.2	1.3	.5	.6	.9	.9	1.6	2.3	2.2	2.4	2.8
DAILY VALUE	.4	1.3	2.3	-.6	.7	1.9	.6	2.4	5.4	1.0	2.8	5.1
0001 - 0600	.4	.7	.9	.1	.3	.4	.4	.5	.6	1.9	1.9	2.0
0601 - 1200	.4	1.0	1.3	.1	1.2	2.8	1.4	3.0	4.6	2.2	3.1	4.2
1201 - 1800	1.9	2.2	2.4	2.4	3.3	3.9	4.3	5.7	6.6	4.2	4.6	4.8
1801 - 2400	.7	.9	1.2	.9	1.3	1.7	1.4	1.9	2.5	1.3	2.0	2.9
DAILY VALUE	.4	1.2	2.4	.1	1.5	3.9	.4	2.8	6.6	1.3	2.9	4.8
0001 - 0600	.3	.4	.4	.6	.7	.9	.9	1.0	1.3	.8	.9	1.0
0601 - 1200	.6	1.7	2.6	1.1	2.2	3.4	1.6	2.6	3.2	1.3	3.2	5.4
1201 - 1800	2.9	3.9	4.4	2.3	3.2	4.1	4.0	4.3	4.7	4.2	5.9	6.9
1801 - 2400	.9	1.4	1.9	-.1	.3	.9	1.9	2.3	2.8	.9	1.6	2.4
DAILY VALUE	.3	1.8	4.4	-.1	1.6	4.1	.9	2.6	4.7	.8	2.9	6.9
0001 - 0600	.3	.4	.6	-.1	-.0	.0	1.6	1.7	1.8	----	----	----
0601 - 1200	.3	1.3	2.6	.7	1.7	2.4	1.9	2.6	3.4	----	----	----
1201 - 1800	2.8	4.0	5.2	2.0	2.4	2.6	3.6	4.0	4.2	----	----	----
1801 - 2400	.3	1.0	1.8	.9	1.1	1.4	1.6	2.0	2.6	----	----	----
DAILY VALUE	.3	1.7	5.2	-.1	1.3	2.6	1.6	2.6	4.2	----	----	----
0001 - 0600	-.4	-.2	-.1	.6	.6	.7	1.4	1.5	1.6			
0601 - 1200	.6	1.7	2.9	1.2	2.3	3.6	1.6	2.9	4.9	MONTHLY VALUE		
1201 - 1800	2.3	3.1	3.6	2.8	3.7	4.2	4.5	6.2	7.2			
1801 - 2400	.8	1.2	1.5	.4	1.1	1.9	1.4	2.0	2.7	-.6	2.0	7.2
DAILY VALUE	-.4	1.4	3.6	.4	1.9	4.2	1.4	3.2	7.2			

Appendix Table A-13 (Continued).

- MAY 1983 -

TIME PERIOD	DAYS 1 - 8			DAYS 9 - 16			DAYS 17 - 24			DAYS 25 - 31		
	MIN	MEAN	MAX	MIN	MEAN	MAX	MIN	MEAN	MAX	MIN	MEAN	MAX
0001 - 0600	.5	.7	.8	-----	-----	-----	-----	-----	-----	-----	-----	-----
0601 - 1200	1.7	3.6	5.8	-----	-----	-----	-----	-----	-----	-----	-----	-----
1201 - 1800	4.2	5.6	6.8	-----	-----	-----	-----	-----	-----	-----	-----	-----
1801 - 2400	2.3	2.7	3.1	-----	-----	-----	-----	-----	-----	-----	-----	-----
DAILY VALUE	.5	3.2	6.8	-----	-----	-----	-----	-----	-----	-----	-----	-----
0001 - 0600	2.0	2.1	2.1	-----	-----	-----	-----	-----	-----	-----	-----	-----
0601 - 1200	2.6	3.5	4.6	-----	-----	-----	-----	-----	-----	-----	-----	-----
1201 - 1800	4.0	4.6	5.0	-----	-----	-----	-----	-----	-----	-----	-----	-----
1801 - 2400	2.0	2.4	2.9	-----	-----	-----	-----	-----	-----	-----	-----	-----
DAILY VALUE	2.0	3.2	5.0	-----	-----	-----	-----	-----	-----	-----	-----	-----
0001 - 0600	1.9	1.9	2.0	-----	-----	-----	-----	-----	-----	-----	-----	-----
0601 - 1200	2.3	3.1	4.2	-----	-----	-----	-----	-----	-----	-----	-----	-----
1201 - 1800	-.2	-.1	.0	-----	-----	-----	-----	-----	-----	-----	-----	-----
1801 - 2400	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
DAILY VALUE	-.2	1.6	4.2	-----	-----	-----	-----	-----	-----	-----	-----	-----
0001 - 0600	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
0601 - 1200	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
1201 - 1800	-.2	.8	1.3	-----	-----	-----	-----	-----	-----	-----	-----	-----
1801 - 2400	.9	1.0	1.3	-----	-----	-----	-----	-----	-----	-----	-----	-----
DAILY VALUE	-.2	-----	1.3	-----	-----	-----	-----	-----	-----	-----	-----	-----
0001 - 0600	.9	.9	.9	-----	-----	-----	-----	-----	-----	-----	-----	-----
0601 - 1200	1.3	2.4	3.6	-----	-----	-----	-----	-----	-----	-----	-----	-----
1201 - 1800	4.3	4.7	4.9	-----	-----	-----	-----	-----	-----	-----	-----	-----
1801 - 2400	1.4	2.0	2.8	-----	-----	-----	-----	-----	-----	-----	-----	-----
DAILY VALUE	.9	2.5	4.9	-----	-----	-----	-----	-----	-----	-----	-----	-----
0001 - 0600	1.0	1.1	1.2	-----	-----	-----	-----	-----	-----	-----	-----	-----
0601 - 1200	1.4	2.9	4.4	-----	-----	-----	-----	-----	-----	-----	-----	-----
1201 - 1800	3.9	4.5	4.8	-----	-----	-----	-----	-----	-----	-----	-----	-----
1801 - 2400	1.3	1.9	2.6	-----	-----	-----	-----	-----	-----	-----	-----	-----
DAILY VALUE	1.0	2.6	4.8	-----	-----	-----	-----	-----	-----	-----	-----	-----
0001 - 0600	.9	1.1	1.2	-----	-----	-----	-----	-----	-----	-----	-----	-----
0601 - 1200	1.4	2.4	3.4	-----	-----	-----	-----	-----	-----	-----	-----	-----
1201 - 1800	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
1801 - 2400	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
DAILY VALUE	.9	-----	3.4	-----	-----	-----	-----	-----	-----	-----	-----	-----
0001 - 0600	-----	-----	-----	-----	-----	-----	-----	-----	-----			
0601 - 1200	-----	-----	-----	-----	-----	-----	-----	-----	-----	MONTHLY VALUE		
1201 - 1800	-----	-----	-----	-----	-----	-----	-----	-----	-----			
1801 - 2400	-----	-----	-----	-----	-----	-----	-----	-----	-----	-.2	-----	6.8
DAILY VALUE	-----	-----	-----	-----	-----	-----	-----	-----	-----			

DRAFT
WINTER REPORT
10/20/83

APPENDIX B

Incubation Habitat:

Data collected within standpipes and at adjacent surface water locations.

DRAFT
WINTER REPORT
10/20/83

Appendix B consists of raw data (Appendix Tables B-5 to B-8) and corresponding summary tables (Appendix Tables B-1 to B-4). Summary tables preceed the raw data tables in this Appendix for ease of reference. These data were collected by ADF&G personnel during two sampling periods (April 15-18 and April 29-May 2) in spring, 1983. In the summary tables, sampling periods are referred to as "first" and "second", respectively.

LIST OF APPENDIX B TABLES

Appendix Table B-1 Summary of intragravel and corresponding surface water quality data collected along the left bank of specific sites in sloughs 8A, 9, 11 and 21 during early (April 15-18) and late (April 29-May 2) sampling periods in spring, 1983.

					Intragravel Water					Surface Water				
Slough	Site	Sampling Period	Slough Bank	Variable	Min	Mean	Max	SD	N	Min	Mean	Max	SD	N
Slough 8A	A	Early	Left	Dissolved Oxygen	4.0	4.3	4.6	0.2	10	7.4	9.5	10.5	1.0	10
	A	Late	Left	Dissolved Oxygen	4.0	4.4	4.6	0.2	10	10.5	11.1	11.3	0.3	10
	A	Early	Left	Water Temperature	2.0	2.3	2.5	0.2	10	2.0	2.4	3.0	0.384	10
	A	Late	Left	Water Temperature	3.0	3.6	5.8	0.8	10	4.2	4.6	5.0	0.245	10
	A	Late	Left	Specific Conductance	236	254	258	6	10	178	183	188	3.0	10
	A	Early	Left	pH	7.2		7.3	--	10	7.1		7.3	--	10
	A	Late	Left	pH	6.4		6.6	--	5	6.4		6.8	--	5
Slough 9	B	Early	Left	Dissolved Oxygen	5.5	6.2	6.8	0.4	10	9.0	9.5	10.0	0.3	10
	B	Late	Left	Dissolved Oxygen	5.3	6.0	6.6	0.5	10	10.4	10.7	10.9	0.1	10
	C	Late	Left	Dissolved Oxygen	1.3	3.3	6.4	27	3	8.0	8.1	8.2	0.1	3
	B	Early	Left	Water Temperature	3.0	3.9	4.9	0.6	10	5.0	5.2	5.4	0.129	10
	B	Late	Left	Water Temperature	3.5	4.0	4.5	0.3	10	6.0	6.3	6.5	0.204	10
	C	Late	Left	Water Temperature	4.0	4.1	4.2	0.1	3	5.2	5.6	6.2	0.513	3
	B	Late	Left	Specific Conductance	201	217	236	15	10	153	157	163	3.0	10
	C	Late	Left	Specific Conductance	218	242	257	21	3	192	196	198	3.0	3
	B	Early	Left	pH	6.5		7.0	--	10	6.5		7.0	--	10
	B	Late	Left	pH	6.2		6.4	--	5	5.9		6.3	--	5
Slough 11	A	Early	Left	Dissolved Oxygen	7.4	7.9	8.4	0.3	10	11.3	11.5	11.6	0.1	10
	A	Late	Left	Dissolved Oxygen	6.7	7.1	7.5	0.3	10	10.9	11.1	11.2	0.1	10
	B	Early	Left	Dissolved Oxygen	6.2	9.0	10.5	1.1	10	9.8	10.2	11.0	6.4	10
	B	Late	Left	Dissolved Oxygen	8.1	8.9	9.2	0.3	10	10.8	11.1	11.3	0.2	10
	A	Early	Left	Water Temperature	2.5	2.8	3.0	0.1	10	3.0	3.1	3.2	0.103	10
	A	Late	Left	Water Temperature	3.5	4.7	7.2	1.0	10	7.5	7.8	8.2	0.271	10
	B	Early	Left	Water Temperature	2.0	2.1	2.2	0.1	10	2.0	2.0	2.0	0.000	10
	3	Late	Left	Water Temperature	3.5	4.0	4.5	0.4	10	6.0	6.1	6.2	0.097	10
	A	Late	Left	Specific Conductance	245	260	268	6	10	241	245	247	2	10
	B	Early	Left	Specific Conductance	258	268	271	4	8	198	262	285	25	9
	A	Early	Left	pH	7.1		7.3	--	10	7.1		7.2	--	10
Slough 21	A	Early	Left	Dissolved Oxygen	2.3	6.1	6.9	1.4	10	6.2	8.5	9.4	1.1	10
	A	Late	Left	Dissolved Oxygen	6.7	7.0	7.4	0.2	9	7.3	9.2	10.2	1.1	9
	A	Early	Left	Water Temperature	2.5	3.0	3.5	0.3	10	2.5	4.5	5.5	1.047	10
	A	Late	Left	Water Temperature	2.5	2.9	4.0	0.5	9	2.5	4.8	6.8	1.571	9
	A	Late	Left	Specific Conductance	236	242	248	4	9	245	251	262	5	9
	A	Early	Left	pH	6.6		7.1	--	10	6.6		7.2	--	10
	A	Late	Left	pH	6.6		6.8	--	5	6.6		6.8	--	5

Appendix Table B-2 Summary of intragravel and corresponding surface water quality data collected along the right bank of specific sites in sloughs 8A, 9, 11 and 21 during early (April 15-18) and late (April 29-May 2) sampling periods in spring, 1983.

					Intragravel Water					Surface Water				
Slough	Site	Sampling Period	Slough Bank	Variable	Min	Mean	Max	SD	N	Min	Mean	Max	SD	N
Slough 8A	A	Early	Right	Dissolved Oxygen	4.2	5.0	9.2	1.5	10	10.2	11.1	11.6	0.4	10
	A	Late	Right	Dissolved Oxygen	4.4	4.9	7.9	1.1	10	11.3	11.4	11.6	0.1	10
	A	Early	Right	Water Temperature	0.4	1.8	2.0	0.5	10	0.3	0.5	1.8	0.478	10
	A	Late	Right	Water Temperature	2.2	2.9	3.2	0.3	10	2.0	3.7	4.5	0.696	10
	A	Late	Right	Specific Conductance	215	246	255	11	10	164	179	184	6	10
	A	Early	Right	pH	7.2		7.3	--	10	7.1		7.3	--	10
	A	Late	Right	pH	6.7		6.8	--	5	6.6		6.8	--	5
Slough 9	A	Early	Right	Dissolved Oxygen	3.7	4.9	6.7	0.9	10	9.3	9.6	9.8	0.2	10
	A	Late	Right	Dissolved Oxygen	7.1	8.8	10.8	1.3	10	10.9	11.0	11.0	0.1	10
	A	Early	Right	Water Temperature	4.1	4.3	5.2	0.4	10	5.1	5.3	5.3	0.070	10
	A	Late	Right	Water Temperature	3.5	4.0	5.0	0.5	10	5.8	6.0	6.2	0.133	10
	A	Late	Right	Specific Conductance	128	156	186	19	10	146	153	156	3	10
	A	Early	Right	pH	6.8		7.1		10	6.8		7.0	--	10
	A	Late	Right	pH	6.2		6.6		5	6.3		6.8	--	5
Slough 11	B	Early	Right	Dissolved Oxygen	9.5	10.0	10.8	0.4	10	9.8	10.3	10.6	0.2	10
	B	Late	Right	Dissolved Oxygen	9.4	9.8	10.4	0.3	10	10.3	10.8	11.0	0.2	10
	C	Early	Right	Dissolved Oxygen	1.3	4.9	11.2	4.5	4	11.0	11.6	12.4	0.6	4
	C	Late	Right	Dissolved Oxygen	1.1	4.3	10.2	4.1	4	10.5	10.6	10.8	0.1	4
	B	Early	Right	Water Temperature	1.8	2.1	2.2	0.1	10	1.8	2.0	2.2	0.094	10
	B	Late	Right	Water Temperature	3.5	4.2	4.8	0.4	10	5.2	5.7	6.2	0.357	10
	C	Early	Right	Water Temperature	2.2	2.4	2.5	0.1	4	1.8	1.9	2.0	0.100	4
	C	Late	Right	Water Temperature	4.0	4.7	5.2	0.6	4	5.2	5.4	5.5	0.173	4
	B	Early	Right	Specific Conductance	267	273	280	5	10	267	269	271	2	10
	C	Late	Right	Specific Conductance	159	191	234	35	4	232	239	245	5	4
	B	Early	Right	pH	6.8		6.8	--	1	6.3		6.3	--	1
	C	Early	Right	pH	6.2		6.4	--	4	6.3		6.4	--	4
Slough 21	A	Early	Right	Dissolved Oxygen	5.0	7.6	8.8	1.1	10	9.5	9.8	10.0	0.2	10
	A	Late	Right	Dissolved Oxygen	7.3	7.7	8.4	0.4	10	10.3	10.5	10.6	0.1	10
	A	Early	Right	Water Temperature	4.0	4.4	5.0	0.3	10	5.2	5.2	5.2	0.000	10
	A	Late	Right	Water Temperature	3.8	4.1	4.5	0.3	10	6.8	7.1	7.5	0.207	10
	A	Late	Right	Specific Conductance	174	201	216	16	10	238	243	248	3	10
	A	Early	Right	pH	6.9		7.1	--	10	6.7		7.2	--	10
	A	Late	Right	pH	6.8		6.8	--	5	6.7		6.9	--	5

Appendix Table B-3 Summary of intragravel and corresponding surface water quality data collected at specific sites in sloughs 8A, 9, 11 and 21 during early (April 15-18) and late (April 29-May 2) sampling periods in spring, 1983.

		Sampling		Intragravel Water					Surface Water				
Slough	Site	Period	Variable	Min	Mean	Max	SD	N	Min	Mean	Max	SD	N
Slough 8A	A	Early	Dissolved Oxygen	4.0	4.6	9.2	1.1	20	7.4	10.3	11.6	1.1	20
	A	Late	Dissolved Oxygen	4.0	4.6	7.9	0.8	20	10.5	11.2	11.6	0.2	20
	A	Early	Water Temperature	0.4	2.0	2.5	0.5	20	0.3	1.4	3.0	1.0	20
	A	Late	Water Temperature	2.2	3.2	5.8	0.7	20	2.0	4.1	5.0	0 7	20
	A	Late	Specific Conductance	215	250	258	10	20	164	181	188	5	20
	A	Early	pH	7.2		7.3	--	20	7.1		7.3	--	20
	A	Late	pH	6.4		6.8	--	10	6.4		6.8	--	10
Slough 9	A	Early	Dissolved Oxygen	3.7	4.9	6.7	0.9	10	9.3	9.6	9.8	0.2	10
	A	Late	Dissolved Oxygen	7.1	8.8	10.8	1.3	10	10.9	11.0	11.0	0.1	10
	B	Early	Dissolved Oxygen	5.5	6.2	6.8	0.4	10	9.0	9.5	10.0	0.3	10
	B	Late	Dissolved Oxygen	5.3	6.0	6.6	0.5	10	10.4	10.7	10.9	0.1	10
	C	Late	Dissolved Oxygen	1.3	3.3	6.4	2.7	3	8.0	8.1	8.2	0.1	3
	A	Early	Water Temperature	4.1	4.3	5.2	0.4	10	5.1	5.3	5.3	0.1	10
	A	Late	Water Temperature	3.5	4.0	5.0	0.5	10	5.8	6.0	6.2	0.1	10
	B	Early	Water Temperature	3.0	3.9	4.9	0.6	10	5.0	5.2	5.4	0.1	10
	B	Late	Water Temperature	3.5	4.0	4.5	0.3	10	6.0	6.3	6.5	0.2	10
	C	Late	Water Temperature	4.0	4.1	4.2	0.1	3	5.2	5.6	6.2	0.5	3
	A	Late	Specific Conductance	128	156	186	19	10	146	153	156	3	10
	B	Late	Specific Conductance	201	217	236	15	10	153	157	163	3	10
	C	Late	Specific Conductance	218	242	257	21	3	192	196	198	3	3
	A	Early	pH	6.8		7.1	--	10	6.8		7.0	--	10
	A	Late	pH	6.2		6.6	--	5	6.3		6.8	--	5
	B	Early	pH	6.5		7.0	--	10	6.5		7.0	--	10
	B	Late	pH	6.2		6.4	--	5	5.9		6.3	--	5
Slough 11	A	Early	Dissolved Oxygen	7.4	7.9	8.4	0.3	10	11.3	11.5	11.6	0.1	10
	A	Late	Dissolved Oxygen	6.7	7.1	7.5	0.3	10	10.9	11.1	11.2	0.1	10
	B	Early	Dissolved Oxygen	6.2	9.5	10.8	1.0	20	9.8	10.3	11.0	0.3	20
	B	Late	Dissolved Oxygen	8.1	9.3	10.4	0.6	20	10.3	10.9	11.3	0.2	20
	C	Early	Dissolved Oxygen	1.3	4.9	11.2	4.5	4	11.0	11.6	12.4	0.6	4
	C	Late	Dissolved Oxygen	1.1	4.3	10.2	4.1	4	10.5	10.6	10.8	0.1	4
	A	Early	Water Temperature	2.5	2.8	3.0	0.1	10	3.0	3.1	3.2	0.1	10
	A	Late	Water Temperature	3.5	4.7	7.2	1.0	10	7.5	7.8	8.2	0.3	10
	B	Early	Water Temperature	1.8	2.1	2.2	0.1	20	1.8	2.0	2.2	0.1	20
	B	Late	Water Temperature	3.5	4.1	4.8	0.4	20	5.2	5.9	6.2	0.3	20
	C	Early	Water Temperature	2.2	2.4	2.5	0.1	4	1.8	1.9	2.0	0.1	4
	C	Late	Water Temperature	4.0	4.7	5.2	0.6	4	5.2	5.4	5.5	0.2	4
	A	Late	Specific Conductance	245	260	268	6	10	241	245	247	2	10
	B	Early	Specific Conductance	258	270	280	5	18	198	265	285	17	19
	C	Late	Specific Conductance	159	191	234	35	4	232	239	245	5	4
	A	Early	pH	7.1		7.3	--	10	7.1		7.2	--	10
	B	Early	pH	6.8		6.8	--	1	6.3		6.3	--	1
	C	Early	pH	6.2		6.4	--	4	6.3		5.4	--	4

Appendix Table B-3 (Continued)

Slough	Site	Sampling Period	Variable	Intragravel Water					Surface Water				
				Min	Mean	Max	SD	N	Min	Mean	Max	SD	N
Slough 21	A	Early	Dissolved Oxygen	2.3	6.9	8.8	1.4	20	6.2	9.1	10.0	1.0	20
	A	Late	Dissolved Oxygen	6.7	7.4	8.4	0.5	19	7.3	9.9	10.6	1.0	19
	A	Early	Water Temperature	2.5	3.7	5.0	0.8	20	2.5	4.8	5.5	0.8	20
	A	Late	Water Temperature	2.5	3.5	4.5	0.7	19	2.5	6.0	7.5	1.6	19
	A	Late	Specific Conductance	174	221	248	24	19	238	247	262	6	19
	A	Early	pH	6.6		7.1	--	20	6.6		7.2	--	20
	A	Late	pH	6.6		6.8	--	10	6.6		6.9	--	10

Appendix Table B-4 Summary of intragravel and corresponding surface water quality data collected in sloughs 8A, 9, 11 and 21 during early (April 15-18) and late (April 29-May 2) sampling periods in spring, 1983.

Slough	Sampling Period	Variable	Intragravel Water					Surface Water				
			Min	Mean	Max	SD	N	Min	Mean	Max	SD	N
Slough 8A	Early	Dissolved Oxygen	4.0	4.6	9.2	1.1	20	7.4	10.3	11.6	1.1	20
	Late	Dissolved Oxygen	4.0	4.6	7.9	0.8	20	10.5	11.2	11.6	0.2	20
	Early	Water Temperature	0.4	2.0	2.5	0.5	20	0.3	1.4	3.0	1.0	20
	Late	Water Temperature	2.2	3.2	5.8	0.7	20	2.0	4.1	5.0	0.7	20
	Late	Specific Conductance	215	250	258	10	20	164	181	188	5	20
	Early	pH	7.2		7.3	--	20	7.1		7.3	--	20
	Late	pH	6.4		6.8	--	10	6.4		6.8	--	10
Slough 9	Early	Dissolved Oxygen	3.7	5.6	6.8	0.9	20	9.0	9.6	10.0	0.2	20
	Late	Dissolved Oxygen	1.3	6.9	10.8	2.3	23	8.0	10.5	11.0	1.0	23
	Early	Water Temperature	3.0	4.1	5.2	0.5	20	5.0	5.2	5.4	0.1	20
	Late	Water Temperature	3.5	4.0	5.0	0.4	23	5.2	6.1	6.5	0.3	23
	Late	Specific Conductance	128	194	257	39	23	146	160	198	14	23
	Early	pH	6.5		7.1	--	20	6.5		7.0	--	20
	Late	pH	6.2		6.6	--	10	5.9		6.8	--	10
Slough 11	Early	Dissolved Oxygen	1.3	8.5	11.2	2.2	34	9.8	10.8	12.4	0.7	34
	Late	Dissolved Oxygen	1.1	5.1	10.4	2.2	34	10.3	11.0	11.3	0.2	34
	Early	Water Temperature	1.8	2.3	3.0	0.4	34	1.8	2.3	3.2	0.5	34
	Late	Water Temperature	3.5	4.3	7.2	0.7	34	5.2	6.4	8.2	1.0	34
	Early	Specific Conductance	258	270	280	5	18	198	265	285	17	19
	Late	Specific Conductance	159	240	268	87	14	232	243	247	4	14
	Early	pH	6.2		7.3	--	15	6.3		7.2	--	15
Slough 21	Early	Dissolved Oxygen	2.3	6.9	8.8	1.4	20	6.2	9.1	10.0	1.0	20
	Late	Dissolved Oxygen	6.7	7.4	8.4	8.5	19	7.3	9.9	10.6	1.0	19
	Early	Water Temperature	2.5	3.7	5.0	0.8	20	2.5	4.8	5.5	0.8	20
	Late	Water Temperature	2.5	3.5	4.5	0.7	19	2.5	6.0	7.5	1.6	19
	Late	Specific Conductance	174	221	248	24	19	238	247	262	6	19
	Early	pH	6.6		7.1	--	20	6.6		7.2	--	20
	Late	pH	6.6		6.8	--	10	6.6		6.9	--	10

Appendix Table B-6 Intragravel and corresponding surface water quality measurements collected in Slough 8A (RM 125.9, Geographic Code S30N03W30BCD) of the Susitna River during two sampling periods (April 15-18 and April 29-May 2) in spring, 1983.

			INTRAGRAVEL				SURFACE WATER			
SITE	SAMPLING DATE	SLOUGH BANK	pH	WATER TEMP(C)	D.O. (mg/l)	SPEC.COND. (umhos/cm)	pH	WATER TEMP(C)	D.O. (mg/l)	SPEC.COND. (umhos/cm)
A	830417	LEFT	7.3	2.0	4.4	—	7.3	2.0	10.4	—
A	830417	LEFT	7.2	2.0	4.2	—	7.3	2.2	9.2	—
A	830417	LEFT	7.2	2.2	4.3	—	7.3	2.0	10.5	—
A	830417	LEFT	7.2	2.2	4.5	—	7.2	2.5	7.4	—
A	830417	LEFT	7.2	2.5	4.6	—	7.3	2.5	9.5	—
A	830417	LEFT	7.2	2.5	4.4	—	7.3	2.2	10.4	—
A	830417	LEFT	7.2	2.5	4.2	—	7.2	2.2	9.5	—
A	830417	LEFT	7.2	2.5	4.3	—	7.3	3.0	8.4	—
A	830417	LEFT	7.2	2.5	4.3	—	7.2	3.0	9.4	—
A	830417	LEFT	7.2	2.5	4.0	—	7.1	2.0	10.2	—
A	830417	RIGHT	7.2	.4	9.2	—	7.3	.3	11.3	—
A	830417	RIGHT	7.2	1.8	4.5	—	7.2	.3	11.4	—
A	830417	RIGHT	7.3	1.8	4.8	—	7.3	.3	11.3	—
A	830417	RIGHT	7.2	2.0	4.4	—	7.2	.3	11.4	—
A	830417	RIGHT	7.2	1.8	4.5	—	7.2	.3	11.2	—
A	830417	RIGHT	7.2	2.0	4.8	—	7.2	.3	11.6	—
A	830417	RIGHT	7.2	1.8	4.6	—	7.2	.3	11.4	—
A	830417	RIGHT	7.2	2.0	4.2	—	7.1	.8	10.8	—
A	830417	RIGHT	7.2	2.0	4.4	—	7.1	.5	10.2	—
A	830417	RIGHT	7.2	2.0	4.4	—	7.2	1.8	10.6	—
A	830501	LEFT	6.4	5.8	4.3	236	6.4	5.0	10.5	178
A	830501	LEFT	6.4	3.8	4.6	255	6.5	5.0	11.0	181
A	830501	LEFT	6.4	3.8	4.3	252	6.6	4.5	11.2	181
A	830501	LEFT	6.5	3.2	4.3	257	6.8	4.5	10.9	188
A	830501	LEFT	6.6	3.2	4.4	257	6.8	4.5	11.3	184
A	830501	LEFT	—	3.2	4.4	257	—	4.5	11.3	184
A	830501	LEFT	—	3.0	4.3	258	—	4.5	11.3	181
A	830501	LEFT	—	3.2	4.5	257	—	4.5	11.3	184
A	830501	LEFT	—	3.2	4.4	257	—	4.5	11.2	184
A	830501	LEFT	—	3.2	4.0	257	—	4.2	11.2	186
A	830501	RIGHT	6.7	2.2	7.9	215	6.6	2.0	11.3	164
A	830501	RIGHT	6.8	2.8	4.6	249	6.8	3.5	11.3	183
A	830501	RIGHT	6.7	2.8	4.6	249	6.8	3.5	11.3	183
A	830501	RIGHT	6.8	2.8	4.5	249	6.6	3.8	11.4	181
A	830501	RIGHT	6.8	3.0	4.7	248	6.7	3.8	11.3	181
A	830501	RIGHT	—	2.8	4.5	249	—	3.2	11.3	184
A	830501	RIGHT	—	3.2	4.6	246	—	3.8	11.4	181
A	830501	RIGHT	—	3.0	4.4	251	—	4.2	11.5	179
A	830501	RIGHT	—	3.2	4.6	250	—	4.2	11.6	179
A	830501	RIGHT	—	3.0	4.4	255	—	4.5	11.3	181

Appendix Table B-8 Intragravel and corresponding surface water quality measurements collected in Slough 9 (RM 129.2, Geographic Code S30N03W09DCB) of the Susitna River during two sampling periods (April 15-18 and April 29-May 2) in spring, 1983.

			INTRAGRAVEL				SURFACE WATER			
SITE	SAMPLING DATE	SLOUGH BANK	pH	WATER TEMP(C)	D.O. (mg/l)	SPEC.COND. (umhos/cm)	pH	WATER TEMP(C)	D.O. (mg/l)	SPEC.COND. (umhos/cm)
A	830418	RIGHT	7.0	4.2	3.7	—	6.9	5.2	9.4	—
A	830418	RIGHT	7.1	4.4	4.0	—	7.0	5.3	9.8	—
A	830418	RIGHT	7.0	4.2	4.7	—	7.0	5.2	9.8	—
A	830418	RIGHT	6.8	4.7	4.1	—	6.9	5.3	9.6	—
A	830418	RIGHT	6.8	4.2	4.9	—	6.8	5.3	9.7	—
A	830418	RIGHT	6.9	4.1	5.1	—	6.8	5.1	9.8	—
A	830418	RIGHT	6.8	4.2	5.1	—	6.8	5.3	9.3	—
A	830418	RIGHT	6.9	4.1	5.4	—	7.0	5.3	9.4	—
A	830418	RIGHT	6.8	4.1	5.4	—	6.8	5.3	9.5	—
A	830418	RIGHT	7.0	5.2	6.7	—	6.9	5.3	9.7	—
A	830502	RIGHT	6.4	4.5	7.1	184	6.3	6.0	10.9	146
A	830502	RIGHT	6.2	3.5	7.7	152	6.3	5.8	10.9	156
A	830502	RIGHT	6.5	4.2	7.2	186	6.8	6.0	11.0	155
A	830502	RIGHT	6.6	4.5	8.0	171	6.5	6.0	11.0	155
A	830502	RIGHT	6.6	3.5	8.6	158	6.4	5.8	11.0	156
A	830502	RIGHT	—	3.8	10.8	128	—	6.0	10.9	151
A	830502	RIGHT	—	3.8	9.8	147	—	6.2	10.9	154
A	830502	RIGHT	—	3.5	9.5	158	—	6.2	10.9	154
A	830502	RIGHT	—	4.2	10.4	141	—	6.0	11.0	155
A	830502	RIGHT	—	5.0	9.3	136	—	6.0	11.0	150
B	830418	LEFT	6.8	3.0	5.5	—	6.8	5.0	9.3	—
B	830418	LEFT	6.5	4.0	5.8	—	6.5	5.3	10.0	—
B	830418	LEFT	6.8	4.3	6.7	—	6.8	5.2	9.2	—
B	830418	LEFT	6.6	4.9	6.1	—	6.6	5.2	9.6	—
B	830418	LEFT	6.8	3.8	6.4	—	6.8	5.1	9.6	—
B	830418	LEFT	7.0	3.1	6.8	—	7.0	5.1	9.0	—
B	830418	LEFT	6.8	3.9	6.3	—	6.8	5.2	9.6	—
B	830418	LEFT	6.7	4.1	6.3	—	6.7	5.4	9.6	—
B	830418	LEFT	6.7	4.6	6.1	—	6.7	5.4	9.4	—
B	830418	LEFT	6.8	3.8	6.4	—	6.8	5.2	9.7	—
B	830502	LEFT	6.3	3.5	5.7	227	6.2	6.0	10.7	155
B	830502	LEFT	6.4	4.0	5.4	236	6.3	6.0	10.7	155
B	830502	LEFT	6.2	4.5	5.5	233	5.9	6.2	10.5	163
B	830502	LEFT	6.2	4.5	5.3	236	6.3	6.2	10.7	158
B	830502	LEFT	6.3	3.8	5.8	221	6.2	6.5	10.7	156
B	830502	LEFT	—	3.8	6.6	203	—	6.2	10.4	163
B	830502	LEFT	—	3.8	6.3	203	—	6.5	10.7	153
B	830502	LEFT	—	4.0	6.4	206	—	6.2	10.8	158
B	830502	LEFT	—	4.0	6.1	206	—	6.5	10.9	156
B	830502	LEFT	—	4.2	6.6	201	—	6.5	10.6	156
C *	830502	LEFT	—	4.2	6.4	218	—	6.2	8.2	192
C *	830502	LEFT	—	4.0	2.3	257	—	5.5	8.0	197
C *	830502	LEFT	—	4.0	1.3	250	—	5.2	8.0	198

* This site was actually located in Slough 9B (see Figure 3).

Appendix Table B-7 Intragravel and corresponding surface water quality measurements collected in Slough 11 (RM 135.3, Geographic Code S31N02W19DDD) of the Susitna River during two sampling periods (April 15-18 and April 29-May 2) in spring, 1983.

			INTRAGRAVEL				SURFACE WATER			
SITE	SAMPLING DATE	SLOUGH BANK	pH	WATER TEMP(C)	D.O. (mg/l)	SPEC.COND. (umhos/cm)	pH	WATER TEMP(C)	D.O. (mg/l)	SPEC.COND. (umhos/cm)
A	830417	LEFT	7.3	2.8	7.8	—	7.2	3.2	11.6	—
A	830417	LEFT	7.2	3.0	7.4	—	7.1	3.2	11.3	—
A	830417	LEFT	7.1	2.6	8.4	—	7.1	3.2	11.4	—
A	830417	LEFT	7.1	2.8	7.8	—	7.1	3.2	11.3	—
A	830417	LEFT	7.1	2.5	7.8	—	7.1	3.2	11.5	—
A	830417	LEFT	7.2	3.0	7.3	—	7.1	3.2	11.4	—
A	830417	LEFT	7.2	2.8	7.6	—	7.2	3.0	11.4	—
A	830417	LEFT	7.2	2.8	8.3	—	7.2	3.0	11.5	—
A	830417	LEFT	7.2	2.8	8.2	—	7.2	3.0	11.6	—
A	830417	LEFT	7.1	3.0	7.5	—	7.2	3.0	11.6	—
A	830430	LEFT	—	4.8	6.7	260	—	7.8	11.2	244
A	830430	LEFT	—	5.0	7.4	262	—	7.5	11.2	246
A	830430	LEFT	—	4.0	6.7	264	—	7.5	11.1	246
A	830430	LEFT	—	4.0	7.0	267	—	7.5	10.9	246
A	830430	LEFT	—	3.5	7.5	268	—	7.8	11.1	244
A	830430	LEFT	—	4.5	7.3	263	—	7.8	11.1	247
A	830430	LEFT	—	4.8	7.2	257	—	8.0	11.1	246
A	830430	LEFT	—	4.8	7.3	257	—	8.0	11.2	243
A	830430	LEFT	—	4.8	7.3	257	—	8.2	11.0	241
A	830430	LEFT	—	7.2	6.9	245	—	8.2	11.1	241
B	830415	LEFT	—	2.2	9.3	—	—	2.0	10.0	—
B	830415	LEFT	—	2.0	9.3	—	—	2.0	10.2	198
B	830415	LEFT	—	2.0	8.8	271	—	2.0	10.0	285
B	830415	LEFT	—	2.0	9.0	265	—	2.0	10.1	269
B	830415	LEFT	—	2.0	8.8	267	—	2.0	9.8	267
B	830415	LEFT	—	2.2	9.3	271	—	2.0	10.2	269
B	830415	LEFT	—	2.0	6.2	258	—	2.0	9.8	267
B	830415	LEFT	—	2.2	9.5	271	—	2.0	10.4	267
B	830415	LEFT	—	2.2	10.5	269	—	2.0	10.6	269
B	830415	LEFT	—	2.2	9.5	269	—	2.0	11.0	267
B	830415	RIGHT	6.8	2.0	9.8	267	6.3	2.0	9.8	267
B	830415	RIGHT	—	2.0	10.0	271	—	2.2	10.6	267
B	830415	RIGHT	—	2.2	9.5	269	—	2.0	10.2	267
B	830415	RIGHT	—	2.0	9.6	267	—	2.0	10.6	271
B	830415	RIGHT	—	1.8	10.8	271	—	1.8	10.4	269
B	830415	RIGHT	—	2.0	10.6	273	—	2.0	10.4	269
B	830415	RIGHT	—	2.2	10.1	276	—	2.0	10.5	271
B	830415	RIGHT	—	2.2	9.6	276	—	2.0	10.2	267
B	830415	RIGHT	—	2.2	10.1	278	—	2.0	10.1	267
B	830415	RIGHT	—	2.2	9.7	280	—	2.0	10.2	271
B	830429	RIGHT	—	4.0	9.7	—	—	5.8	10.3	—
B	830429	RIGHT	—	4.5	9.4	—	—	5.2	10.5	—
B	830429	RIGHT	—	3.8	9.5	—	—	5.2	10.8	—
B	830429	RIGHT	—	4.2	10.1	—	—	5.5	10.9	—
B	830429	RIGHT	—	4.5	10.4	—	—	5.2	11.0	—

Appendix Table B-7 (Cont).

			INTRAGRAVEL				SURFACE WATER			
SITE	SAMPLING DATE	SLOUGH BANK	pH	WATER TEMP(C)	D.O. (mg/l)	SPEC.COND. (umhos/cm)	pH	WATER TEMP(C)	D.O. (mg/l)	SPEC.COND. (umhos/cm)
B	830429	RIGHT	—	4.5	9.9	—	—	6.2	10.8	—
B	830429	RIGHT	—	4.8	9.8	—	—	5.8	10.9	—
B	830429	RIGHT	—	4.0	9.6	—	—	6.0	10.7	—
B	830429	RIGHT	—	4.0	9.6	—	—	5.8	10.9	—
B	830429	RIGHT	—	3.5	9.6	—	—	5.8	11.0	—
B	830429	LEFT	—	3.8	9.0	—	—	6.0	10.8	—
B	830429	LEFT	—	4.0	9.0	—	—	6.0	11.1	—
B	830429	LEFT	—	4.5	8.6	—	—	6.2	11.1	—
B	830429	LEFT	—	4.0	8.6	—	—	6.0	11.0	—
B	830429	LEFT	—	4.5	8.1	—	—	6.0	11.1	—
B	830429	LEFT	—	4.0	9.0	—	—	6.0	11.1	—
B	830429	LEFT	—	4.2	8.9	—	—	6.2	11.3	—
B	830429	LEFT	—	3.5	9.2	—	—	6.2	11.2	—
B	830429	LEFT	—	3.5	9.0	—	—	6.0	10.9	—
B	830429	LEFT	—	3.8	9.2	—	—	6.0	11.3	—
C	830417	RIGHT	6.4	2.5	11.2	—	6.4	2.0	11.4	—
C	830417	RIGHT	6.3	2.5	4.8	—	6.3	1.8	11.0	—
C	830417	RIGHT	6.3	2.5	2.3	—	6.3	1.8	11.6	—
C	830417	RIGHT	6.2	2.2	1.3	—	6.3	1.8	12.4	—
C	830430	RIGHT	—	4.0	10.2	206	—	5.5	10.8	245
C	830430	RIGHT	—	4.5	3.6	234	—	5.2	10.7	238
C	830430	RIGHT	—	5.2	2.3	159	—	5.2	10.6	241
C	830430	RIGHT	—	5.2	1.1	166	—	5.5	10.5	232

Appendix Table B-8 Intragravel and corresponding surface water quality measurements collected immediately below the mouth of Slough 21 (RM 142.0, Geographic Code S31N02W02AAA) of the Susitna River during two sampling periods (April 15-18 and April 29-May 2) in spring, 1983.

			INTRAGRAVEL				SURFACE WATER			
SITE	SAMPLING DATE	SLOUGH BANK	pH	WATER TEMP(C)	D.O. (mg/l)	SPEC.COND. (umhos/cm)	pH	WATER TEMP(C)	D.O. (mg/l)	SPEC.COND. (umhos/cm)
A	830416	LEFT	7.1	2.8	2.3	—	7.2	2.8	6.2	—
A	830416	LEFT	7.0	2.5	6.5	—	6.8	2.5	6.5	—
A	830416	LEFT	6.9	3.0	6.8	—	6.7	4.0	6.8	—
A	830416	LEFT	6.6	3.0	6.9	—	6.6	5.0	8.8	—
A	830416	LEFT	6.7	3.2	6.0	—	6.7	5.0	8.8	—
A	830416	LEFT	6.7	3.2	6.7	—	6.7	4.5	8.6	—
A	830416	LEFT	6.7	3.0	6.5	—	6.7	5.0	8.7	—
A	830416	LEFT	6.7	3.0	6.6	—	6.7	5.2	9.4	—
A	830416	LEFT	6.8	3.0	6.5	—	6.8	5.2	9.3	—
A	830416	LEFT	6.7	3.5	6.7	—	6.7	5.5	9.4	—
A	830416	RIGHT	7.1	4.0	7.4	—	7.2	5.2	9.6	—
A	830416	RIGHT	7.1	4.0	7.5	—	7.1	5.2	9.8	—
A	830416	RIGHT	7.1	4.0	7.7	—	7.1	5.2	10.0	—
A	830416	RIGHT	7.1	4.5	8.6	—	7.1	5.2	9.8	—
A	830416	RIGHT	7.0	4.5	7.7	—	7.1	5.2	9.7	—
A	830416	RIGHT	7.0	4.5	5.0	—	7.1	5.2	9.5	—
A	830416	RIGHT	7.0	4.5	8.8	—	7.1	5.2	9.8	—
A	830416	RIGHT	7.1	4.5	8.4	—	7.1	5.2	9.8	—
A	830416	RIGHT	7.1	4.5	8.2	—	6.9	5.2	10.0	—
A	830416	RIGHT	6.9	5.0	6.8	—	6.7	5.2	9.7	—
A	830501	LEFT	6.7	2.5	6.7	239	6.6	2.5	7.3	245
A	830501	LEFT	6.8	2.5	7.1	245	6.6	2.5	7.7	248
A	830501	LEFT	6.8	2.8	7.4	242	6.6	5.0	9.4	254
A	830501	LEFT	6.6	3.0	7.1	241	6.8	5.2	9.8	252
A	830501	LEFT	6.7	2.5	7.0	239	6.8	4.0	8.7	262
A	830501	LEFT	—	2.5	7.0	248	—	4.8	9.8	255
A	830501	LEFT	—	2.8	6.9	246	—	6.8	9.7	245
A	830501	LEFT	—	3.2	6.9	243	—	6.0	10.1	251
A	830501	LEFT	—	4.0	6.9	236	—	6.5	10.2	250
A	830501	RIGHT	6.8	4.5	7.3	216	6.8	7.5	10.5	240
A	830501	RIGHT	6.8	4.0	7.4	212	6.9	7.2	10.5	238
A	830501	RIGHT	6.8	3.8	7.5	213	6.8	7.0	10.5	244
A	830501	RIGHT	6.8	4.0	7.6	206	6.7	7.0	10.5	239
A	830501	RIGHT	6.8	4.2	7.6	210	6.7	7.2	10.5	242
A	830501	RIGHT	—	4.5	7.7	208	—	7.0	10.5	244
A	830501	RIGHT	—	4.0	8.3	174	—	7.0	10.6	244
A	830501	RIGHT	—	3.8	7.9	175	—	7.0	10.5	244
A	830501	RIGHT	—	3.8	8.4	[illegible]	—	6.8	10.5	248
A	830501	RIGHT	—	4.0	7.6	[illegible]	—	6.8	10.3	248

DRAFT
WINTER REPORT
10/20/83

APPENDIX C

Burbot winter catch data and
age, length, and sex data.

LIST OF APPENDIX C TABLES

Appendix Table C-1. Burbot catch per unit effort (CPUE) at selected fish habitat (SFH) sites in the Susitna River between Cook Inlet and Devil Canyon, December, 1982 to March, 1983.

Location	RM/TRM	Date(s) Sampled	Method of Capture	Numbers of Fish Captured	(CPUE)
Deshka River	40.6/0.0	12/2 - 12/3	Trotline	22	1.69
Deshka River	40.6/0.0	12/2 - 12/3	Burbot Set	1	0.50
Deshka River	40.6/2.0	12/2 - 12/3	Trotline	13	2.17
Deshka River	40.6/2.0	12/2 - 12/3	Burbot Set	1	0.50
Deshka River	40.6/0.0	11/11 - 1/12	Trotline	10	1.25
Deshka River	40.6/2.0	1/10 - 1/12	Trotline	8	0.80
Deshka River	40.6/0.0	2/16 - 2/17	Trotline	19	2.70
Deshka River	40.6/0.0	2/16 - 2/17	Burbot Set	1	1.00
Indian River	138.6/0.0	1/27 - 1/29	Trotline	1	0.17
Mainstem	136.7	12/19 - 12/24	Trotline	2	0.08
Mainstem	76.1	3/10 - 3/11	Trotline	5	1.00
Mainstem	72.0	3/11 - 3/12	Trotline	6	1.50

Appendix Table C-2 Burbot age-length[1] relationships on the Susitna River between Cook Inlet and Devil Canyon, December 1982 to March 1983.

	Cook Inlet to Chulitna Confluence			Chulitna Confluence to Devil Canyon			Cook Inlet to Devil Canyon			
Age (Years)	Total No. of fish Sampled	Mean length (mm)	Range of lengths (mm)	Total No. of fish Sampled	Mean length (mm)	Range of lengths (mm)	Total No. of fish Sampled	Percent Frequency	Mean length (mm)	Range of lengths (mm)
0	-	-	-	-	-	-	-	-	-	-
I	-	-	-	-	-	-	-	-	-	-
II	-	-	-	-	-	-	-	-	-	-
III	-	-	-	-	-	-	-	-	-	-
IV	3	417	395-430	-	-	-	3	4.4	417	395-430
V	15	472	440-545	-	-	-	15	21.7	472	440-545
VI	19	503	430-580	1	470	-	20	29.0	502	430-580
VII	7	525	420-600	1	585	-	8	11.6	532	420-600
VIII	7	554	490-660	-	-	-	7	10.1	554	490-660
IX	6	625	598-710	1	660	-	7	10.1	630	598-710
X	5	703	604-795	-	-	-	5	7.3	703	604-795
XI	2	725	670-780	-	-	-	2	2.9	725	670-780
XII	2	730	695-765	-	-	-	2	2.9	730	695-765
TOTAL	66	584	395-795	3	572	470-660	69	100.0	[illegible]	395-795

---

[1] Total length in millimeters.

Appendix Table C-3. Relative spawning maturity of burbot captured in the Susitna River between Cook Inlet and Devil Canyon, December, 1982 to March, 1983.

Condition of Gonads	Length[1]	Age	Date Captured	Area of Capture	River/Tributary Mile/River Mile
Sex - Male					
ripe	424	5	12/3	Deshka R.	40.6/0.0
ripe	425	5	12/3	Deshka R.	40.6/0.0
immature	425	4	3/12	Mainstem	72.0
ripe	427	5	1/12	Deshka R.	40.6/0.0
ripe	430	4	12/3	Deshka R.	40.6/0.0
ripe	445	5	1/12	Deshka R.	40.6/0.0
ripe	465	5	12/3	Deshka R.	40.6/0.0
ripe	492	7	12/3	Deshka R.	40.6/0.0
ripe	498	6	1/12	Deshka R.	40.6/0.0
ripe	535	5	1/12	Deshka R.	40.6/0.0
ripe	540	7	1/12	Deshka R.	40.6/0.0
immature	545	5	3/12	Mainstem	72.0
ripe	580	8	12/3	Deshka R.	40.6/0.0
immature	585	7	1/29	Indian R.	138.6/0.0
ripe	725	10	1/11	Deshka R.	40.6/0.0
spent	420	7	2/17	Deshka R.	40.6/0.0
spent	435	5	2/17	Deshka R.	40.6/0.0
spent	440	5	2/17	Deshka R.	40.6/0.0
spent	500	6	2/17	Deshka R.	40.6/0.0
spent	515	6	2/17	Deshka R.	40.6/0.0
spent	630	9	3/11	Mainstem	76.1
spent	660	9	3/11	Mainstem	76.1
spent	780	11	3/11	Mainstem	76.1

Total number males, 23.

---

[1] Total length in millimeters.

Appendix Table C-3 (Continued).

Condition of Gonads	Length[1]	Age	Date Captured	Area of Capture	River/Tributary Mile/River Mile
Sex - Female					
immature	395	4	1/11	Deshka R.	40.6/2.0
ripe	430	6	12/3	Deshka R.	40.6/2.0
ripe	440	6	12/3	Deshka R.	40.6/2.0
ripe	440	5	12/3	Deshka R.	40.6/2.0
immature	440	6	12/3	Deshka R.	40.6/2.0
ripe	460	6	12/3	Deshka R.	40.6/2.0
ripe	461	6	1/12	Deshka R.	40.6/0.0
ripe	465	5	12/3	Deshka R.	40.6/0.0
ripe	470	6	12/20	Mainstem	136.7
ripe	471	6	12/3	Deshka R.	40.6/0.0
ripe	474	6	12/3	Deshka R.	40.6/2.0
ripe	488	5	12/3	Deshka R.	40.6/2.0
ripe	490	7	12/3	Deshka R.	40.6/2.0
immature	495	5	1/12	Deshka R.	40.6/2.0
ripe	510	5	12/3	Deshka R.	40.6/2.0
immature	525	6	1/12	Deshka R.	40.6/0.0
immature	535	5	3/12	Mainstem	72.0
ripe	543	6	12/3	Deshka R.	40.6/0.0
ripe	550	8	12/3	Deshka R.	40.6/2.0
ripe	550	6	1/12	Deshka R.	40.6/0.0
ripe	550	6	1/12	Deshka R.	40.6/2.0
ripe	552	7	12/3	Deshka R.	40.6/2.0
ripe	555	8	12/3	Deshka R.	40.6/0.0
ripe	568	6	1/11	Deshka R.	40.6/2.0
ripe	570	6	12/3	Deshka R.	40.6/0.0
ripe	578	7	12/3	Deshka R.	40.6/0.0
ripe	580	6	12/3	Deshka R.	40.6/0.0
ripe	598	9	12/3	Deshka R.	40.6/0.0

---

[1] Total length in millimeters.

Appendix Table C-3 (Continued).

Condition of Gonads	Length[1]	Age	Date Captured	Area of Capture	River/Tributary Mile/River Mile
Sex - Female					
ripe	600	7	1/11	Deshka R.	40.6/2.0
ripe	600	8	1/12	Deshka R.	40.6/0.0
ripe	604	10	12/3	Deshka R.	40.6/0.0
ripe	610	9	12/3	Deshka R.	40.6/0.0
ripe	615	9	12/3	Deshka R.	40.6/2.0
ripe	626	10	12/3	Deshka R.	40.6/0.0
immature	695	12	3/12	Mainstem	72.0
immature	710	9	3/12	Mainstem	72.0
ripe	765	12	12/3	Deshka R.	40.6/2.0
spent	470	6	2/17	Deshka R.	40.6/0.0
spent	490	8	2/17	Deshka R.	40.6/0.0
spent	490	8	2/17	Deshka R.	40.6/0.0
spent	515	6	2/17	Deshka R.	40.6/0.0
spent	590	9	2/17	Deshka R.	40.6/0.0
spent	660	8	3/11	Mainstem	76.1
spent	670	11	2/17	Deshka R.	40.6/0.0
spent	765	10	3/11	Mainstem	76.1
spent	795	10	3/12	Mainstem	72.0

Total number of females, 46

---

[1] Total length in millimeters.

Appendix Table C-4 Burbot age-length[1/] relationships by sex on the Susitna River between Cook Inlet and Devil Canyon, February 1981 to March 1983.

		Cook Inlet to Chulitna Confluence			Chulitna Confluence to Devil Canyon			Cook Inlet to Devil Canyon			Both Sexes: Cook Inlet to Devil Canyon			
Age (Years)	Sex	Total No. of fish Sampled	Mean length (mm)	Range of length (mm)	Total No. of fish Sampled	Mean length (mm)	Range of length (mm)	Total No. of fish Sampled	Mean length (mm)	Range of length (mm)	Total No. of fish Sampled	Precent Frequency	Mean length (mm)	Range of length (mm)
0	I	5	99	85-115	2	108	102-114	7	102	85-115	-	-	-	-
I	I	5	189	168-205	1	110	-	6	175	168-205	-	-	-	-
II	I	1	180	-	-	-	-	1	180	-	-	-	-	-
III	M	4	355	295-400	3	334	322-353	7	346	295-400	13	5.0	339	238-400
	F	2	289	238-340	4	351	330-398	6	331	238-398				
IV	M	10	404	303-450	1	415	-	11	405	303-450	30	11.6	418	303-490
	F	16	422	355-490	3	441	430-460	19	425	355-490				
V	M	26	448	370-550	7	457	390-530	33	450	370-550	62	24.0	453	365-550
	F	21	466	365-535	8	432	378-482	29	457	365-535				
VI	M	12	497	430-555	6	490	440-575	18	495	430-575	47	18.2	492	394-580
	F	23	496	430-580	6	471	394-525	29	491	394-580				
VII	M	6	534	420-614	6	546	468-600	12	540	420-614	28	10.9	523	418-614
	F	12	517	418-600	4	489	469-510	16	510	418-600				
VIII	M	9	585	513-672	2	581	515-647	11	585	513-672	33	12.8	568	456-672
	F	17	563	456-660	5	546	480-600	22	559	456-660				
IX	M	4	638	572-680	2	615	570-660	6	631	570-680	17	6.6	615	500-710
	F	8	615	556-710	3	585	500-675	11	607	500-710				
X	M	3	658	600-725	-	-	-	3	658	600-725	11	4.3	662	555-795
	F	7	659	555-795	1	690	-	8	663	555-795				
XI	M	3	670	609-780	1	780	-	4	697	609-780	8	3.1	697	609-780
	F	2	690	670-710	2	703	665-740	4	696	665-740				
XII	M	2	697	654-740	-	-	-	2	697	654-740	6	2.3	725	654-790
	F	3	721	695-765	1	790	-	4	739	695-790				
XIII	F	1	900	-	-	-	-	1	900	-	1	0.4	900	-
XIV	F	1	815	-	-	-	-	1	815	-	1	0.4	815	-
XV	F	1	804	-	-	-	-	1	804	-	1	0.4	804	-
TOTAL		204	535	85-900	68	497	102-790	272	537	85-900	258	100.0	616	238-900

I = Immature, sex not identified
M = Male
F = Female

[1/] Total length in millimeters.

DRAFT
WINTER REPORT
10/20/83

APPENDIX D

Winter radio telemetry data on burbot, rainbow trout, and Arctic grayling.

LIST OF APPENDIX D TABLES

Appendix Table D-1 List of tributaries, sloughs and lakes in the Susitna River drainage that were aerial surveyed to track the movements of radio-tagged Arctic grayling, rainbow trout and burbot. Surveys for the tributaries start at their mouths.

Trib, slough, lake surveyed (distance surveyed (in miles)	# Surveys/by 2 month intervals			
	Sep Oct	Nov Dec	Jan Feb	Mar Apr
Cook Inlet to Devils Canyon				
Alexander Creek (7.0)		2		1
Yentna River (10.0)		2		1
Deshka River (6.0)	1	2	1	
Kroto Slough (complete)		1		
Willow Channel (complete		4	1	2
Kashwitna River (5.0)				1
Montana Creek (3.0)		1		
Rabideux Creek (2.5)		2		
Sunshine Slough (complete)		2		1
Birch Creek Slough (complete)		1		
Talkeetna River (20.0			1	1
Larson Lake (complete)				1
Sheep River (5.0)				1
Clear Creek (12.0)				1
Fish Creek (complete)				1
Chulitna River (20.0)				1
Byer Lake (complete)				1
Cook Inlet to Devils Canyon (Cont)				
Whiskers Creek (4.0)				1
Slough 6a (complete)				1
Gash Creek & Lake (complete)				1
Slough 8a (complete)				1
Slough 9 (complete)				1
Fourth of July Creek (3.0)	3	1		1
Unnamed lake, drains into Fourth of July Creek 4 mi upstream from its mouth (complete)				1
Indian River (10.0)	3	1		2
Miami Lake (complete)				1
Proposed Impoundment Area:				
Tsusena Creek (4.0,	5			
Deadman Creek (14.0)	5	1		1
Deadman Lake (complete)	1	1		
Watana Creek (E.Fork-8.0)	4	1		
Kosina Creek (6.0)	4	3	1	2
Clarence Lake (complete)				1
Oshetna River (4.0)	4	3	1	2

Appendix Table D-2 Summary of tagging and tracking data for radio-tagged rainbow trout in the Susitna River between Cook Inlet and Devil Canyon, September 1982 to April 1983.

Capture Data, 1982

Tracking Data: Date tracked, location and rivermile

Radio Frequency	Length[a]	Age	Date	Date Tagged	River-Mile	Date Released	Sept					OCT			Nov	Dec			Feb	Mar			Apr
							10	14	15	22	25	4	15	30	15	2	14	30	4	4	9	12	19
							P	B	B	P	P	P	P	P	P	P	P	P	P	P	P	S	P
600-.5	410	-	10/13	10/14	77.0	10/15							76.5	72.0	72.0	72.0	72.0	NS	73.5	NS	NS	NC	NC
601-1	508	7	9/19	9/20	131.0	9/21				131.0	130.5	129.5	129.5	131.0	131.0	131.0	131.5	NC	131.1	131.5	131.5	131.5	NS
600-3	443	6	10/9	10/10	138.6	10/11							138.0	134.8	131.0	83.5	64.0	62.0	62.0	63.0	63.0	63.0	NC
620-1	445	6	9/19	9/20	131.1	9/21				130.4	129.1	128.0	128.0	128.4	128.4	128.0	121.5	111.0	112.0	NS	131.5	NC	NS
540-1	448	-	10/9	10/10	138.6	10/11							138.6	NS	138.2	NS	NS	NS	97.0[b]	NS	NS	NC	NC
660-.5	435	6	9/7	9/8	125.3	9/9	125.5	126.1	112.8	113.5	113.5	113.5	111.5	112.5	112.5	112.5	113.4	113.4	113.4	113.1	113.1	113.1	113.1
660-1	423	-	10/9	10/10	138.6	10/11							138.6	135.3	118.0	117.8	83.0	83.0	83.0	NS	NS	NC	NC
670-3	440	6	9/18	9/19	131.1	10/20				NS	129.6	128.8	129.0	127.0	127.0	127.0	126.6	NS	NS	NS	NS	NC	NS
680-1	445	-	9/18	9/19	131.1	9/20				130.9	131.0	131.0	132.5	132.5	132.5	132.5	129.5	130.0	NS	NS	NS	NC	NS
710-1	440	-	9/18	9/19	131.1	9/20				130.6	127.7	128.0	126.0	124.8	123.2	118.5	NS	104.0	103.5	NS	NS	NC	NS

---

[a] Fork length in millimeters
[b] Talkeetna River, TRM 1.5

Note - P = Tracked by plane or helicopter
B = Boat survey
S = Snowmobile survey
NC = Not checked
NS = No signal

Appendix Table D-3 Summary of tagging and tracking data for radio-tagged burbot in the Susitna River between Cook Inlet and Devil Canyon, August 1982 to April 1983.

Capture Data, 1982						Tracking Data: Date tracked, location and rivermile									
						AUG			SEPT						
Radio Frequency	Length[a]	Date	Date Tagged	River-Mile	Date Released	22 P	26 P	28 B	2 B	5 B	9 P	15 B	18 B	22 B	25 P
600-2	660	9/14	9/15	139.5	9/16								139.6	139.6	139.6
610-2	584	8/18	8/19	101.2	8/20	101.2	101.2	100.0	99.5	98.7	91.0	NC	NC	NC	NS
630-2	865	9/10	9/11	103.0	9/13							103.0	101.0	96.7	92.7
640-2	570	8/19	8/20	137.3	9/21	137.3	137.3	136.9	136.9	136.9	136.9	136.9	136.9	NS	101.0
660-2	715	9/19	9/20	139.5	9/21									NC	139.6
660-3	607	9/19	9/20	135.7	9/21									135.7	135.7
670-1	580	10/13	10/13	83.7	10/15										
670-2	565	10/13	10/13	83.7	10/15										
680-2	535	10/13	10/13	83.7	10/15										
710-3	615	10/13	10/13	83.7	10/15										
740-3	667	9/19	9/20	129.2	9/21									128.1	128.0

---

[a] Total length in millimeters

Note - P = Tracked by plane or helicopter
B = Boat survey
S = Snowmobile survey
NC = Not checked
NS = No signal

Appendix Table D-3 Continued

Capture Data, 1982						Tracking Data: Date tracked, location and rivermile											
Radio Frequency	Length[a]	Date	Date Tagged	River-Mile	Date Released	OCT			NOV	DEC				FEB	MAR		APR
						4	15	30	15	2	14	19	30	4	4	12	19
						P	P	P	P	P	P	S	P	P	P	S	P
600-2	660	9/14	9/15	139.5	9/16	139.6	139.6	NS	139.6	139.6	139.6	NC	NC	139.6	NS	NC	NS
610-2	584	8/18	8/19	101.2	8/20	5.0	NS	NS	- Presumed dead, out to Cook Inlet -								
630-2	865	9/10	9/11	103.0	9/13	80.0	50.0	NS	NS	NS	NS	NS	- Presummed dead, out to Cook Inlet -				
640-2	570	8/19	8/20	137.3	9/21	100.0	100.0	NS	100.0	100.0	100.0	NC	100.0	100.0	NS	NS	NS
660-2	715	9/19	9/20	139.5	9/21	136.0	135.3	NS	26.0	26.0	26.0	NC	26.0	27.0	NS	NC	NC
660-3	607	9/19	9/20	135.7	9/21	135.7	135.3	135.3	135.3	135.3	135.3	135.3	- Dead, located in 2" of water-				
670-1	580	10/13	10/13	83.7	10/15		83.5	83.6	83.0	83.0	82.5	NC	83.0	83.0	82.5	82.5	NC
670-2	565	10/13	10/13	83.7	10/15		83.5	NS	NS	NS	NS	NS	- Presumed tag failure -				
680-2	535	10/13	10/13	83.7	10/15		83.0	77.5	77.5	77.5	77.0	NC	76.0	75.0	72.0	72.0	NC
710-3	615	10/13	10/13	83.7	10/15		83.2	80.0	80.0	NS	79.5	NC	79.0	76.0	76.1	76.1	NC
740-3	667	9/19	9/20	129.2	9/21	128.0	NS	NS	NS	NS	NS	NS	- Presumed tag failure -				

[a] Total length in millimeters

Note - P = Tracked by plane or helicopter
B = Boat survey
S = Snowmobile survey
NC = Not checked
NS = No signal

DRAFT
WINTER REPORT
10/20/83

Appendix Table D-4 Summary of tagging and tracking data for radio-tagged Arctic grayling in the proposed impoundment area of the Susitna River drainage above Devil Canyon, August 1982 - April 1983. All fish were captured by hook and line.

	Capture Data, 1982					Tracking Data: Date tracked, location and river mile; Susitna River mile/Tributary River mile											
						Sept			OCT			Nov	Dec		Feb	Mar	Apr
Radio Frequency	Length (mm)[a]	Date Captured	Location (tributary rivermile)	Date Tagged	Date Released	16 P	18 P	27 P	2 P	15 P	30 P	15 P	2 P	-14 P	4 P	3-4 G	19 P
600-1	375	8/18	Oshetna(1.7)	8/19	8/20	NC	233.4 /1.2	0 /1.2	233.4 /1.2	NS	NS	233.4 /0.2	233.4 /0.2	233.4 /0.2	NS	NS	NS
620-.6	375	9/10	Tsusena(1.5)	9/11	9/12	181.3 /1.5	181.3 /1.5	181.3 /1.5	177.5	154.0	154.5	154.5	154.5	NS	NS	NS	NS
630-.5	395	8/24	Watana (East Fork 8.0)	8/25	8/26	194.1 /8.0	194.1 /8.0	194.1 /8.0	194.1 /8.0	194.1 0.0	193.5	193.5	193.0	192.0	192.0	191.8	NS
650-.5	375	9/30	Kosina(1.6)	10/1	10/2	-	-	-	-	206.1	205.0	187.5	NS	186.7	186.7	187.0	187.0
650-.6	380	9/10	Tsusena(1.5)	9/11	9/12	T/1.5	T/0.7	NS	153.0	153.0	154.0	153.8	153.8	153.6	153.1	153.1	NS
660-.6	375	9/8	Tsusena(1.5)	9/9	9/10	T/1.5	T/0.7	T/0.1	T/0.0	T/0.0	174.5	174.5	NS	NS	NS	NS	NS
670-1	395	9/7	Oshetna(0.7)	9/8	9/9	NC	232.5	227.5	206.3	NS	NS	192.5	191.5	191.5	191.5	190.9	NS
710-.5	375	9/28	Kosina(1.6)	9/29	9/30	-	-	-	206.4 /1.0	206.4 /0.8	206.4 /0.8	206.4 /0.5	206.4 /0.5	206.4 /0.5	206.4 /0.5	NS	NS
710-1	385	8/22	Kosina(4.0)	8/23	8/24	NC	156.0	NC	153.0	156.0	156.0	156.0	NS	NS	NS	NS	NS
720-.5	380	9/15	Kosina(1.6)	9/16	9/17	-	206.4 /1.6	NS	NS	NS	197.0	198.0	198.5	198.5	198.5	198.0	198.0
720-.6	390	9/10	Tsusena(1.5)	9/11	9/12	T/1.5	172.5	174.0	NS	NS	179.5	176.6	NS	NS	175.0	NS	NS
720-1	395	8/18	Oshetna(1.7)	8/19	8/20	NC	233.4 /1.7	233.4 /1.7	220.0	201.8	205.5	206.0	206.0	206.0	NS	NS	NS
730-.5	370	9/15	Kosina(1.6)	9/16	9/17		206.4 /1.6	206.4 /1.4	206.4 /1.4	202.0	196.5	197.0	197.0	197.0	198.0	197.5	197.5
740-.5	390	9/30	Kosina(1.6)	10/1	10/2	-	-	-	T/1.6	NS	NS	206.8	NS	NS	NS	NS	NS
740-.6	390	9/7	Oshetna(0.7)	9/8	9/9	NC	233.4 /1.0	233.4 /1.0	233.4 /1.0	233.4 /0.0	233.4	228.0	226.7	226.7	226.7	NS	NS

[a] Fork length

Note - P = Tracked by plane or helicopter
G = Ground survey
NC = Not checked
NS = No signal