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Subtask 7.10

Phase 1 Final Draft Report Vol. 1

Aquatic Habitat & Instream Flow Project

ADF & G / Su Hydro 1981

ALASKA
DEPARTMENT OF FISH AND GAME

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SUSITNA HYDROELECTRIC PROJECT

Subtask 7.10

Phase 1 Final Draft Report Vol. 1

Aquatic Habitat & Instream Flow Project

ADF & G / Su Hydro 1981

by

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1. SUMMARY

This fisheries habitat subject report was prepared by the Aquatic Habitat and Instream Flow Study section of the Alaska Department of Fish and Game (ADF&G) Aquatic Studies Program for the Alaska Power Authority as part of the environmental feasibility assessment studies for the proposed Susitna River Hydroelectric project. Data presented were collected by project personnel in the winter, spring, summer and fall, 1981.

Portions of information from this and other subject reports describing the fisheries and aquatic habitats of the Susitna River will be integrated into an ADF&G Aquatic Studies Program Phase I Final Report. The Phase I Final Report will be forthcoming in February 1982.

2. INTRODUCTION

This initial Aquatic Habitat and Instream Flow (AH) report is one of a series of subject reports representing first stage data reduction of Phase I fisheries and habitat information collected in the winter, spring, summer and fall, 1981 by the Alaska Department of Fish and Game (ADF&G) Susitna Hydroelectric (Su-Hydro) Aquatic Studies Program personnel. Portions of the information from this and the other Phase I subject reports (Adult Anadromous Fisheries, AA; and Resident and Juvenile Anadromous Fisheries, RJ; reports) will be synthesized and integrated into a Phase I Aquatic Studies Program Final Report. The Phase I Final Report will be forthcoming in February 1982 and will present the relationships drawn from the respective ADF&G subject reports above and reports of others containing information relevant to the assessment of the proposed Susitna Hydroelectric project impacts on fisheries.

Realizing the need for these AH data by Acres American and its various subcontractors to enable them to meet their respective report deadlines, portions of the data contained herein were previously distributed upon request in preliminary form.

Existing information on the fishery resources and aquatic habitat within the Susitna River drainage ranges from the most fundamental and generalized to localized and specific data on species managed by the Department in areas where competition for these species is keen. It should be noted, however, that information on all species in the Susitna River drainage, even those studied in greatest detail during this first year of the Phase I/II study, is still largely preliminary. Additional data must be collected on selected species and life phases present in the area, including data on their interrelationships with other species and with their physiochemical surroundings. These data will be required for determining the impacts of the proposed Su Hydro project on the fishery resources and evaluating its feasibility. This will be discussed further in the February Aquatic Studies Report.

Prior to the initiation of the Phase I Su Hydro Aquatic Study Program, the ADF&G collected baseline data on fisheries and habitat between 1974 and 1977 (ADF&G 1974, 1976, 1977, 1978) to enable the ADF&G to design the necessary study plan for determining the impacts of this proposed project on the fishery resources. The five year comprehensive Plan of Study was submitted to the Alaska Power Authority (APA) in December, 1977 and included in the 1978 ADF&G report, Preliminary Environmental Assessment of Hydroelectric Development on the Susitna River (ADF&G 1978). However, studies were not implemented because funding was unavailable. In September 1979, the ADF&G agreed to update and revise the 1977 Plan of Study, submitting it to the APA in November 1979 (ADF&G 1979). The APA approved portions of the study and provided funding to the ADF&G under a Reimbursable Services Agreement to initiate Phase I of the Phase I/II fisheries studies in July 1980.

The Susitna River (Figure E.2.1) is approximately 275 miles long from its sources in the Alaska Mountain Range to its point of discharge into Cook Inlet. Its drainage encompasses an area of 19,400 square miles. The mainstem and major tributaries of the Susitna River, including the Chulitna, Talkeetna and Yentna Rivers, originate in glaciers and carry a heavy load of glacial flour during the ice-free months. There are also many smaller tributaries which are perennially silt-free. The Susitna River and the major rivers

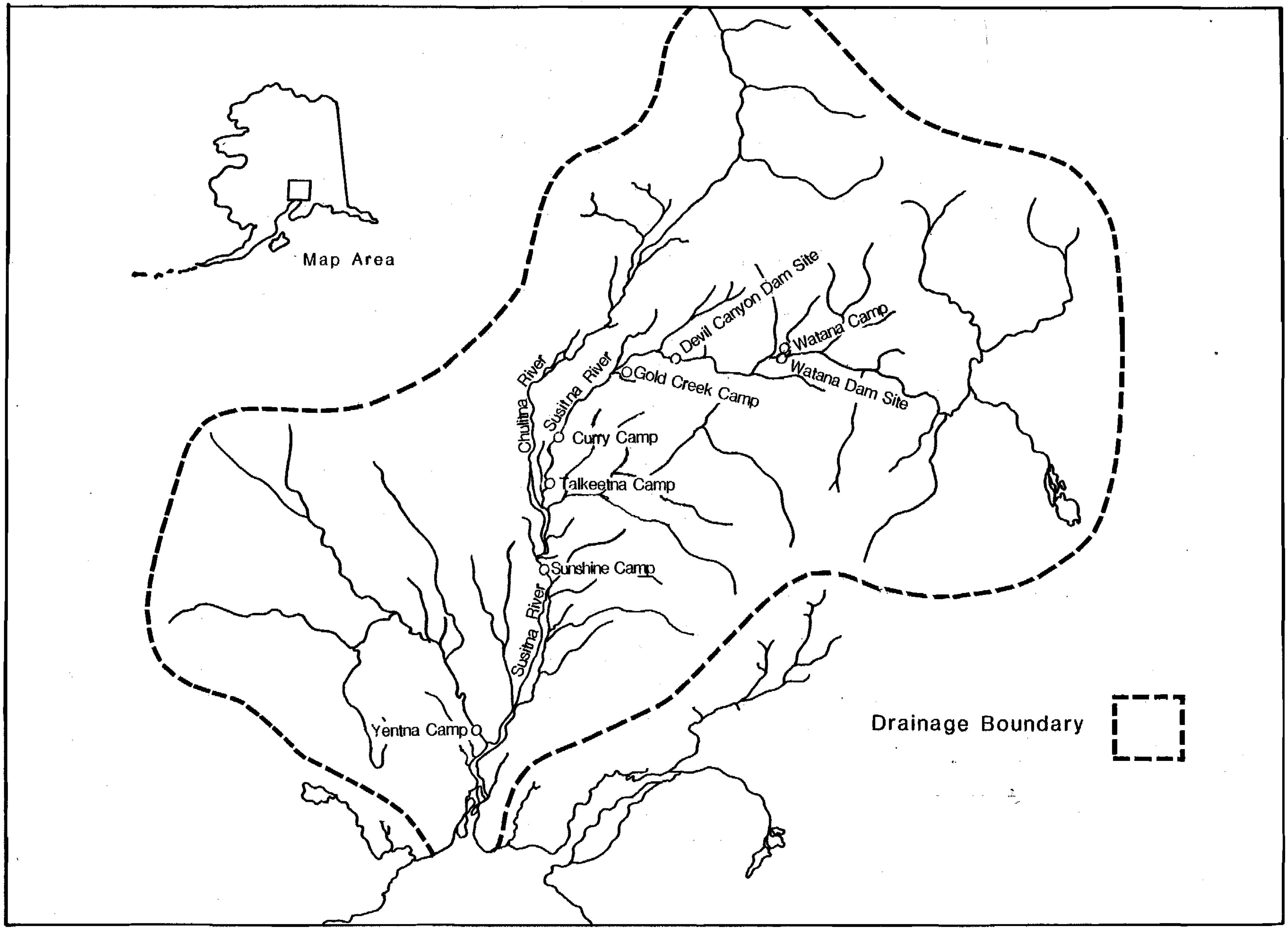


Figure E.2.1. Susitna River drainage.

entering Knik Arm represent approximately 70-80% of the total freshwater entering Cook Inlet (Rosenberg et al. 1967).

The proposed Susitna hydroelectric project will have various impacts on the aquatic environments of the Susitna River. The majority of the impacts on fish species will likely result from changes in the natural regimes of the river. Primary areas of concern are modification of seasonal instream flows,* increased turbidity levels during winter months, and variation of thermal and chemical parameters. Preliminary studies indicate that alterations of the habitat may adversely affect the existing fish populations and render portions of the drainage either non-productive or unavailable in future years (ADF&G 1978; 1979).

Continuously moving water, or current, is the distinguishing physical habitat feature of the Susitna River and its tributaries. Instream flows influence various physical and chemical parameters and biological organisms to create particular aquatic environments in the Susitna River Basin. These include volume, velocity, temporal variation of flows, channel morphology (size, shape, gradient, and geologic material of channel), water quality (temperature, turbidity, dissolved gases, etc.), and stream load (bed load, suspended solids, and other materials, such as watershed inputs, in transport).

Analogous chains of events follow any alterations of instream flow. The altered stream will attempt to establish new equilibrium conditions; and this

* The flow of water which appears in the Susitna River at a given time constitutes the "instream flow".

dynamic process may lead to substantial changes in channel shape, wetted area, substrate characteristics, water quality, etc. Moreover, these changes may be felt as far downstream from the proposed dams as Cook Inlet (Bishop 1975).

It is important to remember that the complexity of the physical interactions outlined above is compounded by the fact that natural flows fluctuate with seasonal and climatic variations. As a result, impacts produced by the proposed dams will stem not only from the amount of flow modification but also from the timing of the modification in relationship to normal seasonal flow fluctuations. Reduction, elimination, or rescheduling of naturally recurring high flows can have serious consequences on channel characteristics. An increase in flow can also induce profound changes in the lotic environment during naturally occurring low flows.

The physical conditions and interactions within the Susitna River Basin discussed above, provide essential habitats for aquatic, riparian, and other organisms. As a result, any alteration in the physical environment also affects the associated biological populations. Although the data from this and related Phase I and earlier reports will be used as the first step towards identifying the potential impacts of proposed instream flow changes on the Susitna fisheries, it should be apparent that instream flows can exert similar profound effects on other aquatic organisms, as well as on riparian and terrestrial wildlife, navigation and other instream flow related uses (Erickson 1977; Stalnaker and Arnette 1976; Hinz 1977; Newell 1977; Martin 1977; Klarich and Thomas 1977; Judy and Gore 1978; MDFWP 1980; White et al. 1981; American Fisheries Society and American Society of Civil Engineers 1976a, b; Townsend 1975).

Instream flow may, therefore, be considered one of the most essential determinants of aquatic habitat and hence fisheries productivity. Modifications of naturally occurring seasonal instream flows will produce a variety of changes in essential fishery habitat areas such as spawning, incubation, rearing, overwintering, and passage habitats. Decreased flows in the late spring and summer can for example lead to dewatering of sloughs. Increased flows in the winter can wash away spawning substrate or destroy sheltering areas and increase turbidity levels. Decreases and increases in flows which alter stream productivity will modify food availability in rearing and overwintering habitats.

In addition to modifying essential habitats, alterations to the Susitna flow regimes can affect the seasonal behavior of fish species. Hynes (1970) discusses the important interrelationships between seasonal flow regimes, fish movement, and human alterations of lotic environment. As a result, the protection of fisheries resources requires not only that certain volumes of instream flow be maintained throughout each life history stage, but also that these specific flows be available at particular times of the year.

In summary, seasonal fluctuations in the physiochemical composition of the aquatic habitat are apparently the major factors influencing distribution of fish within the drainage. Any alterations resulting from the proposed hydroelectric related project activities which will restrict or reduce quality or quantity of required habitat will also reduce fish populations and associated members of the aquatic community. Conversely, alterations which will expand or improve quality or quantity of habitat will provide the potential for enhancing fish productivity.

3. OBJECTIVES

To insure adequate information will be available for evaluating the potential impacts of the proposed hydroelectric project on the fishery resources of the Susitna River prior to determining project feasibility, a two-phase five year data collection program has been initiated.

The following objectives were addressed in the Phase I ADF&G Aquatic Studies ice-covered (December 1980-May 1981) and open water (June 1981 - October 1981) field seasons. The ice-covered study program was subdivided into two sections: RJ, and AH. The open water program was subdivided into three sections: AA, RJ, and AH.

AA Study Section

OBJECTIVE 1.* Determine the seasonal distribution and relative abundance of adult anadromous fish populations produced within the study area (Figure 2).

Task 1.1 Enumerate and characterize the runs of the adult anadromous fish.

Task 1.2 Determine the timing and nature of migration, milling and spawning activities.

* Objective one was not included as part of the ice-covered winter study program.

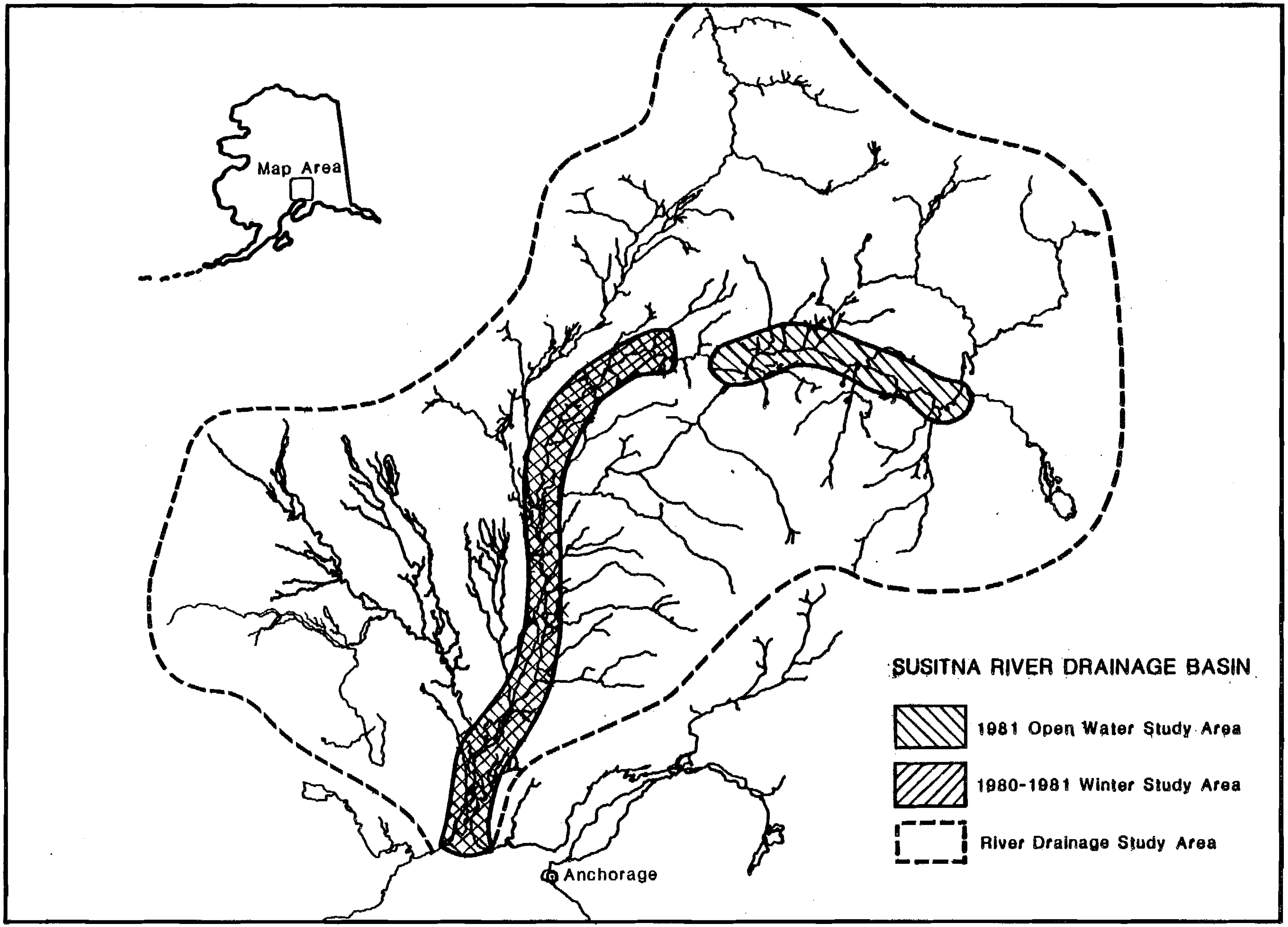


Figure E-3-1. Susitna River drainage showing Phase I study areas.

Task 1.3 — Identify spawning locations within the study area (i.e. subreaches of the mainstem sloughs and side channels, tributary confluences, lakes and ponds, etc.) and estimate their comparative importance.

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

RJ Study Section

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

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

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

AH Study Section

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

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

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

It should be emphasized that this initial report is limited to a presentation of the first stage data reduction of the AH information. Therefore, the above AH objectives will not be addressed in detail until relevant data from the other ADF&G reports and other cooperators are integrated with these data in the February 1982 report.

4. STUDY DESCRIPTION AND RATIONALE

Phase I of the AH Study was subdivided into two segments (Figure E.4.1): 1) fishery habitat evaluations of the principal resident fish, and juvenile and adult anadromous salmon sampling areas and included point specific and general habitat evaluations; and 2) selected habitat evaluations of five sloughs which are representative of other sloughs in the study area between Talkeetna and Devil Canyon.

4.1 Fishery Habitat Evaluations

Fishery habitat evaluation studies were performed during the winter and summer field seasons and were subdivided into point specific and general habitat evaluations (Figure E.4.2). Data were collected by 15 biologists from the AH and RJ projects assigned to five joint crews, four in the lower river and one in the upper river. Crews in the lower river were based in semi-permanent tent camps located at the Yentna, Sunshine and Talkeetna AA fishwheel sites (Figure E.3.1; ADF&G 1981a) and at Gold Creek*. Each crew was self contained and utilized a pickup truck, outboard jet powered riverboat and helicopter for logistical support. The upper river crew utilized a truck, helicopter fixed wing aircraft and river rafts for logistical support. Mobile camps were set up and disassembled at each camp site each sampling period.

* Winter crews were housed in cabins at Gold Creek, Alexander Creek and Talkeetna.

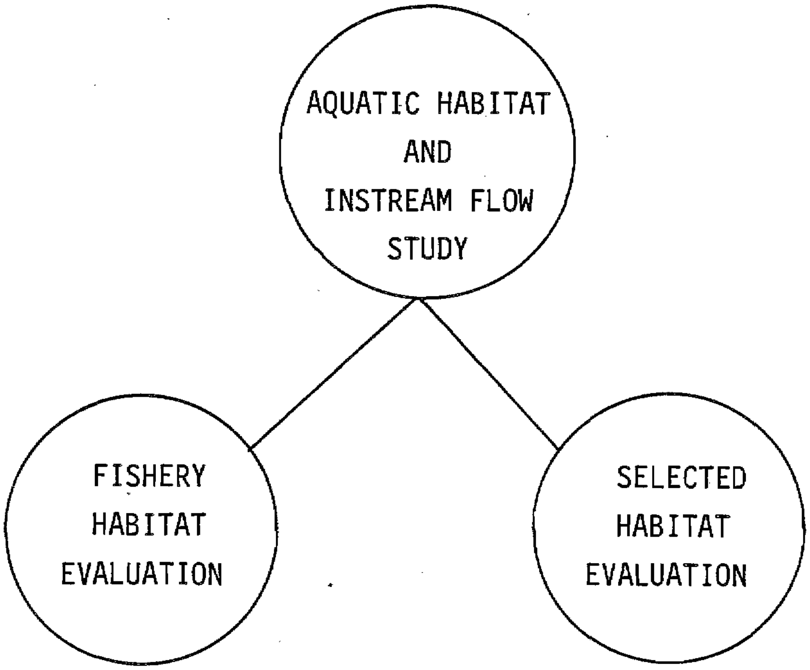


Figure E.4.1. Aquatic habitat and instream flow study program components.

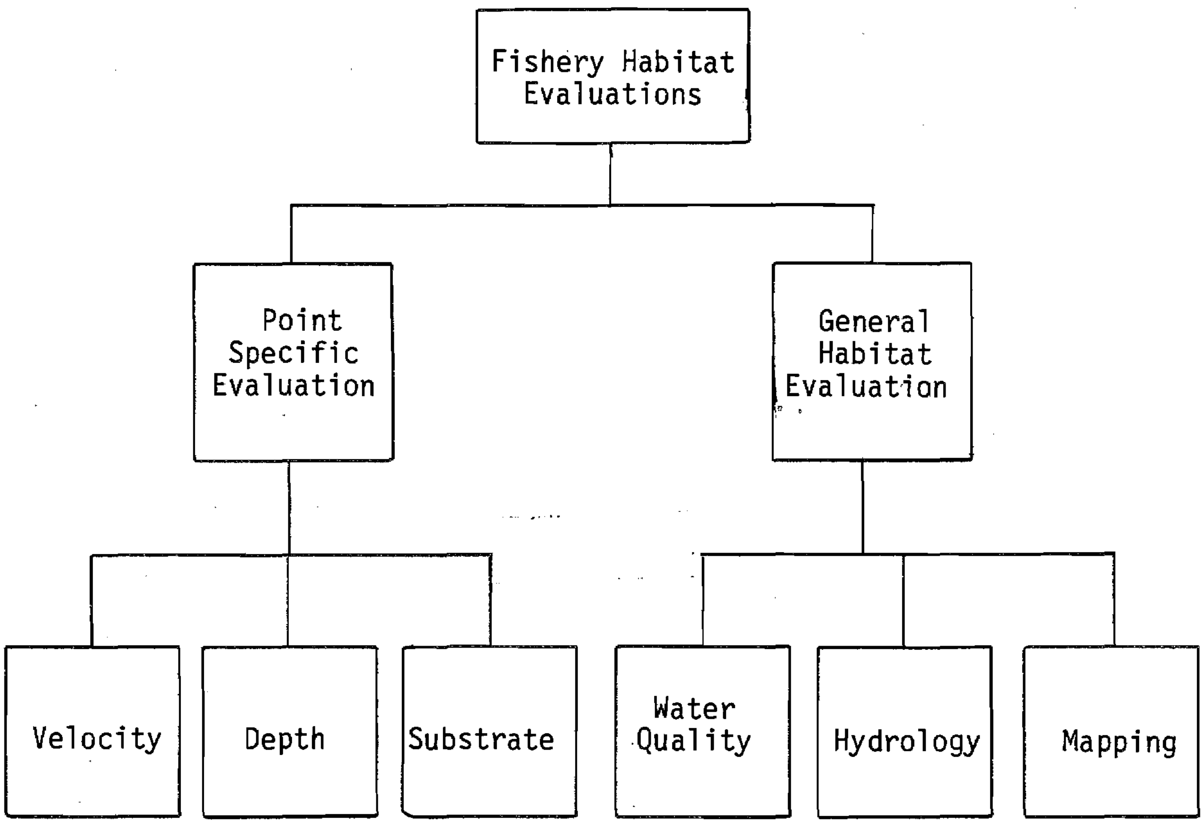


Figure E.4.2. Fishery habitat evaluation components.

4.1.1 Point Specific Evaluation

Velocity, depth, and substrate data were collected at the gear placement sites (gps) (Appendix EG) to characterize the range of streamflow dependent characteristics which appeared to be influencing the suitability of various habitat types for the species and life stages of interest. Incidental velocity, depth, and substrate data were also recorded where fish were observed.

4.1.2 General Habitat Evaluation

General habitat evaluations provided the necessary data to describe and map the overall habitat characteristics of each RJ and AA study site. These data were collected in the study area below Devil Canyon on a twice per month basis with the exception of discharge. Data collected included the parameters listed in Table E.4.1.

4.2 Selected Habitat Evaluation

The Selected habitat evaluation program was designed to evaluate the relationships of mainstem hydraulic and water quality conditions to fisheries habitat in slough areas between Talkeetna and Devil Canyon. The study was divided into two segments:

(1) water quality and discharge data collection; and

(2) surveying and discharge measurements.

4.2.1 Water Quality and Discharge Data Collection

The water quality and discharge measurement data were collected on a cooperative basis with the U.S. Geological Survey (USGS). One crew of two AH biologists and one USGS water quality specialist operated out of the Gold Creek semi-permanent lower river camp. Logistical support was provided by train, fixed wing aircraft, helicopter, pickup truck and an inboard jet boat. These data were collected to characterize ranges of water quality parameters (Table E.4.2) and discharge within the five selected habitat evaluation study sloughs. The sampling was conducted concurrently with the USGS's routine sampling of the mainstem Susitna River at Gold Creek in order to allow comparisons of the water quality parameters between the various sloughs and the mainstem. Samples were obtained three times, one time per seasonal low, medium, and high flows. Two additional sampling trips with the USGS are scheduled for the winter of 1981-82, to characterize low flow winter conditions.

4.2.2 Surveying and Discharge Measurements

Surveying techniques were employed to collect elevation data. One crew of three biologists operated out of the Gold Creek and Talkeetna semi-permanent lower river camps and a mobile tent camp. Logistical support was provided by train, fixed-wing aircraft, helicopter, pickup truck, and an inboard jet boat. Stage and discharge measurements were also collected. These two types of information were used to develop a physical description of each of the five selected habitat evaluation study sloughs and identify, on a preliminary basis, which flow regimes of the mainstem Susitna River would permit accessibility to and from slough habitats by fish. In addition, the relationship between intragravel and surface water temperatures were evaluated at one slough through the use of thermographs.

Table E.4.1. General habitat evaluation parameters.

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

*Note: These parameters were not measured in the Impoundment reach.

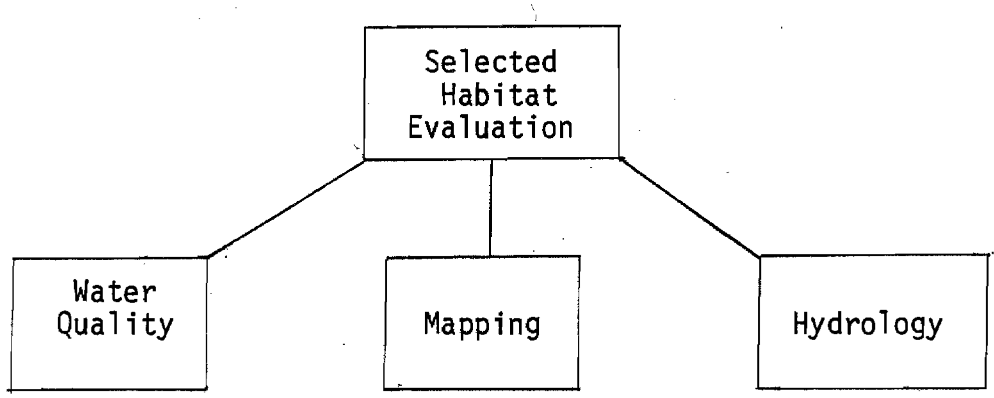


Figure E.4.3 Selected habitat evaluation components.

Table E.4.2. Selected Habitat evaluation, USGS water quality parameters.

Physical and field parameters

Water temperature	°C
Air temperature	°C
Stream flow	cfs
Specific conductance, field	umho/cm
Specific conductance, lab	umho/cm
Dissolved oxygen	mg/l
Percent oxygen saturation	--
pH field	--
pH lab	--
Alkalinity, field	mg/l $CaCO_3$
Alkalinity, lab	mg/l $CaCO_3$
Turbidity	NTU
Sediments, suspended	mg/l
Sediments, discharge suspended	tons/day
Solids, residue at 180°C	mg/l
Solids, sum of constituents	mg/l
Solids, dissolved	mg/l
Solids, dissolved	tons/

Major Constituents

Hardness	mg/l $CaCO_3$
Hardness, non carbonate	mg/l $CaCO_3$
Bicarbonate, incremental titration	mg/l HCO_3
Carbonate incremental titration	mg/l CO_3
Calcium, dissolved	mg/l
Magnesium, dissolved	mg/l
Sodium, dissolved	mg/l
Sodium, percent	--
Sodium, adsorption ratio	--
Potassium, dissolved	mg/l
Chloride, dissolved	mg/l
Sulfate, dissolved	mg/l
Fluoride, dissolved	mg/l
Silica, dissolved	mg/l

Nutrients (all mg/l)

Nitrogen, total
Nitrogen, total as NO_3
Nitrogen, dissolved
Nitrogen, total organic
Nitrogen, dissolved organic
Nitrogen, dissolved ammonia
Nitrogen, dissolved ammonia as NH_4
Nitrogen, total ammonia

Table E.4.2 (Continued)

Nitrogen, ammonia + dissolved organics
Nitrogen, ammonia + total suspended organics
Nitrogen, ammonia + total organics
Nitrogen, total nitrate and nitrite
Nitrogen, dissolved nitrate and nitrite
Phosphorus, total
Phosphorus, total as PO_4
Phosphorus, dissolved
Carbon, dissolved organic
Carbon, total suspended organic

Trace Metals (all ug/l)

Arsenic, total
Arsenic, total suspended
Arsenic, dissolved
Barium, total recoverable
Barium, suspended recoverable
Barium, dissolved
Cadmium, total recoverable
Cadmium, suspended recoverable
Cadmium, dissolved
Chromium, total recoverable
Chromium, suspended recoverable
Chromium, dissolved
Cobalt, total recoverable
Cobalt, suspended recoverable
cobalt, dissolved
Copper, total recoverable
Copper, suspended recoverable
Copper, dissolved
Iron, total recoverable
Iron, suspended recoverable
Iron, dissolved
Lead, total recoverable
Lead, suspended recoverable
Lead, dissolved
Manganese, total recoverable
Manganese, suspended recoverable
Manganese, dissolved
Mercury, total recoverable
Mercury, suspended recoverable
Mercury, dissolved
Nickel, total recoverable
Nickel, suspended recoverable
Nickel, dissolved
Selenium, total
Selenium, total suspended
Selenium, dissolved

Table E.4.2 (Continued)

Silver, total recoverable
Silver, suspended recoverable
Silver, dissolved
Zinc, total recoverable
Zinc, suspended recoverable
Zinc, dissolved

5. STUDY APPROACH

5.1 General Habitat Evaluation

5.1.1 Methods*

5.1.1.1 Physiochemical

Dissolved oxygen, water and air temperature, pH, turbidity, stage and specific conductance were measured twice monthly at each general habitat evaluation study site, except in the Impoundment reach, where these parameters were measured monthly. Data were collected by a joint crew of AH/RJ biologists utilizing customized riverboats as the primary means of transportation. Dissolved oxygen, water temperature, pH, and specific conductance were measured with a Hydrolab model 4041. Calibration of the meter was performed immediately prior to departing for and returning from each sampling period and whenever else deemed necessary. Turbidity samples were collected and stored in 500 ml poly bottles in a cool and dark location until analysis. The turbidity samples were analyzed using a Hach model 2100A turbidity meter. Turbidity samples were analyzed directly from the sample bottles. No filtration or dilution methods were used. Water temperatures were continually recorded at several sites using Ryan Model J-90 thermographs. Stage data were collected by installing staff gages at general habitat evaluation study sites and AA fishwheel and sonar sites.

* Refer to Chapter 5.1.1.3 for a discussion of the 1980-81 winter ice-covered field season methods. Specific methods are presented in Appendix EG.

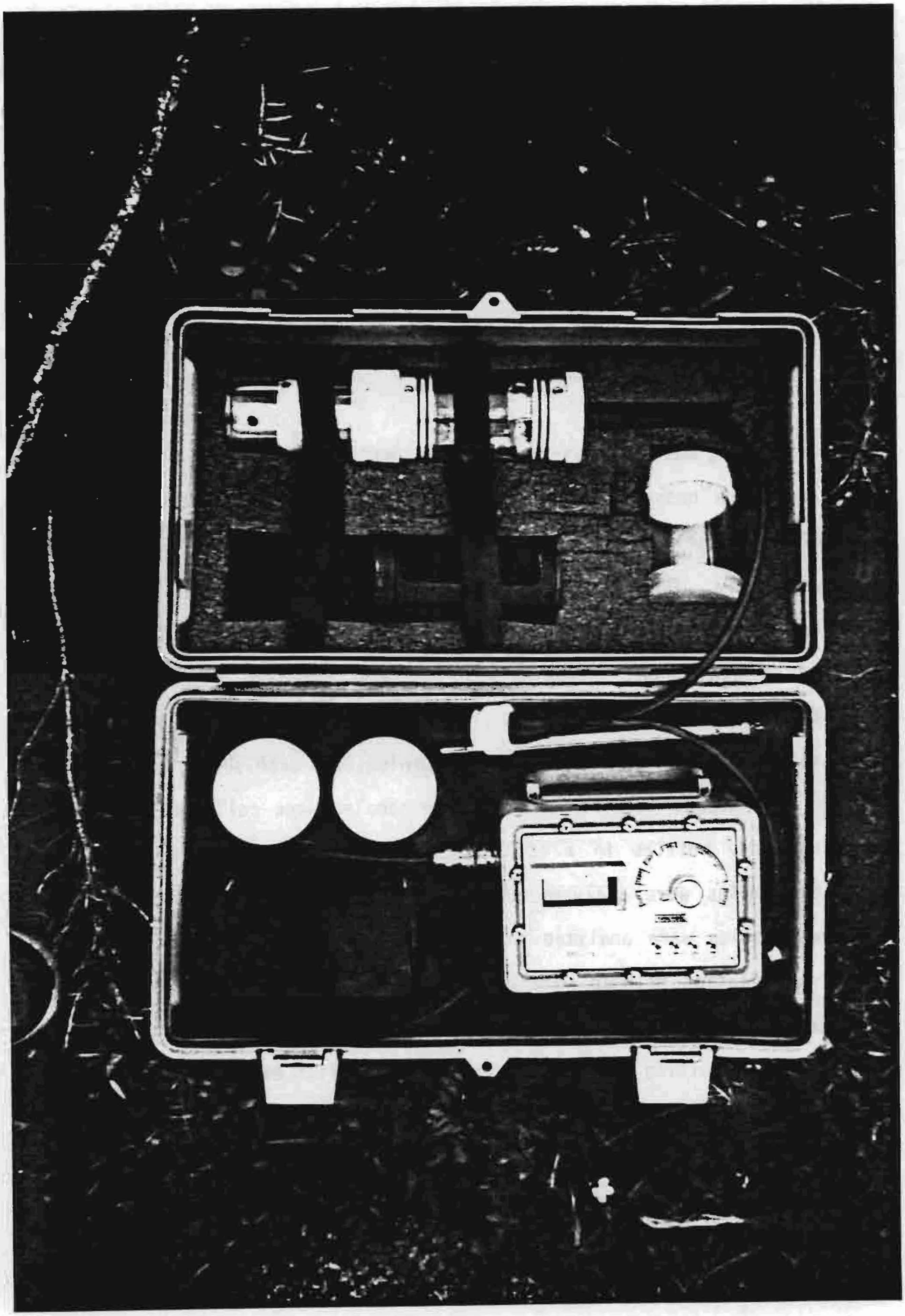


Plate 1. Hydrolab instrument used to collect water quality parameters.

Plate 2. Hydrolab being used to determine water quality parameters at Cache Creek.

Stage data were recorded at least twice monthly at general habitat evaluation sites and one or more times per day at AA sites. Stage data were not collected in the Impoundment study reach. Substrate was categorized as shown in Table E.5.1. Point water velocities were measured with Marsh-McBirney Model 201, Price AA, or pygmy flow meters using standard methods outlined by the respective manufacturers.

Table E.5.1. Substrate size classes

Substrate Class	Size Range (inches)	Substrate Codes*	
--	--	0	Organics
silt	--	1	Silt
sand	--	2	Sand
gravel	1/4-3	3,4,5	1/16"-1/14", 1/4"-1", 1-3"
rubble	3-5	6	3"-5"
cobble	5-10	7	5"-10"
boulders	10	8	greater than 10"
--	--	9	bedrock

* see Appendix EG

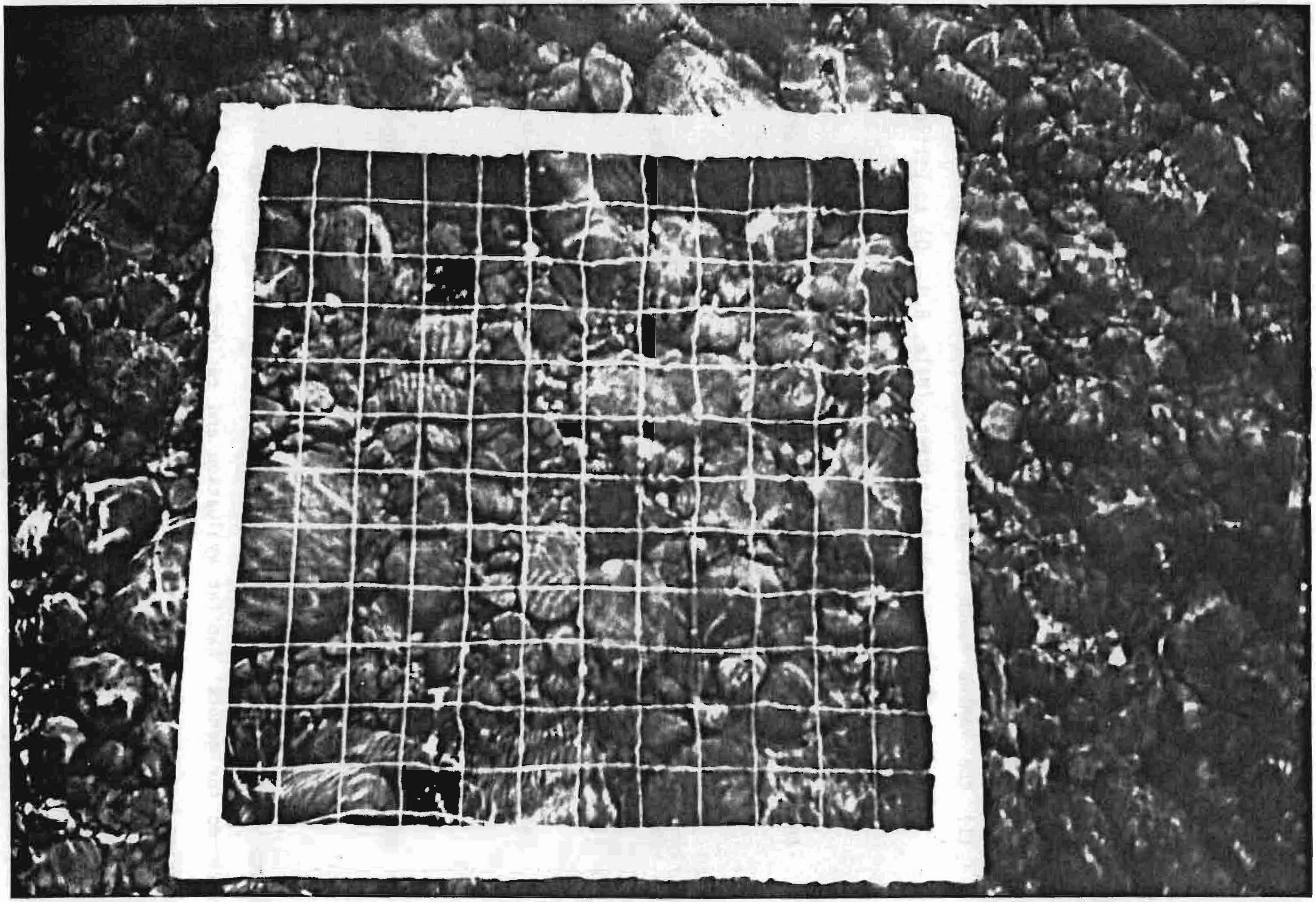


Plate 3. Grid used for substrate determination.

5.1.1.2 Site Selection

The study area (Figure E.3.1) included the majority of the Susitna River between the Denali Highway and Cook Inlet. For logistical and study purposes, the river was divided into the five study reaches (Figures E.5.1-E.5.5) below:

(1) the Yentna reach (Figure E.5.1) extends from the mouth of the Susitna River at Cook Inlet River (Mile, R.M., 0) to Little Willow Creek (R.M. 50.5);

(2) the Sunshine reach (Figure E.5.2) extends from Rustic Wilderness (R.M. 58.1) to the Parks Highway Bridge (R.M. 83.5),

(3) the Talkeetna reach (Figure E.5.3) extends from the Parks Highway Bridge (R.M. 83.5) to Curry (R.M. 120.7),

(4) the Gold Creek reach (Figure E.5.4) extends from Curry (R.M. 120.7) to Portage Creek (R.M. 148.8), and

(5) the Impoundment reach (Figure E.5.5) extends from Devil Canyon (R.M. 151) to the Denali Highway (R.M. 281.0).

Eight to thirteen representative general habitat evaluation study sites were selected for general habitat evaluation and resident and juvenile fisheries studies in each of the five study reaches. Point specific and general habitat

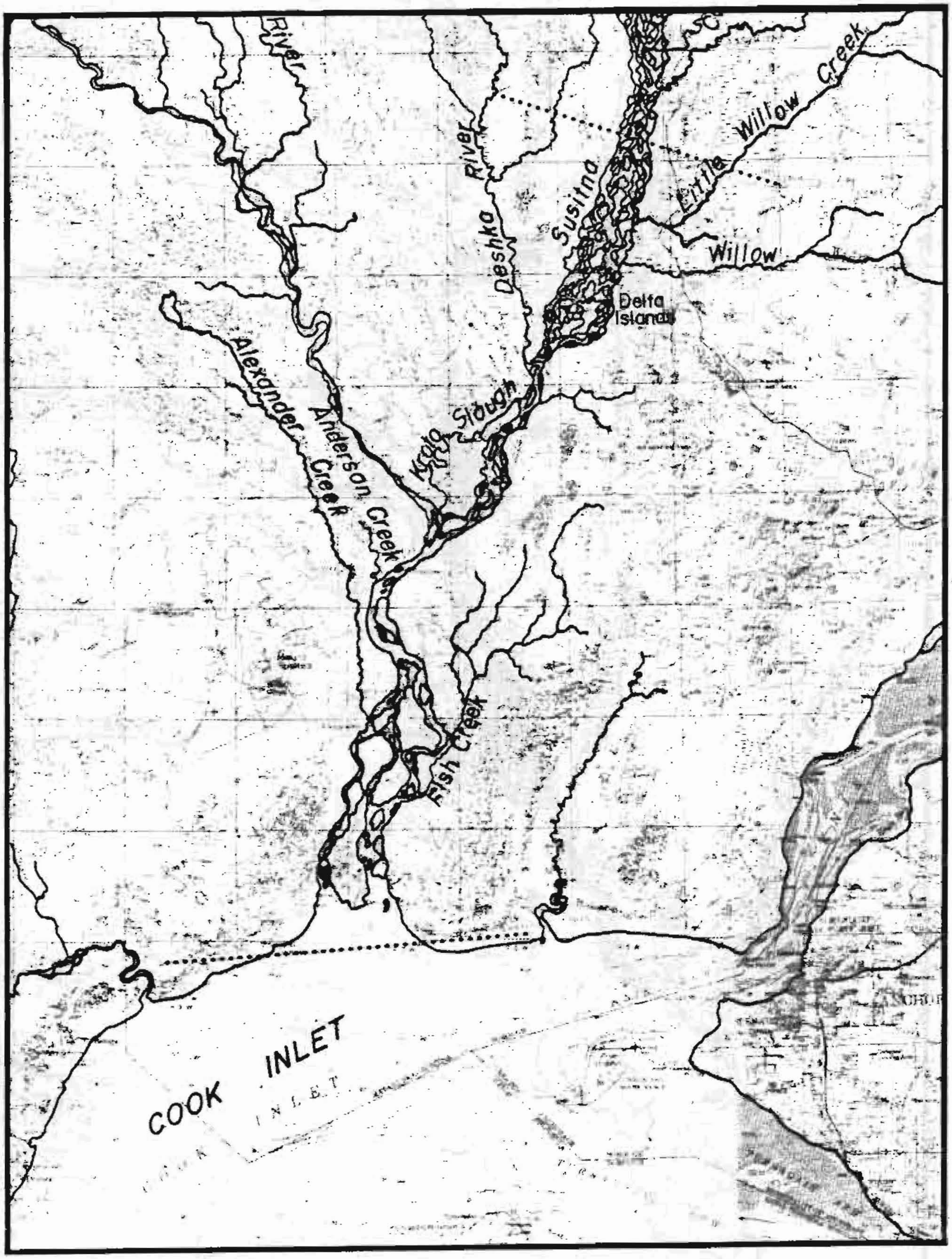


Figure E.5.1. Yentna study reach.

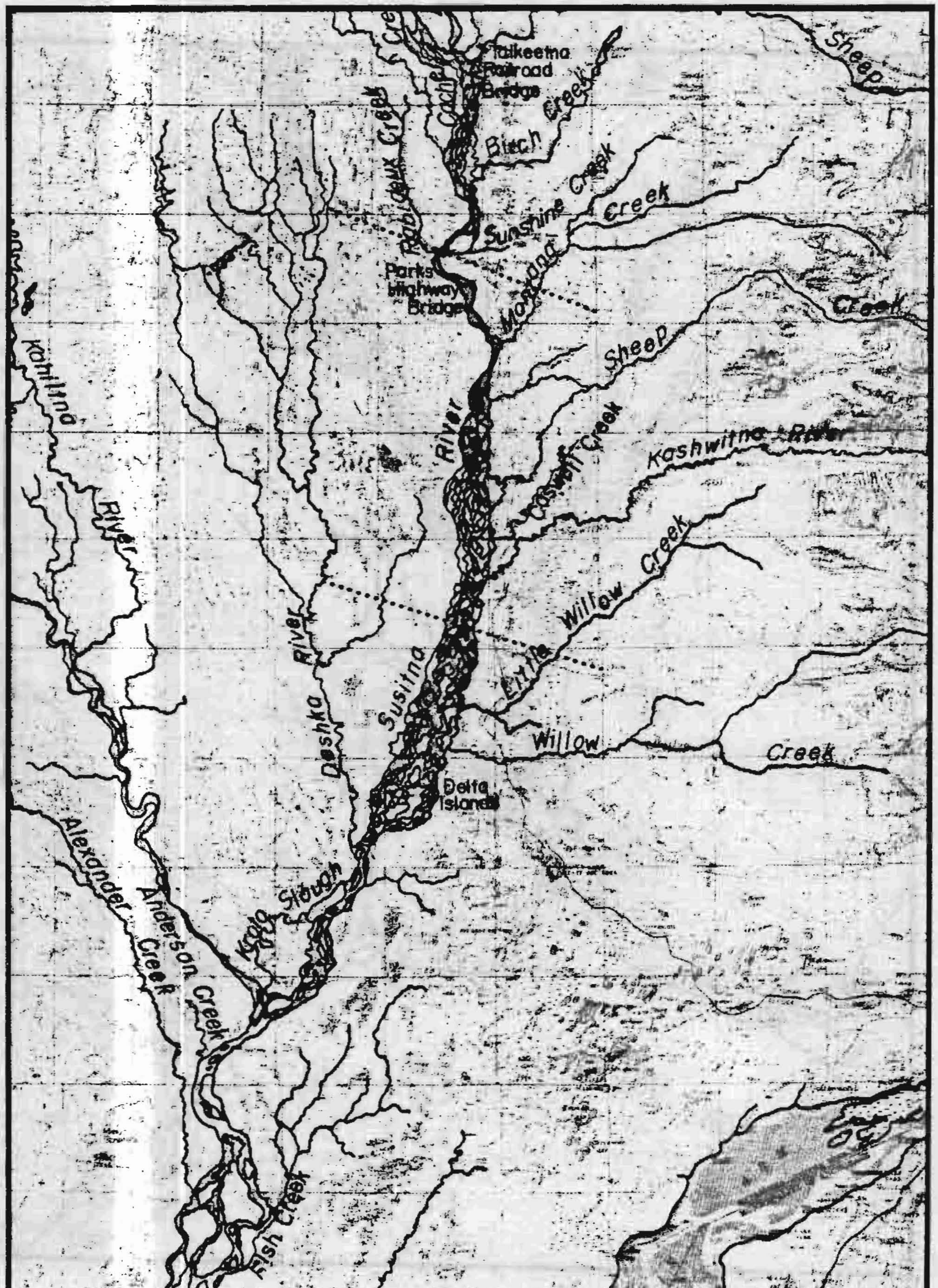


Figure E.5.2. Sunshine study reach.

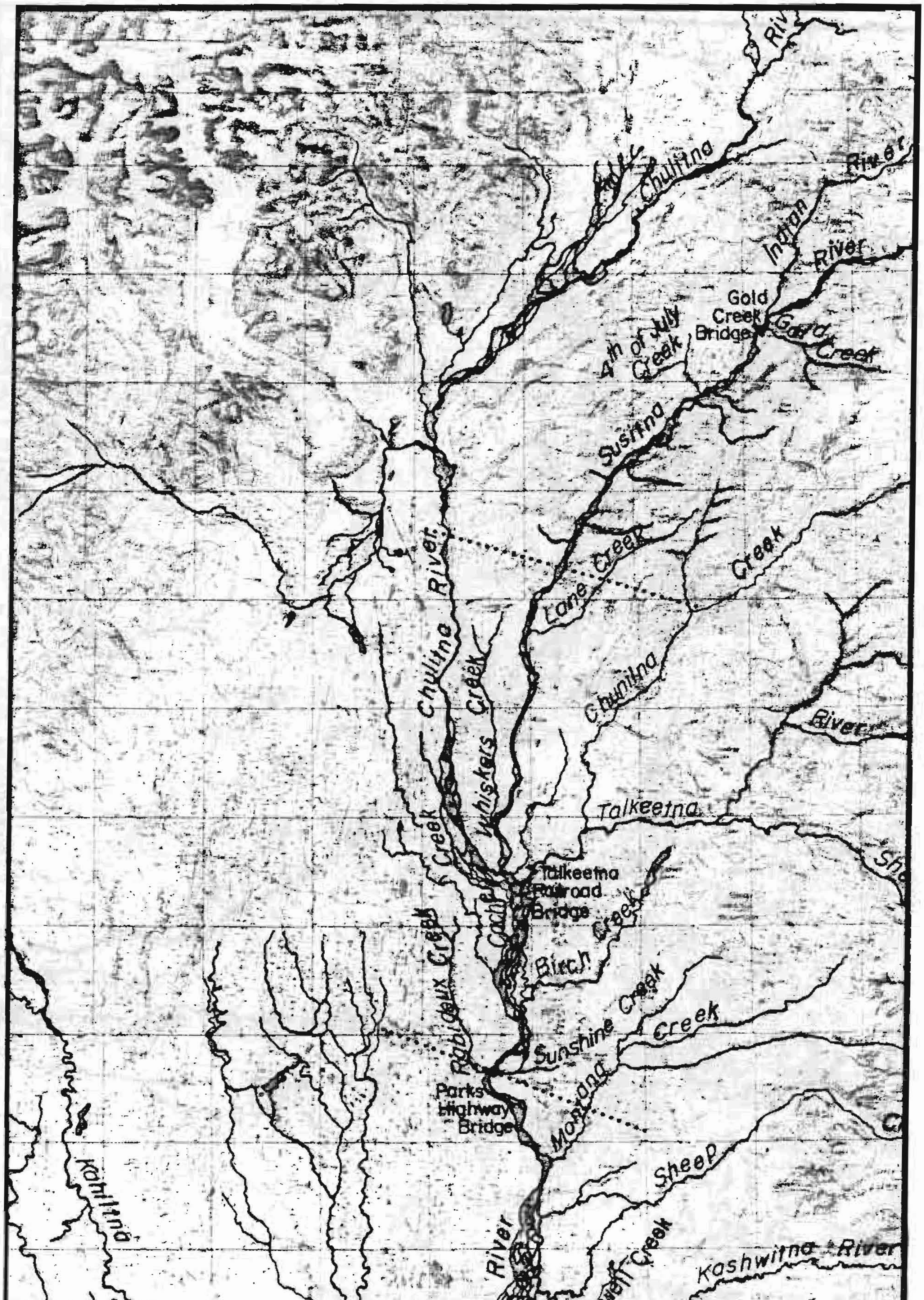


Figure E.5.3. Talkeetna study reach.

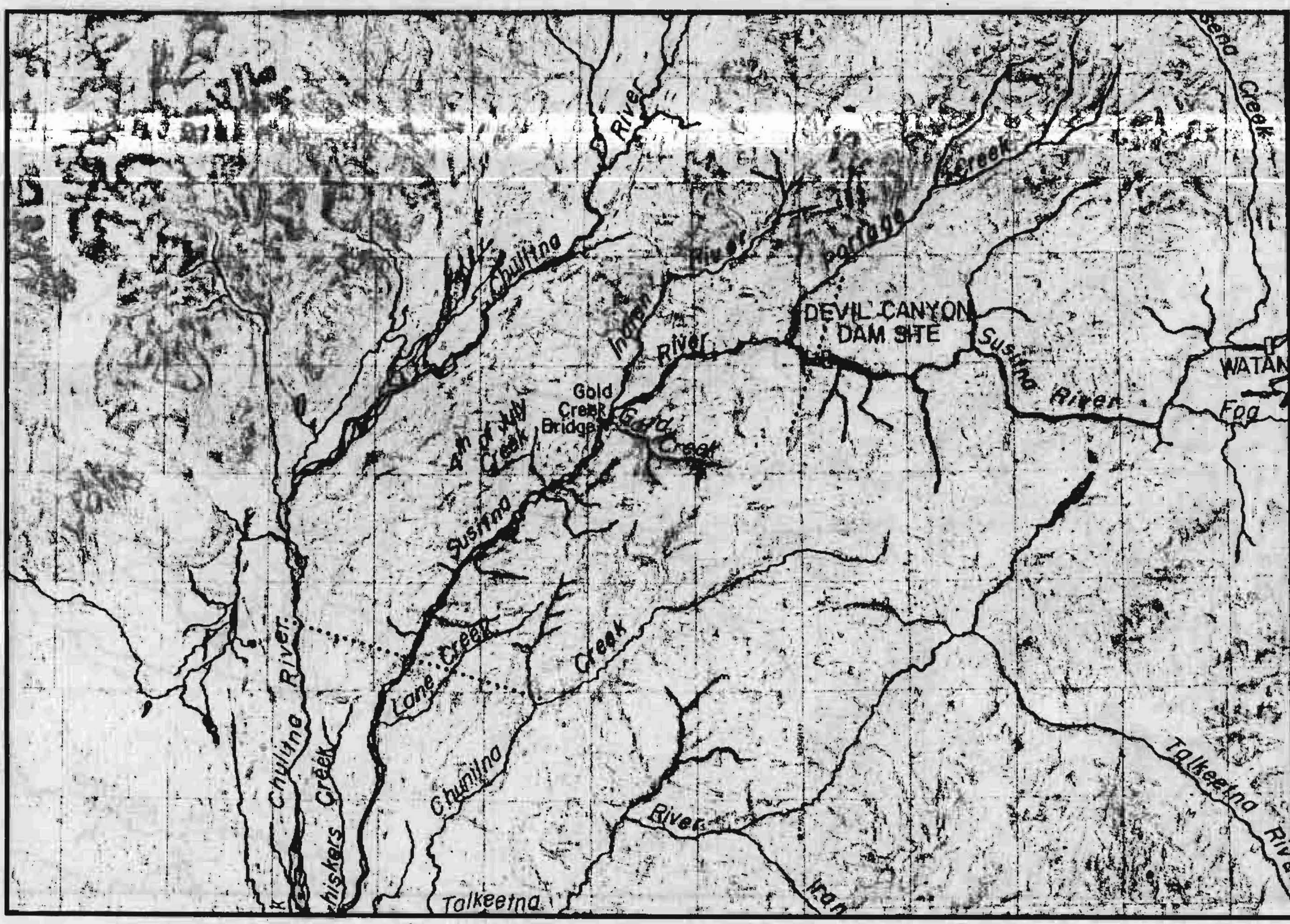


Figure E.5.4. Gold Creek Study reach.

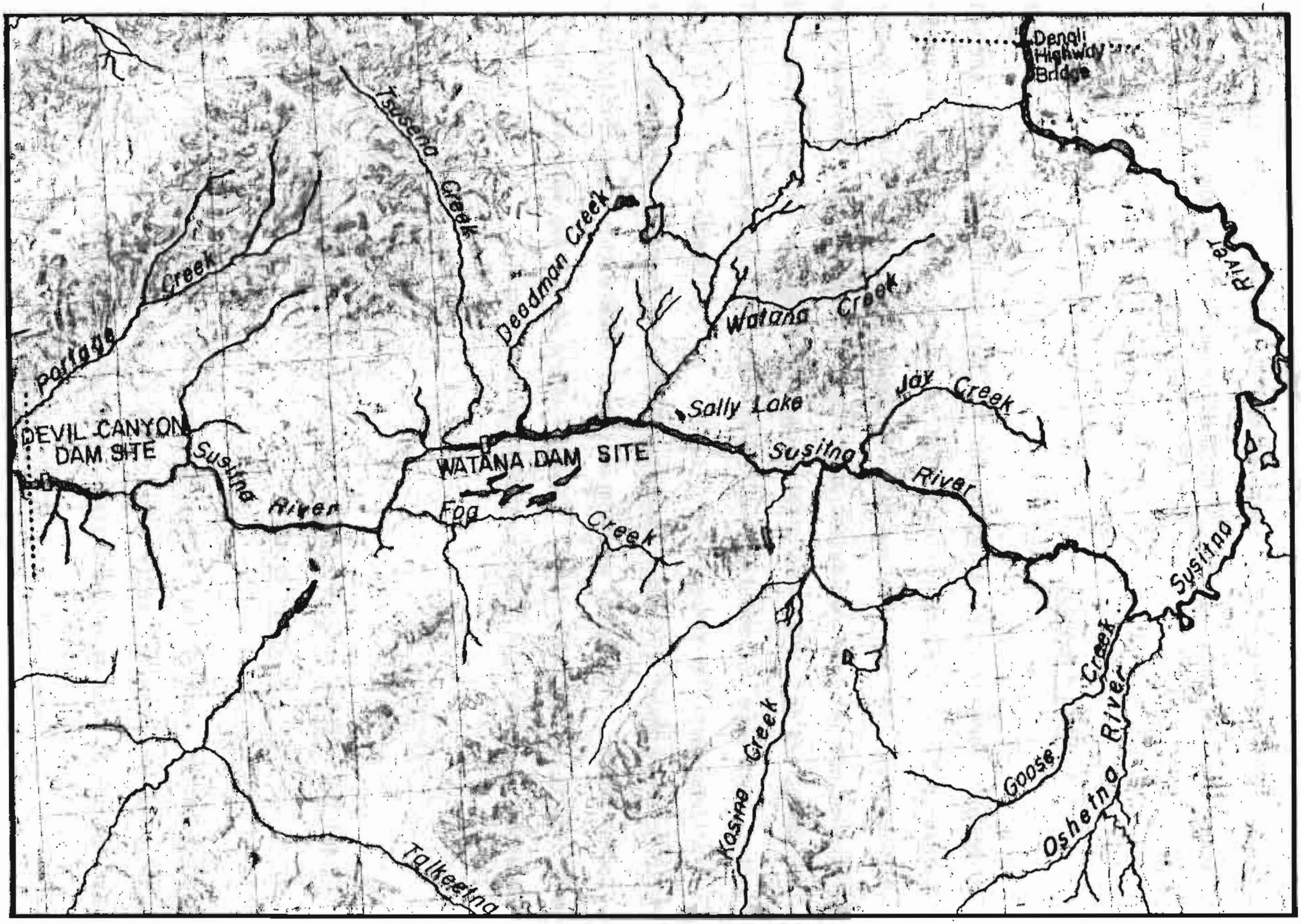


Figure E.5.5. Impoundment study reach.

data were collected at each of these sites. Data were also collected at the AA sonar and fish wheel sites, identified spawning sites and special study areas.

5.1.1.3 Winter Methods

The methods used in the collection of AH data during the winter 1980-81 ice-covered field sampling period varied in several aspects from the summer 1981 sampling. The Hydrolab and Marsh-McBirney units used during the summer period had not yet been purchased, thus other instruments were borrowed from other ADF&G and U.S. Fish and Wildlife Service projects. Water quality and quantity data were collected with a YSI-33 dissolved oxygen meter, a YSI-SCT (salinity-conductivity-temperature) meter, a Digisense pH meter, a Marsh-McBirney Model 201 water velocity meter, and Price AA and Pygmy water velocity meters. Turbidity was not measured. Snow machines and helicopters were used to access study sites. In areas where open leads were not present, ice augers were utilized to access water for sampling.

5.1.2 Findings

5.1.2.1 Habitat Descriptions of Each General Habitat Evaluation Study Site by River Reach.

Representative general habitat evaluation study sites were sampled twice monthly to characterize their physiochemical parameters. A brief habitat description of each general habitat evaluation study site, grouped by river

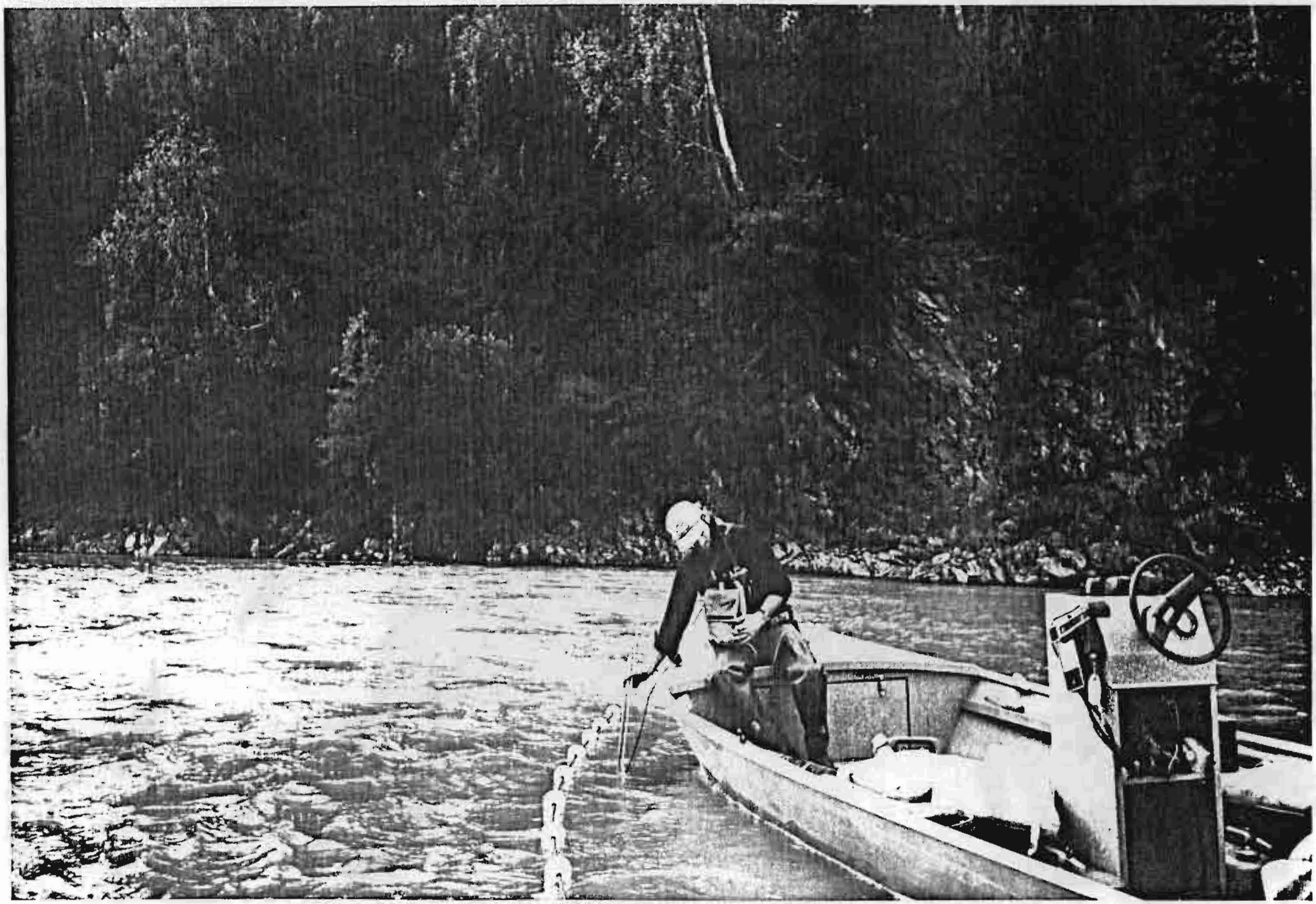


Plate 4. Velocity measurements being taken at a gill net set at Mainstem Susitna - Curry.

Plate 5. Use of an ice auger for winter sampling.

reach, is presented below. Planimetric maps of each general habitat evaluation study site are presented in Appendix EA.

5.1.2.1.1 Yentna Reach

(1) General description.

The Yentna reach (Figure E.5.1) extends from the mouth of the Susitna River at Cook Inlet (R.M. 0.0) to Little Willow Creek (R.M. 50.5). There are 13 general habitat evaluation study sites in the Yentna reach including:

Study Site	River Mile	Geographic Code*
Fish Creek	7.0	15N07W27AAC
Alexander Creek Site A	10.1	15N07W06DCA
Site B - 2.0 Miles Upriver		16N07W32CCB
Site C - 4.0 Miles Upriver		16N07W30ACD
Anderson Creek	23.8	17N07W29DDD
Kroto Slough Mouth	30.1	17N07W01DBC
Mainstem Slough	31.0	17N06W05CAB
Mid-Kroto Slough	36.3	18N06W16BBC
Deshka River Site A	40.6	19N06W35BDA
Site B - 1.0 Miles Upriver		19N06W26BCB
Site C - 3.5 Miles Upriver		19N06W14BCA
Lower Delta Islands	44.0	19N05W19ACB
Little Willow Creek	50.5	20N05W27AAD

* Refer to the ADF&G (1981b) Procedures Manual for a description of the Geographic Code.

The geomorphology of the Susitna River varies in this reach. The Susitna River above the confluence with the Yentna River forms a braided channel. Below the Yentna River, the Susitna River forms a single meandering channel to the head of Bell Island. At Bell Island, the Susitna River separates into two braided channels and remains divided to the inlet. During all but the periods of highest discharge, there are large sand and silt bars and log jams present. The overall gradient for the reach is approximately 1 ft/mile (corresponding to a drop of 50 feet in elevation in 43.5 miles). The surrounding area is low in relief with meadows, muskeg and cottonwood present. The typical substrate is silt and sand.

The Alexander and Deshka Rivers are heavily fished during the chinook and coho salmon seasons. Many year round and seasonal homesites are located on these systems. The only residents on the mainstem Susitna River are near Susitna Station (R.M. 25.4). The mainstem Susitna River is utilized primarily for access to other areas of the river's drainage.

(2) Habitat descriptions of general habitat locations in the Yentna Reach.

Fish Creek

The study site (Appendix EA, Figure EA-1) is located at the confluence of Fish Creek with the east channel of the mainstem Susitna River. Fish Creek is a relatively narrow meandering muskeg-influenced creek which carries a heavy silt load in spring. Depths in the study area vary from 2 feet to over 8 feet near the confluence. A small lake outlet enters the lower portion of the study area. Typical substrate in the study area is silt. Cover is provided by cutbanks, riparian vegetation and high turbidity during the spring runoff. This general habitat evaluation study site was eliminated after one sampling period due to logistical reasons. Adult chinook salmon have been reported in the study site.

Alexander Creek

Alexander Creek, a relatively shallow, meandering muskeg influenced stream, is located at river mile 10.1. There are three separate general habitat evaluation study sites located on this creek. Adult salmon that have been reported to utilize this system include chinook, coho, chum, pink and sockeye salmon.

Site A

Site A (Appendix EA, Figure EA-2) is located at the high water confluence of Alexander Creek with the west channel of the mainstem Susitna River (R.M. 10.1). The creek at this site is relatively deep and wide with a uniform cross section. The Susitna River interface extends upstream approximately 14 the length of the study site. The substrate was predominately composed of silt throughout the sampling season. The west bank is a relatively high cutbank with fallen trees providing cover. The east bank is sloping with alder and willow providing cover under high discharge conditions.

Site B

Site B (Appendix EA, Figure EA-3) on Alexander Creek is located 2.0 miles upstream of the confluence. The creek in the study area is relatively shallow, with substrate consisting of silt and mud. There is a low grass covered mud island in close proximity to the northeast bank. Under high discharge conditions, overhanging and fallen trees provided cover along sloping banks.

Site C

Site C (Appendix EA, Figure EA-4) on Alexander Creek is located 4.0 miles upstream of the confluence. During periods of high discharge, the creek in this study site was relatively deep (3-5 feet). Under these conditions, a deep pool formed on the west bank of the lower portion of the study site. Banks were both sloping and cut. Typical substrate consisted of mud, sand and gravel. A small clearwater tributary, Granite Creek, entered the study area. Under high discharge conditions, Granite Creek deposited a delta of sand and gravel extending across 34 of Alexander Creek. Cover is provided by overhanging vegetation and submerged grasses.

Anderson Creek

The study site (Appendix EA, Figure EA-5) is located at the confluence of Anderson Creek and the Susitna River. The geomorphology and the physiochemistry of this site is greatly influenced by the Susitna River. The creek mouth varies from 15 feet to 40 feet in width and is approximately six feet in depth under high discharge conditions. The width was reduced to approximately five feet as the discharge dropped. Under high discharge conditions, when the flow of the creek was backed up by the Susitna River, velocities in the study site were low (0-0.2 ft.sec.) and turbidities were high. As the discharge dropped and the influence of the Susitna River lessened, velocities increased slightly and turbidities dropped. The substrate and sloping banks consisted almost entirely of silt. During periods of high discharge, cover is provided by overhanging alder. Adult coho, chinook, pink and sockeye salmon have been observed in the study site.

Kroto Slough Mouth

The study site (Appendix EA, Figure EA-6) is located at the confluence of Kroto Slough and the Yentna River, approximately 2.0 miles upriver from the confluence of the Yentna River with the mainstem Susitna River (R.M. 30.1). The major influence on the slough in the study area ultimately depends on the stage at the mid-Kroto Slough fork. Under low discharge conditions, the majority of the flow from upper Kroto Slough is diverted by sandbars into the Susitna River. As a result, the primary influence of the slough at the mouth becomes dependent on tributaries that enter the slough below the fork. Under high discharge conditions, the upper Kroto Slough flow is not entirely diverted, causing the influence of the slough at the mouth to be a mixture of the two water sources. The slough in the study area is relatively shallow and meandering. The width of the study area is approximately 200 feet with depths varying depending on discharge. The north side of the study site consists of a low cutbank and a large silt bar (50-100 feet in length). The south side consists of a higher cutbank (5-8 feet) with no bars present until very low discharges. The substrate consists entirely of silt. Under high discharge conditions, when the banks were flooded, cover was provided by overhanging willow and alder. Overall the site was relatively stable, with the most significant variable being water level fluctuation. Adult chinook, coho and sockeye salmon have been observed in the study site.

Mainstem Slough

The study site (Appendix EA, Figure EA-7) is located in a side channel slough of the Susitna River. The site has two different habitat types. The lower portion of the study consists of a large back eddy (approximately 200 x 1000 feet) characterized by low velocities, silt deposits and depths ranging from 3 to 10 feet. Cover is provided by a debris jam at the lower end of the site and vegetation along sloping banks. The slough in the upper portion of the study site by contrast is relatively narrow, shallow, and fast running. Substrate is typified by rubble. Under low discharge conditions, current in the lower portion of the study site increased, eliminating the back eddy. Adult salmon observed in the study site include chinook, coho, pink, chum and sockeye salmon.

Mid-Kroto Slough

The study site (Appendix EA, Figure EA-8) is located where Kroto Slough forks at river mile 36.3 of the Susitna River. The majority of the flow returns via a fork to the Susitna River. Under low discharge conditions, sand bars appeared in the vicinity of the fork. These sand bars diverted an even greater percentage of the discharge into the Susitna River, causing the downstream portion of the slough to be influenced primmarily by tributaries. The slough at the study site is fairly wide (100-200 feet) and fast running. Substrate is predominantly silt with sand and gravel present in the vicinity of the fork. There is a four foot silt cutbank on the east side of the slough. the bank on the southwest side varies from 2-8 feet in height and has not been eroded recently. During periods of high discharge, cover is provided by bank vegetation and debris. Adult coho and chinook salmon have been observed in the study site.

Deshka River

The Deshka River (Kroto Creek) is a relatively shallow, meandering river influenced by adjacent muskeg habitats. There are three separate general habitat evaluation study sites located on the Deshka River. Adult chinook, coho, chum, pink and sockeye salmon have been reported to utilize this system.

Site A

Site A (Appendix EA, Figure EA-9) is located at the confluence of the Deshka River with the mainstem Susitna River. The study site geomorphology and physiochemistry is heavily influenced directly by the mainstem Susitna River and indirectly through a small slough that enters the study area on the east bank of the Deshka River during periods of high discharge. The river in the study site is relatively wide and deep with the substrate consisting almost entirely of silt. Gear placement was along the west bank, which is steep and wooded with many recreational cabins and small floating docks present. During periods of high discharge, cover was provided by overhanging vegetation.

Site B

Site B (Appendix EA, Figure EA-10) on the Deshka River is located 1.0 mile upriver from the confluence. The river in the study site is relatively shallow and meandering. The channel substrate is silt, with rubble present in several areas of the banks. Gear placement is along the west bank which is steep and wooded. Vegetation provided cover under high discharge conditions. A year round homesite is located on the east bank.

Site C

Site C (Appendix EA, Figure EA-11) on the Deshka River is located 3.5 miles upriver from the confluence. The river in the study site is relatively shallow and narrow. Under low discharge conditions, riffles developed on the east side of the channel. Several holes are present on the west side of the channel. Cover is provided along sloping banks by debris and overhanging vegetation. Substrate is composed of sand, silt and gravel.

Lower Delta Islands

The mainstem study site (Appendix EA, Figure EA-12) is located at the downstream side of the Delta Islands, at the confluence of center channel with the mainstem Susitna River. The river from the west bank to mid-channel is relatively wide, deep and fast flowing. There is a large debris jam present on the west bank. The river in the vicinity of the east bank is relatively shallow and characterized by low velocities. A deep back eddy pool exists at the confluence. The west bank is sloping with overhanging vegetation providing cover. The east bank consists of a silt bar. The channel substrate consists almost entirely of silt. Aside from water level fluctuations, the site was relatively stable. The site was eliminated in mid-August for safety reasons. Adult chinook and pink salmon have been observed in the study site.

Little Willow Creek

The study site (Appendix EA, Figure EA-13) is located at the confluence of Little Willow Creek with an east bank slough of the Susitna River (R.M. 50.5). The creek in the study area is a narrow (approximately 30' wide), meandering clearwater stream, containing a relatively deep pool. Under high discharge conditions, the substrate consisted almost entirely of silt. Under low discharge conditions, when the flow of the creek was no longer backed up by the slough, velocities in the creek increased and the silt substrate was replaced by sand. Cover is provided along sloping banks by debris and overhanging willows. Adult chinook, coho and chum salmon have been observed at this site.

5.1.2.1.2 Sunshine Reach

(1) General description.

The Sunshine reach (Figure E.5.2) of the Susitna River extends from Rustic Wilderness (R.M. 58.1) to the Parks Highway Bridge (R.M. 83.5). Ten general habitat evaluation study sites were located within this reach. The Rabideux

Creek site was eliminated due to logistical difficulties and establishment of sites in four other tributaries of this reach. River miles and geographic codes of the study sites are presented below:

Study Site	River Mile	Geographic Code
Rustic Wilderness	58.1	21N05W25CBD
Kashwitna River	61.0	21N05W13AAA
Caswell Creek	63.0	21N04W06BDD
Slough West Bank	65.6	22N05W27ADC
Sheep Creek Slough Mouth	66.1	22N04W30BAB
Goose Creek (Lower) 1	72.0	23N04W31BBC
Goose Creek (Lower) 2	73.1	23N04W30BBB
Mainstem West Bank	74.4	23N05W13CCD
Montana Creek	77.0	23N04W07ABA
Rabideux Creek	83.1	24N05W16ADC

The reach varies in elevation from approximately 125 to 275 feet above mean sea level and has an approximate gradient of 5.9 ft.mile (corresponding to a 150 foot drop in elevation over 25.4 river miles). This reach lies between the foothills of the Talkeetna Mountains on the east and the marshy area below the Alaska Range on the west. The river in the lower two thirds of this reach is extensively braided with forested islands and non-forested bars between the braids of the channel. The upper third of the reach narrows and the braiding reduces until at the Parks Highway Bridge there is one channel. Above the bridge the river begins to braid again.

The Sunshine reach is the most accessible of the five study reaches. All of the sites on the east side of the river are accessible by the present road system. These roads are a combination of public and private and are either paved, gravel or four wheel drive trails. The sites on the west side are accessible only by boat, helicopter andor snow machine. The Alaska Railroad parallels the Susitna River throughout the reach at a distance of about 200 to 800 yards from the mainstem. Several private airstrips are present.

There are several homesites along this part of the river. The tributaries entering from the east are popular salmon fishing areas with chinook taken in the mid-summer and coho in the early fall. There is potential for future agricultural development in this region. Very little hunting pressure was observed. Recreational boating was associated with salmon fishing.

(2) Habitat Descriptions of General Habitat Study Locations in the Sunshine Reach.

Rustic Wilderness

The Rustic Wilderness study site (Appendix EA, Figure EA-14) is located in an east bank side channel of the Susitna River. It is located adjacent to a real estate development of the same name. The dominant vegetation at this site is spruce-birch forest with alder and willow present where the soil has been disturbed. At high water, 60-70% of the shoreline is densely vegetated. High turbidity made determination of substrate difficult. The site was in a stable area, with no significant change in habitat noted except the rise and fall of water levels.

Kashwitna River

The Kashwitna River study site (Appendix EA, Figure EA-15) is located three miles upstream from Rustic Wilderness, on the east bank of the Susitna River. The Kashwitna River is a fast flowing, relatively stable meandering glacial stream. The study site is located at the confluence of the stream with the mainstem Susitna River. Under high discharges, the mouth of the stream divides into two channels separated by a gravel bar and an island. Only the channel present during low discharges was sampled on a routine basis. Large deposits of light colored, granular sand were observed deposited at the mouth of a slough at the upper end of the site and on the bottom half of the gravel bar separating the high water channels. The channel that was present only during periods of high discharges had bottom substrate of this same sand. During periods of relatively high velocity, parts of the site maintained the same deposits of large debris throughout the season, providing sources of cover. Turbidity and overhanging riparian vegetation also provide sources of cover. Logs are embedded into the bank of the south side of the island. These logs protrude into the main channel providing cover. Adult coho and pink salmon were observed in this study site.

Caswell Creek

This study site (Appendix EAA, Figure EA-16) is located on the east bank of the Susitna River at the confluence of Caswell Creek with the mainstem Susitna River. The water in this creek is of lake and muskeg origin, resulting in its brown appearance. The site is characterized by low velocities during high stage conditions. The creek bottom was covered with silt until late in the sampling season when the lowered stage and increased velocities flushed the silt from the channel exposing a gravel substrate. The banks were perpendicular to the water surface and slightly undercut on the outside of the sharp bends. The creek, in the study site, can be characterized as relatively stable and meandering with shrubs on the banks providing cover. Adult coho, pink and sockeye salmon were observed in this site.

Slough - West Bank

Three study sites were established in a complex slough system on the west bank of the Susitna River, and called Slough West Bank. The upper two study sites were dropped because preliminary investigation determined that the lower site would typify the habitat for this area. Little change was observed in this site (Appendix EA, Figure EA-17) until late summerearly fall when the lowered discharge of the mainstem permitted a slight backflow of the mainstem Susitna River water into the slough. A bloom of algae was observed at that time. Due to high turbidity, the substrate was not observable for most of the season. Probing indicated the substrate to be primarily silt with embedded gravel of undetermined size. During high discharges, overhanging riparian vegetation provided cover along both banks.

Sheep Creek Slough

The study site (Appendix EA, Figure EA-18) is located at the confluence of Sheep Creek Slough and the mainstem Susitna River. Mainstem Susitna River water is permitted through the head of this slough only under extremely high discharge conditions. Even under these conditions, the influence of mainstem water on the study site was minimal. Sheep Creek exerted the dominant water influence on this site for the entire sampling season. The channel bottom was silt laden throughout the entire sampling season. Overhanging riparian vegetation provided cover along most of the north bank but was less extensive on the southern bank, partially due to trampling by fishermen. Concurrent with the low discharges at the end of the sampling season, a build up of sand was observed at the confluence of the mainstem Susitna River and the slough. Adult coho, chinook, pink and chum were observed at the study site.

Goose Creek (Lower) 1

On the east side of the Susitna River, approximately six miles upstream from the mouth of Sheep Creek Slough, a study site (Appendix A, Figure 19) was established at the mouth of Goose Creek. Approximately 1-2 miles upstream from the mouth of Goose Creek, a branch from Sheep Creek enters Goose Creek. This results in the water at the mouth of Goose Creek to be a mixture of the two water sources. Early in the sampling season a wedge of sand entered the top of the site. The sand progressed rapidly downstream to cover the creek bottom over the entire site. The lowered discharges and increased velocities at the end of the season flushed the sand exposing a gravel substrate. The mouth of the creek was stable in most respects. Adult coho, pink and chum salmon were observed in this site.

Goose Creek (Lower) 2

A second study site (Appendix EA, Figure EA-20) on Goose Creek is located approximately one mile north of the main mouth of Goose Creek. This site is located at the confluence of the mouth of a small braided channel off Goose Creek and a mainstem Susitna River slough. The creek substrate consists of sand, which was deposited by the stream at the head of a large deep pool in the slough. The stream water was slightly turbid for most of the season and cleared at the end of the sampling season. The slough was turbid throughout most of the sampling season. Once the mainstem Susitna River stage dropped at the head of the slough, a gravel bar at the head of the slough blocked the flow of mainstem Susitna River water entering the slough, allowing the slough to clear. At the end of the sampling season, the mouth of the slough had a riffle zone passing less than six inches of water. Cover in the stream section is limited to riparian vegetation and a small amount of debris. Cover in the slough is limited to a debris jam at the junction of the stream and the slough, a deep pool and a few boulders. No significant change in the structure of the site was noted throughout the sampling season. Adult coho, pink and chum salmon were observed in this site.

Mainstem - West Bank

Mainstem - West Bank is located 1.5 miles north of Goose 2, on the west bank of the Susitna River. This study site (Appendix EA, Figure EA-21) is located at the lower end of a complex slough system that is approximately two miles in length and 0.5 mile wide, including the islands and channels. The site was turbid until it cleared toward the end of the sampling season when the discharge of the Susitna River dropped, dewatering the head of the slough. A gravel bar that divided the upper half of the site was submerged as the discharge increased. Thin ice and low discharges were observed at the end of the sampling season. Overhanging riparian vegetation was present along most of the banks during high discharges. As the discharges decreased, the vegetation provided cover only along the deeper west bank. At this time the bottom was 100% gravel over most of the site. No adult salmon were observed in this site.

Montana Creek

Two and a half miles north of the Mainstem-West Bank site, on the east bank of the Susitna River, a study site was established at the mouth of Montana Creek (Appendix EA, Figure EA-22). The channel shape and bedload at this site appeared to be the most dynamic of the sites in the Sunshine reach. The upper three-fourths of the site was low in turbidity throughout the entire sampling season while the turbidity of the lower quarter was dependent on the influence of the Susitna River. The geomorphology of the upper half of the site varied mainly with the discharge of the creek, while in the lower half the channel and substrate shifted as the discharge of the Susitna River varied. Cover types were diverse at this site, including overhanging riparian vegetation along both banks, scattered small pools, debris and isolated undercut banks. The types of habitat available in the lower half of the site varied with the level of the water. The substrate consisted mainly of gravel with some sand present. The sand was deposited in areas of low velocities and between the gravels of the bottom. Adult coho, chinook, pink, chum and sockeye salmon were observed in this site.

5.1.2.1.3 Talkeetna Reach

(1) General description.

The Talkeetna reach (Figure E.5.3) encompasses the area along the Susitna River between the Parks Highway Bridge (R.M. 83.5) and Curry (R.M. 120.7). There are 11 general habitat evaluation study sites located in the Talkeetna reach including:

Study Site	River Mile	Geographic Code
Mainstem 1	84.0	24N05W10DCC
Sunshine Creek	85.7	24N05W14AAB
Birch Creek Slough	88.4	25N05W25DCC
Birch Creek	89.2	25N05W25ABD
Cache Creek Slough	95.5	26N05W35ADC
Cache Creek	96.0	26N05W26DCB
Whiskers Creek Slough	101.2	26N05W03ADB
Whiskers Creek	101.4	26N05W03AAC
Slough 6A	112.3	28N05W13CAC
Lane Creek	113.6	28N05W12ADD
Mainstem 2	114.4	28N04W06CAB

The Talkeetna reach can be divided into two distinct geomorphological areas; the upper and lower areas. The confluence of the Susitna, Talkeetna and Chulitna Rivers separates the upper and lower areas. The Susitna River in the upper area is relatively straight to meandering with minimal braiding. The approximate gradient of the upper area is 8.0 ft./mile (corresponding to a 175 foot drop in elevation over 22 miles). Typical substrate is gravel, rubble and cobble with lesser quantities of sand, silt and boulders present. The lower Susitna River portion, by comparison, is moderately braided. Silt is a major substrate type with gravel and rubble present. The approximate gradient over the lower area is 6.7 ft./miles (corresponding to a 100 foot drop in elevation over 15 miles). The approximate gradient of the entire reach is 7.4 ft./mile. Vegetation over the entire reach is black spruce forest interspersed with muskeg bogs, meadows, and stands of cottonwood, birch and aspen.

Access along this reach is limited. In the lower area, public access is provided by unimproved roads into Cache and Sunshine Creeks and boat landings at the Parks Highway Bridge and Talkeetna. Above Talkeetna, access is limited to the railroad and other remote transportation means. Year-round and seasonal homesites are located along the entire reach with year-round settlements at Talkeetna, Cache Creek (R.M. 96.0) and Chase. Recreational uses of the river along this reach include hunting, fishing, boating, hiking and camping.

(2) Description of general habitat study locations in the Talkeetna Reach.

Mainstem 1

Mainstem 1 (Appendix EA, Figure EA-23) is located at the confluence of Sunshine Slough with the mainstem Susitna River. The mainstem Susitna River has a major influence on the overall chemical and physical nature of the site. The study site is a deep (15-25 feet) back eddy/pool type habitat. Sampling gear placement was both on the steep east bank and an adjacent island. The substrate of the east bank is sand and silt interspersed with rubble, cobble and large boulders. Cover is provided along the steep bank by fallen and overhanging trees. The island is predominantly silt. Shrubs occur above the high water line and grasses provide cover along the gently sloping banks. Adult salmon that have been reported in the study site include chum, coho, sockeye, chinook and pink salmon.

Sunshine Creek

The mouth of Sunshine Creek is located at two distinct sites depending on the stage of Sunshine Slough (Appendix EA, Figure EA-24). Since the mouth of the creek is the study site, two separate study areas are located at this general habitat evaluation study site. Under high discharge conditions, the mouth of Sunshine Creek is at an upper site. The upper area is a creek/slough confluence system. The channel is relatively uniform in cross section containing gravel and rubble overladen by 4-12 inches of silt and sand. Cover is provided along the sloping banks by overhanging trees and shrubs with submerged vegetation present. All sampling gear placement was along the northwest bank. The lower area is a slough/creek system that is predominately influenced by Sunshine Creek during low discharge conditions and becomes a branch of Sunshine Slough under high discharge conditions. This area is sampled as the mouth of Sunshine Creek during periods of low discharge. The stream at the lower area has a partially silted channel with gravel and rubble present. Cover is provided along steep banks by overhanging and fallen trees. The channel is partially obstructed by several log and debris jams. Adult salmon that have been reported in the study site include coho and chinook salmon.

Birch Creek Slough

The study site (Appendix EA, Figure EA-25) is located at the confluence of Birch Creek Slough and the mainstem Susitna River. The primary influence on this slough at the mouth ultimately depends on the stage of the mainstem Susitna River at the head of Birch Creek Slough. During periods of low mainstem Susitna River discharge, little or no flow passes through the head of the slough, causing the primary influence of the slough at the mouth to be dependent on Birch Creek. Under these conditions the water in the slough is clear. During periods of high mainstem Susitna River discharge, flow enters at the head of the slough. Under these conditions, the primary influence on the slough at the mouth is dependent on the mainstem Susitna River. The slough in the study site has a relatively uniform channel containing gravel and rubble as substrate overladen by 6-12 inches of silt. Cover is provided along steep banks by overhanging and fallen trees. Adult salmon that have been reported in the study site include coho, chum, sockeye and pink salmon.

Birch Creek

The study site (Appendix EA, Figure EA-26) is located at the confluence of Birch Creek and Birch Creek Slough. Under periods of high discharge, the site is a pool type habitat. Cover is provided along sloping banks by overhanging trees and shrubs and submerged vegetation. Under periods of low discharge, riffles form in addition to the pools. The typical substrate in the study area is gravel and rubble with sand and silt present. A seasonally used cabin is located at the mouth of the creek. Adult salmon that have been reported in the study site include sockeye, coho, chum and pink salmon.

Cache Creek Slough

The study site (Appendix EA, Figure EA-27) is located at the confluence of Cache Creek Slough and the mainstem Susitna River. Due to the proximity of the site to the confluence of the Chulitna and Susitna Rivers (so that complete mixing of the rivers has not yet occurred) and its west bank location, the site is heavily influenced by the Chulitna River. The slough in the study site is braided with sand and silt bars present. Sand and silt are the major substrate types. Except during periods of very low discharge, at which times the slough runs clear, the study area is primarily influenced by slough water. Cover is provided along sloping banks by fallen and overhanging trees and areas of submerged vegetation. Adult salmon that have been reported in the study site include coho, chum, sockeye and pink salmon.

Cache Creek

The study site is (Appendix EA, Figure EA-28) located at the confluence of Cache Creek and Cache Creek Slough. The portion of the creek in the study site has low velocities. As a result, the dissolved oxygen levels fall below saturation during the latter part of the salmon spawning runs. In addition, specific conductances sharply rose during the spawning period. Cover is provided by a broken beaver dam and fallen and overhanging trees along sloping banks. Typical substrate is gravel and rubble overladen, in most areas, by

6-12 inches of sand and silt. Adult salmon that have been reported in the study site include sockeye, coho, chum and pink salmon.

Whiskers Creek Slough

The study site (Appendix EA, Figure EA-29) is located at the confluence of Whiskers Creek Slough and the mainstem Susitna River. The primary influence on this slough depends on the stage of the mainstem Susitna River at the head of Whiskers Creek Slough. During periods of low mainstem Susitna River discharge, little to no flow enters the slough, causing the primary influence of the slough at the mouth to be dependent on Whiskers Creek. Under these conditions the slough runs clear. During periods of high mainstem Susitna River discharge, flow is permitted through the slough. Under these conditions the primary influence on the slough is dependent on the mainstem Susitna River. The slough in the study site is wide and shallow with a relatively uniform cross section. Substrate is gravel, rubble and cobble with boulders present. Extensive areas of the bed are covered with silt. Cover along the sloping banks is limited, except for isolated areas of submerged vegetation. Adult salmon that have been reported in the study site include coho and chinook salmon.

Whiskers Creek

The study site (Appendix EA, Figure EA-30) is located at the confluence of Whiskers Creek and Whiskers Creek Slough. Whiskers Creek in the study area is a relatively narrow, meandering stream containing many riffles and pools. Cover is provided along sloping banks by overhanging and fallen trees and shrubs and areas of submerged vegetation. Typical substrate in the bed is gravel and rubble partially silted over in areas. Aquatic vegetation is present in the channel. Adult salmon that have been reported in the study site include coho and chinook salmon.

Slough 6A

The study site (Appendix EA, Figure EA-31) is located at the confluence of Slough 6A and the mainstem Susitna River. The slough receives very little mainstem Susitna River influence due to a series of beaver dams crisscrossing the slough between its head and mouth. The slough in the study area is a relatively quiescent, muskeg influenced system having a relatively deep uniformly shaped channel. Typical bed substrate is silt interspersed with boulders, organic debris and aquatic vegetation. Cover is provided along sloping banks by overhanging trees and shrubs and submerged vegetation, boulders and debris. Adult salmon that have been reported in the study site include chum salmon.

Lane Creek

The study site (Appendix EA, Figure EA-32) is located at the confluence of Lane Creek and the mainstem Susitna River. The creek in the study site is dynamic, constantly undergoing change in bed structure and geomorphology. The creek is a relatively narrow, shallow, fast running, clearwater stream containing many pools and riffles. Typical substrate in the creek bed is gravel, rubble and cobble with sand, silt and boulders present in areas.

Aquatic vegetation is present in the channel. Cover is provided by overhanging shrubs and trees, submerged vegetation and isolated boulders. Adult salmon that have been reported in the study site include chinook, chum and pink salmon.

Mainstem 2

The study site (Appendix EA, Figure EA-33) is located on the east bank of the mainstem Susitna River, at the mouth of a side channel. During periods of low mainstem Susitna River discharge, the head of the side channel dewaters causing a large backeddy to form in the upper segment of the study area. The study area has several sand/silt and gravel, rubble and cobble bars. Under high discharge conditions, cover is provided by overhanging and fallen trees along a cutbank. Under low discharge conditions, the entire area contains gravel, rubble and cobble substrate, with riffle zones present. Adult salmon that have been reported in the study site include chinook, coho, pink, chum and sockeye salmon.

5.1.2.1.4 Gold Creek Reach

(1) General description.

The Gold Creek reach (Figure E.5.4) of the Susitna River extends from Curry (R.M. 120.7 - elevation 507.6 feet above MSL) to Portage Creek (R.M. 148.8 - elevation 820.9 feet above MSL) and encompasses 28.1 river miles. The river forms a single main channel although several small islands and gravel bars divide the river in areas. Depending on the river stage, 2-3 feet standing waves are present in several places. Substrate varies from silt to bedrock with the majority of mainstem shoreline substrate being rubble and cobble. The major substrate of sloughs and slow water areas is silt. River elevation drops 313.4 feet in 28.1 river miles corresponding to an approximate gradient of 11.2 ft./mile.

In the upper portion of this reach the river flows west. The banks are steep thus having good drainage and support a dense spruce/hardwood forest. Below Gold Creek (R.M. 136.7) the river bends to flow south. Vegetation and banks remain similar.

Four principal tributaries empty into the Susitna River within this reach; Fourth of July Creek, Gold Creek, Indian River and Portage Creek. They are generally turbulent and their channels at the Susitna River confluence exhibit noticeable changes in physical character as discharges vary.

Access to this area is limited. The Alaska Railroad follows the river closely from Curry to Indian River. The stretch of the Susitna River above Indian River is accessible only by helicopter or boat. There is an unpaved runway for landing fixed wing aircraft near the Gold Creek Bridge. A gold dredge is operated on Gold Creek not far above the confluence with the Susitna River. Many of the local residents hunt and fish in this area. Homesites dot the entire stretch with small year round settlements near Sherman (R.M. 130.8) and Gold Creek (R.M. 136.7).

Twelve general habitat evaluation sites are located in the Gold Creek reach:

Study Site	River Mile	Geographic Code
Mainstem Susitna - Curry	120.7	29N04W10BCD
Susitna Side Channel	121.6	29N04W11BBB
Mainstem Susitna - Gravel Bar	123.8	30N04W26DDD
Slough 8A	125.3	30N03W30BCD
4th of July Creek	131.1	30N03W03DAC
Slough 10	133.8	31N03W36AAC
Slough 11	135.3	31N02W19DDD
Mainstem Susitna - Inside Bend	136.9	31N02W17CDA
Indian River	138.6	31N02W09CDA
Slough 20/Waterfall Creek	140.1	31N02W11BBC
Mainstem Susitna Island	146.9	32N01W27DBC
Portage Creek	148.8	32N01W25CDB

(2) Habitat descriptions of general habitat locations in the Gold Creek Reach.

Mainstem Susitna - Curry (Su-Curry)

The lowest study site within this reach is a mainstem Susitna River eddy opposite Curry. The study site (Appendix EA, Figure EA-34) is approximately 500 feet upriver from Curry and on the west bank of the Susitna River. Steep shale strewn banks support dense overhanging alders and willows. The lower portion of the study area consists of large chunks of shale on the west bank and gravel and rubble on the bar. Due to a bend in the river above the sample site, eddies are constantly forming. Substrate at the upper portion of the study site is mainly sand and silt. Build up and shifting of sand and silt occurred. Ground water percolated up from the bed in several of these sandy areas. Water clarity was influenced by the Susitna River. Under low discharge conditions, when the Susitna River no longer entered the study area from above, the sample site was reduced to a narrow inlet. Under these conditions, the direction of flow reversed 180°. Adult chum salmon have been reported at the study site.

Susitna Side Channel (Su-Side Channel)

The study site (Appendix EA, Figure EA-35) in this mainstem Susitna River side channel/cut bank is located one mile above Curry on the east bank of the Susitna River. The railroad closely parallels the bank at the lower end of this site. As floods began eroding the bank in July, 1981, large boulders were moved in by railroad personnel to stabilize the area. This altered the bank and substrate of the lower 75 feet of the site. Depending on discharge, the soil cut bank varied from 1-4 feet high and was undercut in several places. The bank supported a dense growth of overhanging ferns, hemlock, alder and willow. Substrate varied from soil and silt to gravel and rubble. Many debris piles and fallen trees occurred along the shoreline and caused numerous small eddies and slack water areas. A clear narrow slough empties into the mainstem from the east bank several yards above the site. Specific conductance measurements were rarely stable because the clear and turbid waters had not yet mixed. Adult chum salmon have been reported in the study site.

Mainstem Susitna - Gravel Bar (Su-Gravel Bar)

This study site (Appendix EA, Figure EA-36), which is located one mile below Slough 8A, is a large, exposed gravel bar at the lower tip of an island that separates the Susitna River main channel from a side channel. Substrate within the sample area consists of sand, gravel and combinations thereof. Sampling occurred on the west side of the gravel bar. The mainstem Susitna River water is fast flowing with several small eddies along the shore. As discharge increased, the gravel bar became submerged. During these periods, sampling occurred at the lower tip of the aforementioned island. Sampling gear was placed along a 3-4 foot high cut sand bank that supported overhanging alders. Water at this location was shallow and slow moving. Substrate was 100% sand and shifted radically in high water. At the upper (east) end of the bank, ground water percolated up and, when the channel to this site was cut off by shifting sands, springs were visible. The trapped water was clear exhibiting relatively high specific conductances and dissolved oxygen levels below saturation. Adult chum salmon have been reported in the study site.

Slough 8A

Slough 8A (Appendix EA, Figure EA-37) is a calm, relatively shallow, murky slough. The substrate is mostly sand except at the upper end of the sample area where two branches of clear water flow over gravel, rubble and cobble. A thin silt layer covered the rocks in low to medium water levels. The lower mud banks of the slough are covered with grass and equisetum; further from the water the banks are covered with dense willows, alders and cottonwoods. The turbidity of the slough varied with precipitation and the flux of mainstem Susitna River water entering at the head of the slough. Adult salmon that have been reported in the study site include coho, chum and sockeye salmon.

4th of July Creek

At 4th of July Creek (Appendix EA, Figure EA-38) sampling was conducted both in the creek and in the mainstem Susitna River to a point 500 feet below the mouth. The geomorphology of the creek from the mouth to a point 200 feet upstream changed radically throughout the sampling season. Deposits of shifting gravel and rubble in and above the mouth caused drastic rerouting of creek channels. A large log jam occurred 100 feet above the mouth after the first heavy rainstorm of the summer. Several deep holes existed in the creek at the beginning of the summer. After the discharge dropped, the deep holes were filled by gravel, leveling the bed. The substrate of the mainstem Susitna River area sampled is mostly gravel and rubble. The banks are fairly flat and support dense growths of willows, alders, and cottonwoods. Several minor creek channels empty into the mainstem throughout the study area. The mainstem water is turbid, but along the shore, water flows clearer due to the creek's influence immediately upstream. Adult salmon that have been reported at the study site include pink, chinook and coho salmon.

Slough 10

Slough 10 (Appendix EA, Figure EA-39) is a deep slow water slough with two water sources: a clear tributary from the north and a narrow Susitna River side channel from the northeast. At low water discharges, the Susitna River side channel exhibits greatly reduced inflow. The sample area became less turbid under these conditions. The west bank is steep with bedrock outcrops. The east bank is a large sand and gravel bar that supports a sparse growth of young willows and alders. The east bank of the clearwater tributary is flat with dense brush. Substrate varies from sand to silt. When water levels were in a state of flux, the sand and silt shifted radically within the site and became like quick sand. When the discharge dropped, a sand bar (70 x 150 feet) formed at the confluence of the clearwater and silty slough water. From the sand bar to the upper sample site boundary, specific conductance measurements were unstable. Adult chinook and chum salmon have been reported in the study site.

Slough 11

Slough 11 (Appendix EA, Figures EA-40) is relatively stable. The west bank, 4 - 8 feet high, is flat and supports a dense growth of alders. The east bank is 30 feet steep with birch and spruce trees. The lower section of Slough 11 is relatively wide, with slow moving water. Substrate is silt. The upper area is narrow and riffled in places. Substrate varies from sand, gravel and rubble to boulders (10 - 13 inches). As discharges dropped toward the end of this sampling season a large mud bar formed across the mouth of the slough and Susitna River confluence. Adult salmon that have been reported in the study site include coho, chum and sockeye salmon.

Mainstem Susitna - Inside Bend (Su-Gold)

The inside bend study site (Appendix EA, Figure EA-41) located 0.5 mile above the Gold Creek Bridge is on a mainstem Susitna island. Sampling occurred on the lower west side of the island. The mainstem Susitna River flowed fast, deep, and turbid near this site. The shore of the study area is a raised sand, gravel, rubble and cobble bank. Under high discharge conditions the bank was flooded causing shifting of the bank substrate. Under extremely low discharges, a gravel bar surfaced extending across the east channel of the Susitna River almost to the east bank. Adult chinook salmon have been reported in the study site.

Indian River

Sampling at Indian River was conducted from the mouth to a point approximately 500 feet upstream and along the mainstem Susitna River 200 feet downriver from the mouth (Appendix EA, Figure EA-42). The mouth of Indian River was dynamic, constantly undergoing change in bed structure and geomorphology. Deadfall and debris were deposited on gravel bars throughout the area of the mouth depending on channel routing. Water flowed both deep and fast, and shallow and slow. Substrate varied from sand to gravel and rubble. Susitna River water below the Indian River mouth varied in turbidity as the two bodies of water had not mixed completely. Adult salmon that have been reported in the study site include coho, chinook and chum salmon.

Slough 20

Slough 20 (Appendix EA, Figure EA-43) contains diverse habitat. During medium to high Susitna River discharges, the mainstem Susitna River feeds the head of the slough at the upper end of the study site. A small clearwater tributary empties into the slough 250 feet from the head of the slough. Also, several nearby springs feed into the slough. Midway along the slough, Waterfall Creek empties into it on the southeast bank. The study area contains deep pools, deep slow moving water, shallow riffles, and water trickling through gravel, rubble and cobble substrate. Substrates consists of sand, gravel, rubble, cobble and combinations thereof. Under clearwater conditions, a thin layer of glacial flour film was visible over the rubble and cobble areas. Both banks are vegetated by dense willows and alders or dense cottonwoods and alders. Bank heights vary from 0-4 feet. At the slough mouth, banks consist of sand gravel and rubble. Adult chum and sockeye salmon were observed milling in the small clearwater tributary at the head of the slough.

Mainstem Susitna - Island (Su-Island)

The mainstem Susitna River island study site (Appendix EA, Figure EA-44) located two miles below Portage Creek is relatively stable. Both sides of the western tip of the island were sampled. The island is approximately 400 feet in width at the widest point of the study area. During low discharges, the western tip of the island is a large sand bar. Both north and south banks contain rubble and cobble. Vegetation on the island consists of dense stands of alders. Although both mainstem Susitna River channels flow relatively fast, deep, wide and turbid, during low discharges the south channel appeared to be the main channel.

Portage Creek

Portage Creek (Appendix EA, Figure EA-45) is the uppermost general habitat evaluation study site sampled within this reach. Study area extends 475 feet upstream from the creek mouth, 380 feet down the Susitna from the creek mouth, and 100 feet up the Susitna from the creek mouth. The creek width at the mouth is approximately 250 feet in medium to high discharges. The relatively high steep banks are densely vegetated with birch and alder. The creek occupies one channel until it reaches two main bars that are present at the mouth. Depending on the discharge of the creek, the two bars split into several smaller bars causing a delta to form. Substrate shifted as the geomorphology of the mouth changed. The substrate is composed of gravel in the mainstem and near the mouth, and rubble and cobble in the creek and on the highest part of the bars. The creek in the study area is rapid, clear, and relatively deep (3 - 5 feet). Mainstem Susitna River water flow above the creek forms a turbid eddy. Mainstem Susitna River water below the mouth does not yet mix with the creek water, causing variable turbidities. Adult chinook salmon have been reported at this study site.

(3) Special studies - helicopter surveys of Indian River and Portage Creek.

Three sites each along upper Indian River and upper Portage Creek were sampled for general habitat evaluation studies. Sampling was conducted via helicopter in early June, late August, and early October 1981. Sampling was not conducted in July and August due to bad weather conditions. Sites I and II (the lower of the three sites) of both tributaries remained at the same locations during each sample period. Sites III on both Indian River and Portage Creek were relocated after the initial sampling period.

Tributary miles and geographical codes of sampling locations are shown in Table E.5.2.

Table E.5.2. Special study sites in the Gold Creek reach.

HABITAT LOCATION	TRIBUTARY MILE	GEOGRAPHICAL CODE
Indian River Site 1	2.7	32N 02W 28 DDC
Indian River Site 2	7.2	32N 02W 11 DCC
Indian River Site 3A - June 1981	13.5	33N 01W 27 DCC
Indian River Site 3B - Aug. & Oct. 1981	12.0	32N 01W 04 BAB
Portage Creek Site 1	4.5	32N 01E 08 CBA
Portage Creek Site 2	9.2	33N 01E 26 DDC
Portage Creek Site 3A - June 1981	15.6[a]	22S[c] 08W 34 DCC
Portage Creek Site 3B - Aug. & Oct. 1981	15.5[b]	22S[c] 08W 28 BAB

[a] East Fork
[b] North fork
[c] Fairbanks Meridian

Indian I

Site I is the lowest of the three sample sites on the upper Indian River. The river in the lower 400 feet of this site forms a single channel. The river in the upper 400 feet contains two small gravel bars that become bank extensions under low discharge conditions. This shallow clearwater river flows fast over a gravel, rubble and cobble substrate. The east bank is steep and densely vegetated with spruce, birch, and cottonwood. The west bank is flat with similar vegetation. A small side channel (approximately 12 feet in width) rejoins the main channel at the lower site boundary. This channel was dry when the site was visited in October.

Indian II

Indian River at site II forms a single, shallow channel with fast flowing clearwater over a rubble and cobble substrate. A bar (approximately 100 feet in length) divides the channel midway up the site. A small creek empties into the river at the east bank above the bar. Both river banks are densely populated with overhanging willows and alders. During low discharges, riffles appeared along this stretch of the river.

Indian III

The June location of site III differed from the August and October location. When sampling in August and October, the June study site could not be located.

Thus a new representative site was established nearby. At the latter site, the channel is braided and meandering. Both banks are low and vegetated. Mid-channel bars lack vegetation, but have debris pile ups. Substrate is gravel and rubble. At the upper end of the site, slow water from an upstream beaver dam empties into the river. This water source is clear with a red-brown tint. Substrate in this area is silt of a non-glacial origin. Fallen trees and brush piles are scattered along the mud banks of the slow water area.

Portage Creek I

The lowest site (I) on Portage Creek has two side channels to the east of the main channel. In the main channel and nearest side channel, water is fast flowing. The substrate consists of rubble and cobble. The farthest of the channels has slow moving water with several clear pools. This channel appeared to have been dammed below the study site by beaver. Banks are low in relief with dense brush.

Portage Creek II

Portage Creek at site II has a fairly straight, main channel with two side channels present. Flows are fast and uniform over a rubble and cobble substrate. Low discharges in October dewatered the middle channel. The depths of the east channel varied from three feet to less than a foot. Banks are steep with bedrock outcrops.

Portage Creek III

Site III on Portage Creek was the uppermost site sampled on this tributary. Because of a waterfall below the original site III, the site was relocated from the east fork to the north fork of Portage Creek. The latter site III includes two small side channels; one on either side of the main channel. Substrate is predominantly gravel, rubble and cobble. Small pools in the west channel contain some sand substrate. Willow and alder provide bank cover.

5.1.2.1.5 Impoundment Reach

(1) General description.

The upper Susitna River from Devil Canyon to the Oshetna River is a remote wilderness area of high aesthetic and recreational value. Mountainous terrain dominates the area with elevations ranging from 1000 feet near the basin floor of Devil Canyon to over 6000 feet on various mountain peaks in the area. The landscape varies from treeless alpine tundra at higher elevations to low lying areas dominated by black spruce interspersed with muskeg bogs. Occasional stands of cottonwood, birch and aspen are often found throughout the area, especially at lower elevations. Access to the area is limited mostly to aircraft however, portions are also accessible by boat launched at the Denali Highway Bridge. Kayakers have been known to float this entire reach through Devil Canyon.

The watershed of the Susitna River above Devil Canyon includes several major tributaries of glacial origin. These streams carry a heavy load of glacial flour during ice-free months. There are also many smaller tributaries which normally run clear year round. The Susitna River from Devil Canyon to the Oshetna River can be divided into two distinct geomorphological regions: Portage Creek to Fog Creek and Fog Creek to Oshetna River. The river between Portage Creek and Fog Creek forms one channel which lies in a deep valley along most of this route. The average gradient is approximately 20 ft./mile. From Fog Creek to the Oshetna River the channel is wider and often splits into two or more channels with an average gradient of approximately 12 ft./mile.

According to a 1977 report by the Alaska District of the Army Corps of Engineers (1977) with updated surface elevations information provided by Acres American (personal communication; Gill, 1982) the two proposed impoundments in this area would inundate approximately 80 miles of the main river with a total surface area of about 50,500 acres. This would include that portion of the Susitna River from the proposed Devil Canyon dam site (R.M. 152.0) to a point approximately four miles upstream from the Oshetna River (R.M. 231.0). The proposed Devil Canyon dam would create an impoundment 28 miles long with a surface area of 7,550 acres. The maximum probable flood elevation is projected at 1466 feet msl with a normal operating pool level of 1455 feet msl. The proposed Watana Dam (R.M. 182.0) would create an impoundment that would extend for 54 miles and cover 43,000 acres. The maximum probable flood elevation of this impoundment is projected at 2,202 feet msl with a normal operating pool level of 2,185 msl.

Due to the inaccessibility of the Devil Canyon area, and the lack of suitable fisheries habitat, the study area was limited to that section of the Susitna River from Fog Creek to the Oshetna River. Eight habitat locations were chosen within this area for general habitat evaluation studies. These sites were located on the eight major tributaries in the proposed impoundment area. The selection of these sites was based on preliminary studies done in 1977 by the Alaska Department of Fish and Game for the U.S. Fish and Wildlife Service (ADF&G, 1977). These general habitat evaluation study sites, along with their respective river mile and geographic code, are presented in Table E.5.3.

All study sites within the impoundment reach are 500 feet in length with alternating 500 foot non-study areas in between (Figure E.5.6). The initial site at a general habitat evaluation location is always located at the mouth of a particular tributary and successive sites are numbered upstream to a point not exceeding 4500 feet. This procedure essentially covers the lower mile of each tributary. In most cases there are a maximum of five study sites within each general habitat evaluation location. However, in some areas it was not possible or necessary to have the maximum number of sites. In these cases fewer sites were utilized.

Study sites were sampled on a monthly basis. However, various logistical problems and adverse weather sometimes interfered with this schedule. In addition to the regular sites listed in Table E.5.3, Sally Lake was sampled for basic water quality data one time over the course of this season. This data is presented in Appendix EB, Table EB-54.

Access to all general habitat evaluation locations required initial helicopter support. Where possible, rafts were used to gain access between areas.

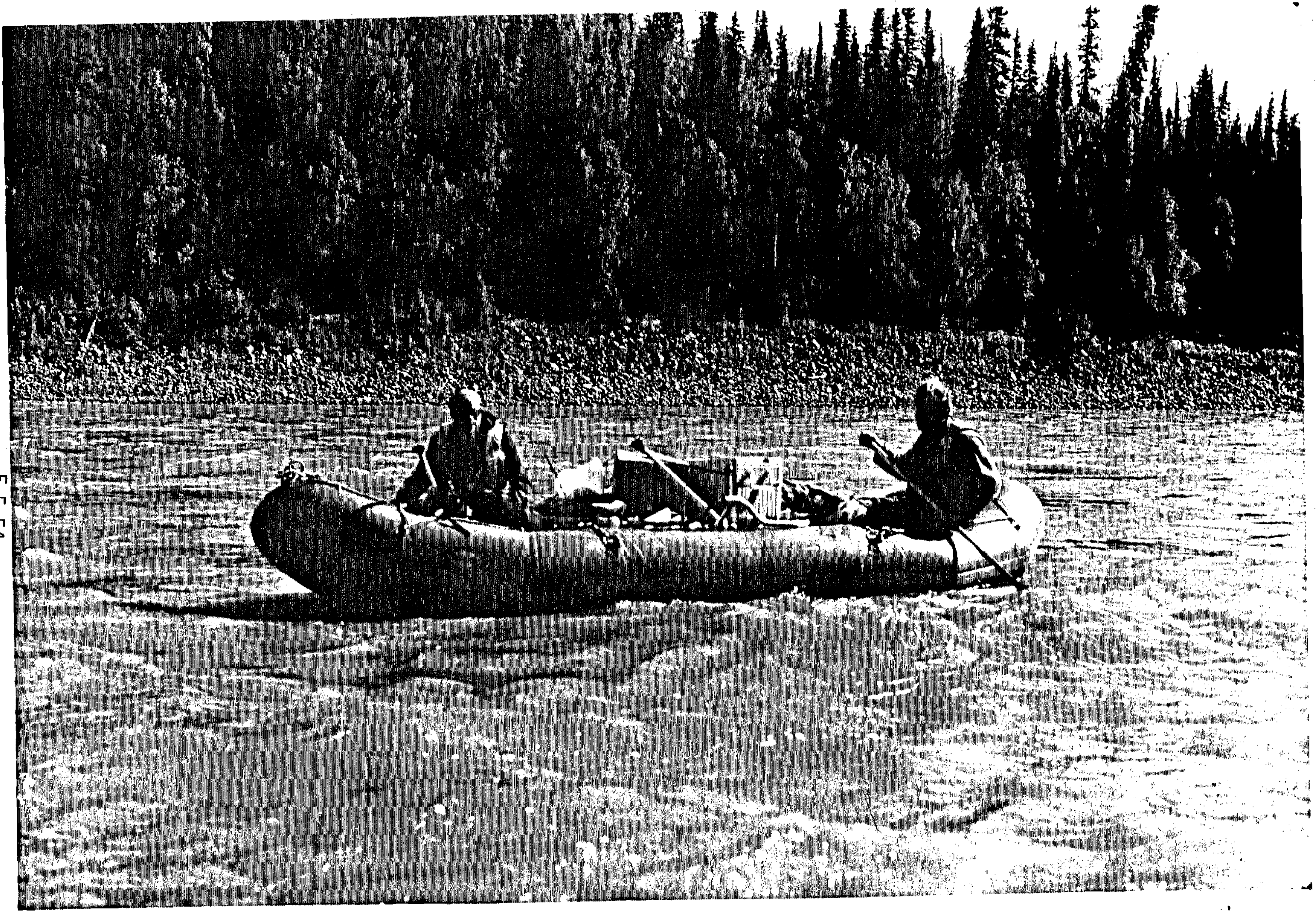


Plate 6. Rafts used for transportation in the Impoundment study reach.

Table E.5.3. General habitat evaluation sites in the Impoundment reach.

Habitat Location	River Mile	# of Study Sites	Approximate Elevation At Mouth	# of Stream Miles To Be Inundated	Gegraphic Code
*Fog Creek	173.9	3	1380	0.7	31N 04E 16 DBB
*Tsusena Creek	178.9	1	1460	mouth only	32N 04E 36 ADB
Deadman Creek	183.4	2	1510	2.3	32N 05E 26 CDB
Watana Creek	190.4	5	1590	9.0	32N 06E 25 CCA
Kosina Creek	202.4	5	1690	4.0	31N 08E 15 BAB
Jay Creek	203.9	5	1710	3.0	31N 08E 13 BCC
Goose Creek (Upper)	224.9	5	2030	1.5	30N 11E 32 DBC
Oshetna River	226.9	5	2050	2.0	30N 11E 34 CCD

* Fog and Tsusena creeks are located in Devil Canyon impoundment. Remaining six tributaries are in Watana impoundment.

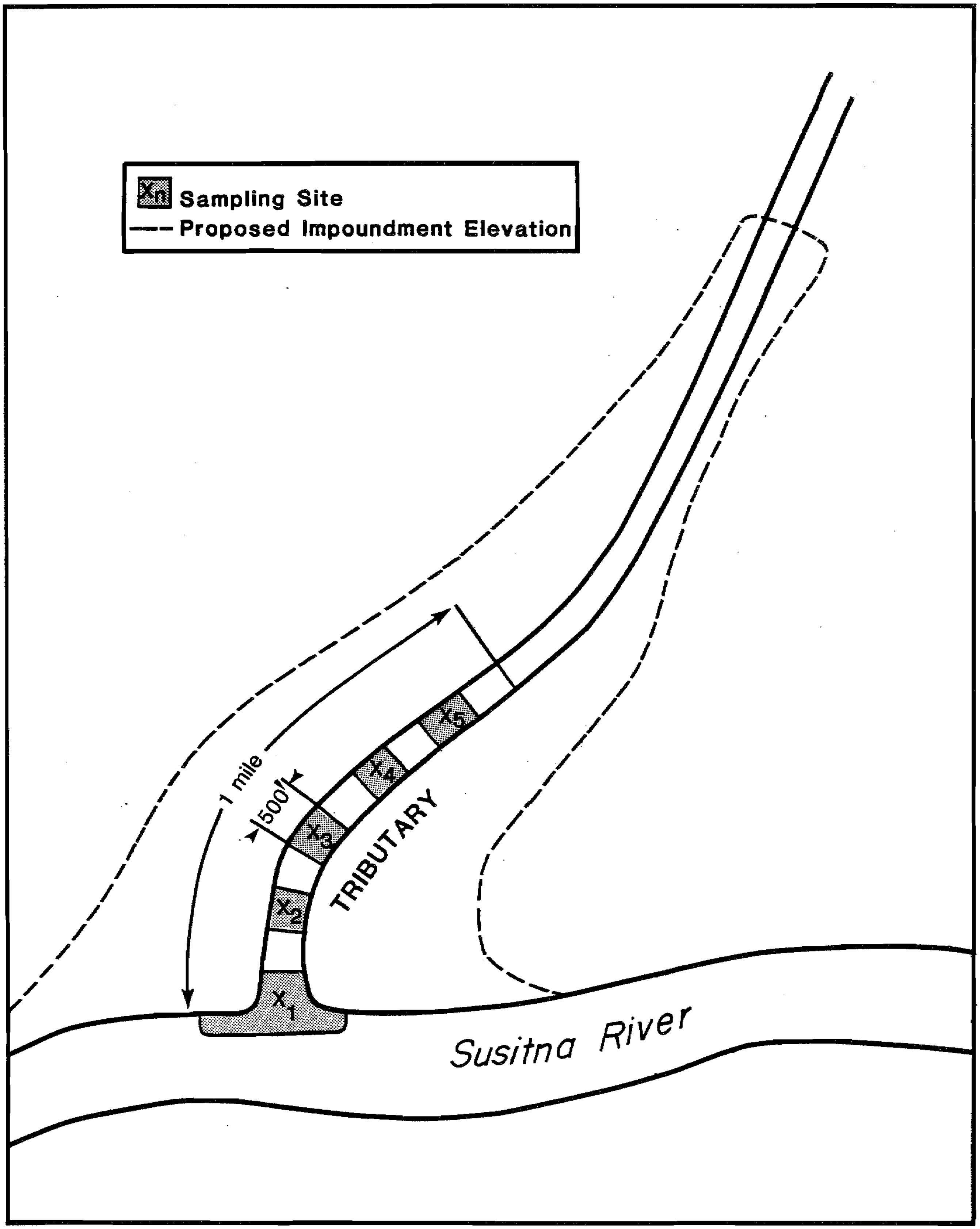


Figure E.5.6. Sampling design used in the Impoundment study reach.

Individual study sites were reached by hiking upstream from the mouth of each tributary. Remote areas in the upper sections of selected streams also required helicopter support.

(2) Descriptions of general habitat study locations in the Impoundment Reach.

Fog Creek

Fog Creek is located at river mile 173.9 on the south side of the Susitna River and is approximately 23 miles upstream from the proposed Devil Canyon Dam. The stream would be inundated to a point approximately 0.7 miles upstream by the proposed impoundment. Three study sites (Appendix EA, Figures EA-46 - EA-48) were established in the lower 2500 feet of the stream.

This clearwater stream is relatively narrow and shallow with widths ranging from 50-75 feet and average depths of 1-2 feet. The stream habitat is predominantly riffle with few pools and little cover present. Substrate consists mostly of rubble and cobble. Most of the study area consists of one stable channel except for the lower 500 feet where it becomes braided. During periods of high discharge, many backwater areas were present. The stream channel at the mouth was dynamic during the season due to the fluctuating discharges of both the Susitna River and Fog Creek.

Tsusena Creek

Tsusena Creek is located at river mile 178.9 on the north side of the Susitna River and lies approximately 28 miles upstream from the proposed Devil Canyon Dam. Only the mouth of this stream will be affected by the proposed impoundment since it lies near the projected Devils Canyon impoundment elevation of 1455 feet. Therefore, only one study site (Appendix EA, Figure EA-49) was established at this location.

The study site consists of a split channel with two distinct habitat types. The east channel which is wide and fast-flowing is approximately 100 feet wide with average depths of 2-4 feet. This section is characterized by riffles and whitewater areas with no prominent pools or cover available. Substrate consisted of cobble and large boulders. The west channel was between 25-50 feet wide with average depth of 1-2 feet. This channel consisted of alternating pool/riffle areas with some cover available along the bank. Substrates consists of gravel and rubble. Both stream channels were stable and the water remained extremely clear despite heavy rains during the summer. The split channel resulted in the formation of two mouths with a large gravel bar separating them. This area was dynamic throughout the season and was often inundated by the high water of the Susitna.

Deadman Creek

Deadman Creek is located at river mile 183.4 on the north side of the Susitna River and lies approximately one mile upstream from the proposed Watana Dam. Approximately 2.3 stream miles would be inundated by the proposed impoundment.

Because of a deep canyon and large waterfall past the first half mile, access to this area was limited and only two study sites (Appendix EA, Figures EA-50 - EA-51) were established in the first 1500 feet of stream.

The study area of Deadman Creek is an extremely fast and turbulent whitewater area with a relatively steep gradient resulting in few pools and little cover. A large waterfall, which is presently a barrier to fish migration, is located approximately 1.0 mile upstream from the mouth. The stream channel below the falls is stable and is situated in a deep canyon for most of this length. Channel widths are between 75-100 feet and average depths are 3-5 feet. Substrates consist mostly of cobble and boulder. Above the falls stream gradient is not as steep and many pools are present. The proposed impoundment would inundate the waterfall and allow fish migration between Deadman Lake, approximately 10 miles upstream, and the Susitna River.

Watana Creek

Watana Creek is located at river mile 190.4 on the north side of the Susitna River and is approximately eight miles upstream from the proposed Watana Dam. About 9.0 stream miles would be inundated by the proposed impoundment. Five study sites (Appendix EA, Figures EA-51 - EA-56) were established in the lower 4500 feet of stream. Due to high water and steep terrain study sites 4 and 5 were inaccessible after the month of June.

Watana Creek is a shallow meandering stream approximately 40-60 feet wide with depths averaging 2-3 feet. It has a shallow gradient resulting in a moderate flow with few pools interspersed between the predominent riffle areas. The substrate consists mostly of gravel and rubble. The water was often turbid during the summer because of heavy rains and unstable soils present upstream. The stream channel itself was stable and did not appear to shift except at the mouth where a dynamic multi-channel system was present during periods of high flow. During low discharge periods only one main channel was present at the mouth.

Kosina Creek

Kosina Creek is located at river mile 202.4 on the south side of the Susitna River and lies approximately 20 miles upstream from the proposed Watana Dam. About 4.0 stream miles would be inundated by the proposed impoundment. Five study sites (Appendix EA, Figures EA-57 - EA-61) were established in the lower 4500 feet of stream.

Kosina Creek is a deep and turbulent stream which is predominantly whitewater interspersed with deep pools and shallower riffle areas which provide excellent fish habitat. Average depths are 3-4 feet but there are several pools which exceed 6-8 feet in depth. Substrates consist mostly of sand, large cobble and boulders. The stream channel is stable and is situated in a narrow valley with a moderate gradient. It is often braided with total widths frequently over 200 feet. A split channel resulted in the formation of two mouths approximately 150 feet apart with a large tree covered island separating them. The west channel, which is the larger of the two, is predominantly whitewater and is about 125 feet wide. The east channel is slow flowing and shallow with alternating pool/riffle areas.

Jay Creek

Jay Creek is located at river mile 203.9 on the north side of the Susitna River and lies approximately 22 miles upstream of the proposed Watana Dam. About 3.0 stream miles would be inundated by the proposed impoundment. Five study sites (Appendix EA, Figures EA-62 - EA-66) were established in the lower 4500 feet of stream.

Jay Creek is a relatively narrow, shallow stream predominantly riffle with a moderate flow. It is between 40-60 feet wide with depths averaging 1-3 feet. Substrate consists of gravel, cobble and rubble often embedded in sand. Although the water is generally clear, unstable soils in upstream areas often result in landslides which can change the water to a turbid condition within minutes. The stream channel itself is stable. The channel splits about 100 feet from the Susitna resulting in two distinct mouths. These mouths are influenced by the changing water level of the Susitna but the effects are minimal.

Jay Creek Slough

Jay Creek Slough is located at river mile 204.0 on the north side of the Susitna River and lies approximately 22 miles upstream of the proposed Watana Dam. The entire slough would be inundated by the proposed impoundment. Although this slough was not designated as a habitat evaluation site, it was surveyed twice during the summer after initial sampling revealed that large numbers of juvenile fish appear to utilize the slough as summer rearing habitat.

Plate 7. Jay Creek slough.

Jay Creek Slough is a small, spring-fed system which enters the Susitna River approximately 600 feet above the mouth of Jay Creek. It extends approximately 2500 feet from the Susitna River to its spring-fed source (Plate 7). The slough consists of one main channel 5-10 feet wide with average depths of 1-3 feet. The substrate in the lower 1000 feet of the slough consists mostly of mud and silt. In the upper areas more rock is exposed and the substrate consists of gravel and cobble embedded in mud and silt. During periods of low precipitation the water is clear and flows are negligible. With increasing precipitation the water can become extremely turbid. Influence from the main Susitna is minimal except during periods of extremely high flows when it may flow through the slough.

Goose Creek (Upper)

Goose Creek is located at river mile 224.9 on the south side of the Susitna River and lies approximately 43 miles upstream from the proposed Watana Dam. About 1.5 stream miles would be inundated by the proposed impoundment. Five study sites (Appendix EA, Figures EA-67 - EA-71) were established in the lower 4500 feet of stream.

Goose Creek is a narrow, shallow stream approximately 40-60 feet wide with average depths of 2-3 feet. The habitat is predominantly riffle with a moderate flow and few pools. Substrate consists of rubble, cobble and boulders often embedded in sand. The stream channel and banks are stable and the water usually remains clear even during periods of moderate rains. The discharge of Goose Creek fluctuated considerably depending on rainfall. This would often result in the formation of a braided channel at the mouth. The mouth was also influenced significantly by the water level of the Susitna River. During periods of high discharge, large amounts of silt and sand were deposited at the mouth only to be washed away by the waters of Goose Creek after the water level of the Susitna had receded.

Oshetna River

The Oshetna River is located at river mile 226.9 on the south side of the Susitna River and lies approximately 45 miles upstream from the proposed Watana Dam. About 2.0 stream miles would be inundated by the proposed impoundment. Five study sites (Appendix EA, Figures EA-72 - EA-76) were established in the lower 4500 feet of stream.

The Oshetna River is a large, meandering stream approximately 100-125 feet wide with average depths of 3-5 feet. Streamflow is slow to moderate with alternating pool/riffle areas which provide excellent fish habitat. Substrate consists mostly of rubble and cobble with some large boulders. The stream channel is stable throughout the study area and contains many large gravel bars. This stream is partially under glacial influence and the water was often turbid even during periods of dry weather.

5.1.2.2 Physiochemical Data for Each General Habitat Evaluation Study Site

Dissolved oxygen, pH, water and air temperatures, turbidity and specific conductance were measured twice monthly at each general habitat evaluation study site, except in the Impoundment reach, where these parameters were measured monthly. The data are presented for each site in a graphical format versus specific points in time (Figures E.5.7-E.5.89). The data are also presented in tabular form in Appendix EB, Table EB-1 - EB-92.

5.1.2.3 Thermograph Data

Water temperature data were continually recorded at 29 sites in the study area (Figure E.5.90, Table E.5.4) using Ryan Model J-90 thermographs. The data were converted into daily means, calculated as the mean of 12, two hour point temperatures. The temperature data for each thermograph site are presented as a function of time (Figures E.5.94 - E.5.113; Appendix EC, Tables EC-1 - EC-23).

5.1.2.4 Stage Data

Stage data were collected at three AA fishwheel sites and each lower river general habitat evaluation study site (Figure E.5.90, Table E.5.5). Data collected at fishwheel sites are presented in Figures E.5.114-E.5.117 and Appendix ED, Tables ED-1 - ED-4. Data collected at relatively stable general habitat evaluation study sites are listed in Appendix ED, Tables ED-5 - ED-8.

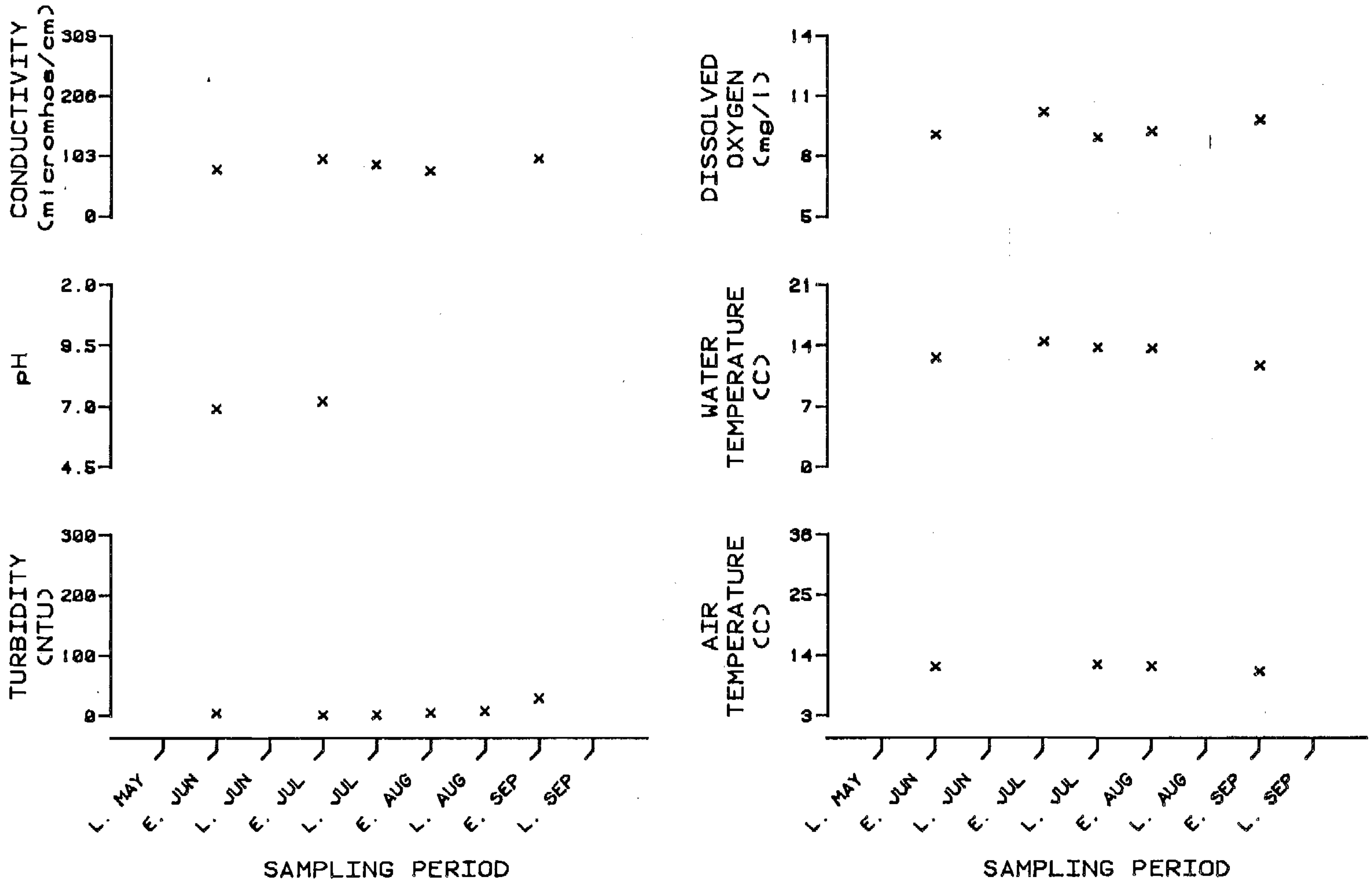


Figure E.5.7. Physiochemical parameters versus time (May-September, 1981)
for Alexander Creek - Site A
(R.M. 10.1, Geographic Code 15N07W06DCA)

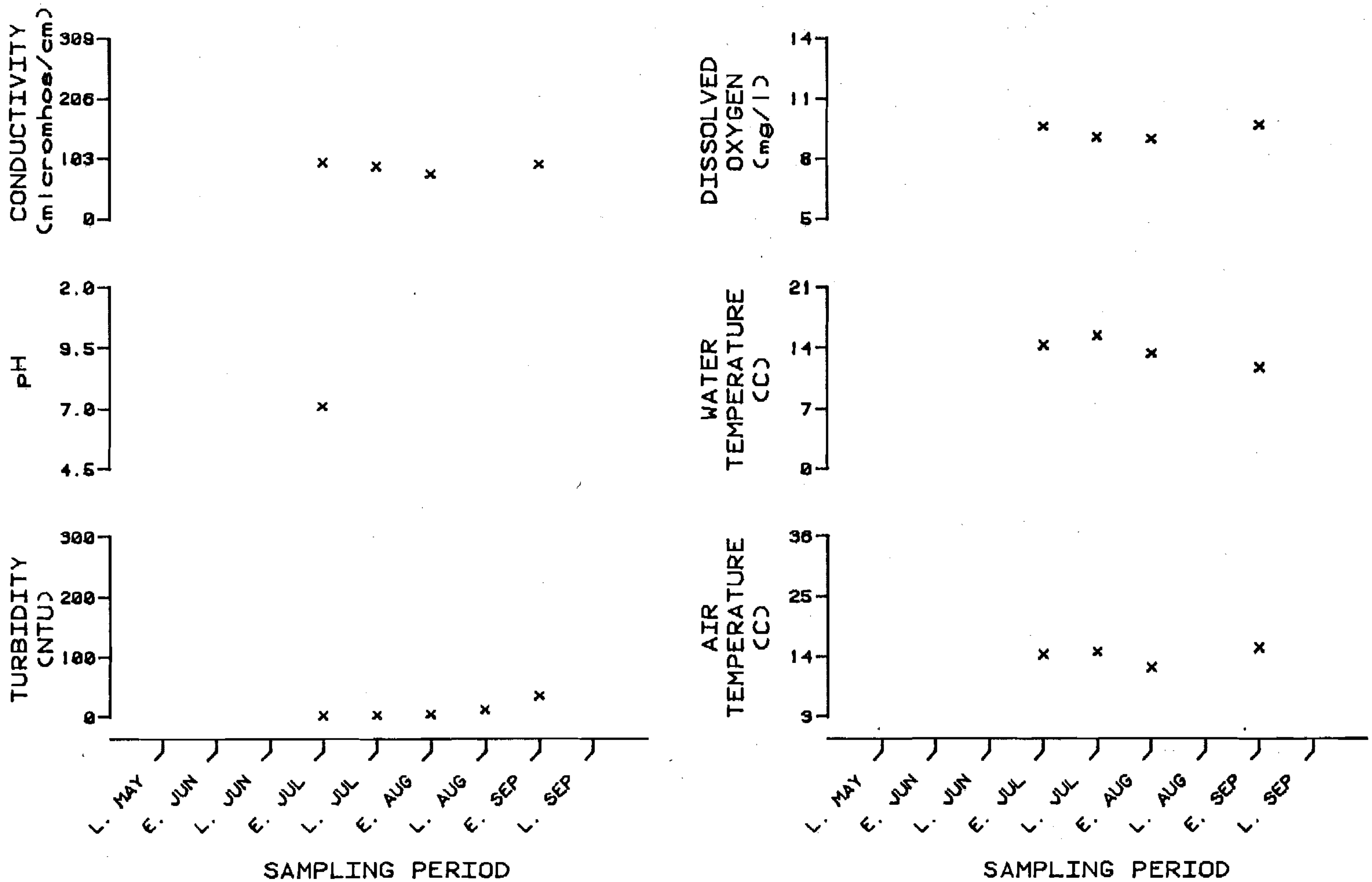


Figure E.5.8. Physiochemical parameters versus time (May-September, 1981)
for Alexander Creek - Site B
(R.M. 10.1, Geographic Code 16N07W32CCB)

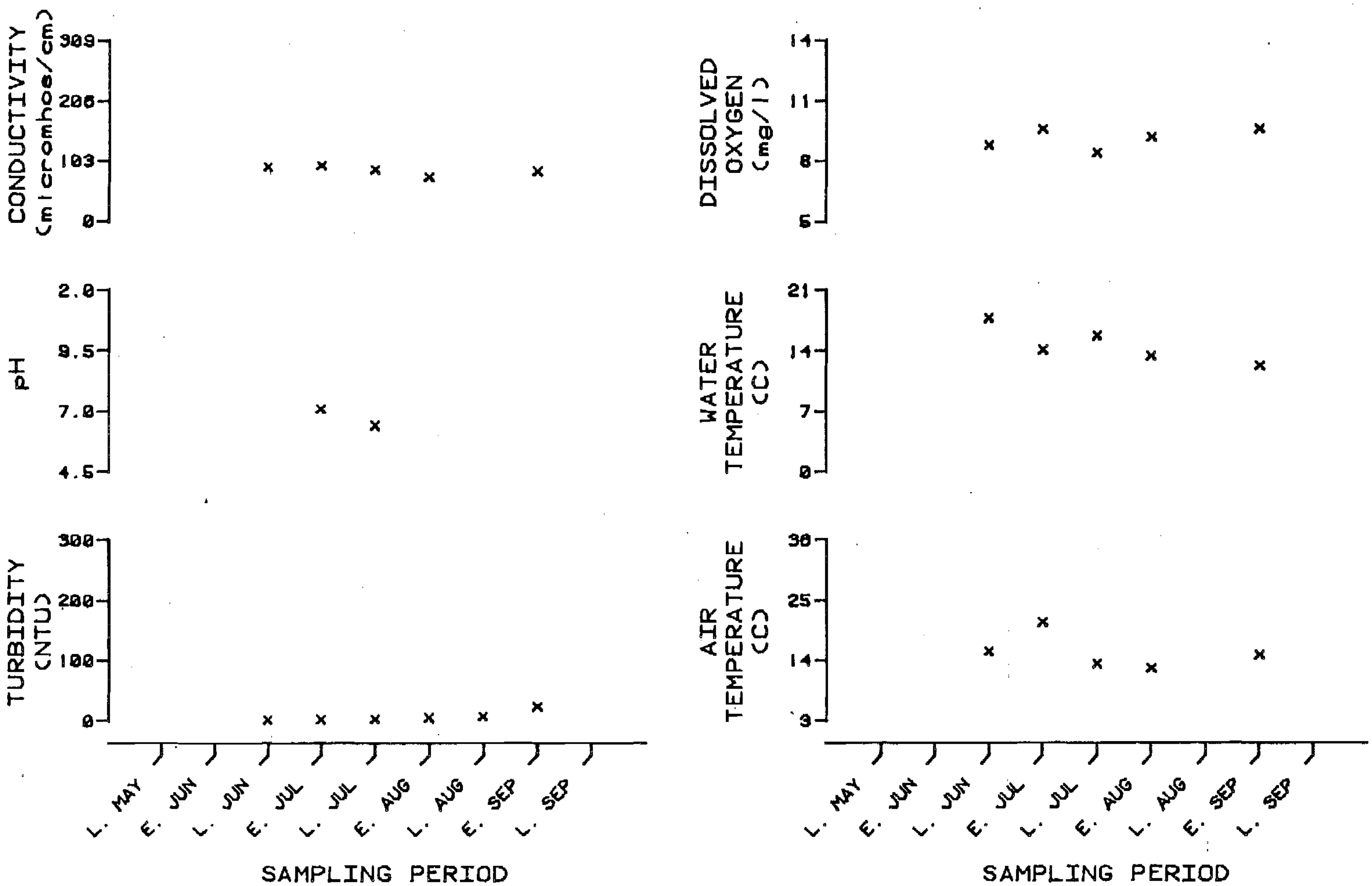


Figure E.5.9. Physiochemical parameters versus time (May-September, 1981) for Alexander Creek - Site C (R.M. 10.1, Geographic Code 16N07W30ACD)

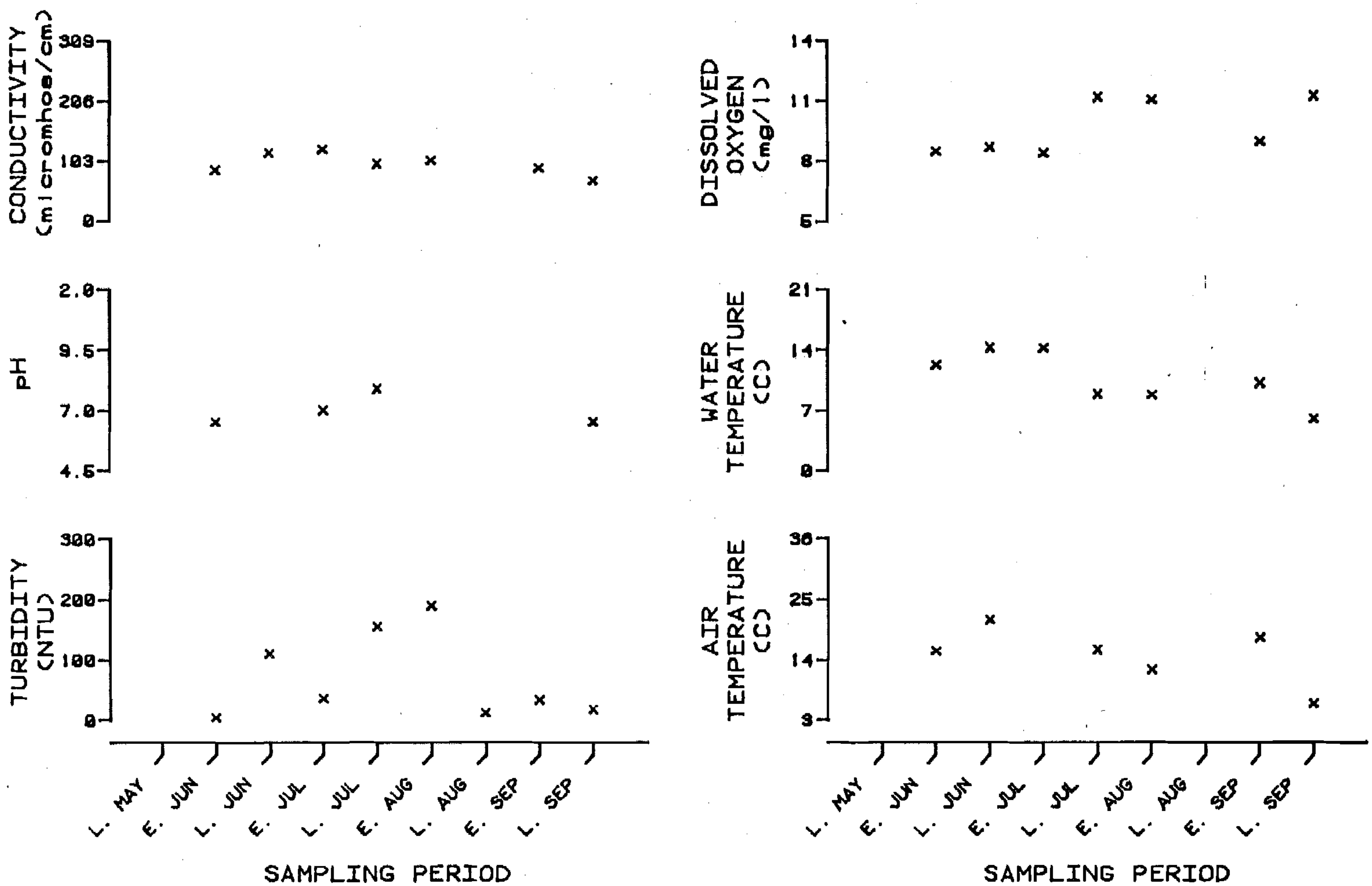


Figure E.5.10. Physiochemical parameters versus time (May-September, 1981)
for Anderson Creek
(R.M. 23.8, Geographic Code 17N07W29DDD)

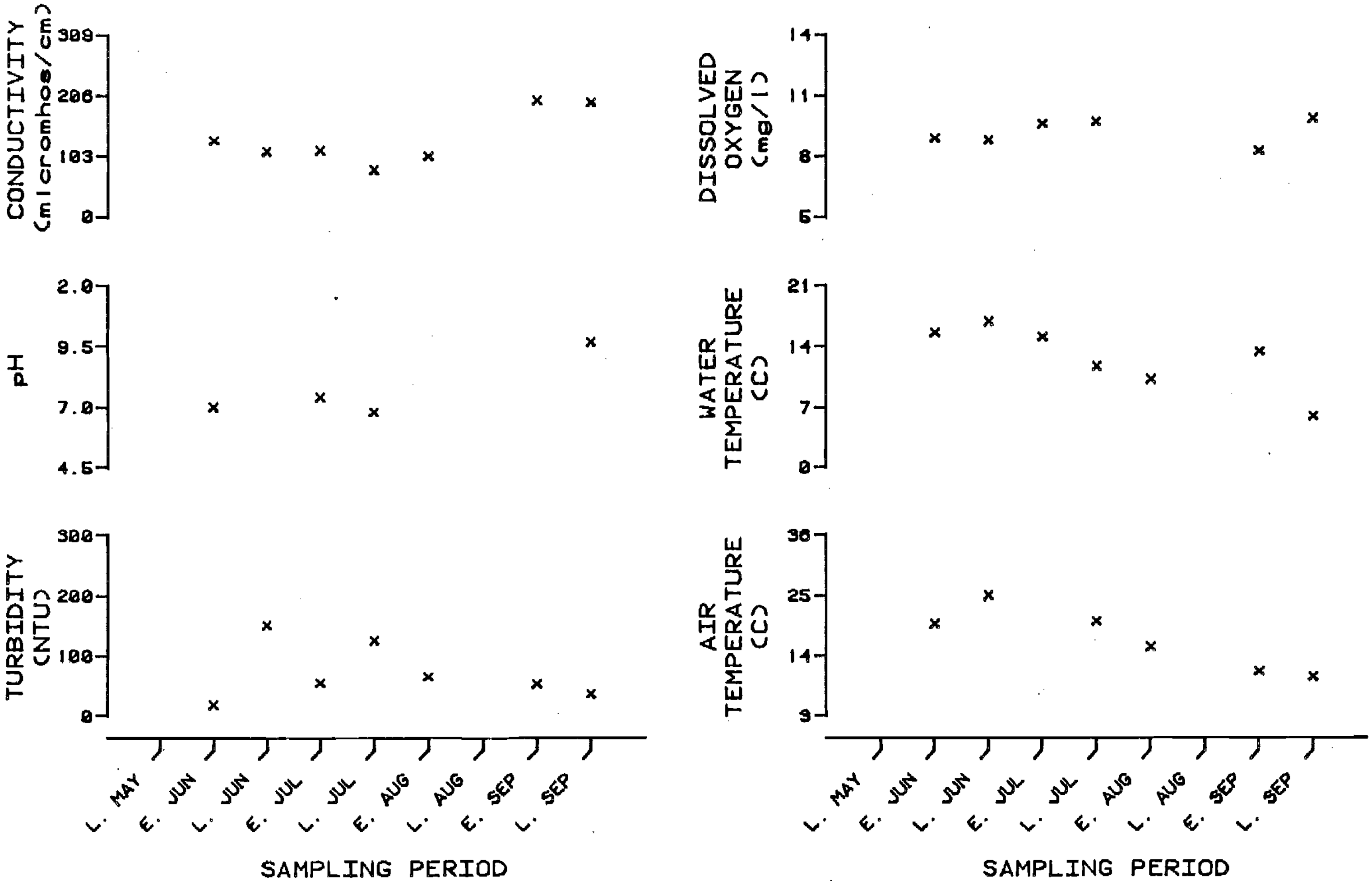


Figure E.5.11. Physiochemical parameters versus time (May-September, 1981)
for Kroto Slough Mouth
(R.M. 30.1, Geographic Code 17N07W01DBC)

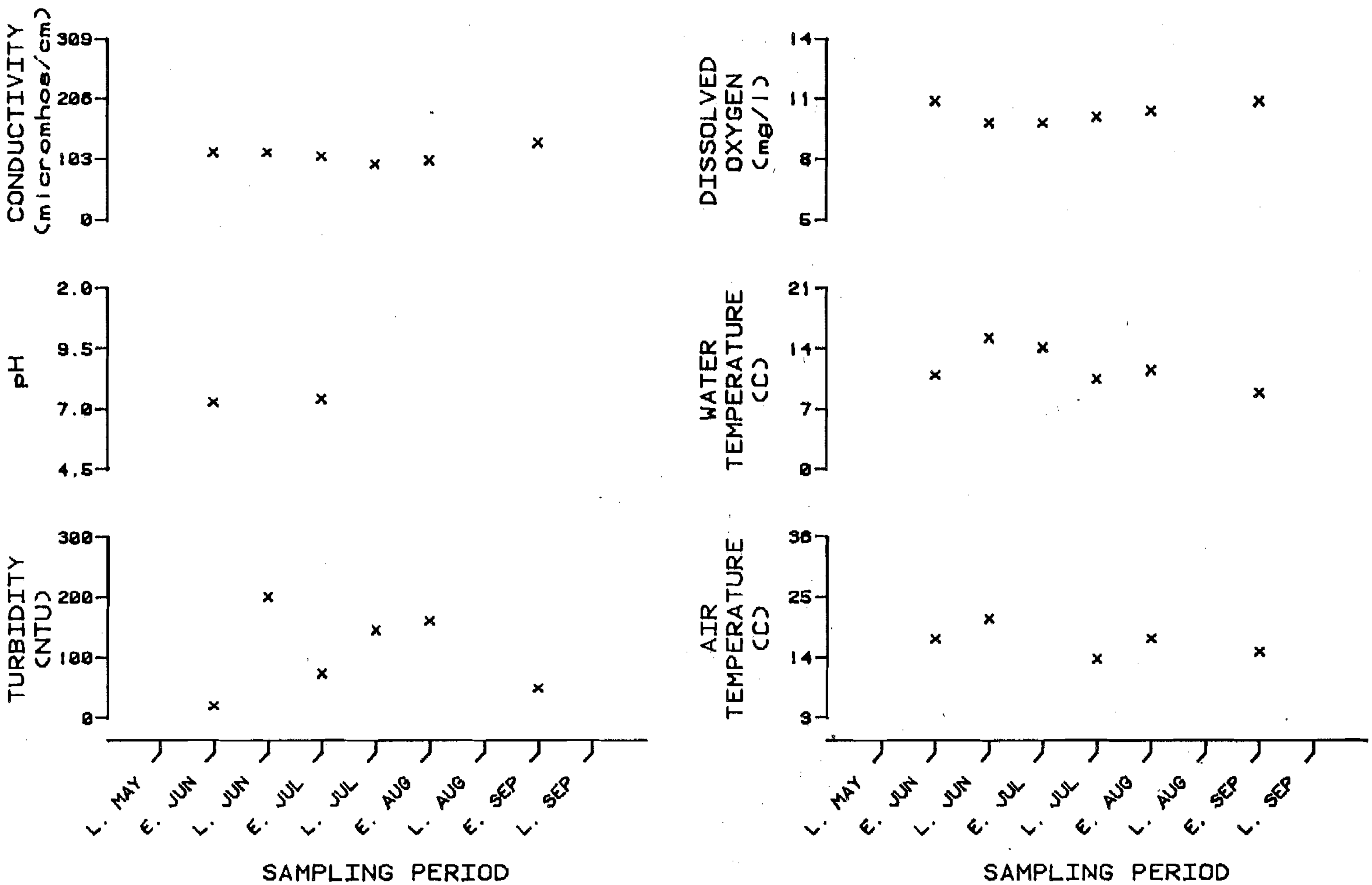


Figure E.5.12. Physiochemical parameters versus time (May-September, 1981) for Mid Kroto Slough (R.M. 36.3, Geographic Code 18N06W16BBC)

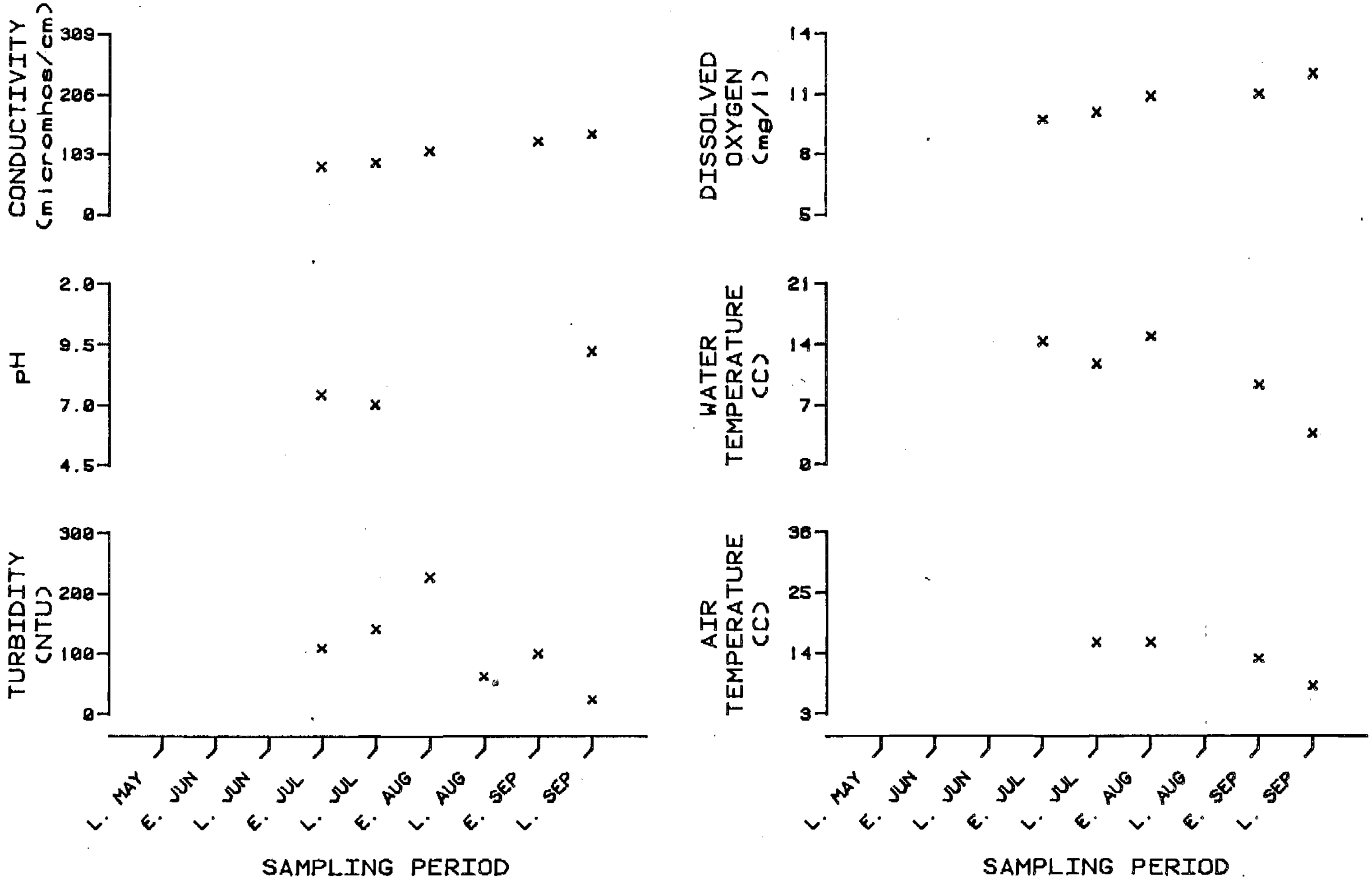


Figure E.5.13. Physiochemical parameters versus time (May-September, 1981) for Mainstem Slough (R.M. 31.0, Geographic Code 17N06W05CAB)

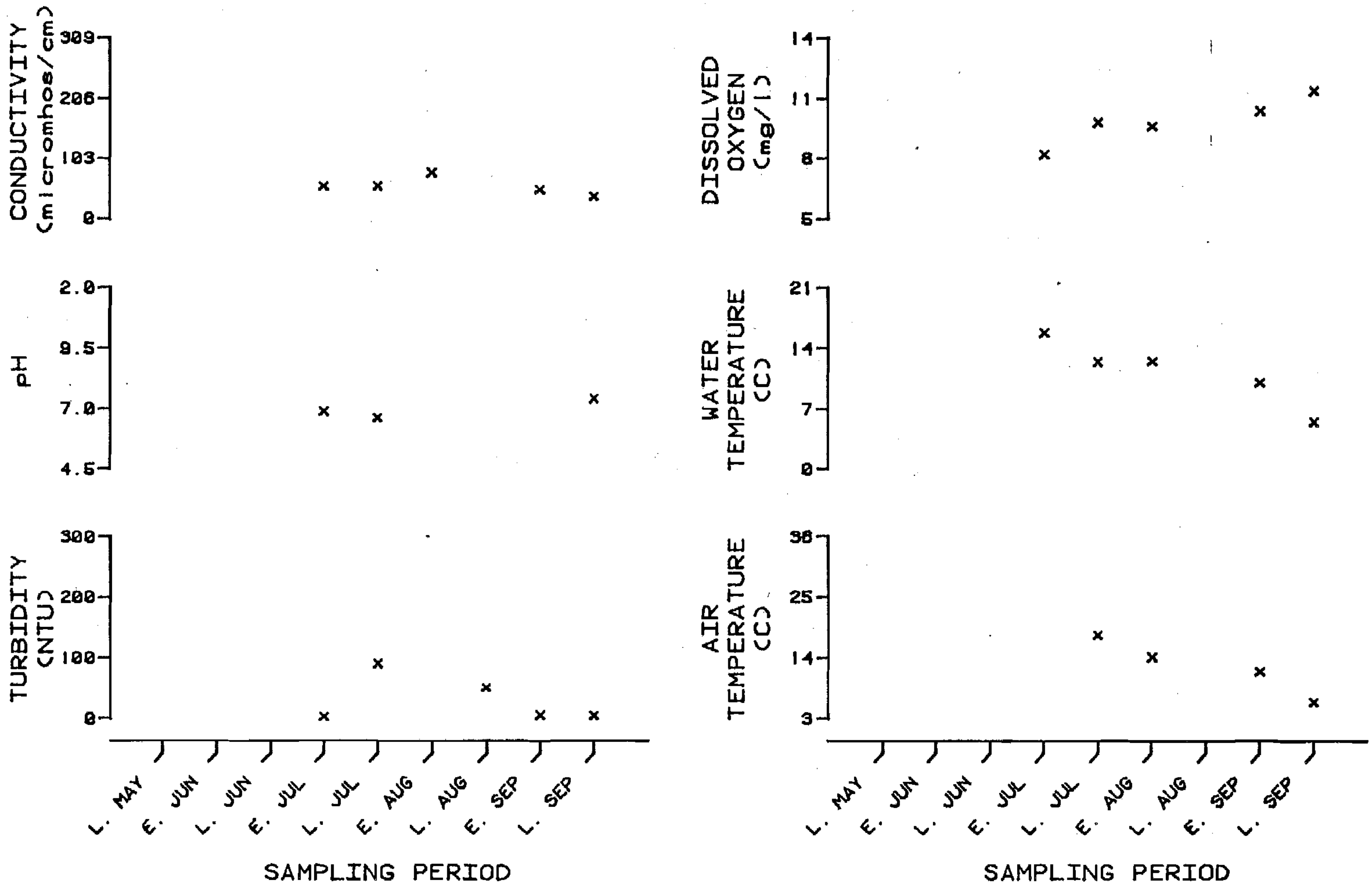


Figure E.5.14. Physiochemical parameters versus time (May-September, 1981) for Deshka River - Site A (R.M. 40.6, Geographic Code 19N06W35BDA)

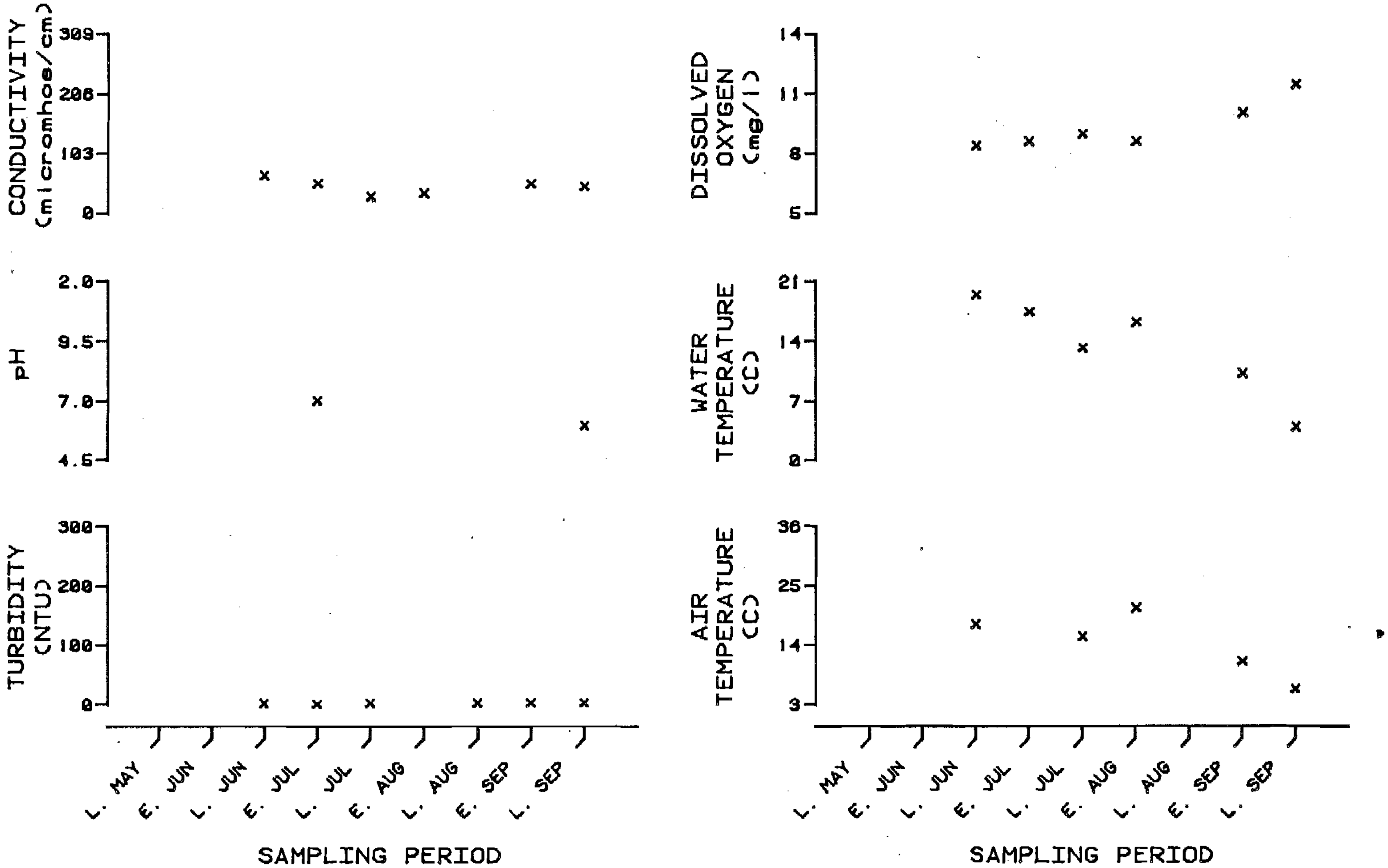


Figure E.5.15. Physiochemical parameters versus time (May-September, 1981) for Deshka River - Site B (R.M. 40.6, Geographic Code 19N06W26BCB)

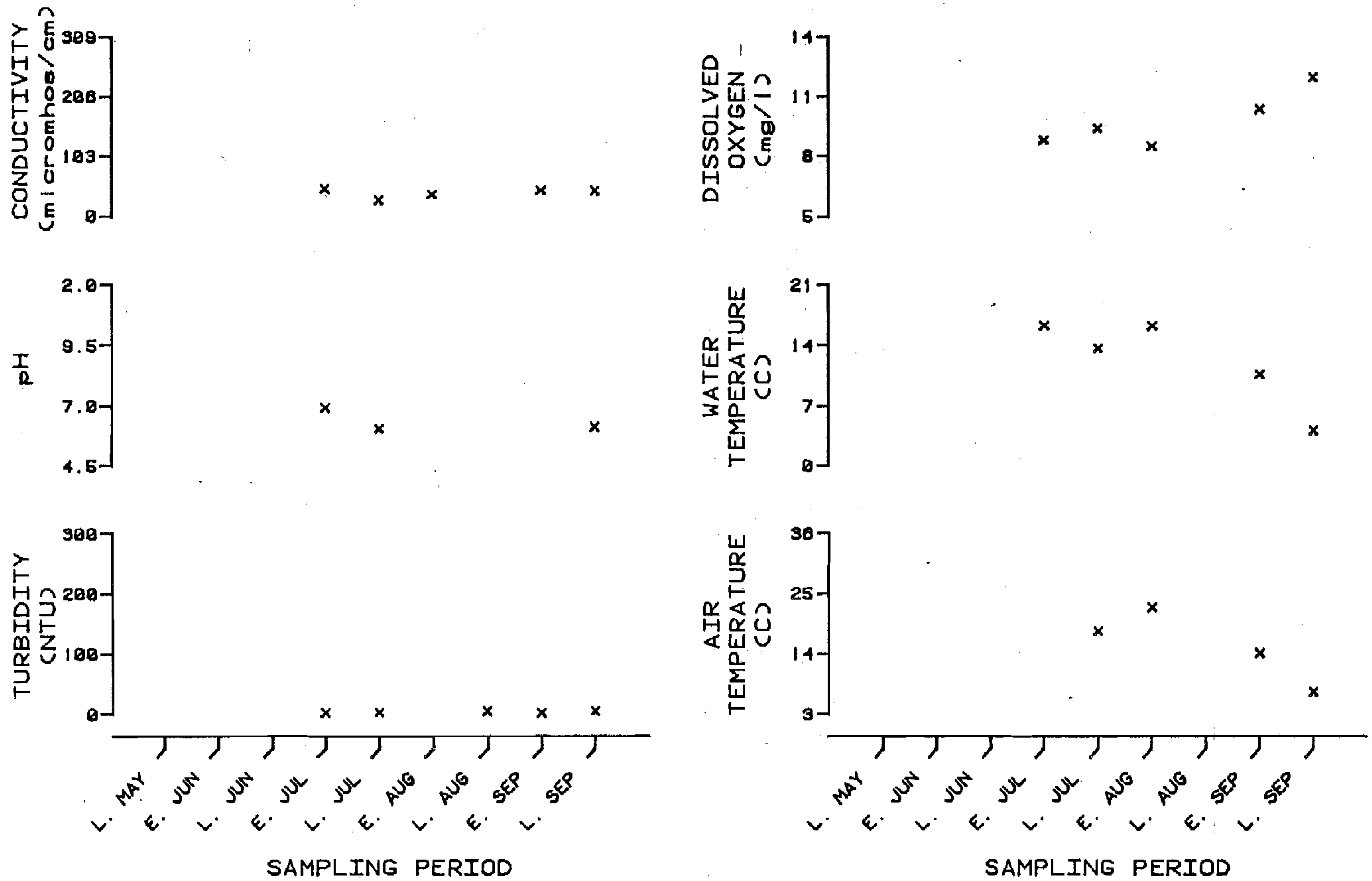


Figure E.5.16. Physiochemical parameters versus time (May-September, 1981) for Deshka River - Site C (R.M. 40.6, Geographic Code 19N06W14BCA)

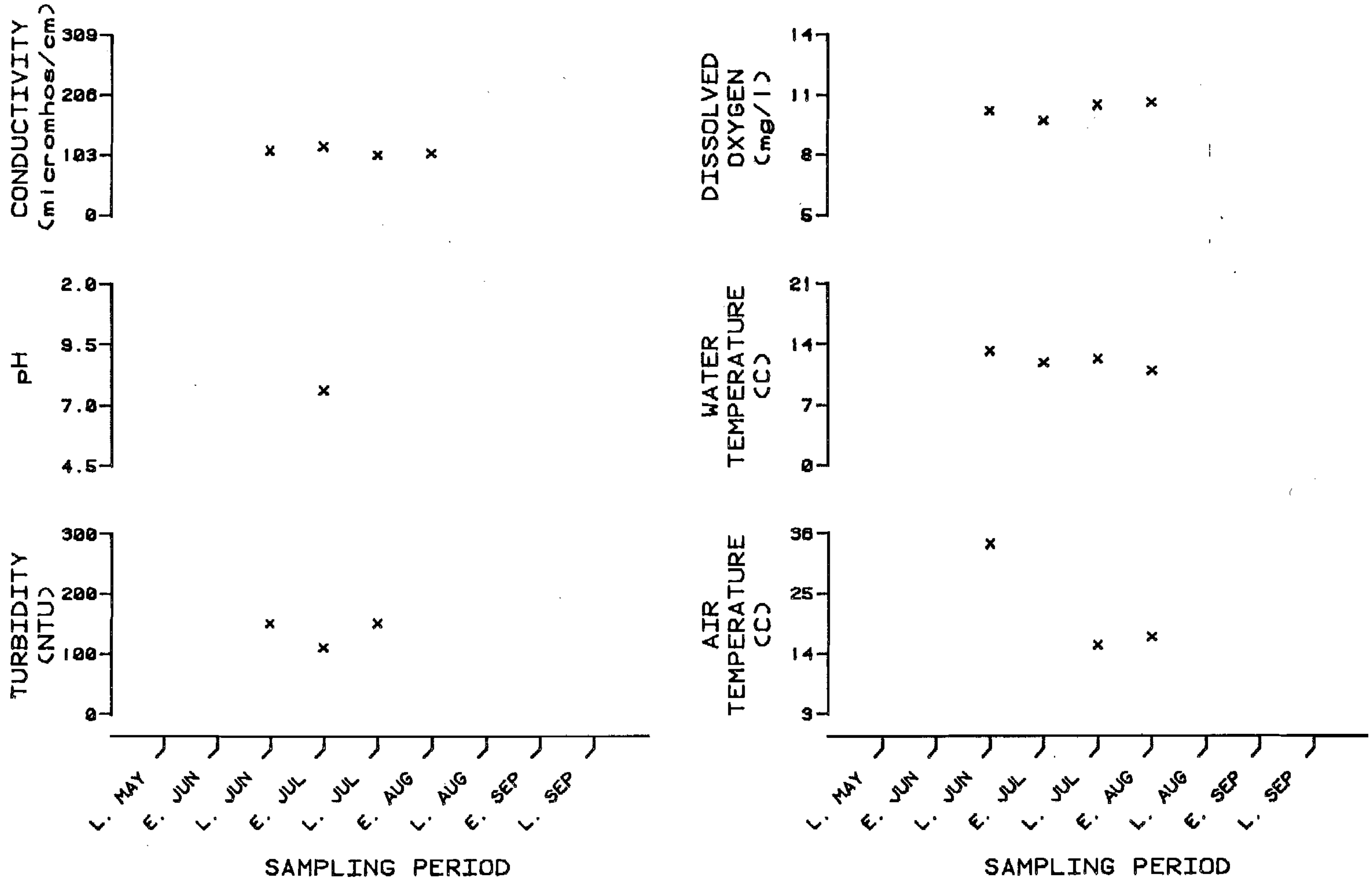


Figure E.5.17. Physiochemical parameters versus time (May-September, 1981) for Lower Delta Islands
(R.M. 44.0, Geographic Code 19N05W19ACB)

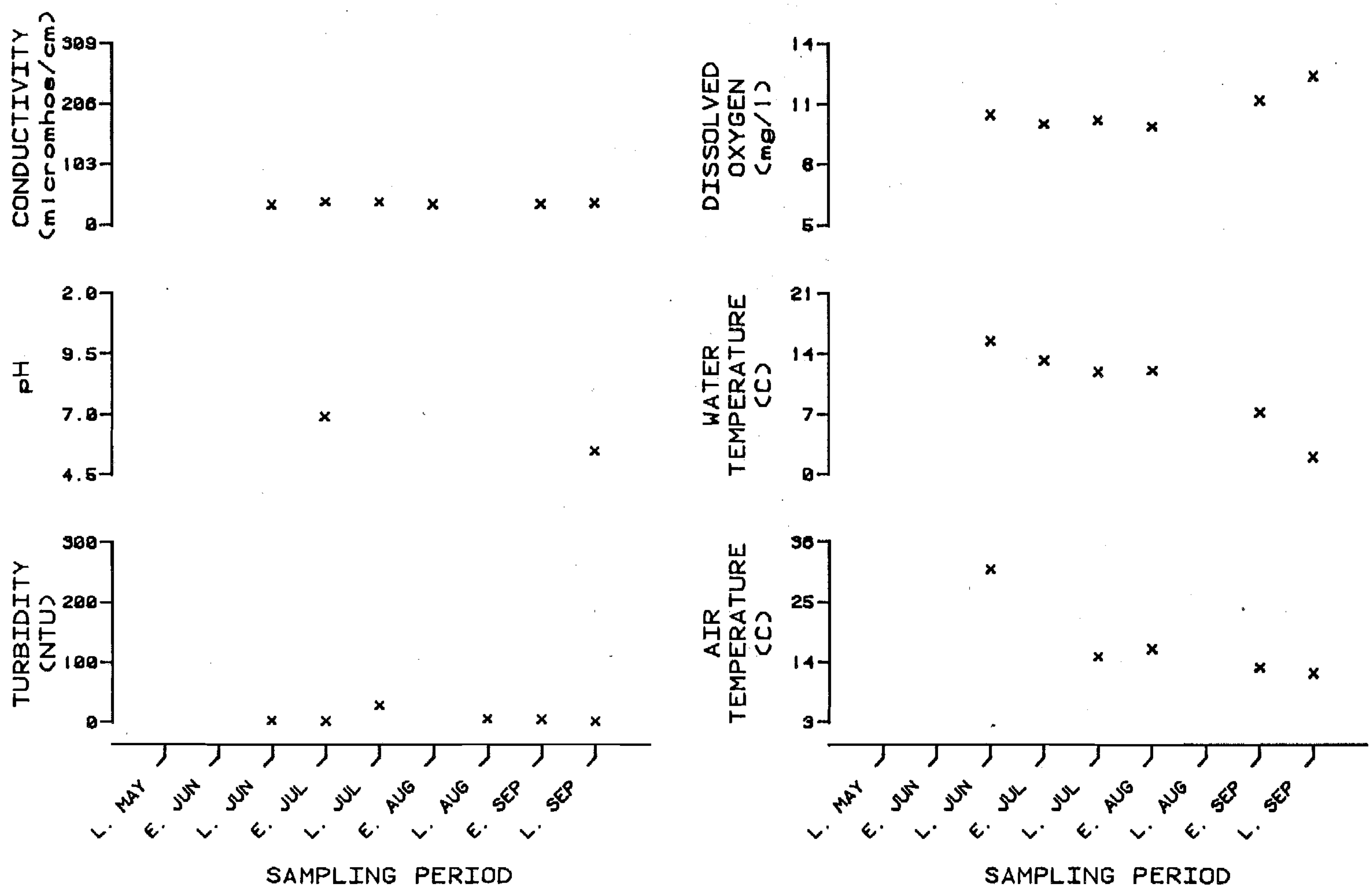


Figure E.5.18. Physiochemical parameters versus time (May-September, 1981)
for Little Willow Creek
(R.M. 50.5, Geographic Code 20N05W27AAD)

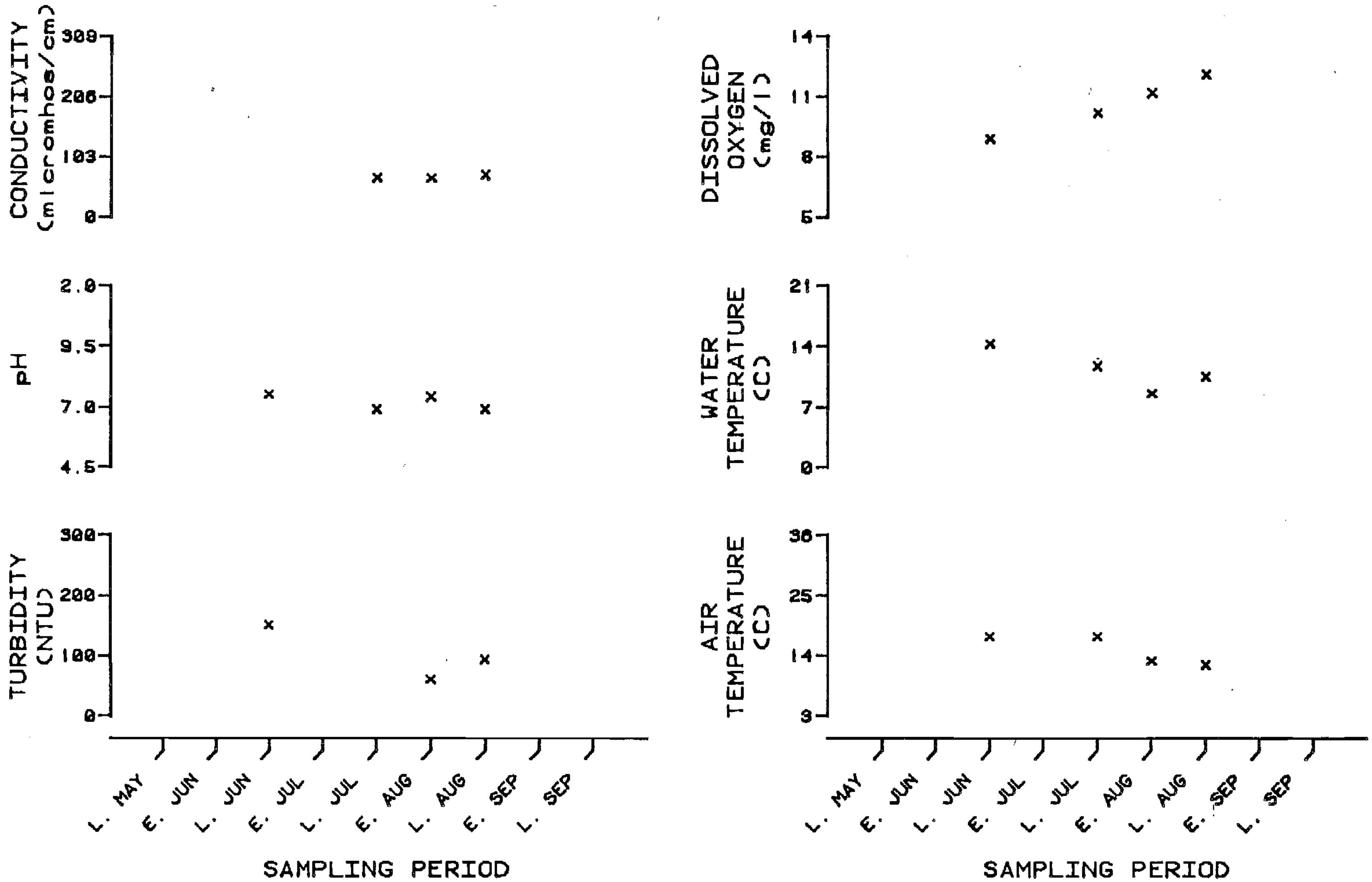


Figure E.5.19. Physiochemical parameters versus time (May-September, 1981)
for Rustic Wilderness
(R.M. 58.1, Geographic Code 21N05W25CBD)

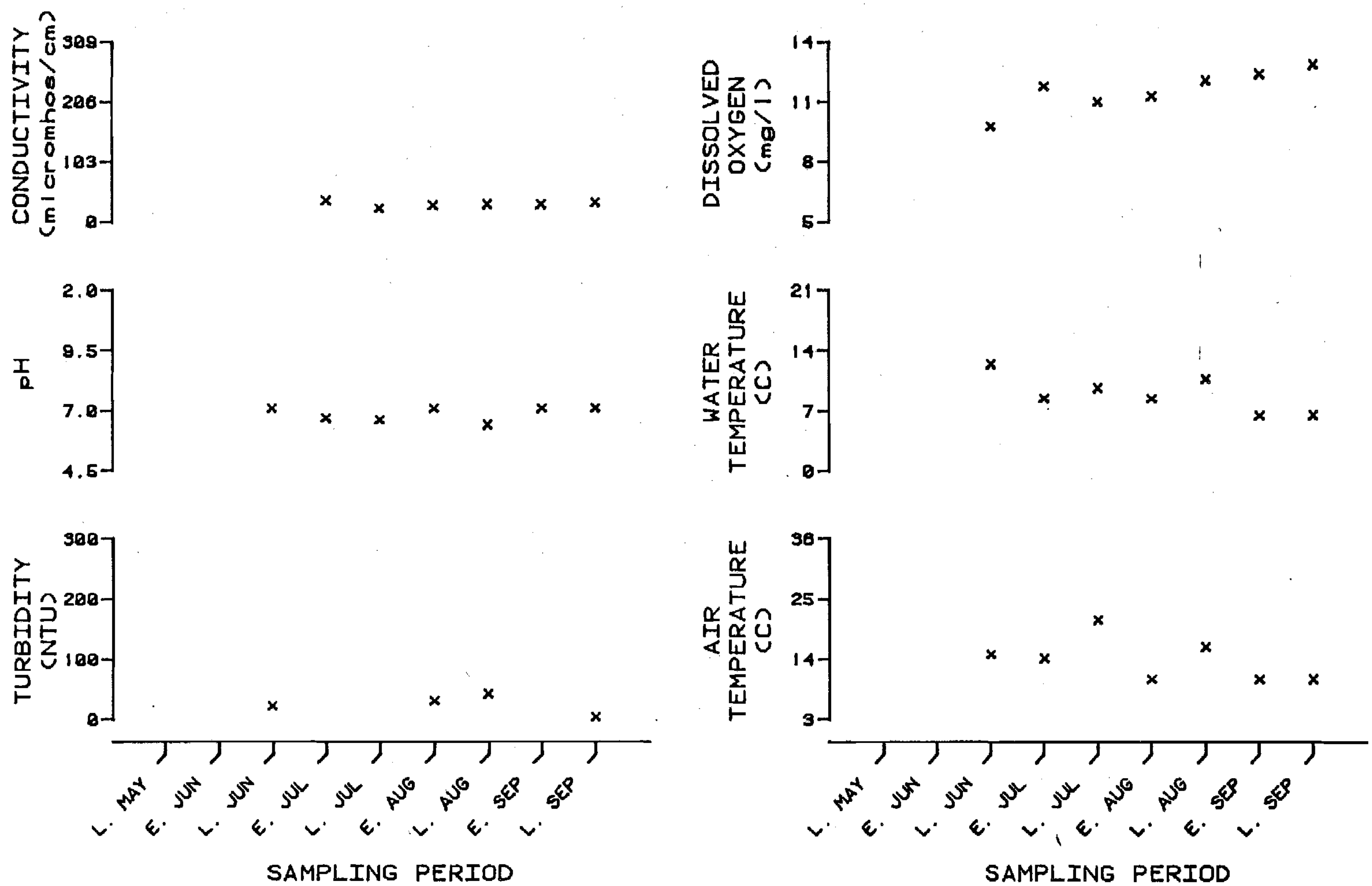


Figure E.5.20. Physiochemical parameters versus time (May-September, 1981)
for Kashwitna River
(R.M. 61.0, Geographic Code 21N05W13AAA)

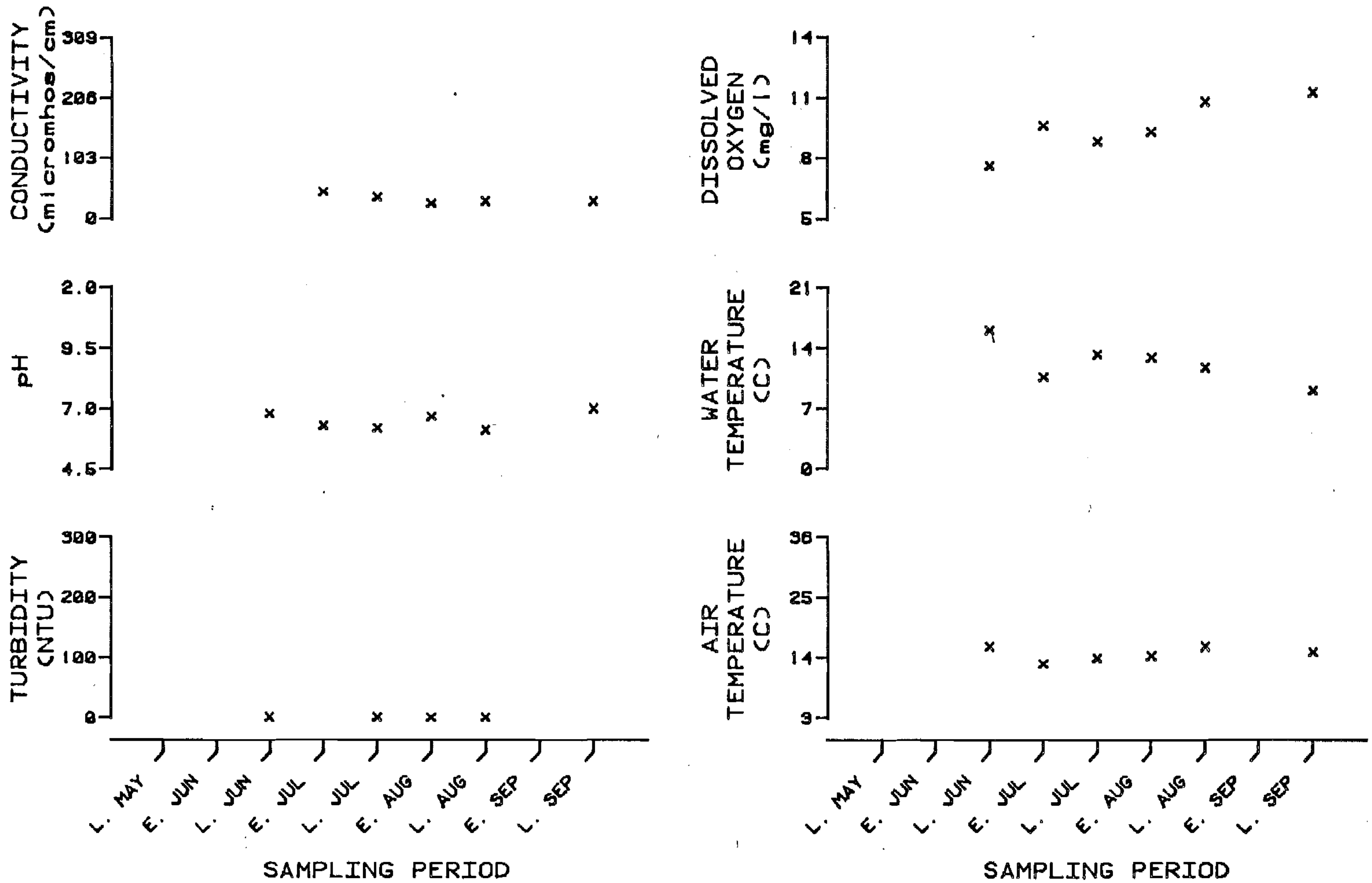


Figure E.5.21. Physiochemical parameters versus time (May-September, 1981) for Caswell Creek (R.M. 63.0, Geographic Code 21N04W06BDD)

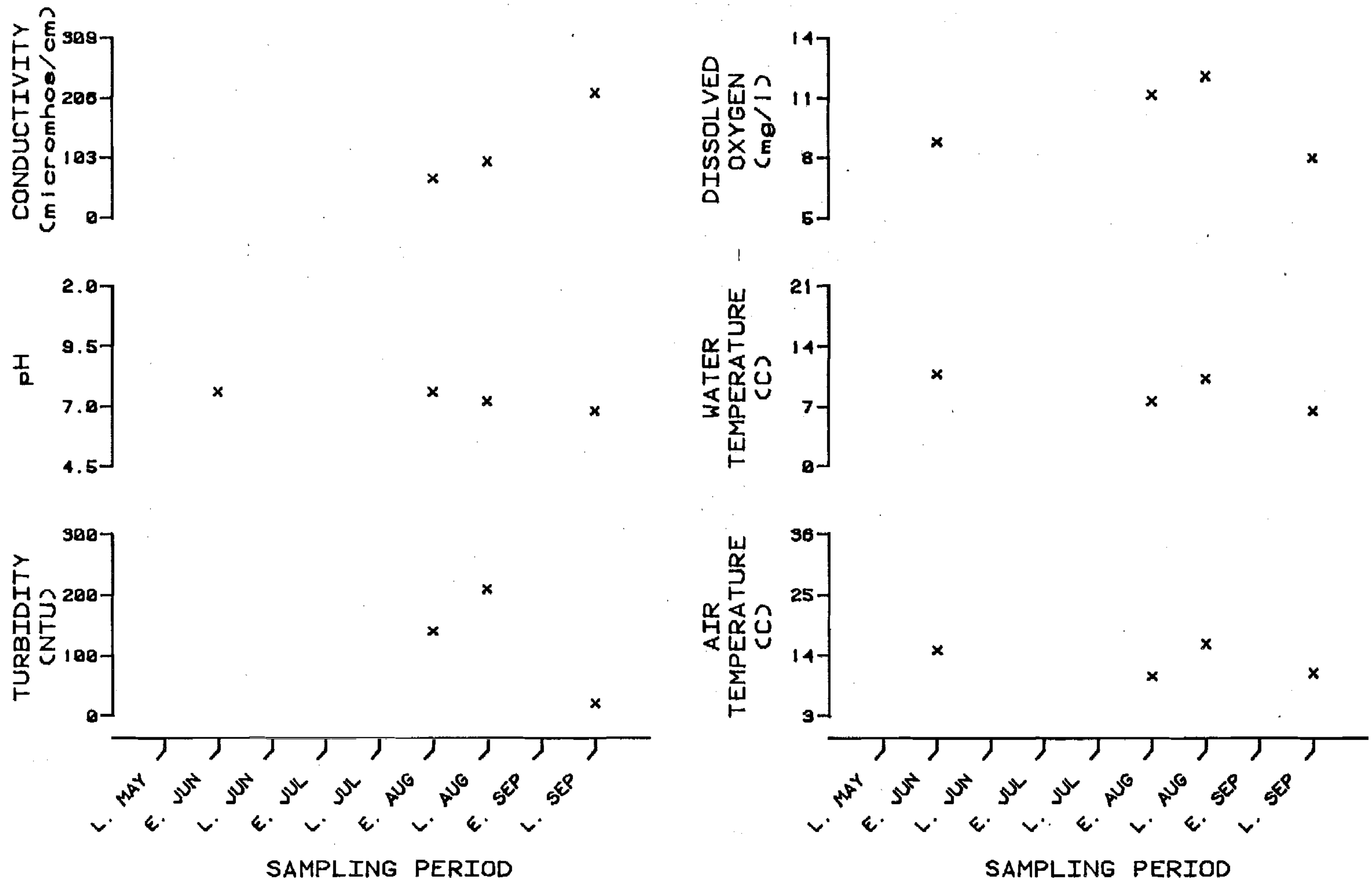


Figure E.5.22. Physiochemical parameters versus time (May-September, 1981) for Slough West Bank (R.M. 65.6, Geographic Code 22N05W27ADC)

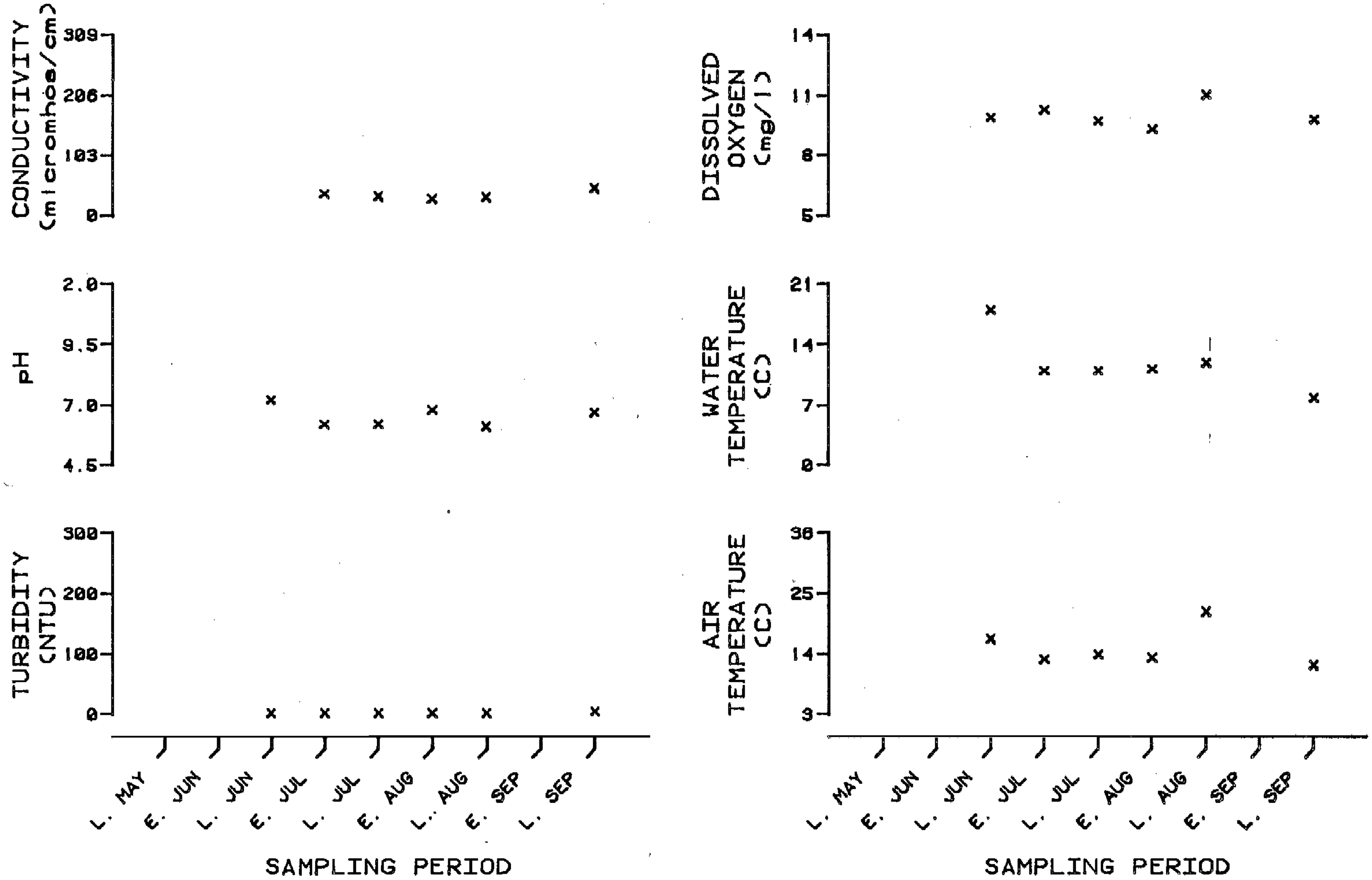


Figure E.5.23. Physiochemical parameters versus time (May-September, 1981)
for Sheep Creek Slough
(R.M. 66.1, Geographic Code 22N04W30BAB)

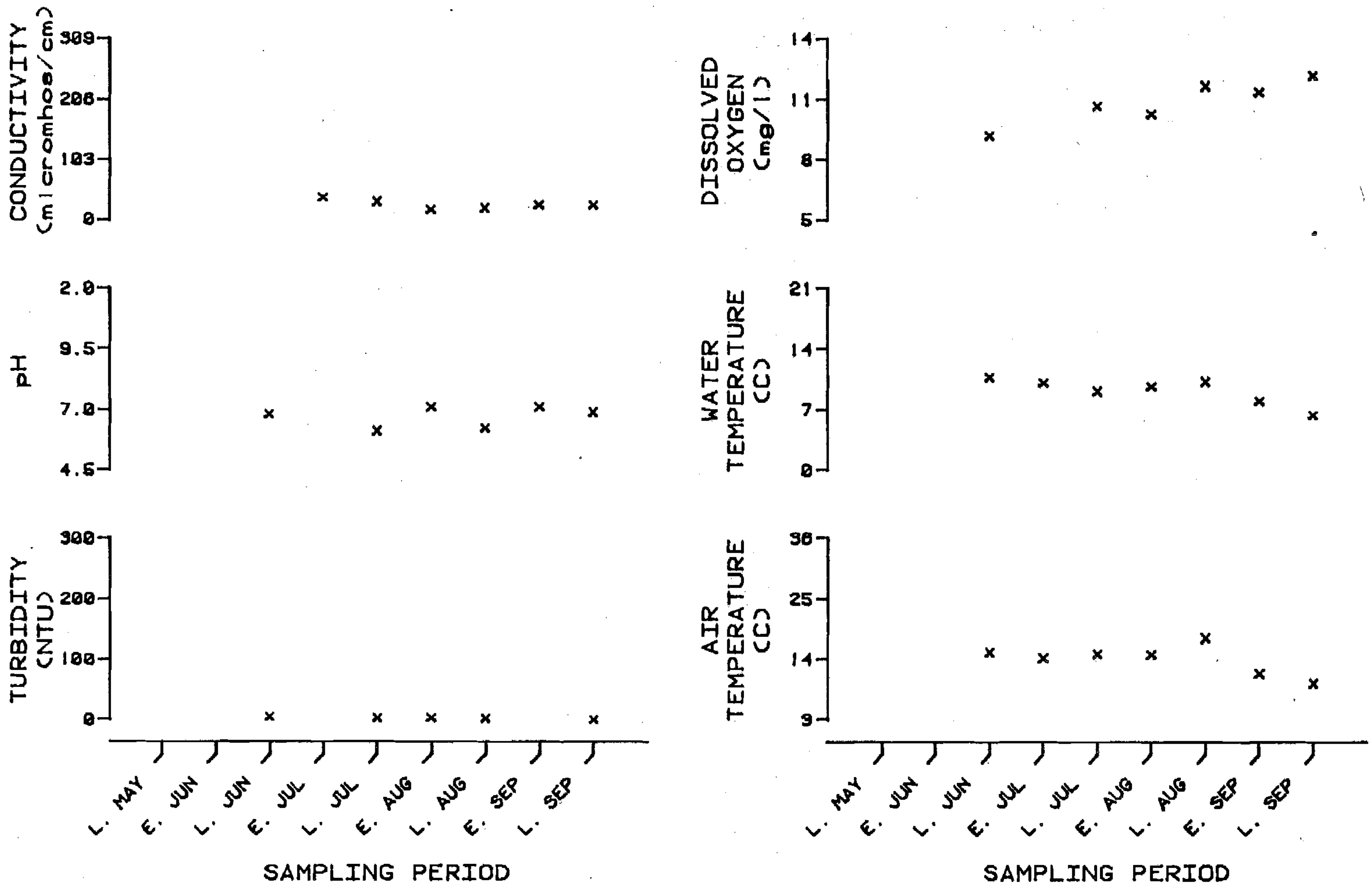


Figure E.5.24. Physiochemical parameters versus time (May-September, 1981)
for Goose Creek - Site 1
(R.M. 72.0, Geographic Code 23N04W31BBC)

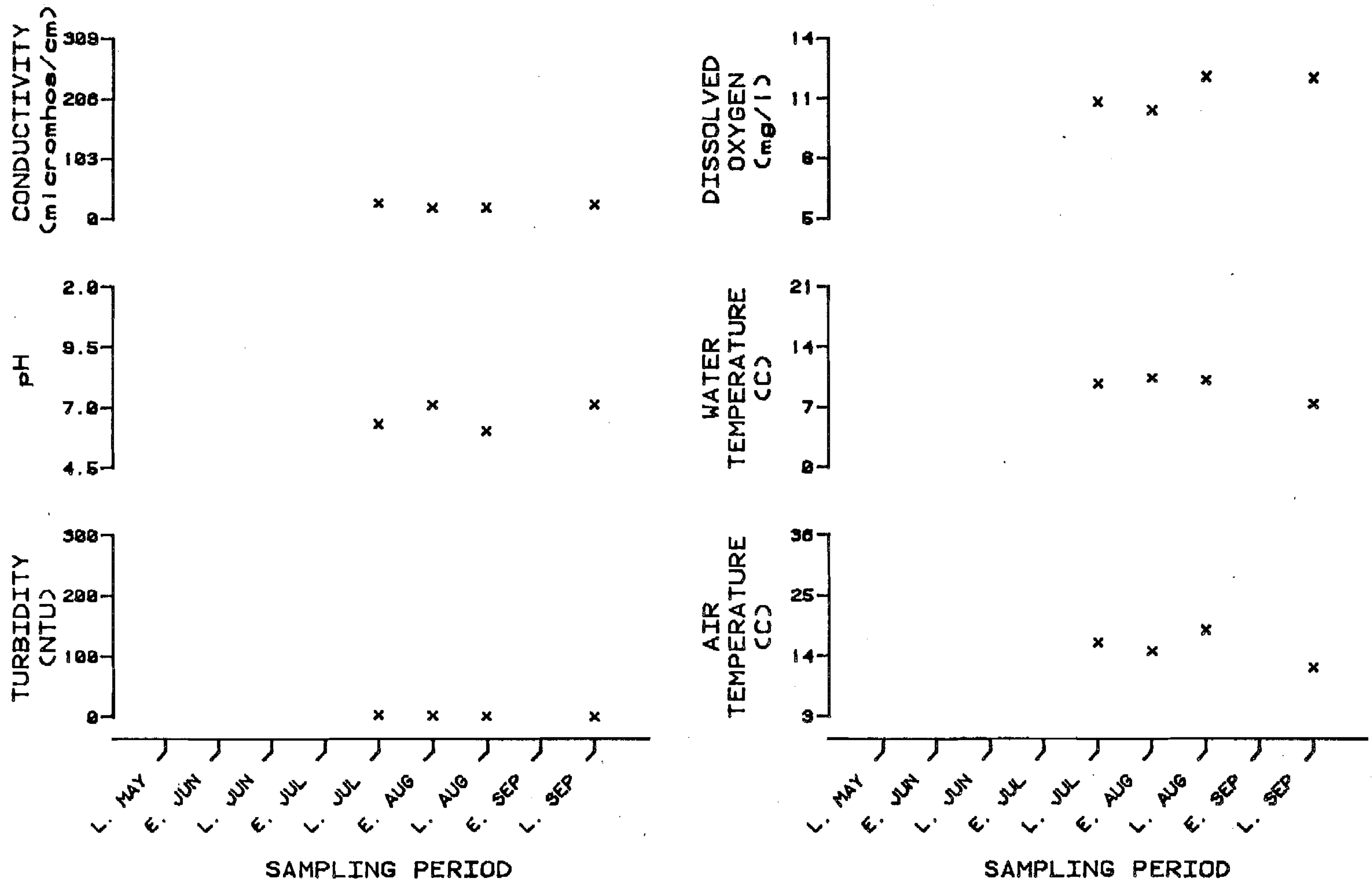


Figure E.5.25. Physiochemical parameters versus time (May-September, 1981) for Goose Creek Lower - Site 2a (R.M. 73.1, Geographic Code 23N04W30BBB)

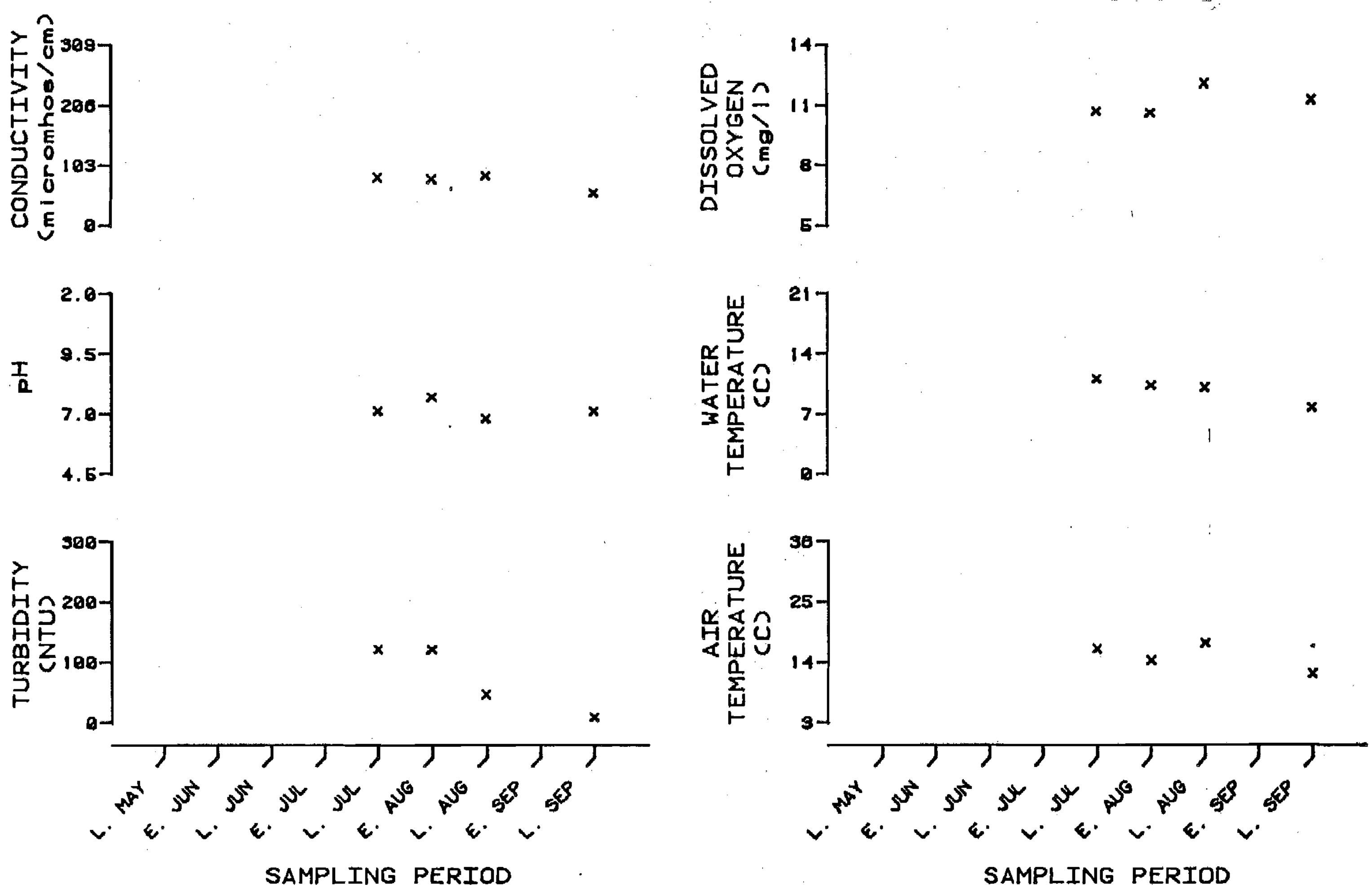


Figure E.5.26. Physiochemical parameters versus time (May-September, 1981)
for Goose Creek Lower - Site 2b
(R.M. 73.1, Geographic Code 23N04W30BBB)

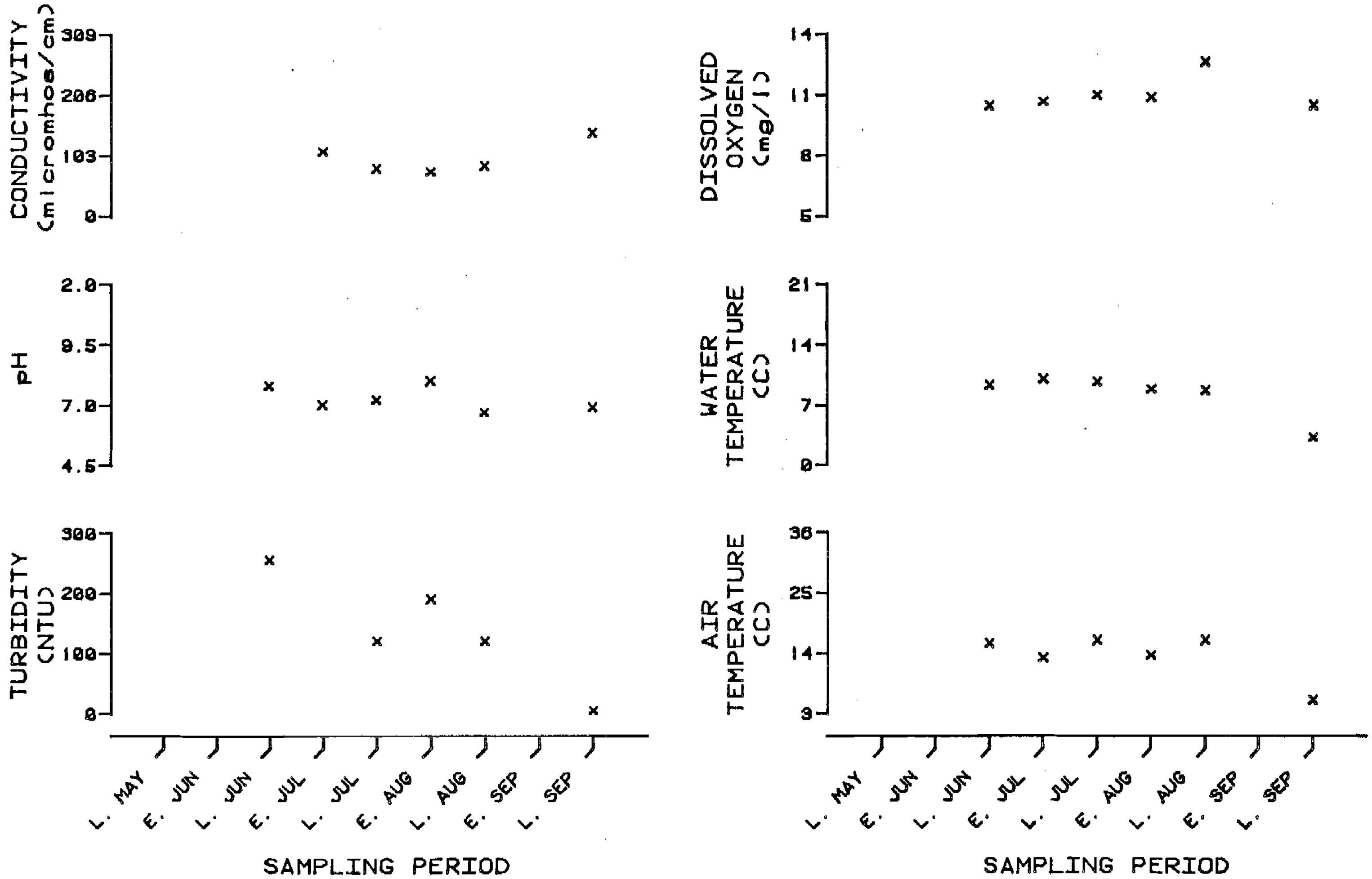


Figure E.5.27. Physiochemical parameters versus time (May-September, 1981) for Mainstem West Bank (R.M. 74.4, Geographic Code 23N05W13CCD)

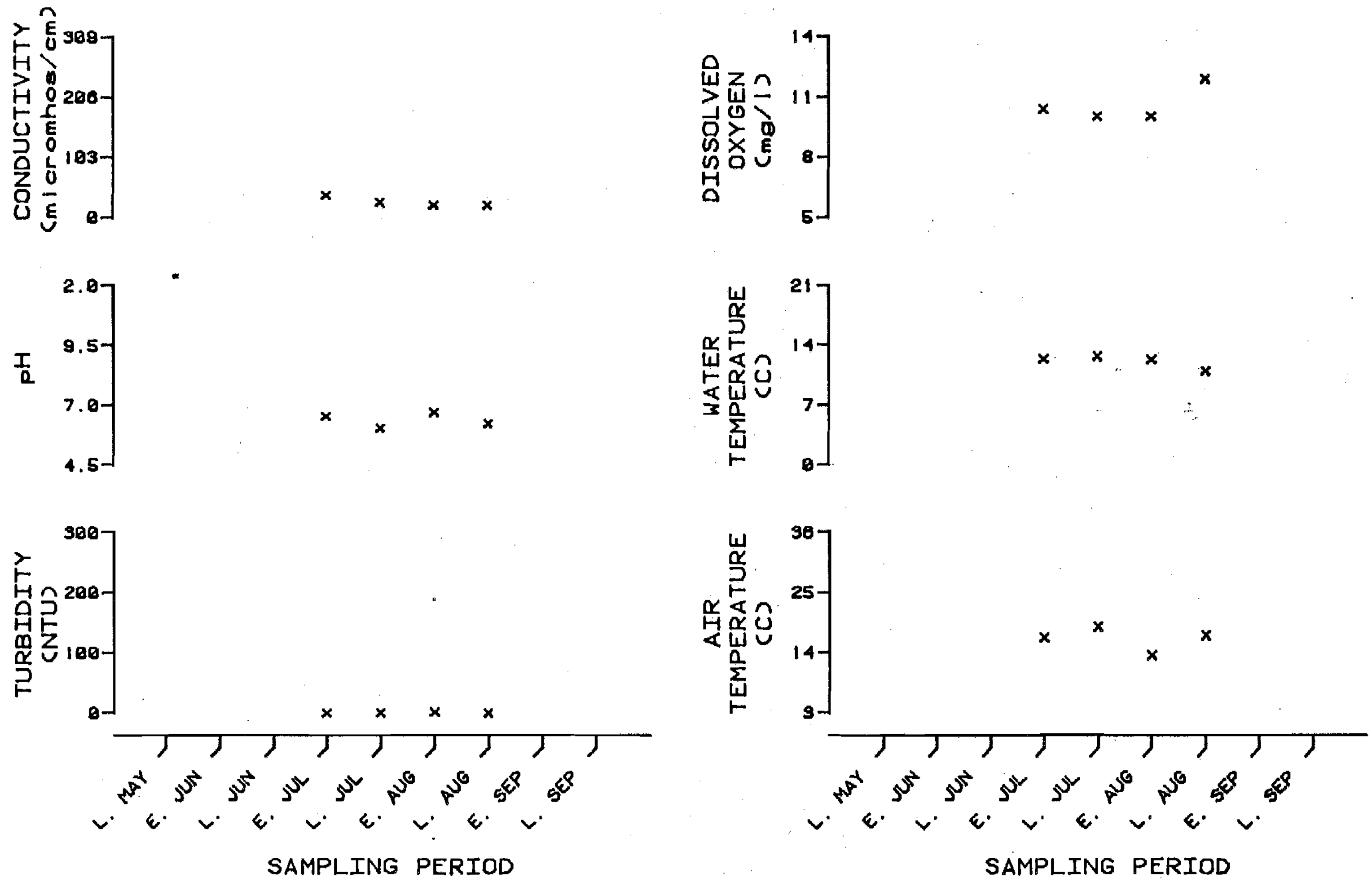


Figure E.5.28. Physiochemical parameters versus time (May-September, 1981)
for Montana Creek
(R.M. 77.0, Geographic Code 23N04W07ABA)

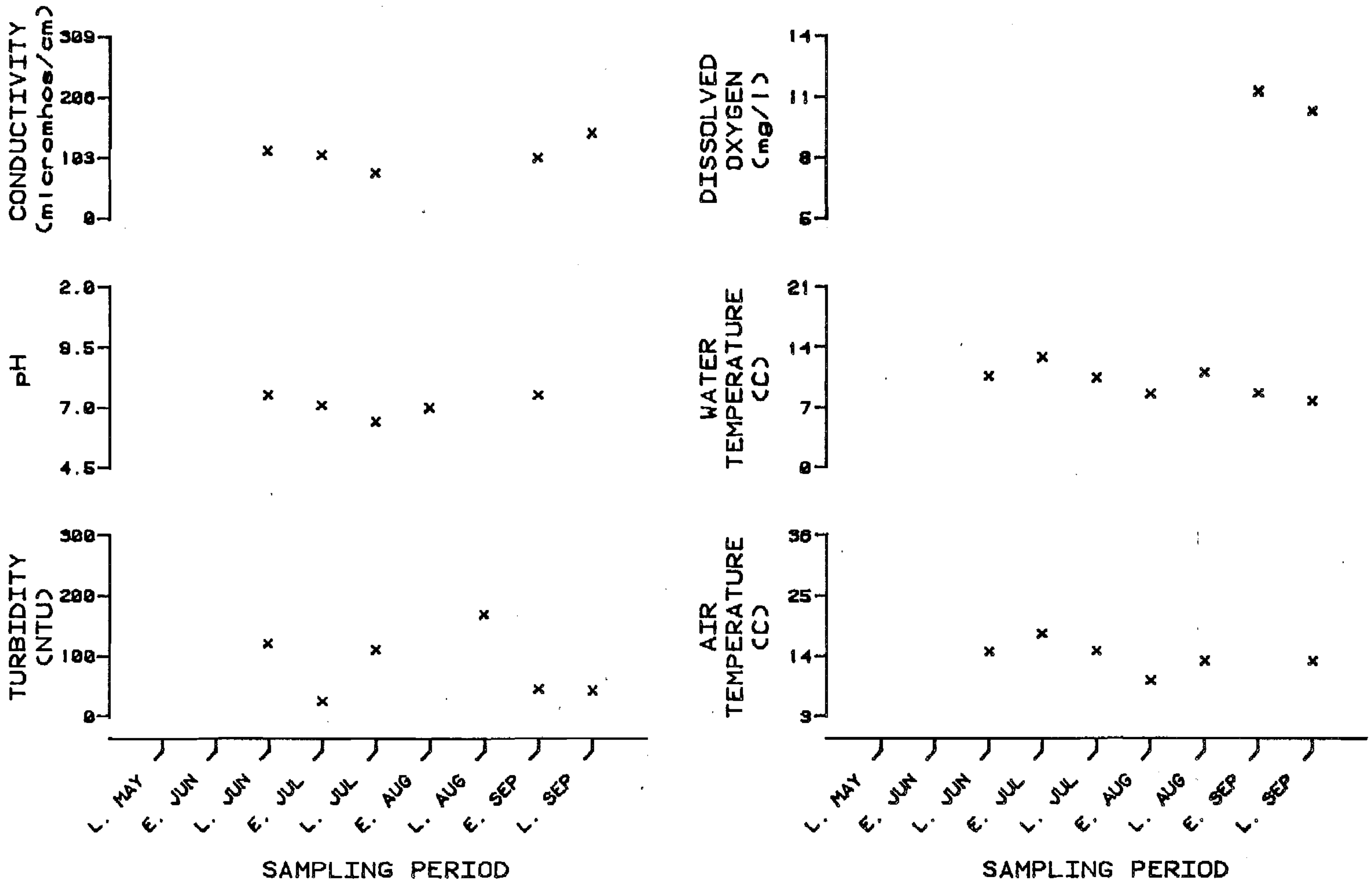


Figure E.5.29. Physiochemical parameters versus time (May-September, 1981)
for Mainstem 1
(R.M. 84.0, Geographic Code 24N05W10DCC)

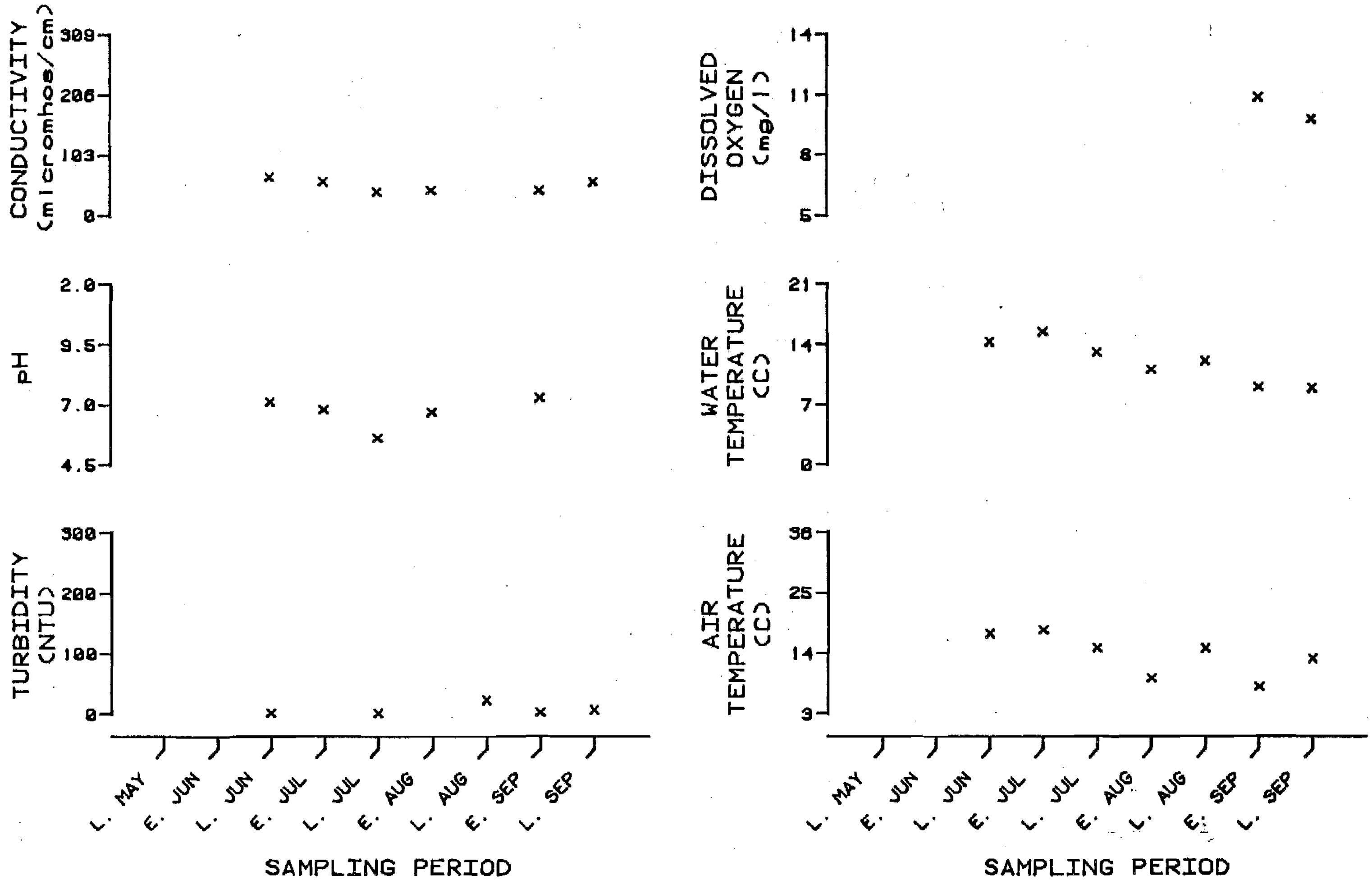


Figure E.5.30. Physiochemical parameters versus time (May-September, 1981)
for Sunshine Creek
(R.M. 85.7, Geographic Code 24N05W14AAB)

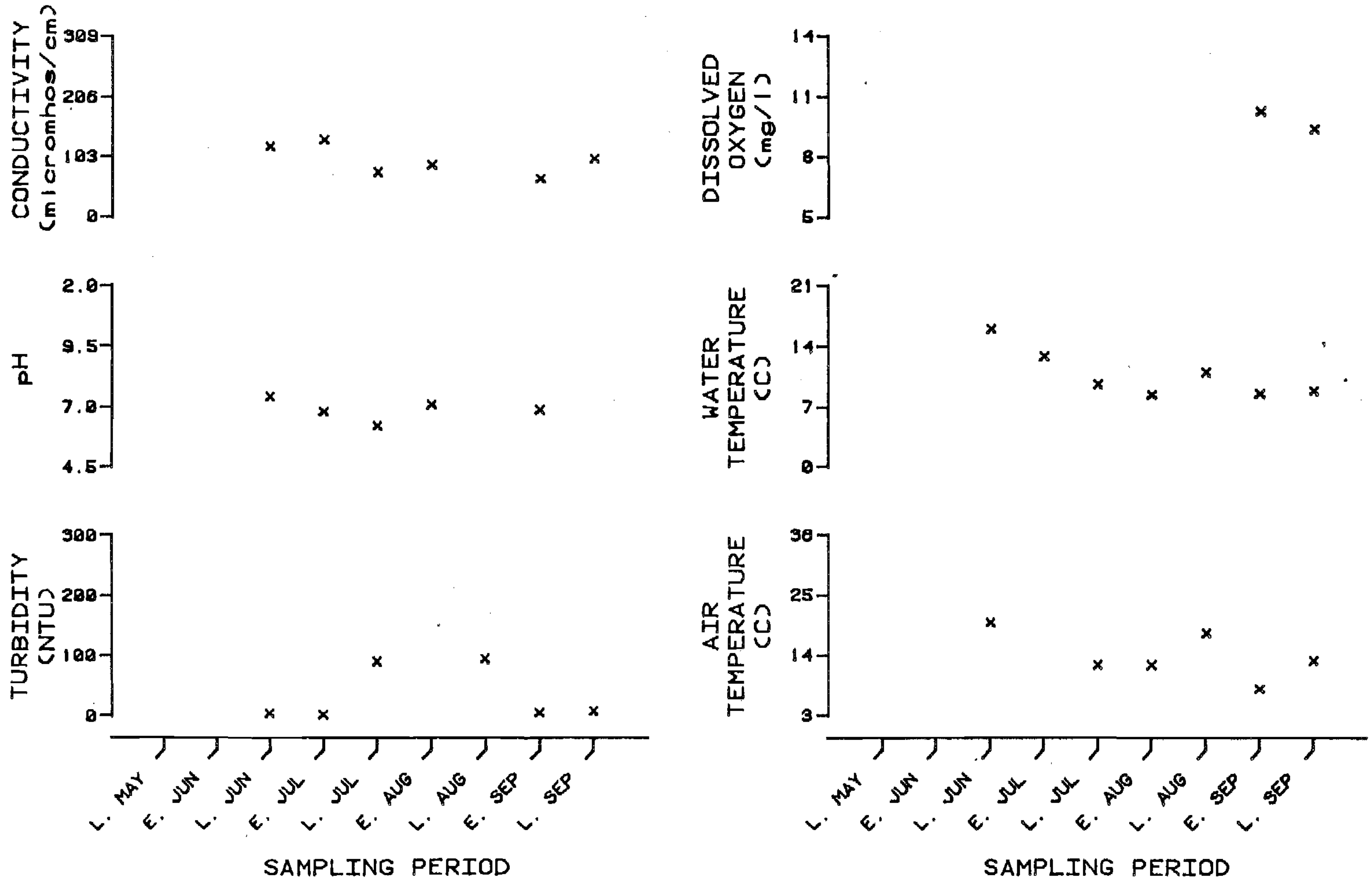


Figure E.5.31. Physiochemical parameters versus time (May-September, 1981)
for Birch Creek Slough
(R.M. 88.4, Geographic Code 25N05W25DCC)

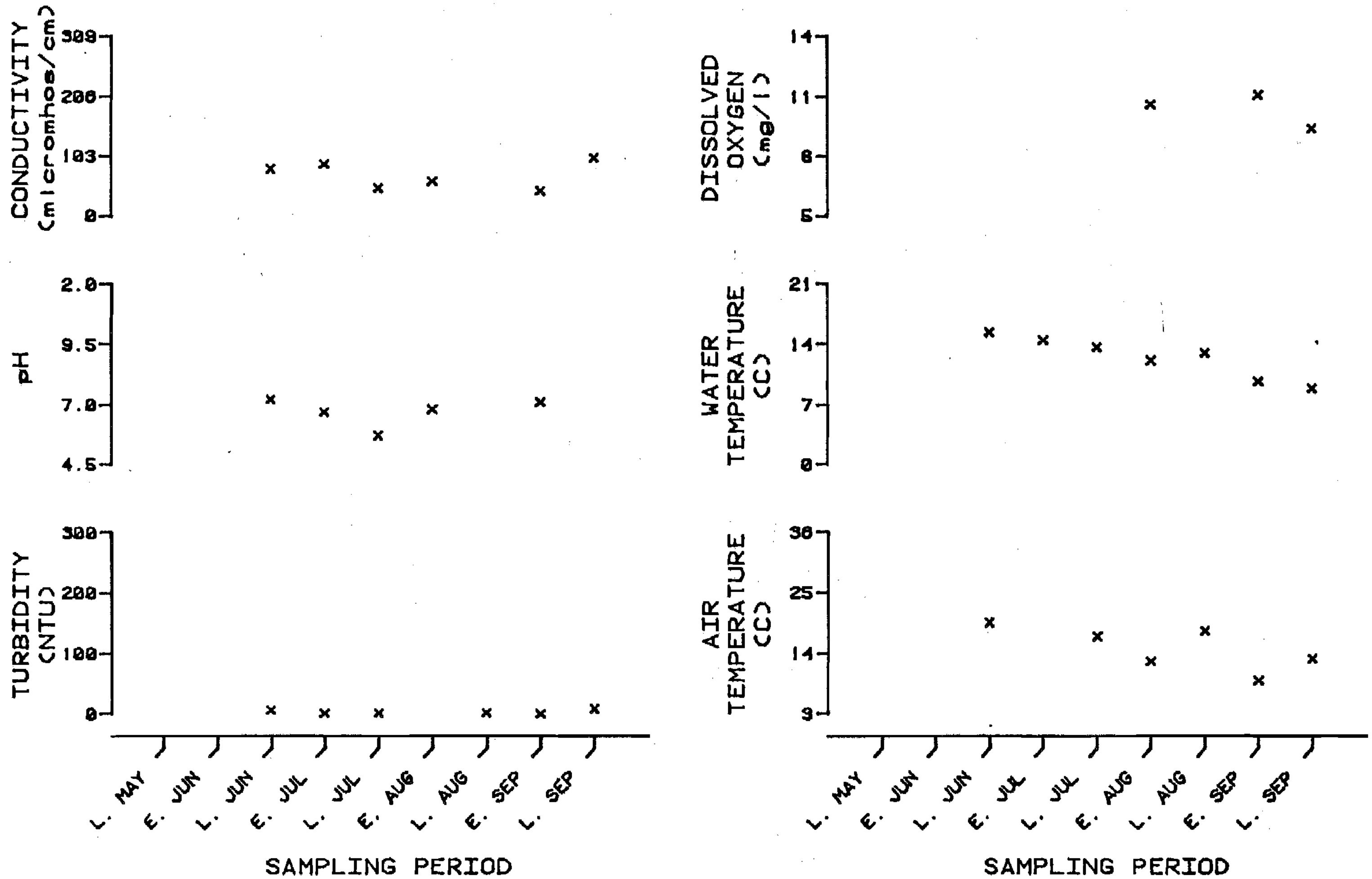


Figure E.5.32. Physiochemical parameters versus time (May-September, 1981)
for Birch Creek
(R.M. 89.2, Geographic Code 25N05W25ABD)

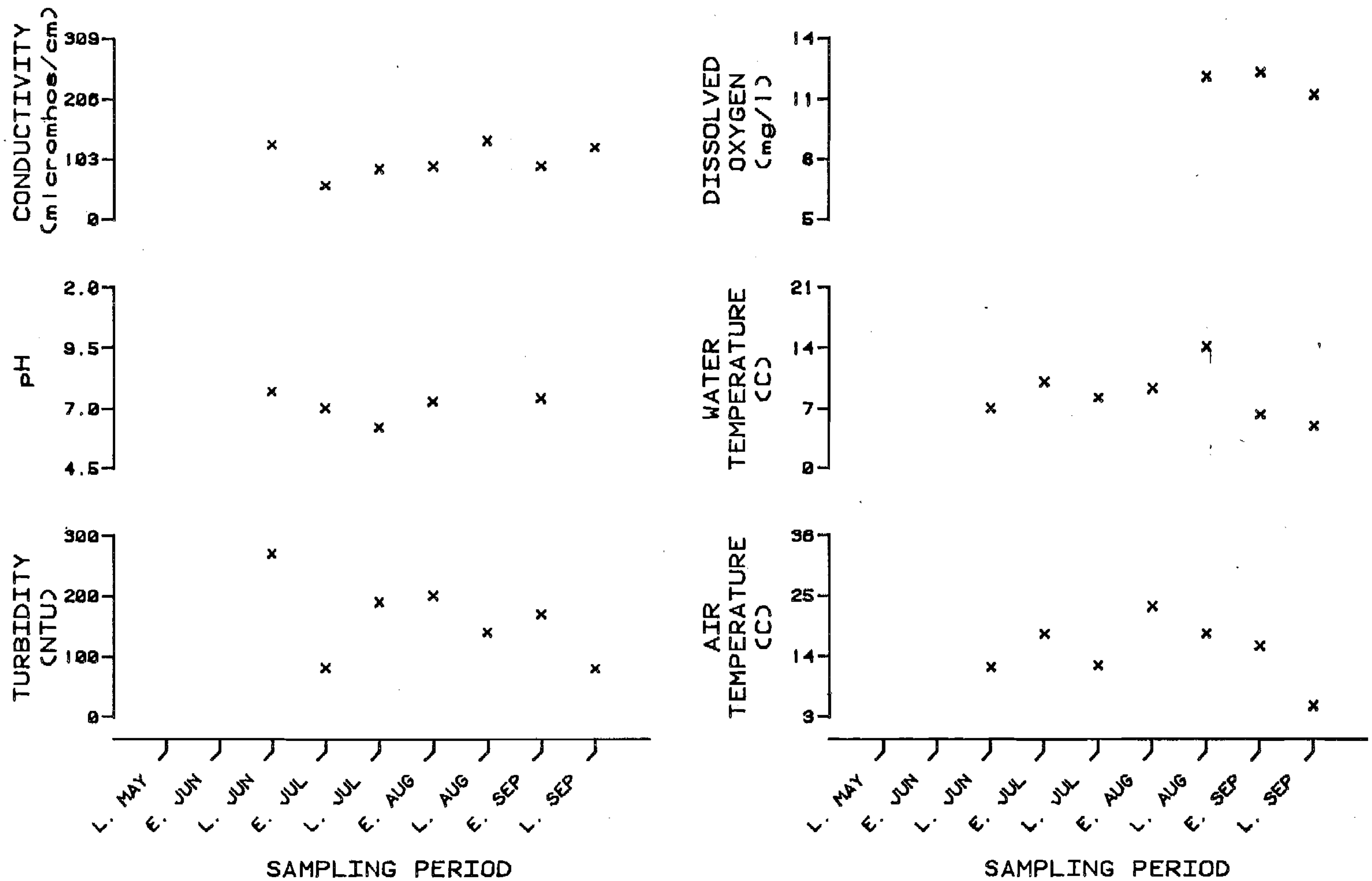


Figure E.5.33. Physiochemical parameters versus time (May-September, 1981) for Cache Creek Slough (R.M. 95.5, Geographic Code 26N05W35ADC)

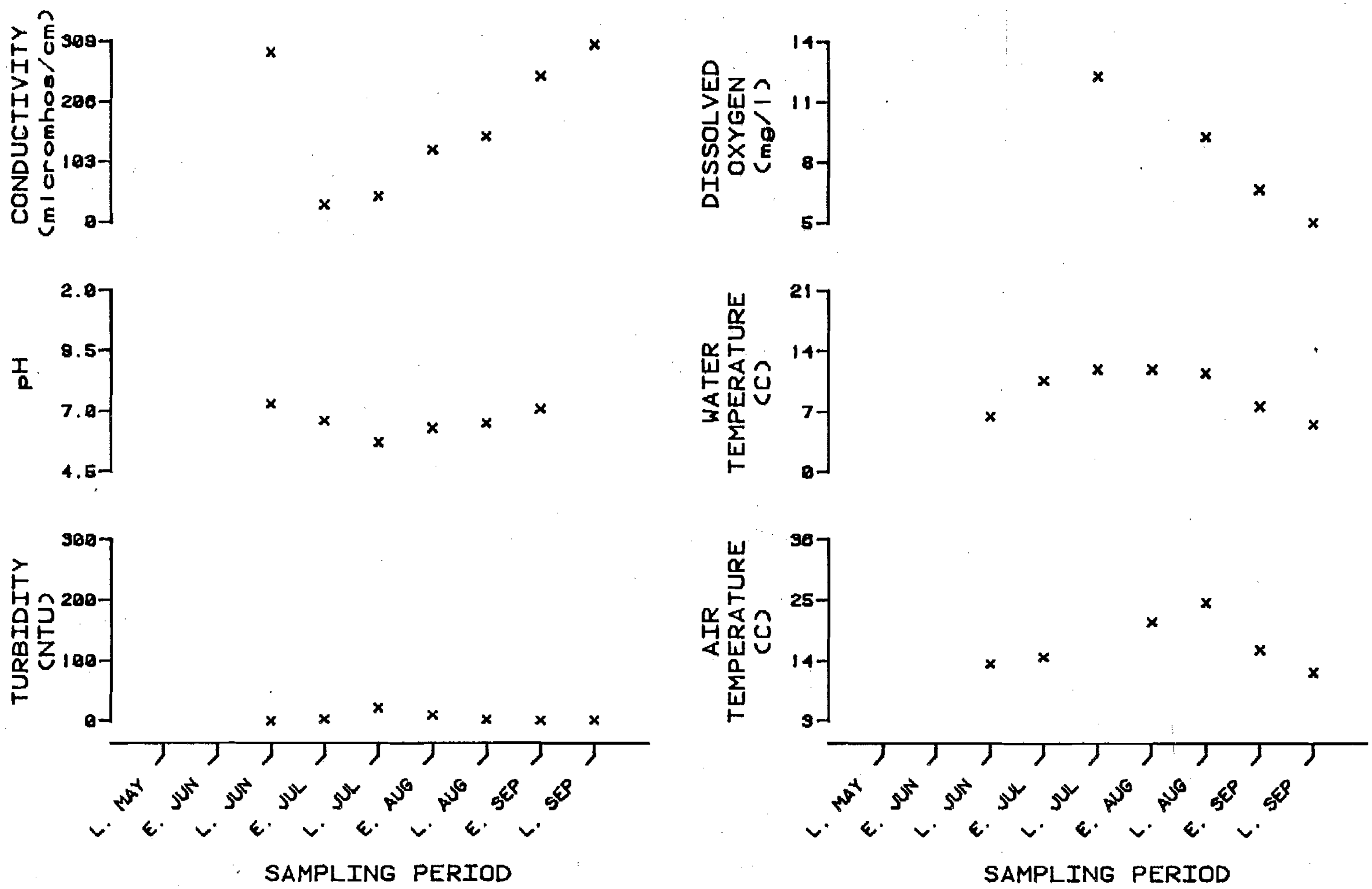


Figure E.5.34. Physiochemical parameters versus time (May-September, 1981) for Cache Creek (R.M. 96.0, Geographic Code 26N05W26DCB)

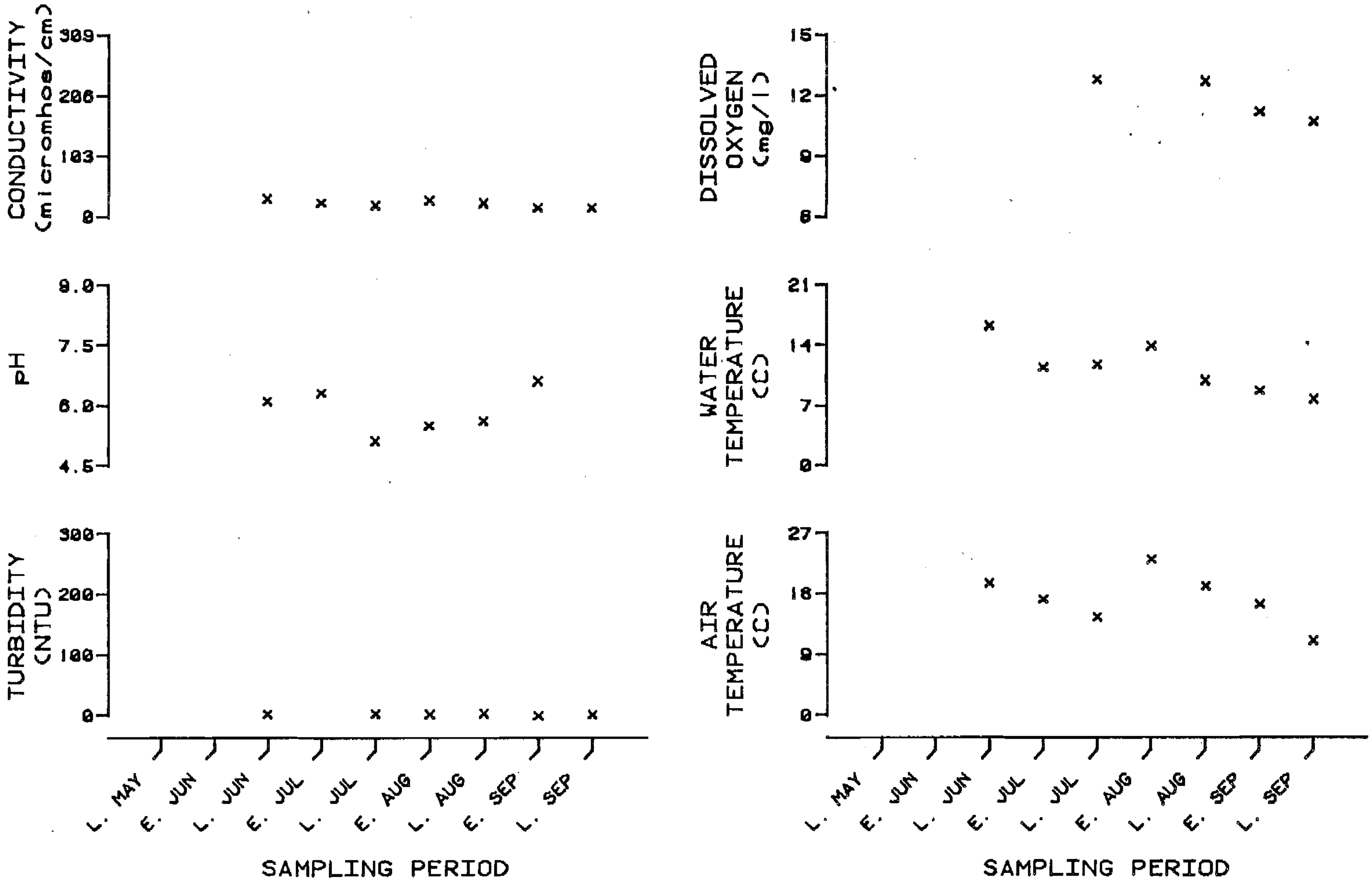


Figure E.5.35. Physiochemical parameters versus time (May-September, 1981)
for Whiskers Creek Slough
(R.M. 101.2, Geographic Code 26N05W03ADB)

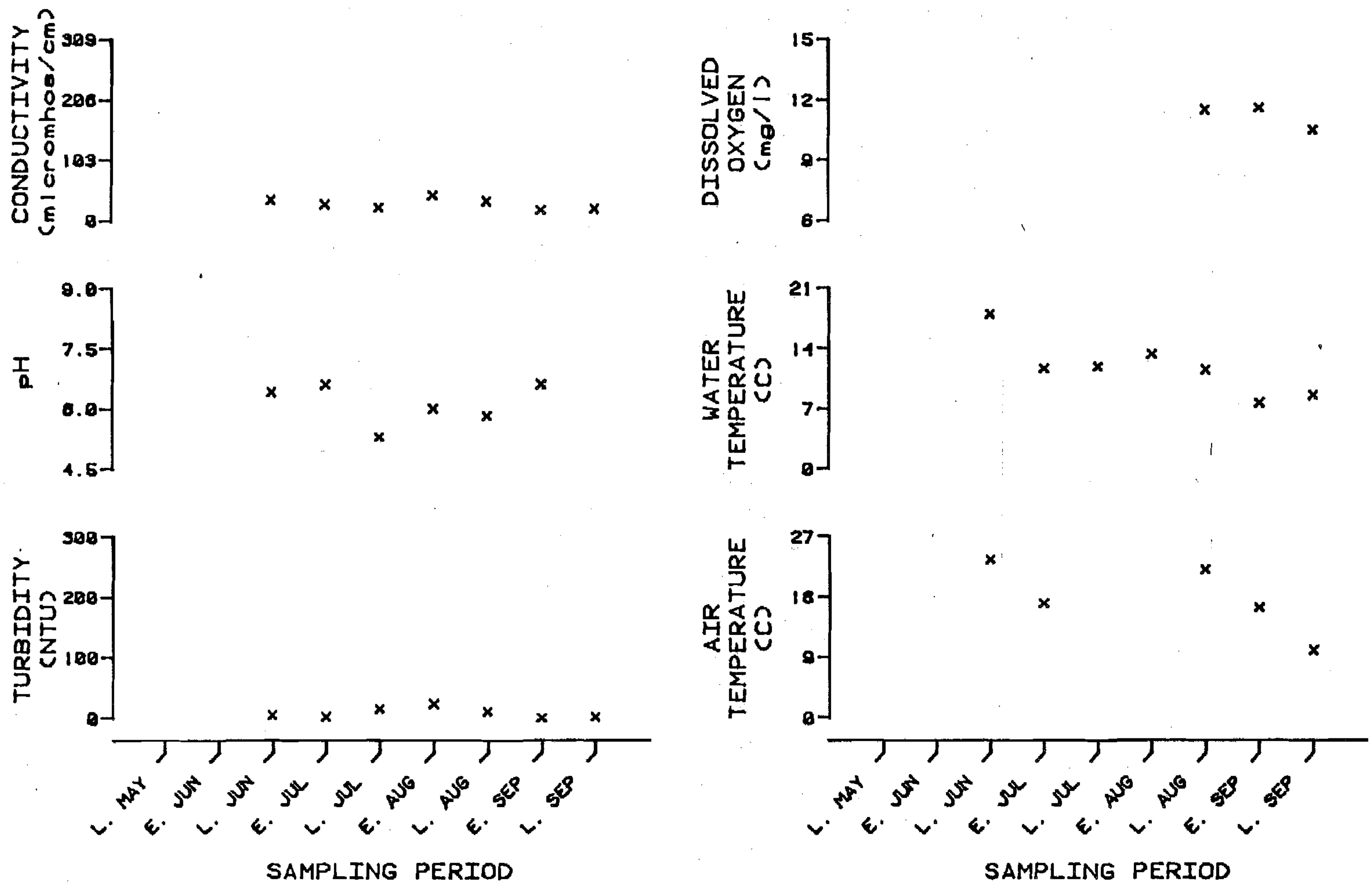


Figure E.5.36. Physiochemical parameters versus time (May-September, 1981)
for Whiskers Creek
(R.M. 101.4, Geographic Code 26N05W03AAC)

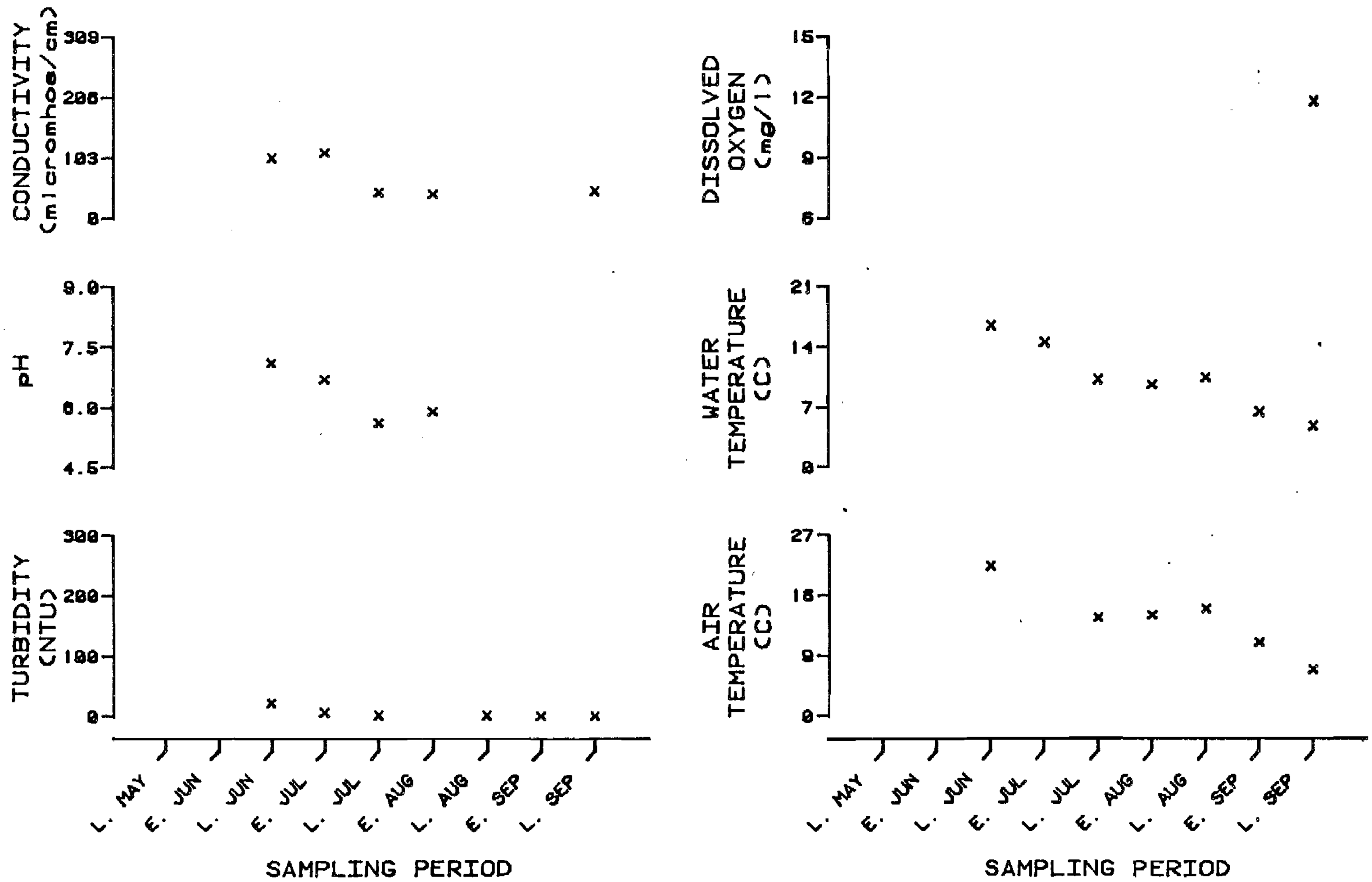


Figure E.5.37. Physiochemical parameters versus tine (May-September, 1981)
for Slough 6A
(R.M. 112.3, Geographic Code 28N05W13CAC)

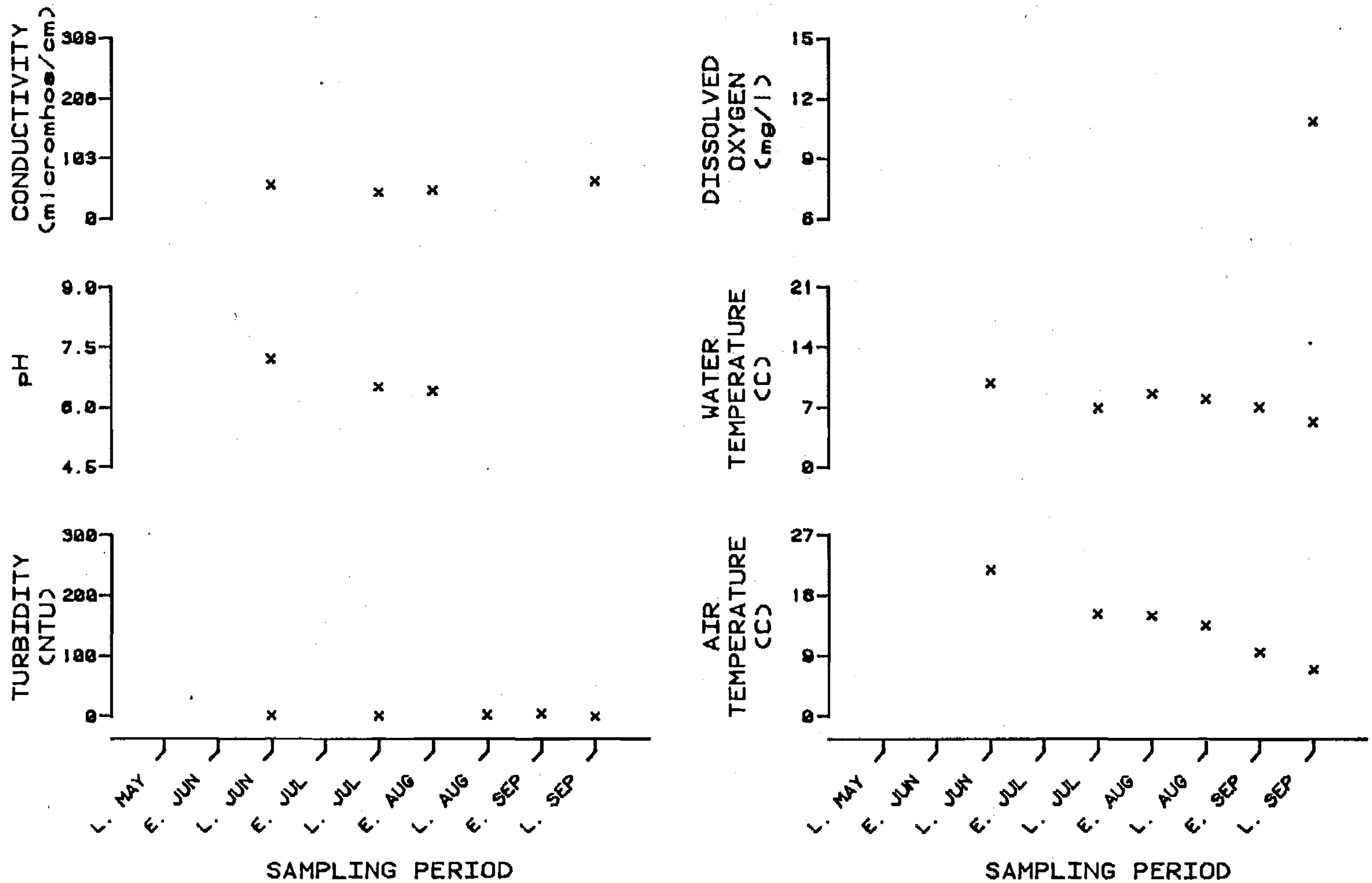


Figure E.5.38. Physiochemical parameters versus time (May-September, 1981)
for Lane Creek
(R.M. 113.6, Geographic Code 28N05W12ADD)

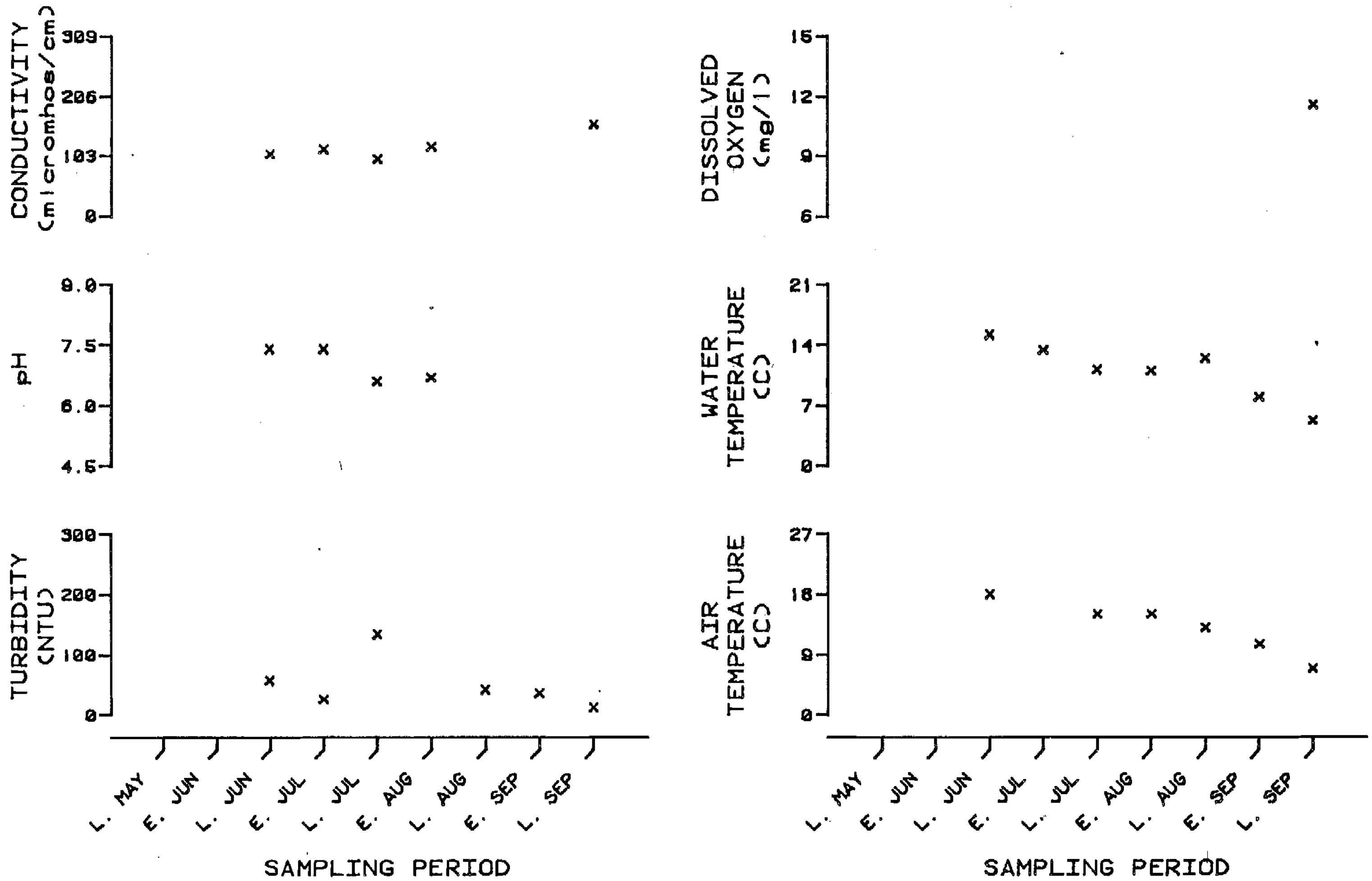


Figure E.5.39. Physiochemical parameters versus time (May-September, 1981)
for Mainstem 2
(R.M. 114.4, Geographic Code 28N04W06CAB)

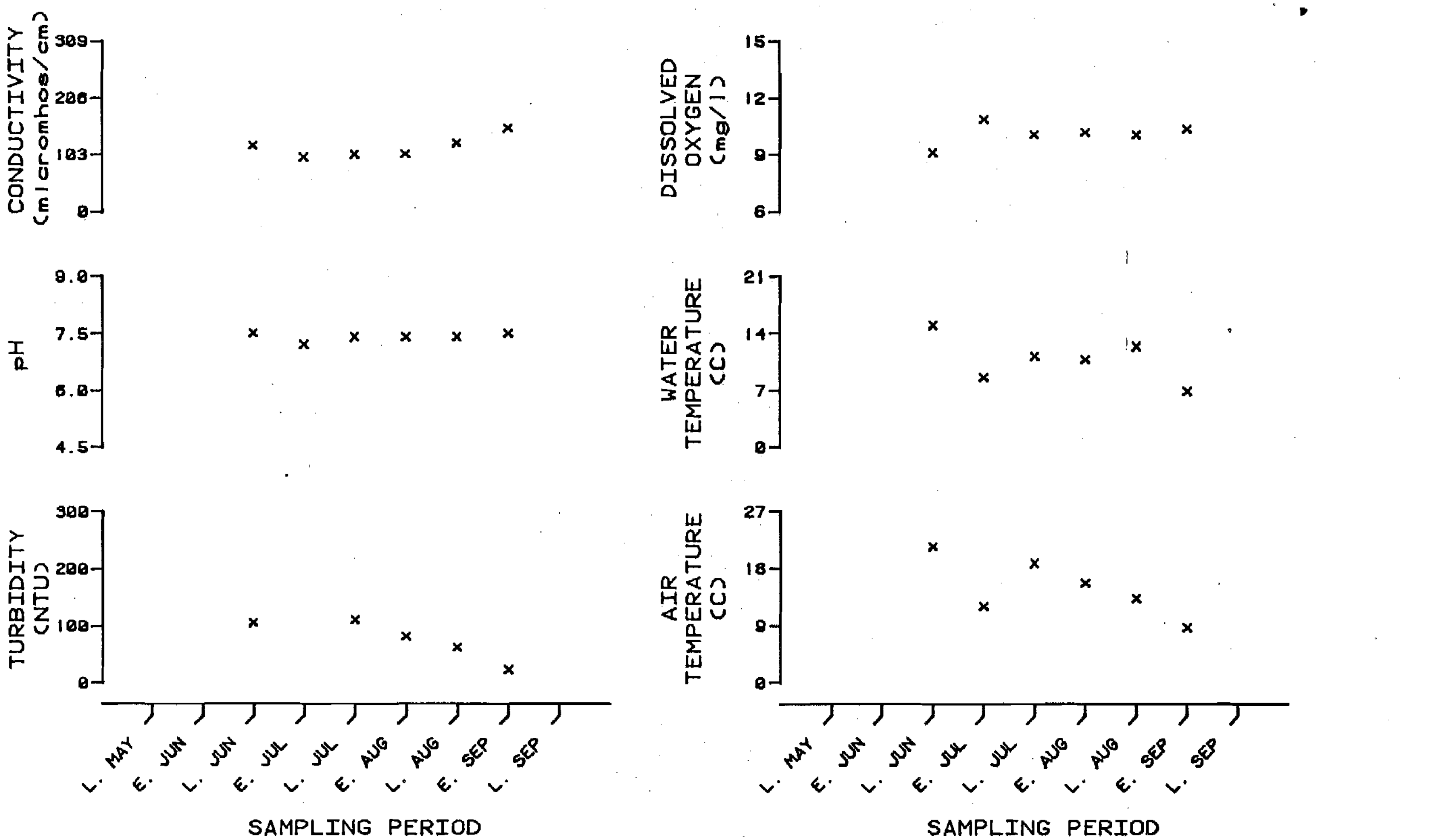


Figure E.5.40. Physiochemical parameters versus time (May-September, 1981) for Mainstem Susitna - Curry (Su-Curry) (R.M. 120.7, Geographic Code 29N04W10BCD)

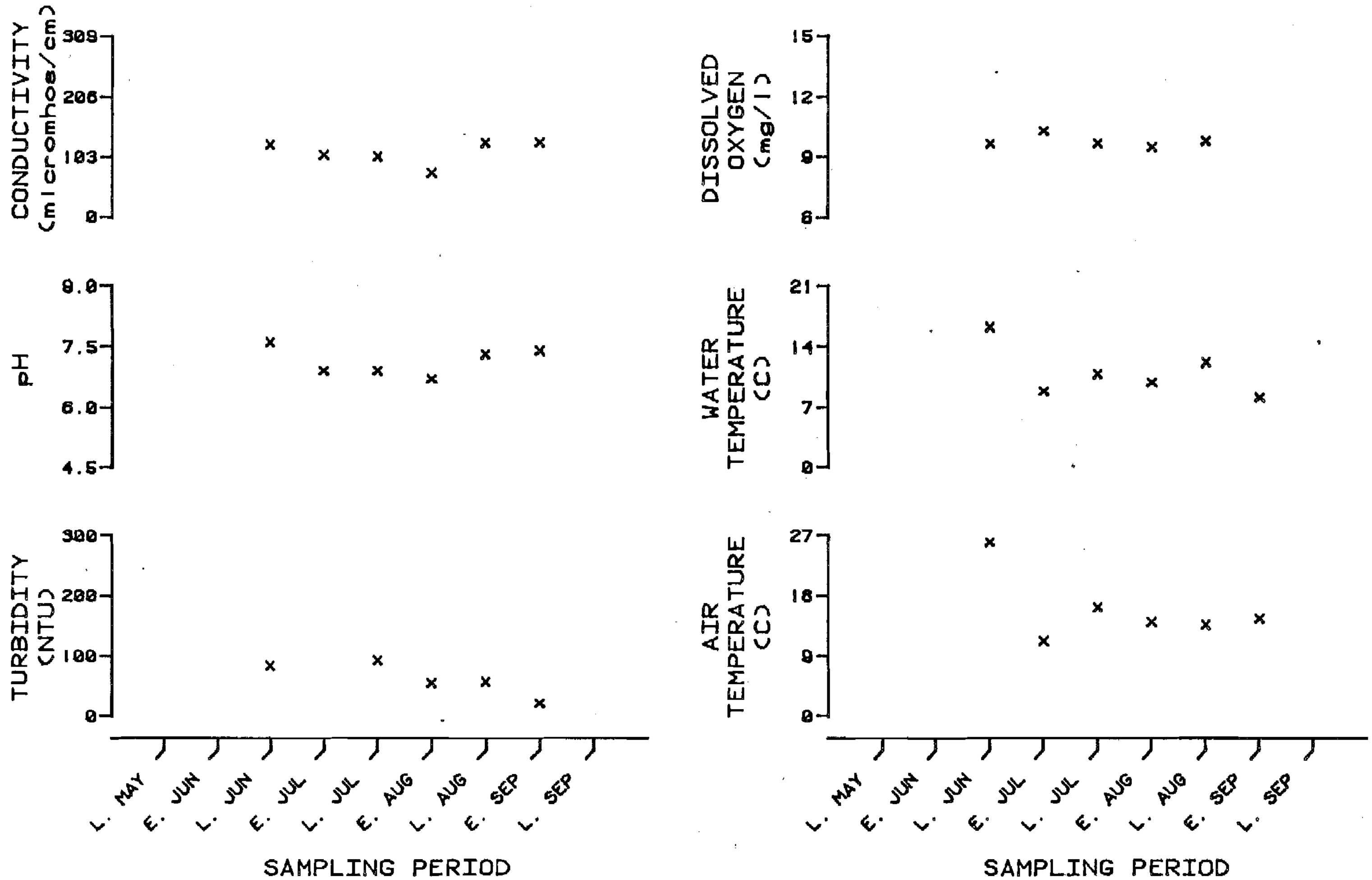


Figure E.5.41. Physiochemical parameters versus time (May-September, 1981) for Susitna Side Channel (Su-Channel) (R.M. 121.6, Geographic Code 29N04W11BBB)

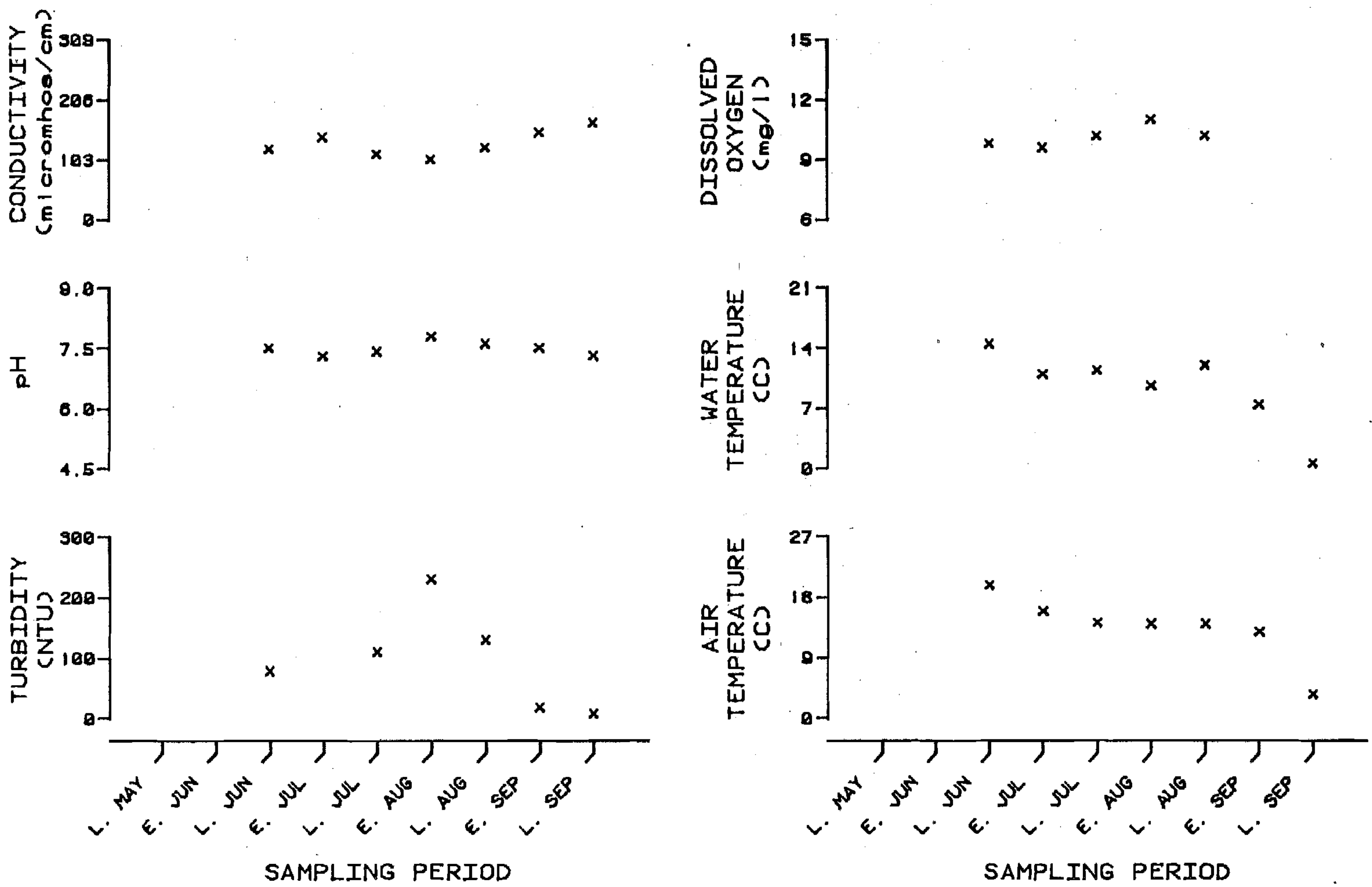


Figure E.5.42. Physiochemical parameters versus time (May-September, 1981) for Mainstem Susitna - Gravel Bar (Su-Gravel Bar) (R.M. 123.8, Geographic Code 30N04W26DDD)

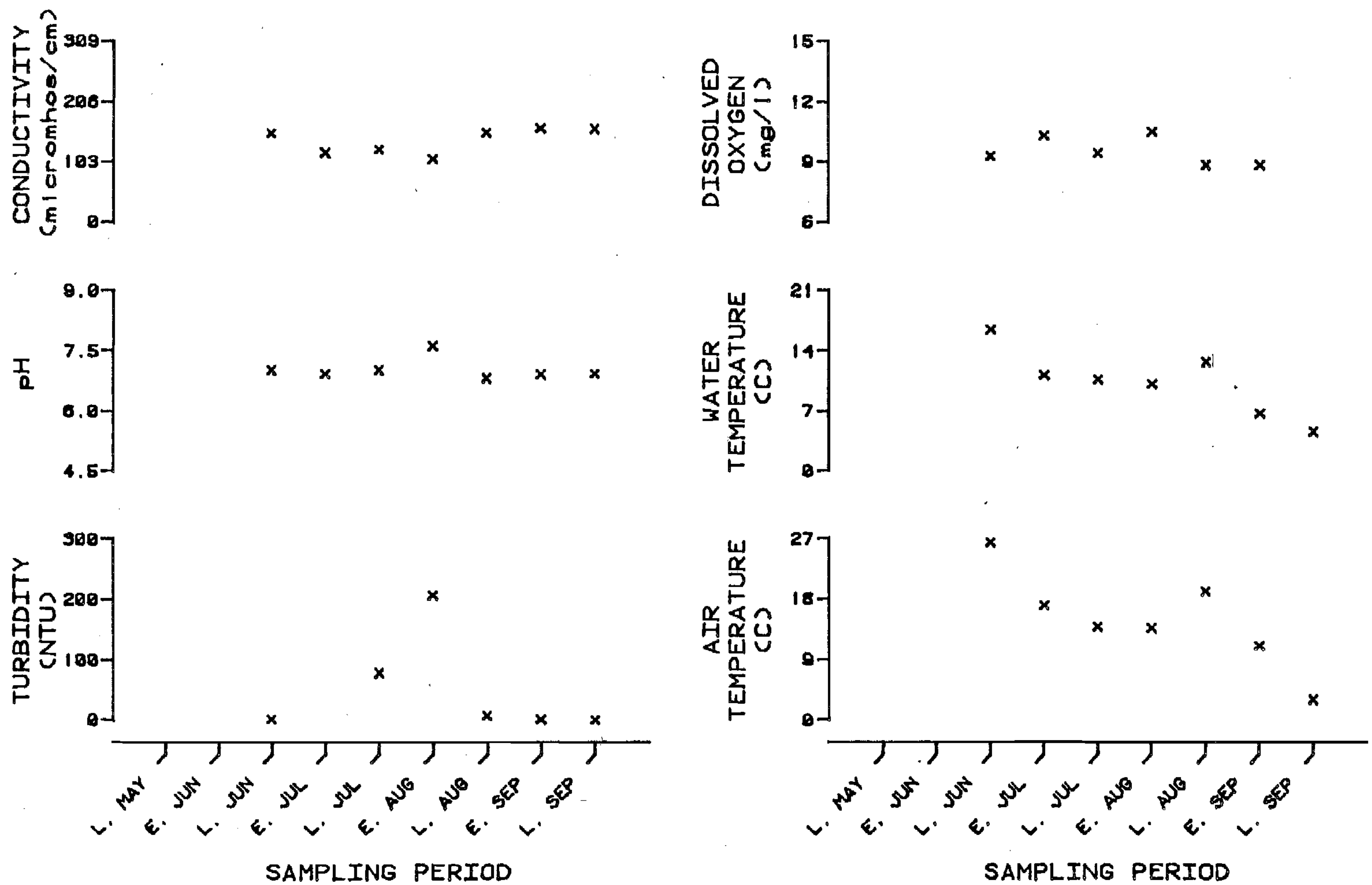


Figure E.5.43. Physiochemical parameters versus time (May-September, 1981) for Slough 8A (R.M. 125.3, Geographic Code 30N03W30BCD)

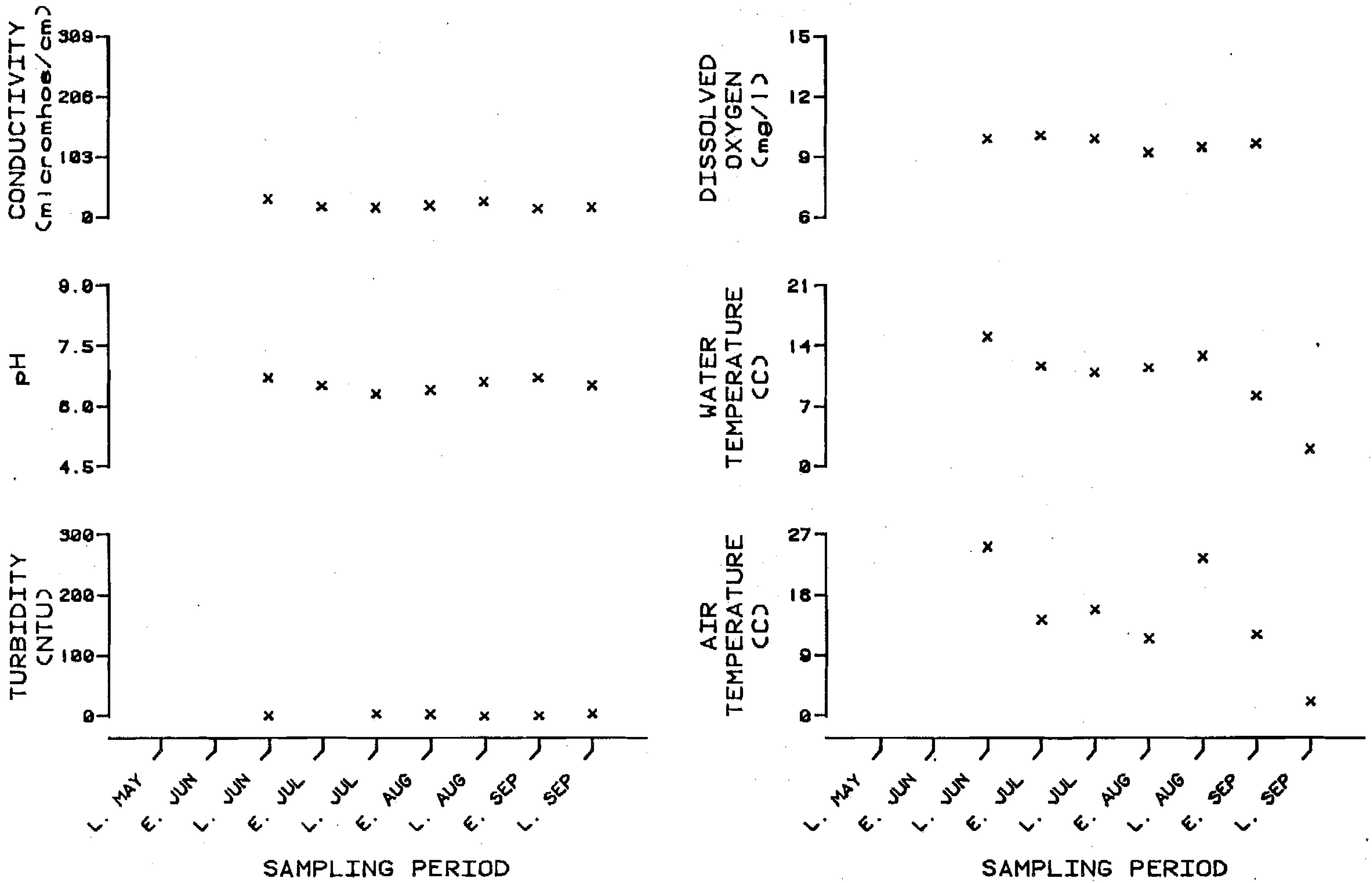


Figure E.5.44. Physiochemical parameters versus time (May-September, 1981) for Fourth of July Creek (R.M. 131.1, Geographic Code 30N03W03DAC)

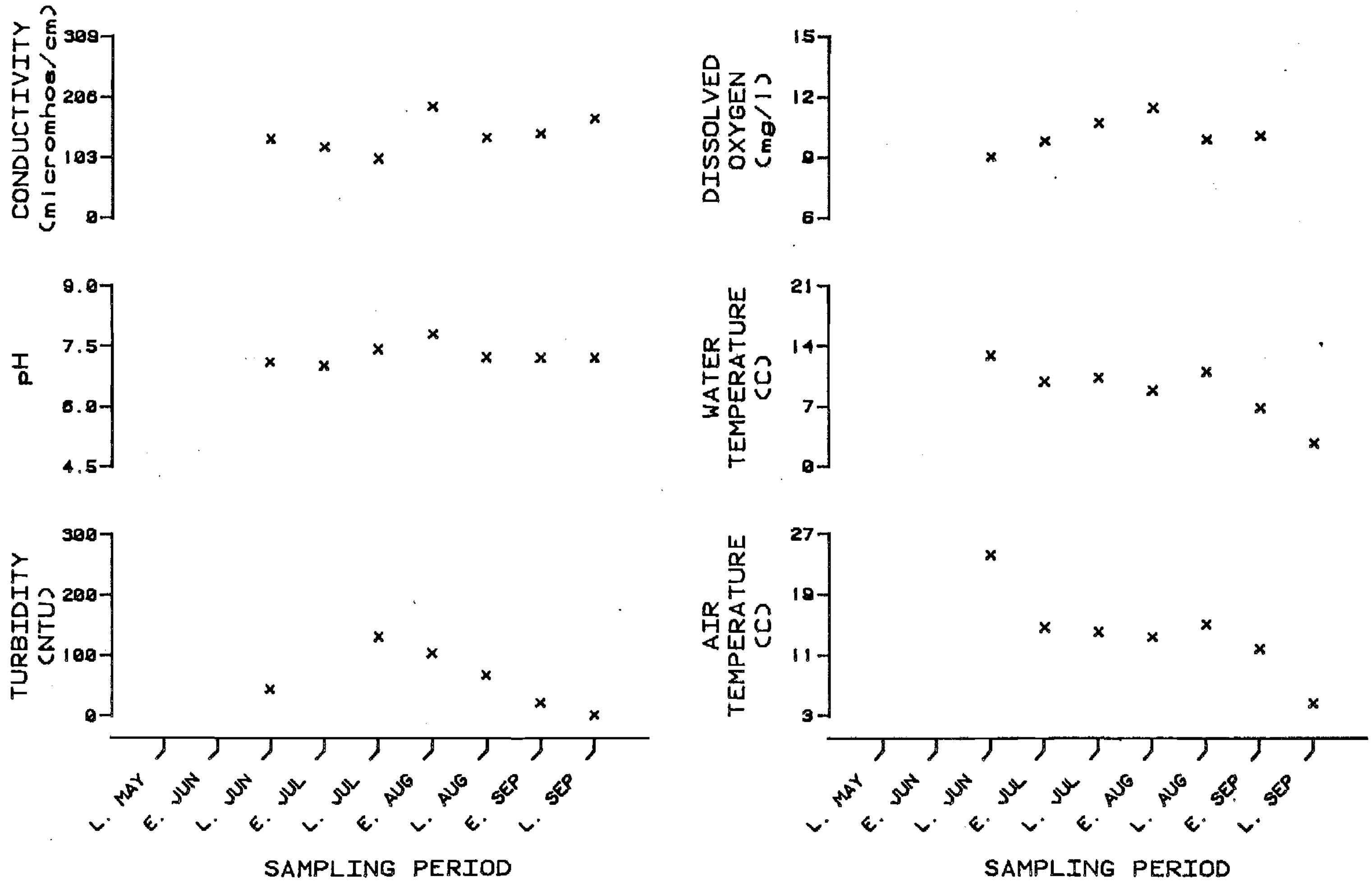


Figure E.5.45. Physiochemical parameters versus time (May-September, 1981) for Slough 10
(R.M. 133.8, Geographic Code 31N03W36AAC)

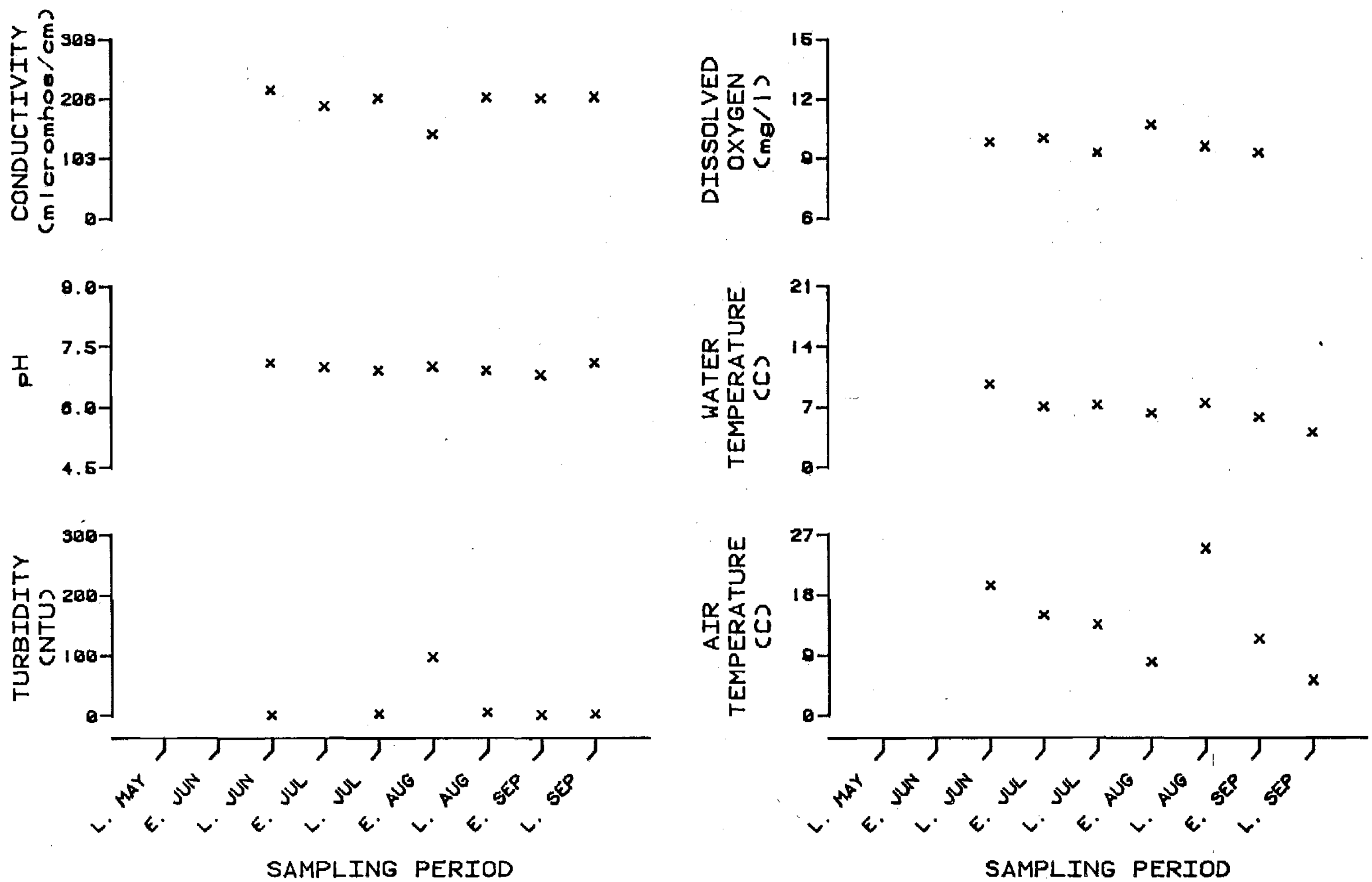


Figure E.5.46. Physiochemical parameters versus time (May-September, 1981)
for Slough 11
(R.M. 135.3, Geographic Code 31N02W19DDD)

E-5-105

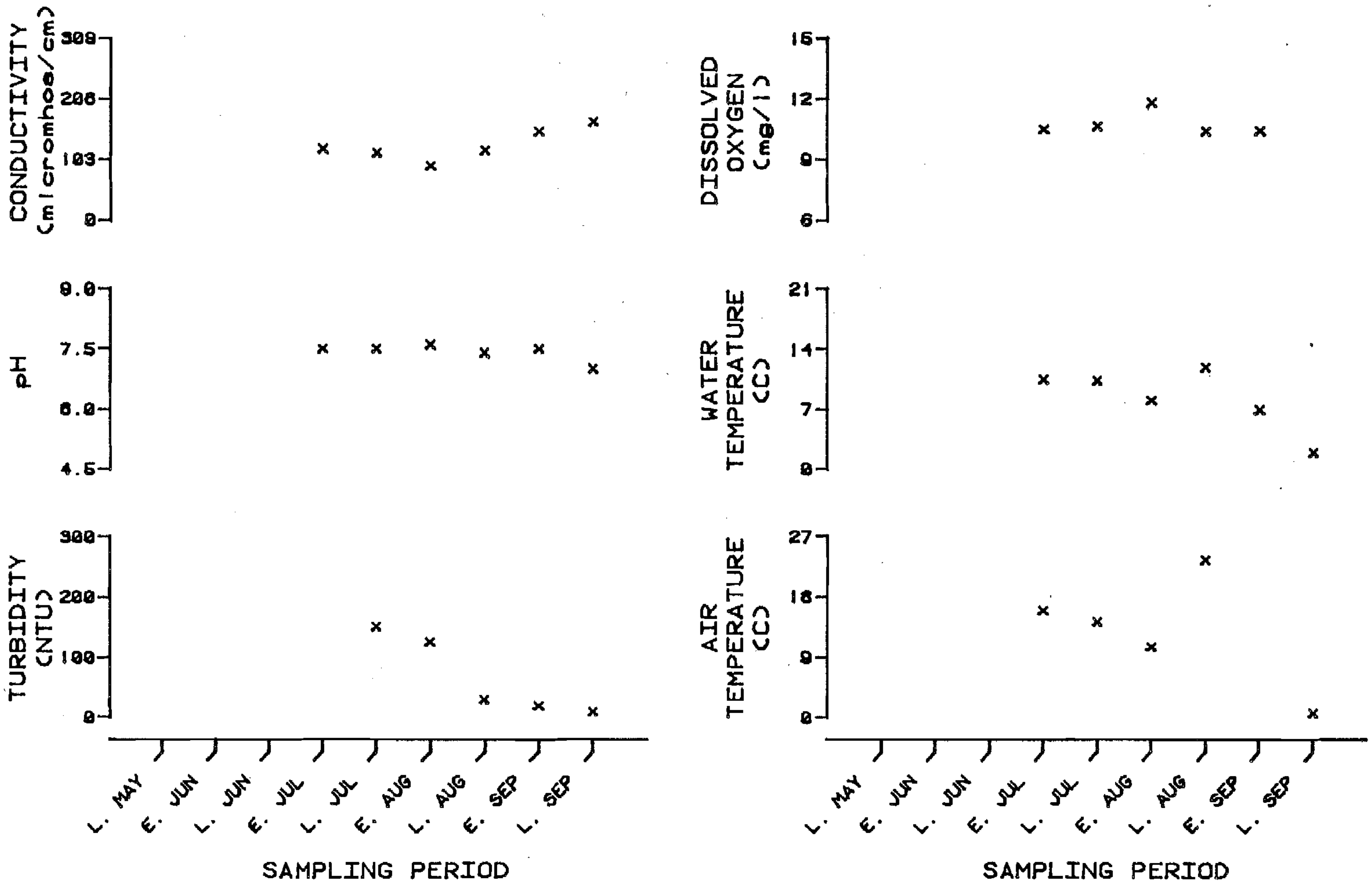


Figure E.5.47. Physiochemical parameters versus time (May-September, 1981)
for Mainstem Susitna - Inside Bend (Su-Gold)
(R.M. 136.9, Geographic Code 31N02W17CDA)

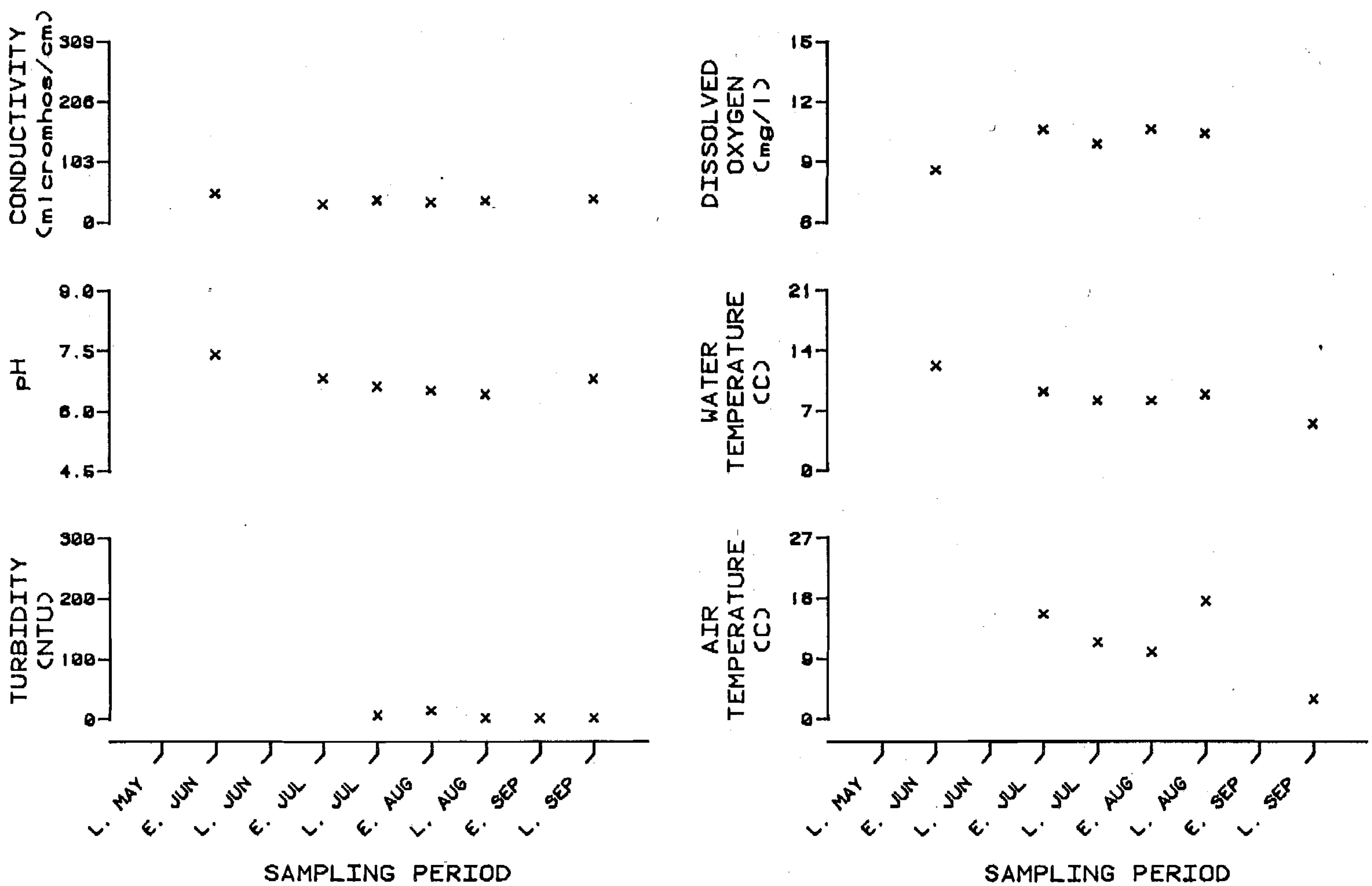


Figure E.5.48. Physiochemical parameters versus time (May-September, 1981) for Indian River (R.M. 138.6, Geographic Code 31N02W09CDA)

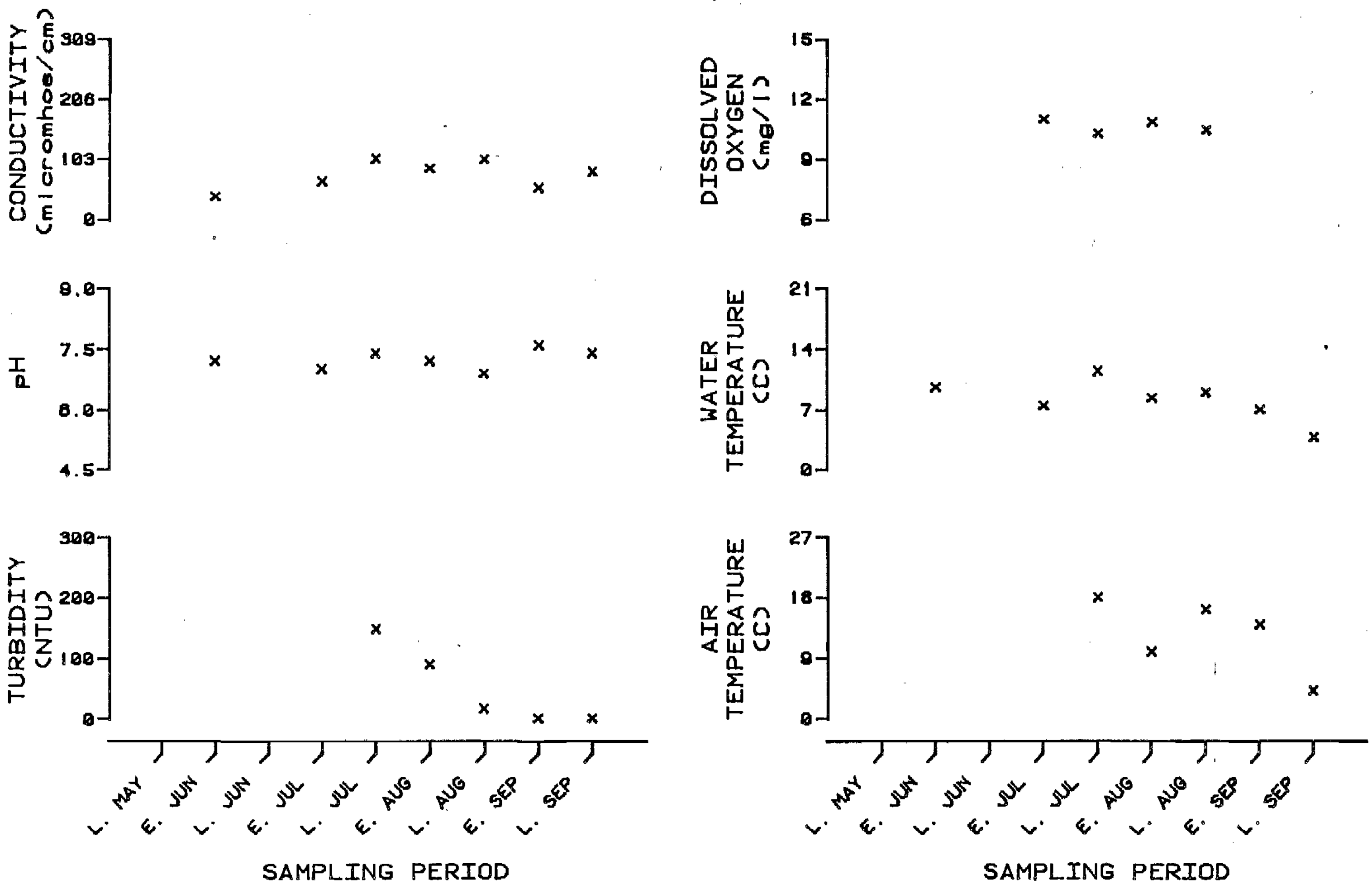


Figure E.5.49. Physiochemical parameters versus time (May-September, 1981) for Slough 20
(R.M. 140.1, Geographic Code 31N02W11BBC)

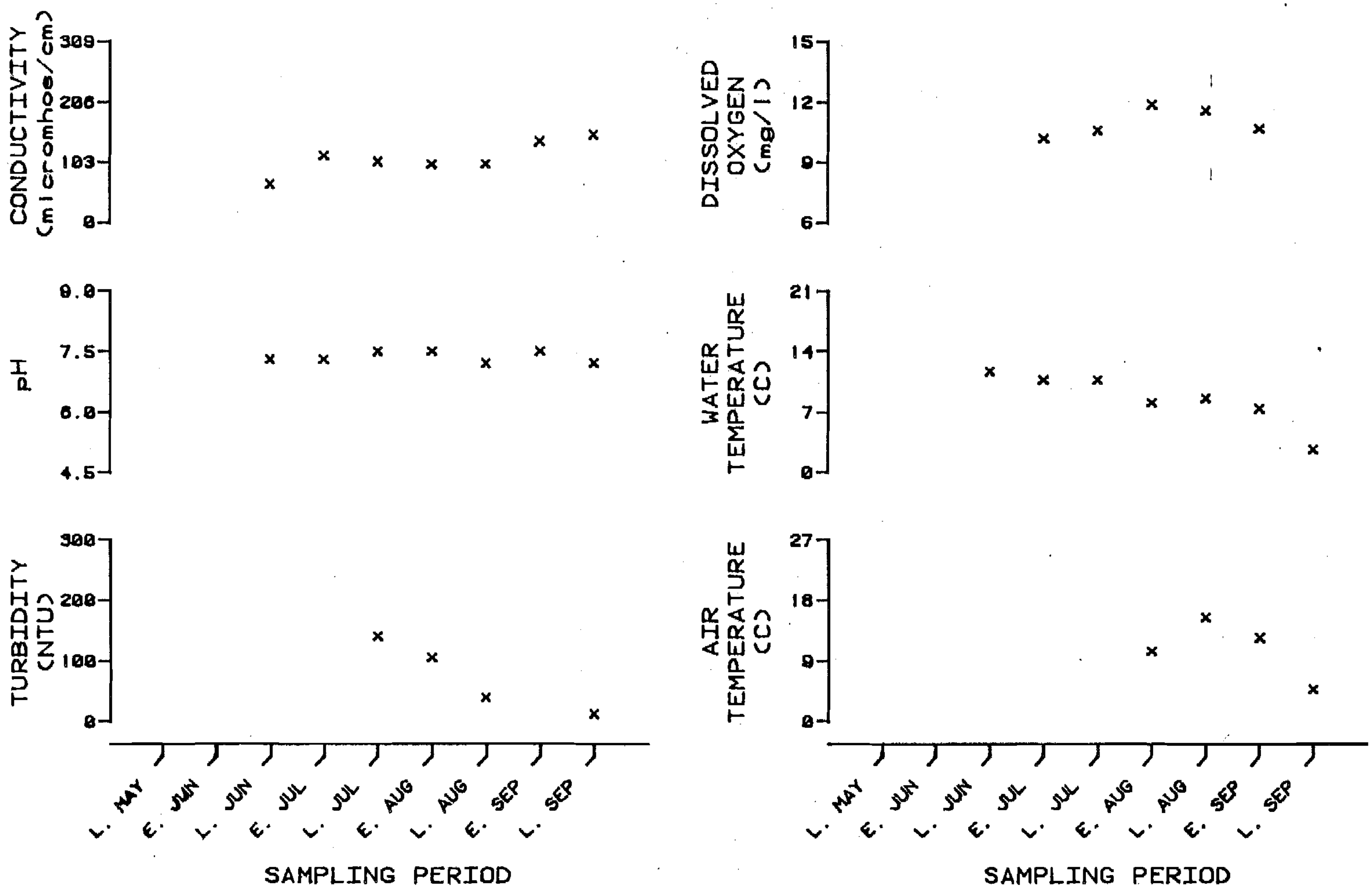


Figure E.5.50. Physiochemical parameters versus time (May-September, 1981) for Mainstem Susitna - Island (Su-Island) (R.M. 146.9, Geographic Code 32N01W27DBC)

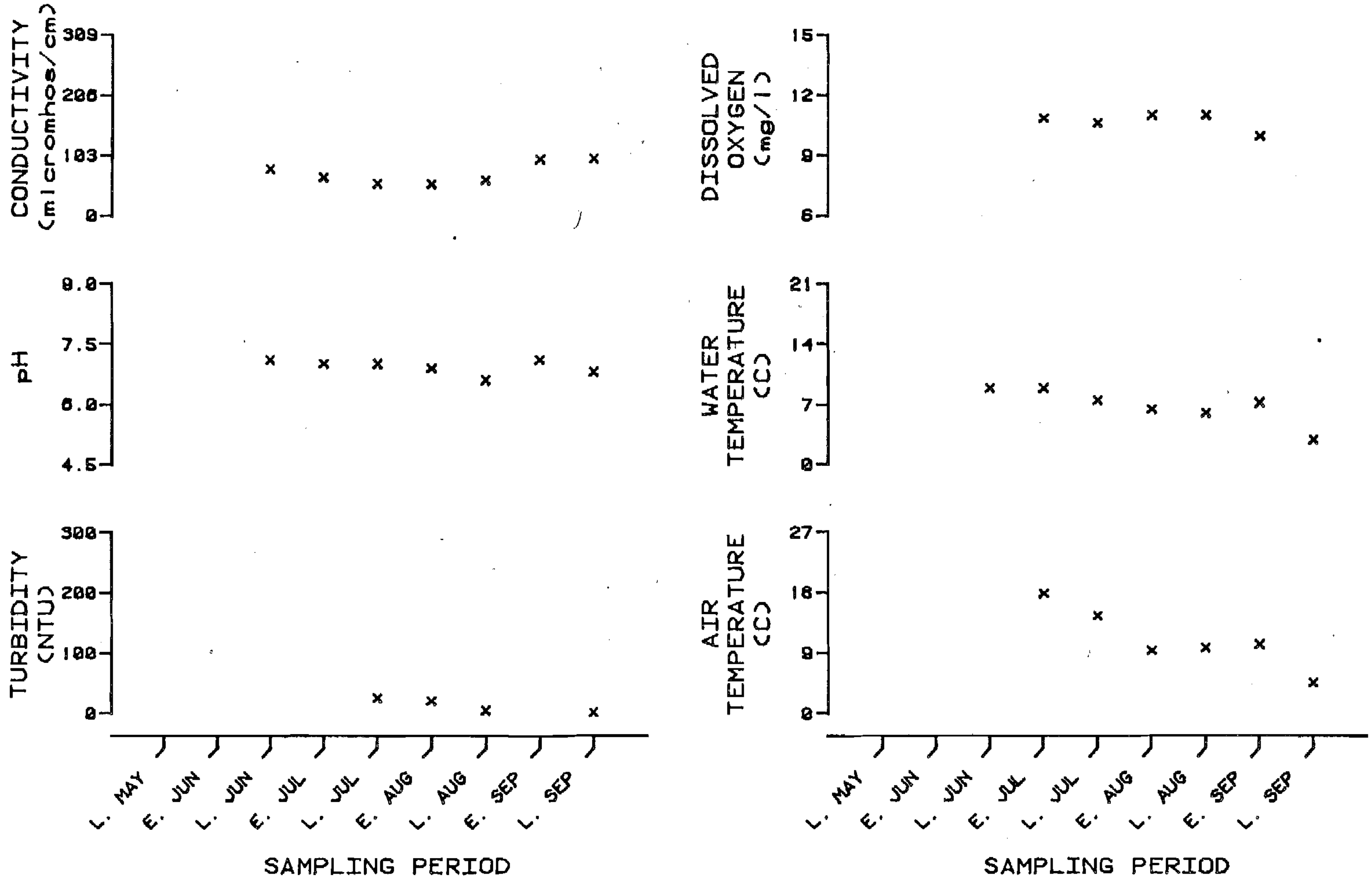


Figure E.5.51. Physiochemical parameters versus time (May-September, 1981) for Portage Creek
(R.M. 148.8, Geographic Code 32N01W25CDB)

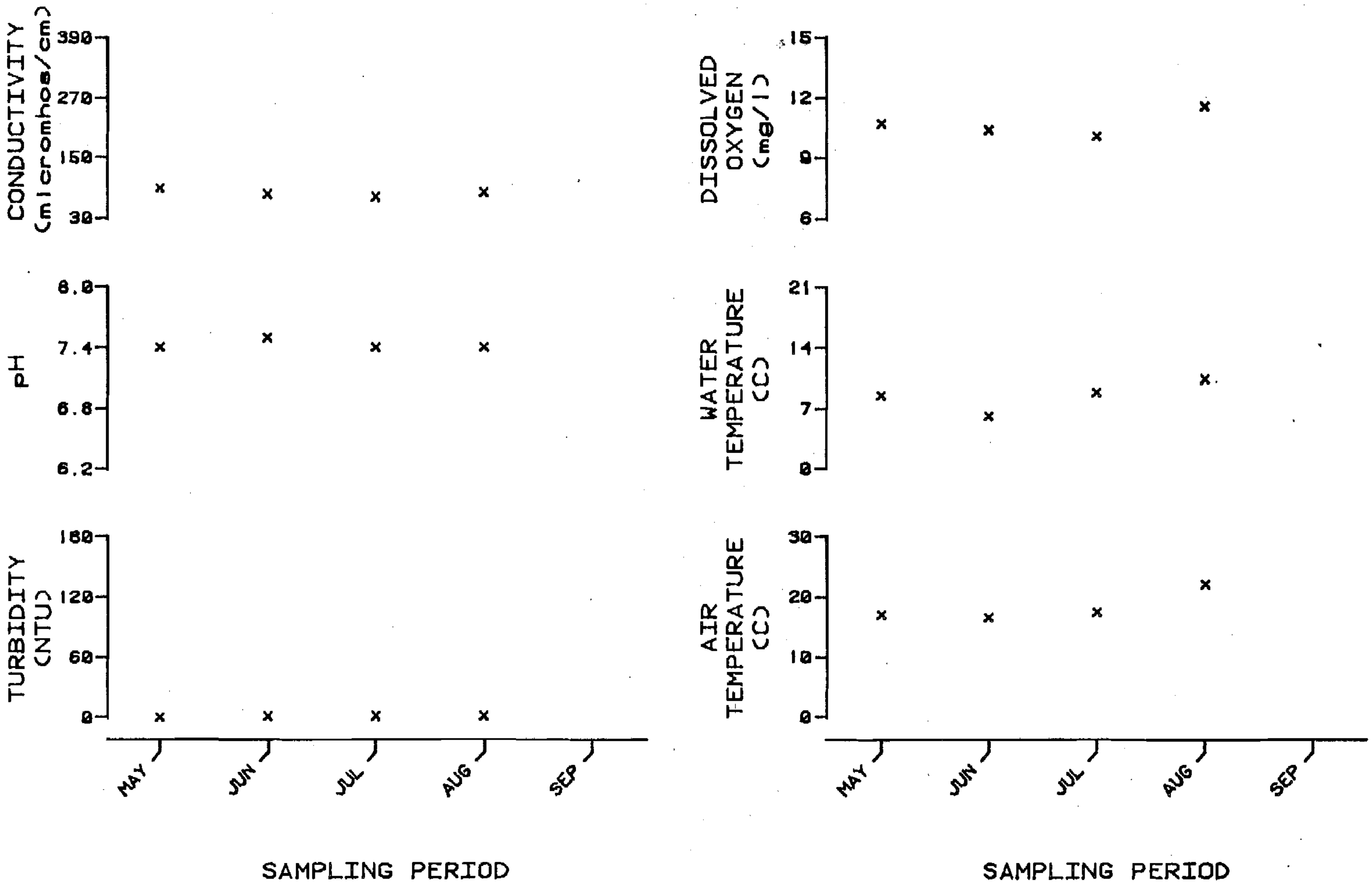


Figure E.5.52. Physiochemical parameters versus time (May-September, 1981) for Fog Creek - Site 1 (R.M. 173.9, Geographic Code 31N04E16DBB)

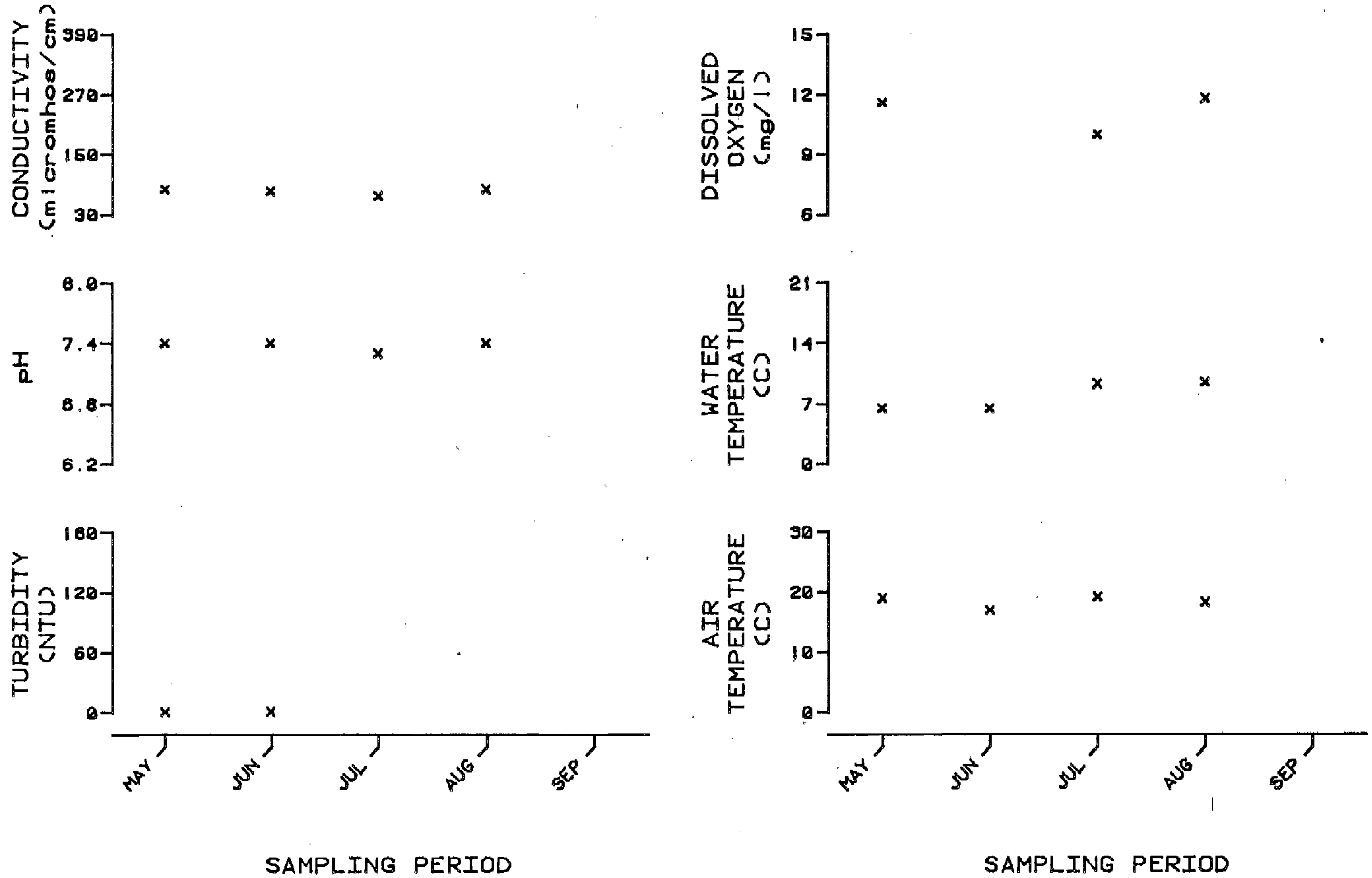


Figure E.5.53. Physiochemical parameters versus time (May-September, 1981)
for Fog Creek - Site 2
(R.M. 173.9, Geographic Code 31N04E16DBD)

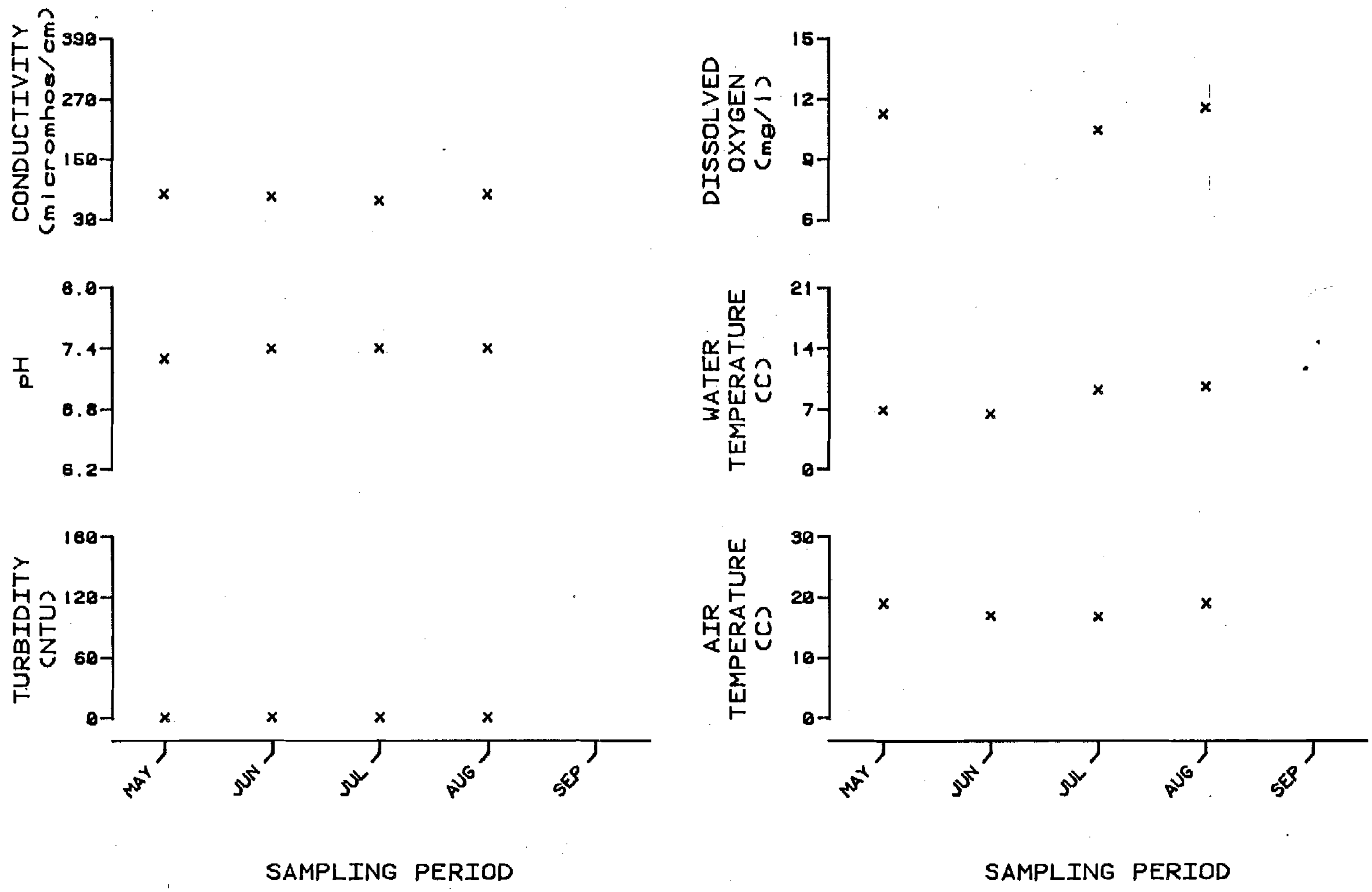


Figure E.5.54. Physiochemical parameters versus time (May-September, 1981) for Fog Creek - Site 3 (R.M. 173.9, Geographic Code 31N04E16DAD)

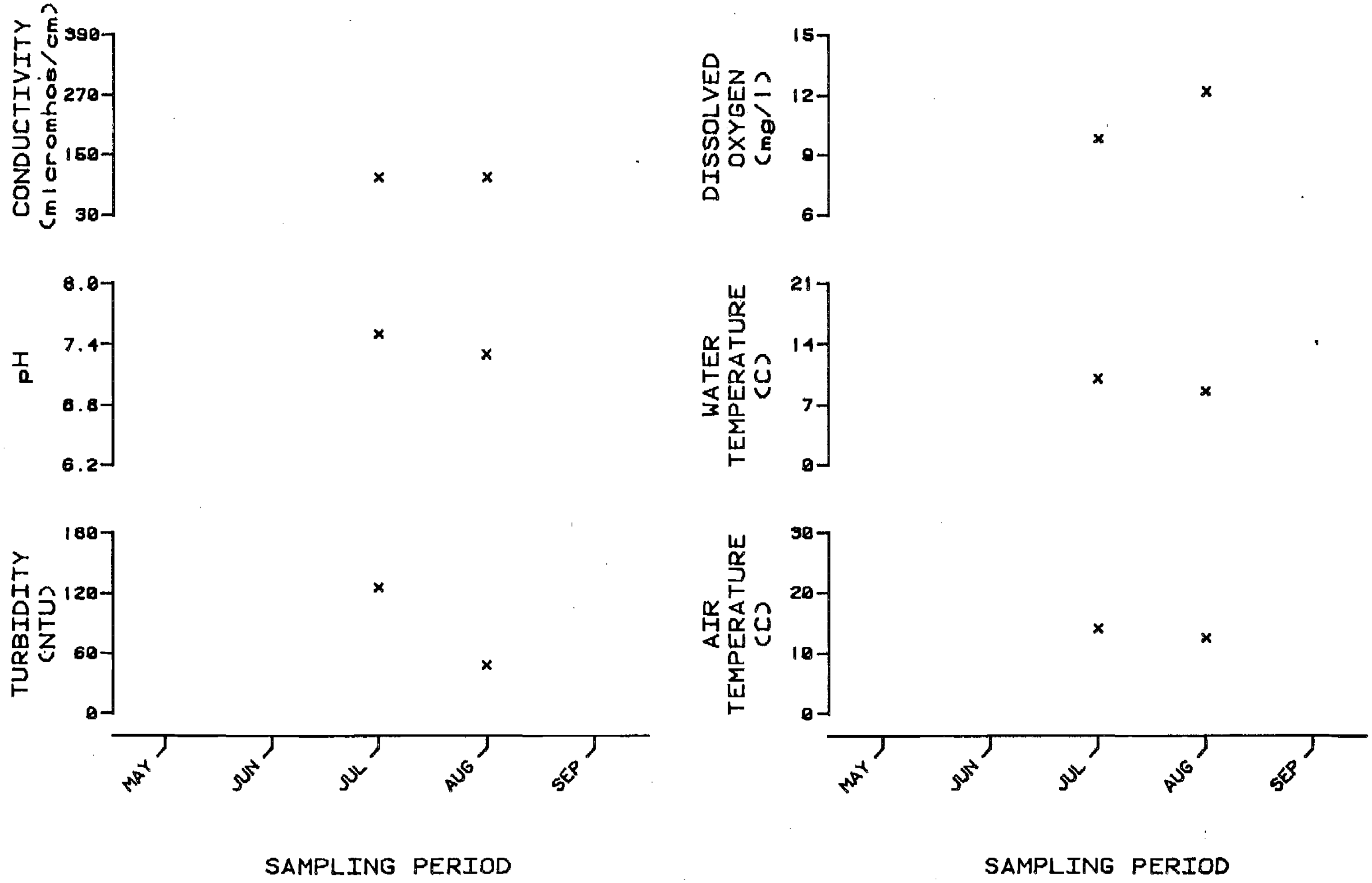


Figure E.5.55. Physiochemical parameters versus time (May-September, 1981)
for Mainstem Susitna 50' upstream of Tsusena River
(R.M. 178.9, Geographic Code 32N04E36ADB)

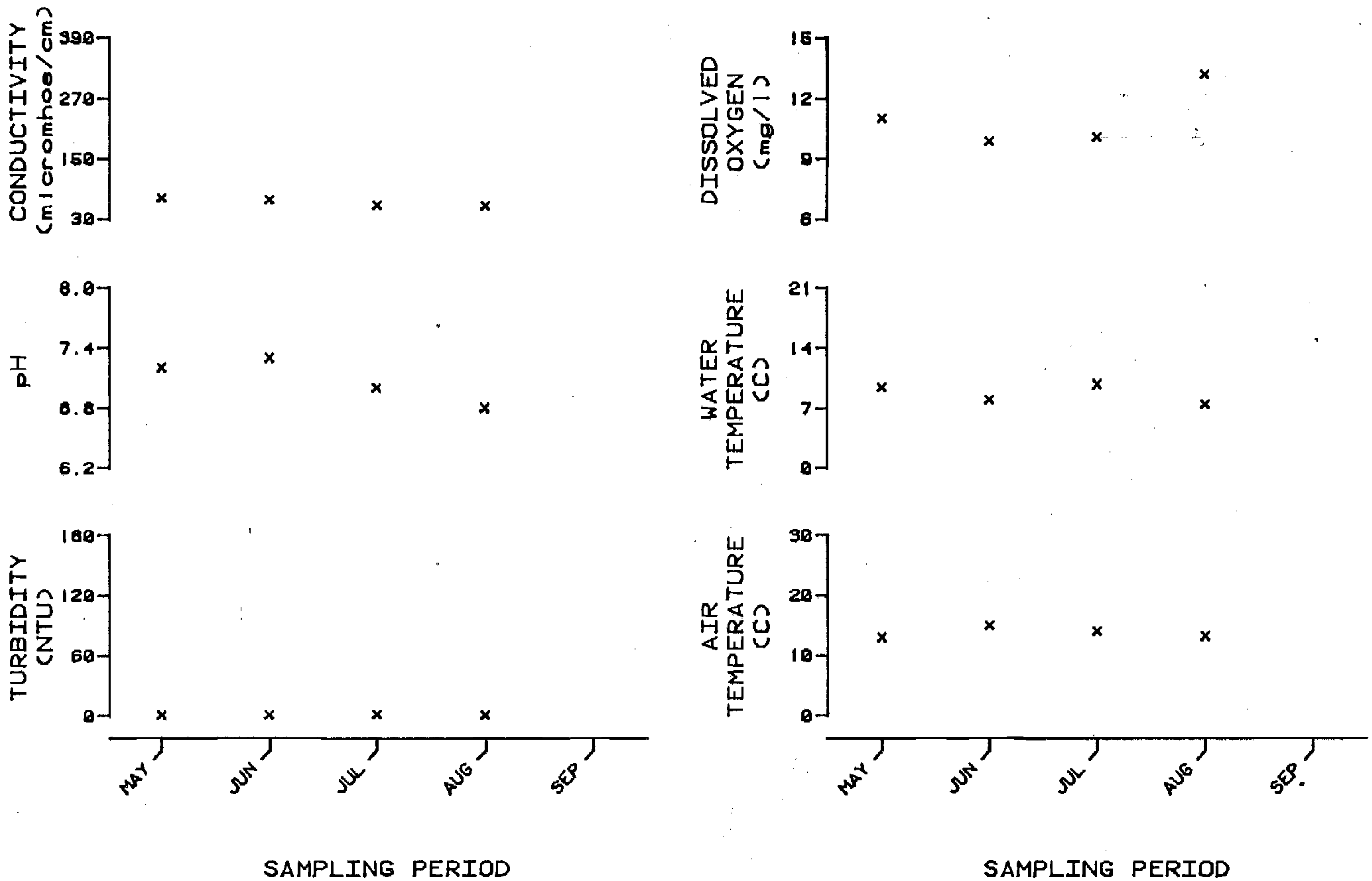


Figure E.5.56. Physiochemical parameters versus time (May-September, 1981)
for Tsusena River - Site 1
(R.M. 178.9, Geographic Code 32N04E36ADB)

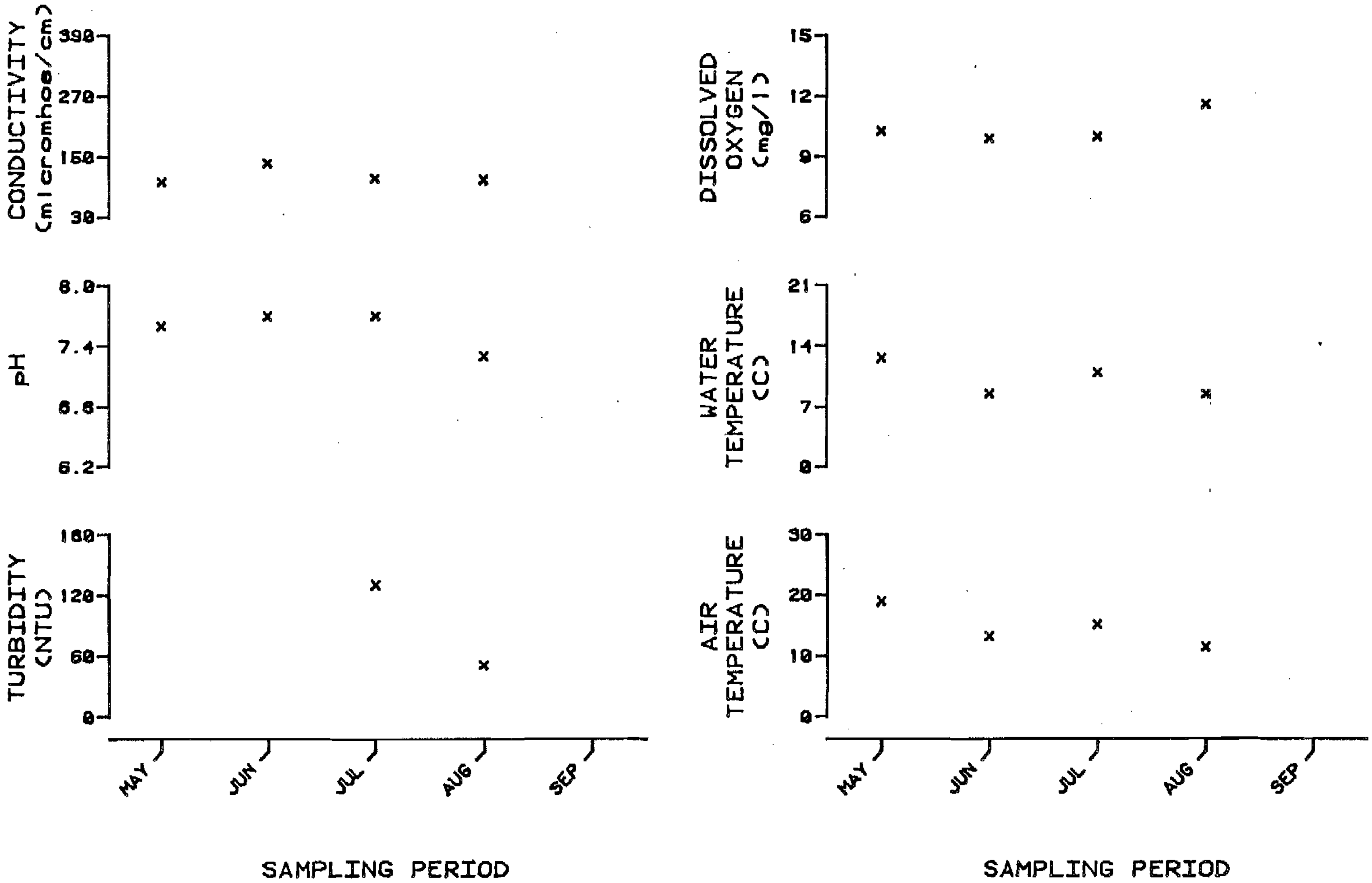


Figure E.5.57. Physiochemical parameters versus time (May-September, 1981)
for Mainstem Susitna 50' upstream of Deadman Creek
(R.M. 183.4, Geographic Code 32N05E26CAA)

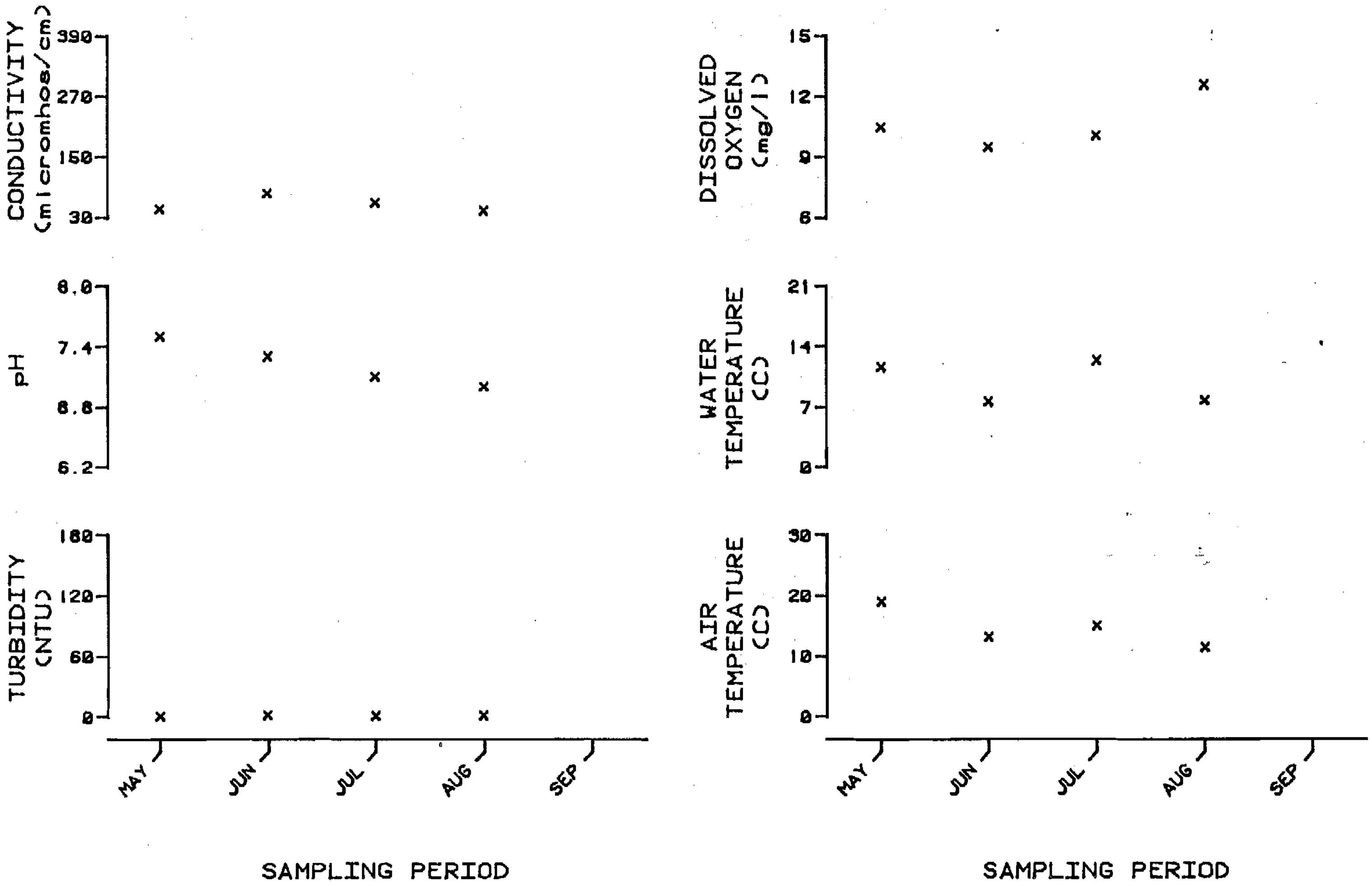


Figure E.5.58. Physiochemical parameters versus time (May-September, 1981)
for Deadman Creek - Site 1
(R.M. 183.4, Geographic Code 32N05E26CDB)

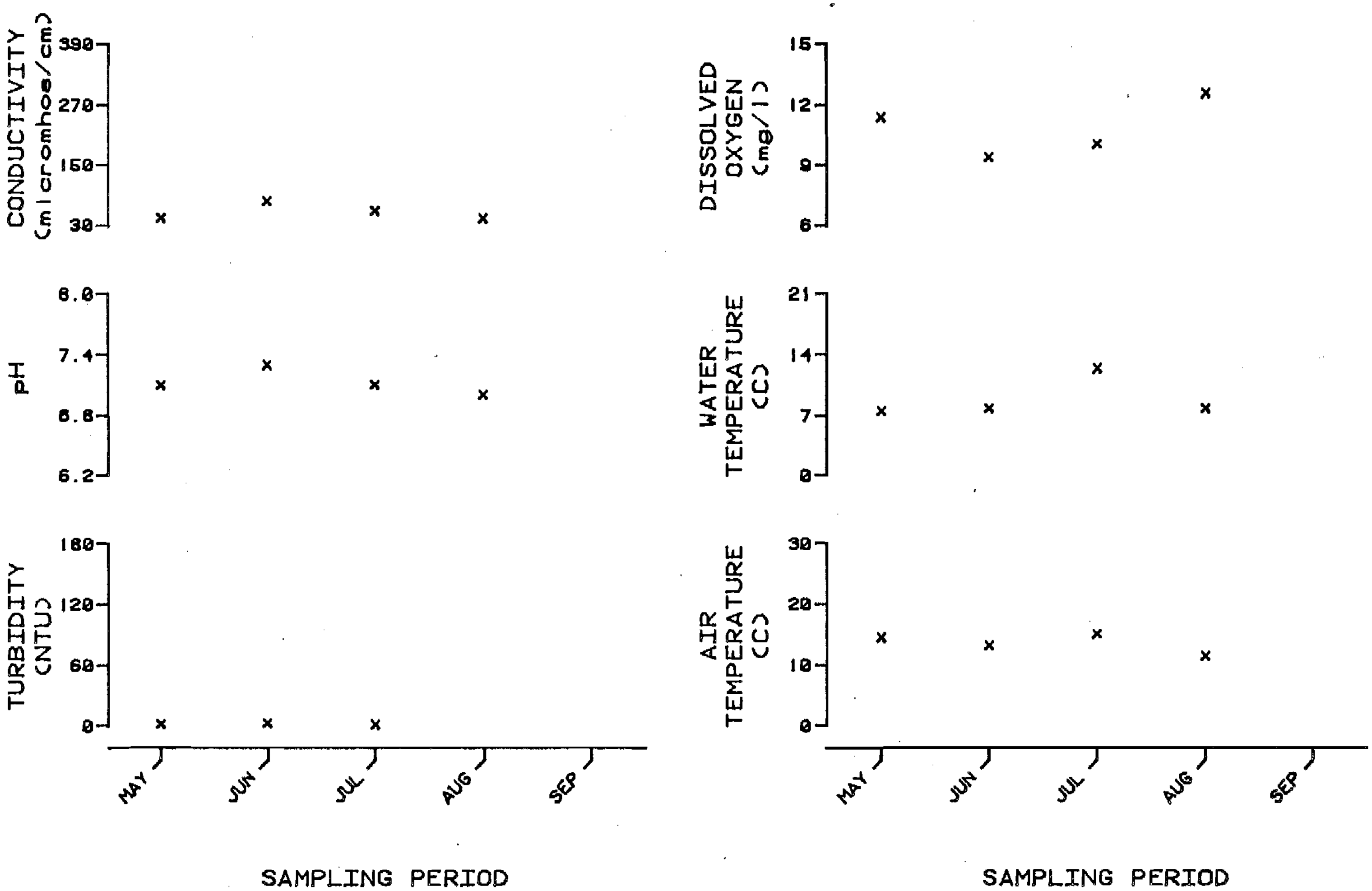


Figure E.5.59. Physiochemical parameter versus time (May-September, 1981) for Deadman Creek - Site 2 (R.M. 183.4, Geographic Code 32N05E26CAA)

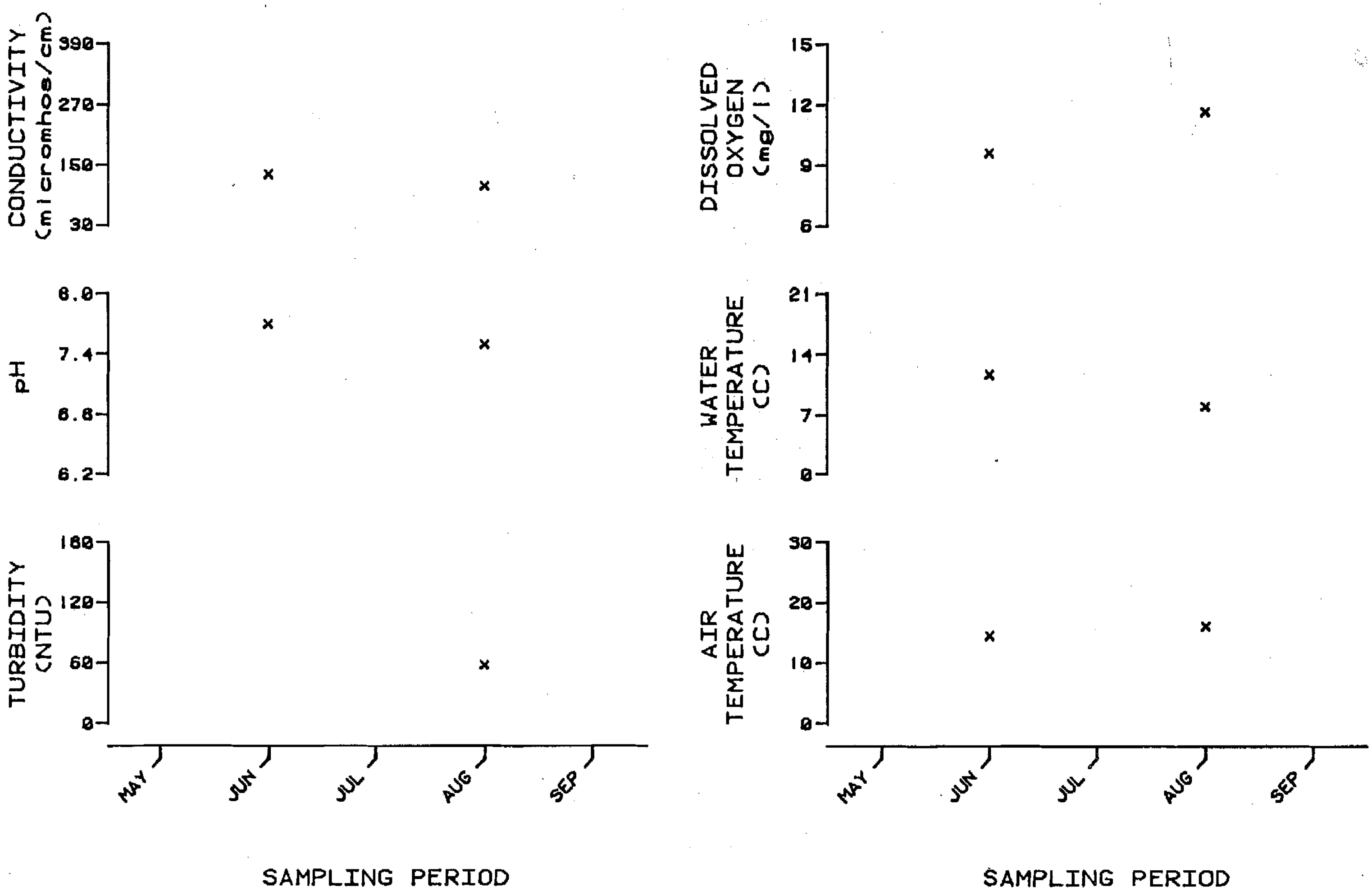


Figure E.5.60. Physiochemical parameters versus time (May-September, 1981) for Mainstem Susitna 50' upstream of Watana Creek (R.M. 190.4, Geographic Code 32N06E25CCA)

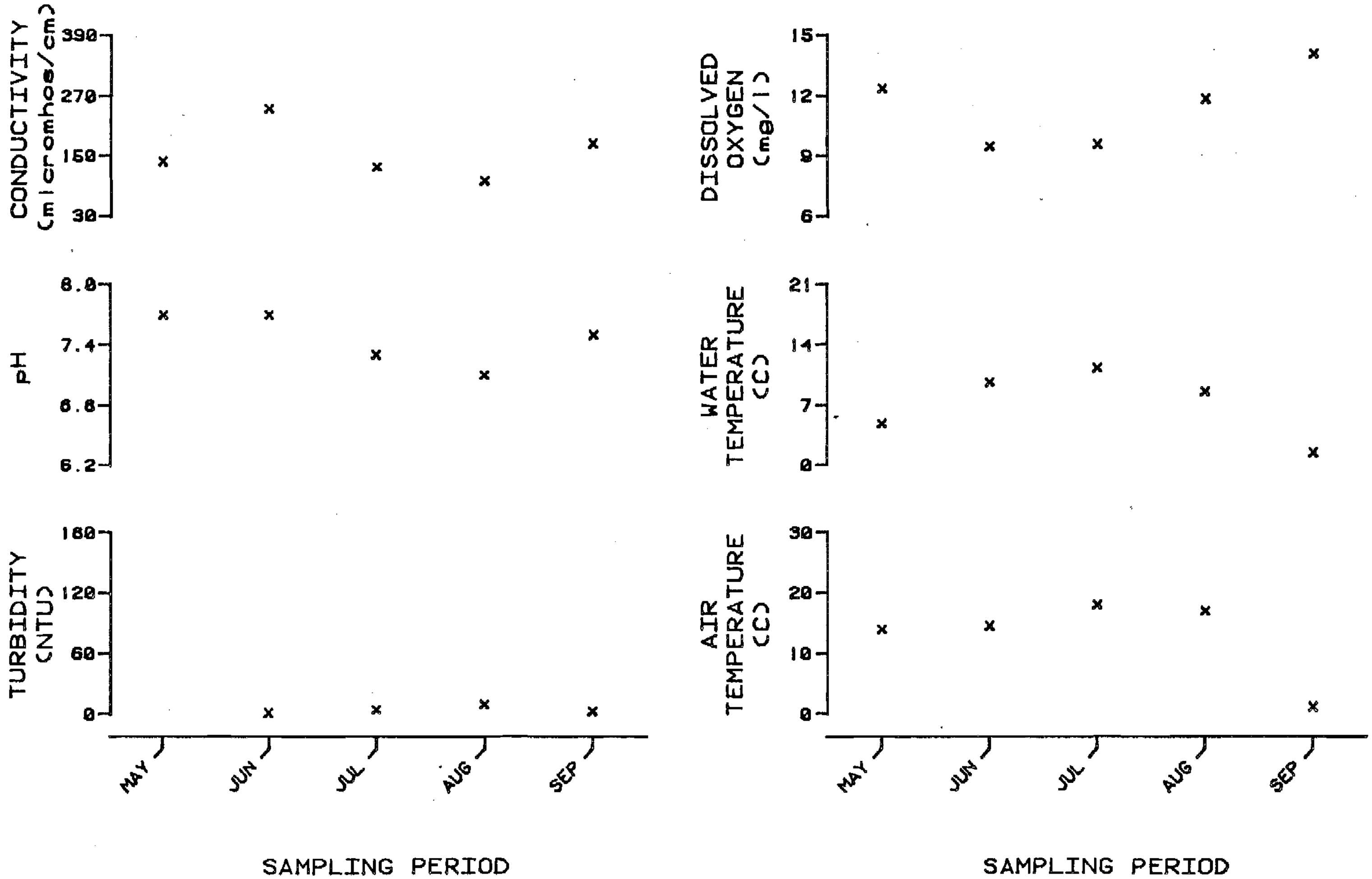


Figure E.5.61. Physiochemical parameters versus time (May - September, 1981)
for Watana Creek - Site 1
(R.M. 190.4, Geographic Code 32N06E25CCA)

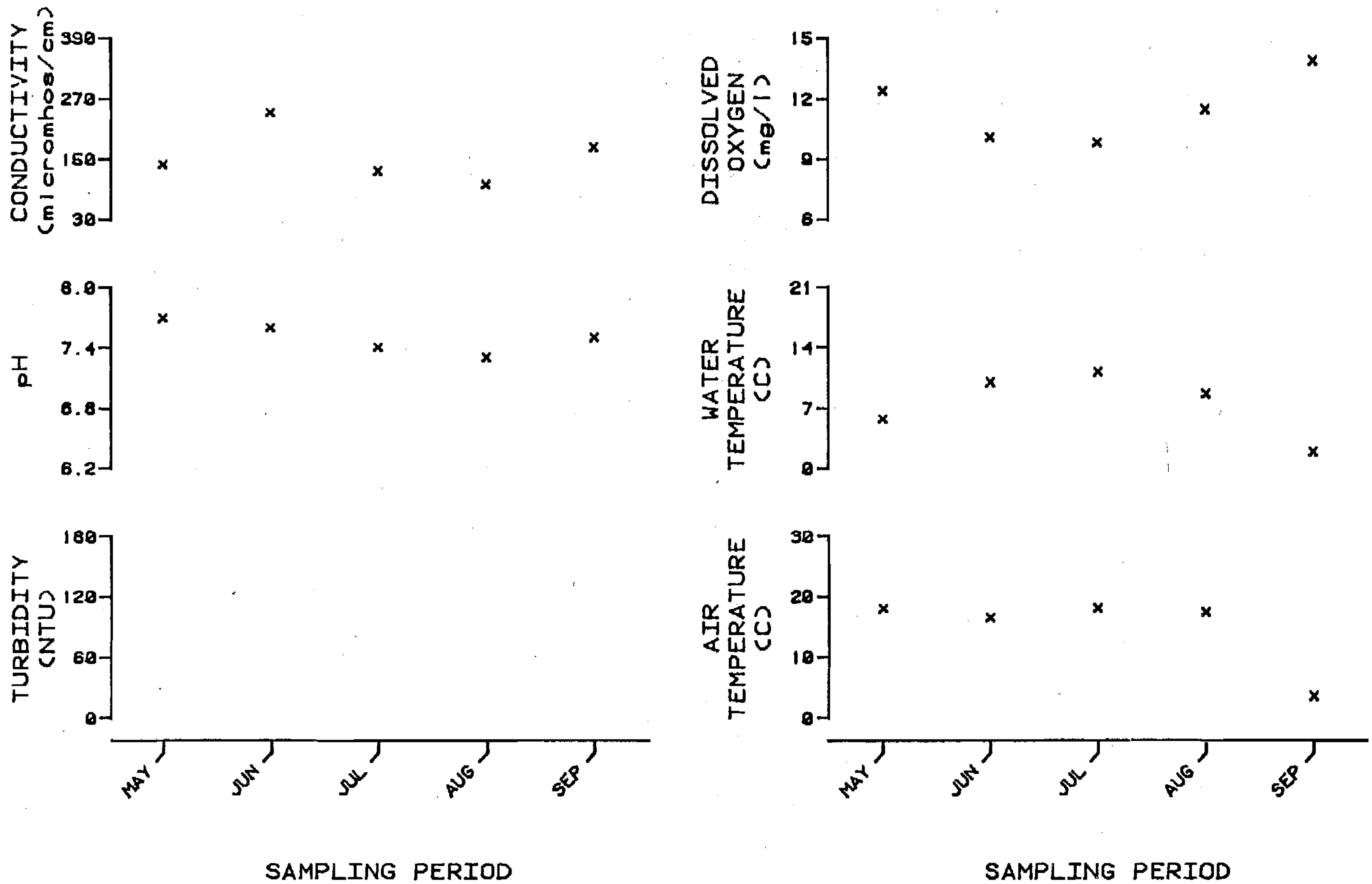


Figure E.5.62. Physiochemical parameters versus time (May - September, 1981)
for Watana Creek - Site 2
(R.M. 190.4, Geographic Code 32N06E25CAB)

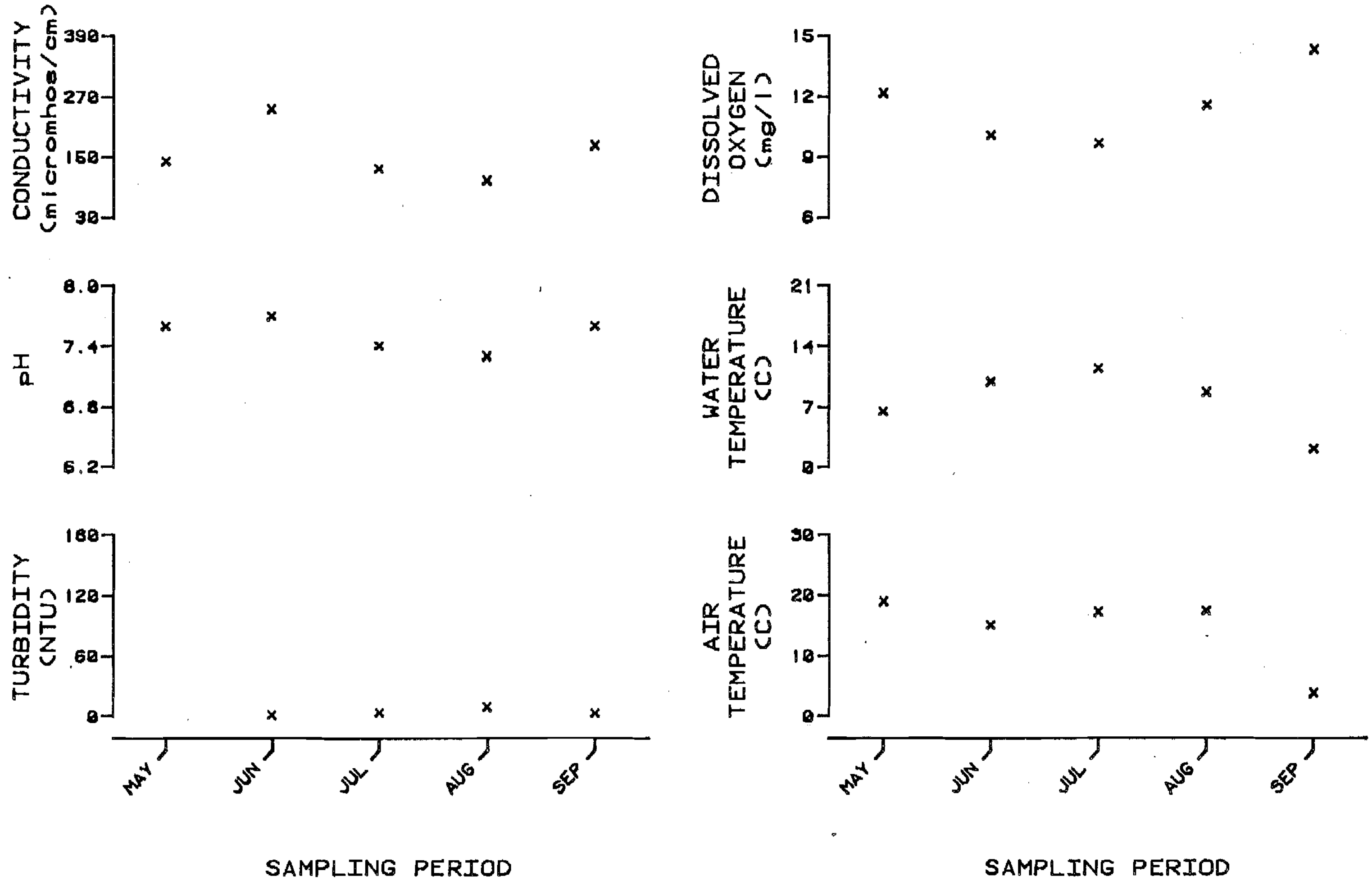


Figure E.5.63. Physiochemical parameters versus time (May-September, 1981) for Watana Creek - Site 3 (R.M. 190.4, Geographic Code 32N06E25BDC)

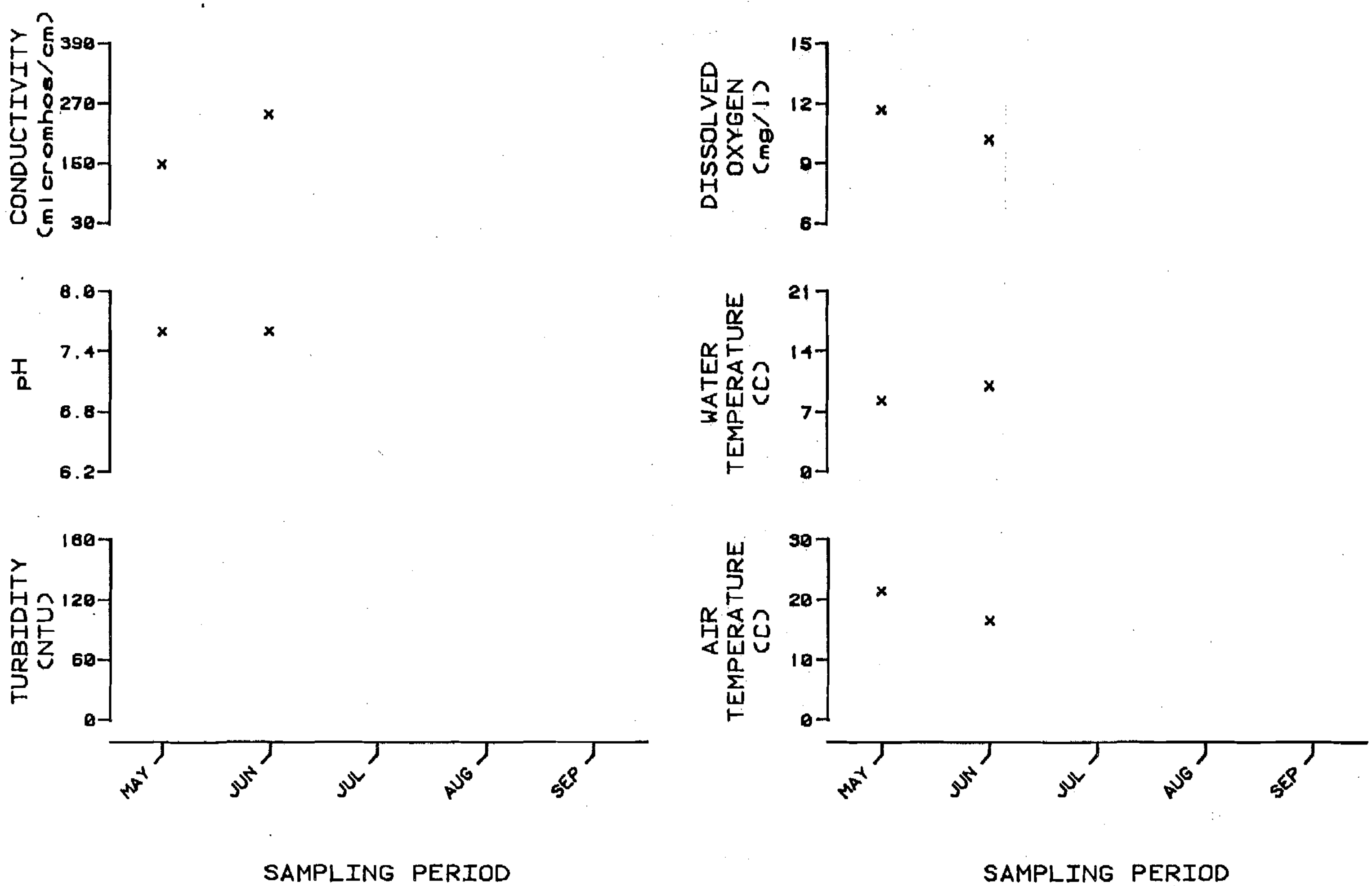


Figure E.5.64. Physiochemical parameters versus time (May-September, 1981) for Watana Creek - Site 4 (R.M. 190.4, Geographic Code 32N06E25ACB)

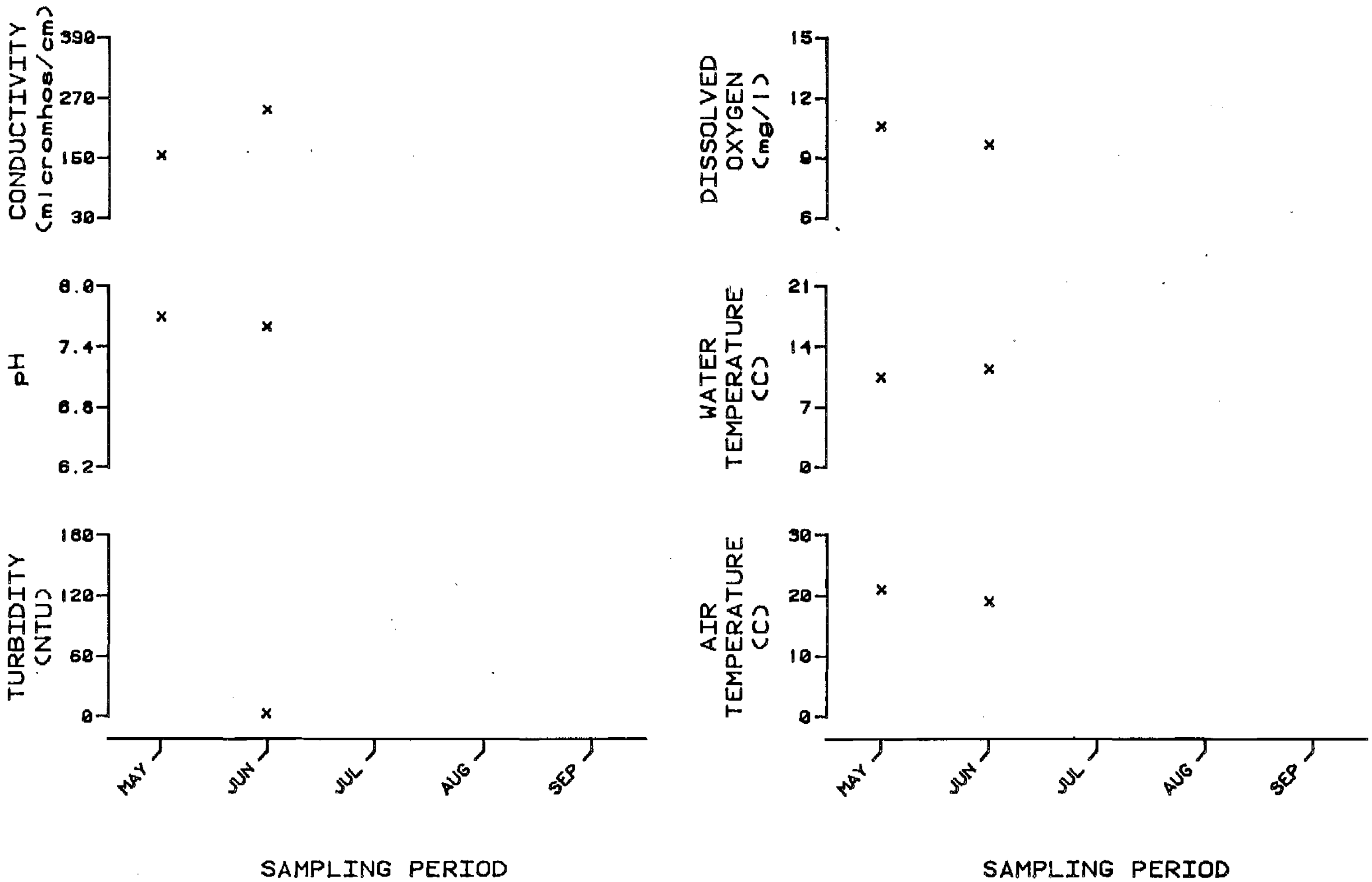


Figure E.5.65. Physiochemical parameters versus time(May-September, 1981)
for Watana Creek - Site 5
(R.M. 190.4, Geographic Code 32N06E25ABC)

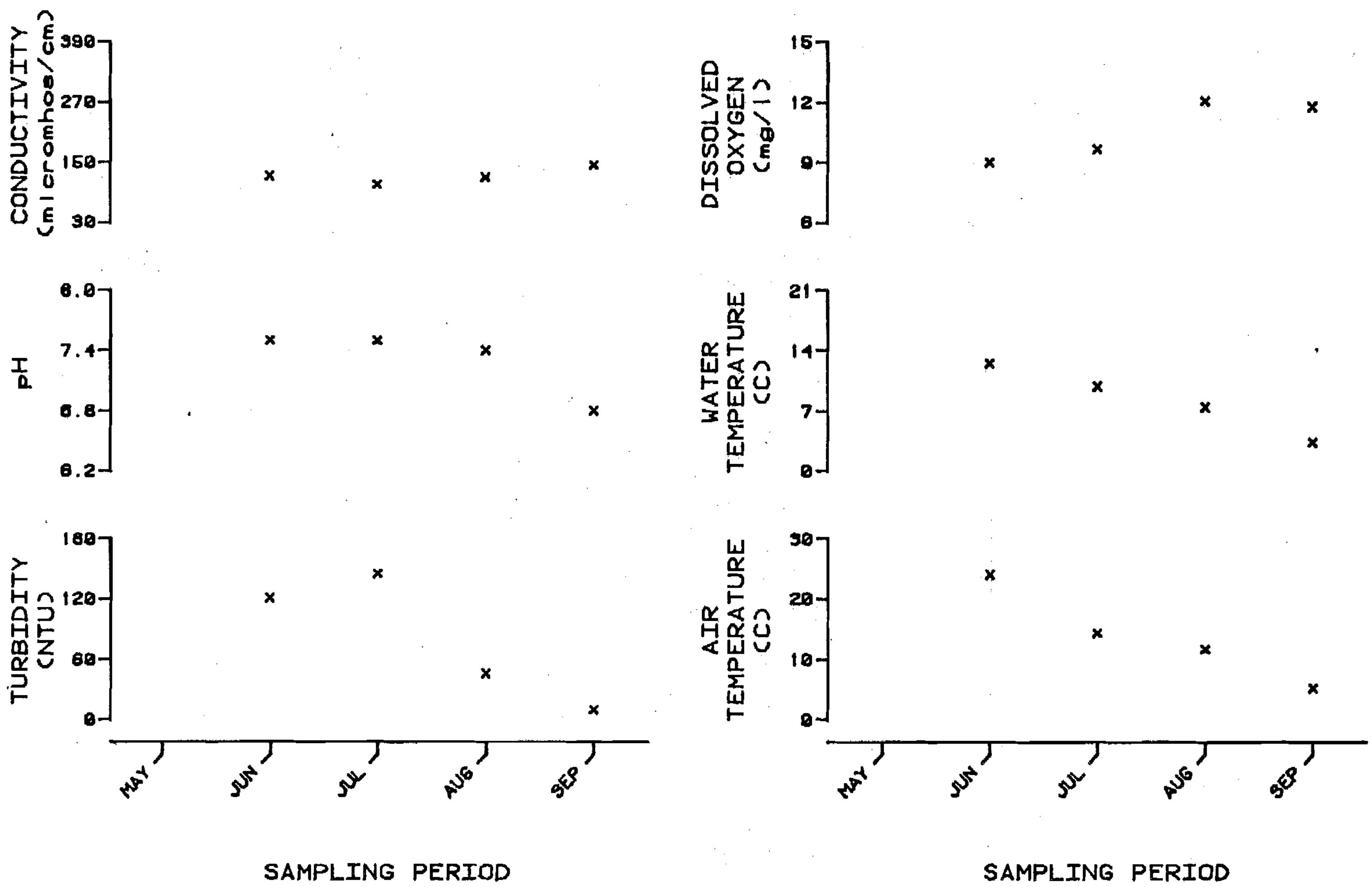


Figure E.5.66. Physiochemical parameters versus time (May-September, 1981) for Mainstem Susitna 50' upstream of Kosina Creek (R.M. 202.4, Geographic Code 31N08E15BAB)

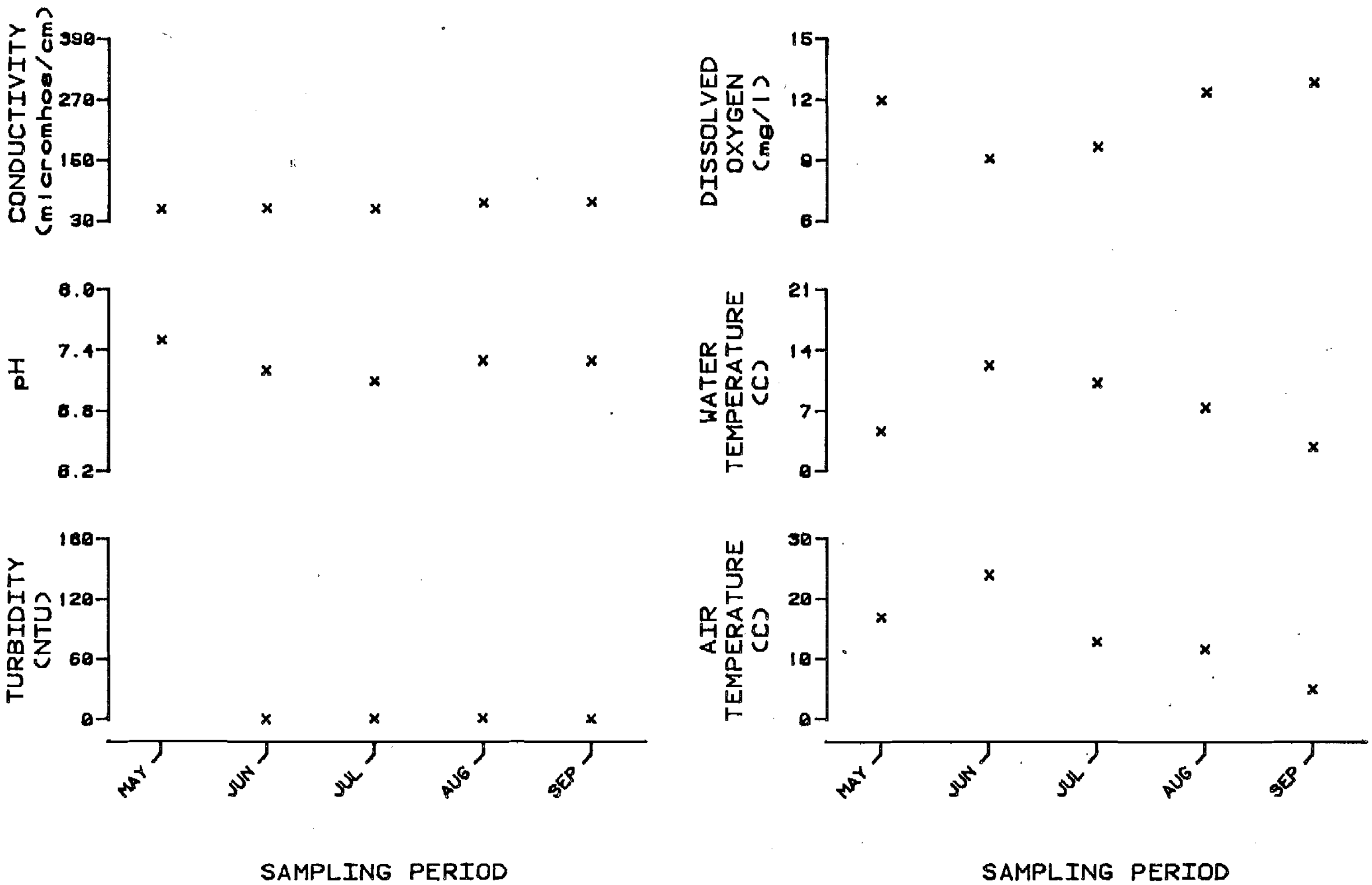


Figure E.5.67. Physiochemical parameters versus time (May-September, 1981)
for Kosina Creek - Site 1
(R.M. 202.4, Geographic Code 31N08E15BAB)

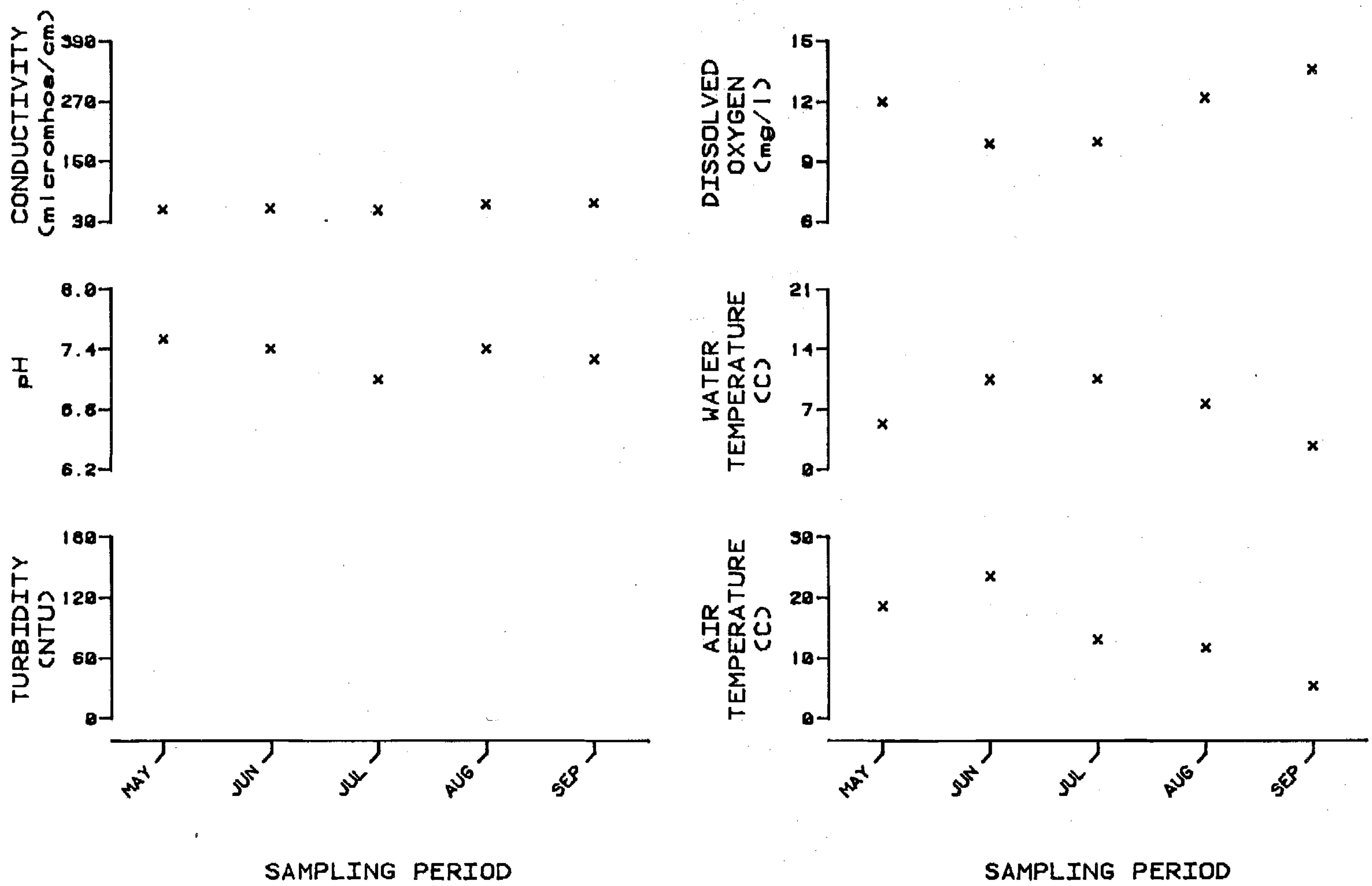


Figure E.5.68. Physiochemical parameters versus time (May-September, 1981)
for Kosina Creek - Site 2
(R.M. 202.4, Geographic Code 31N08E15BAC)

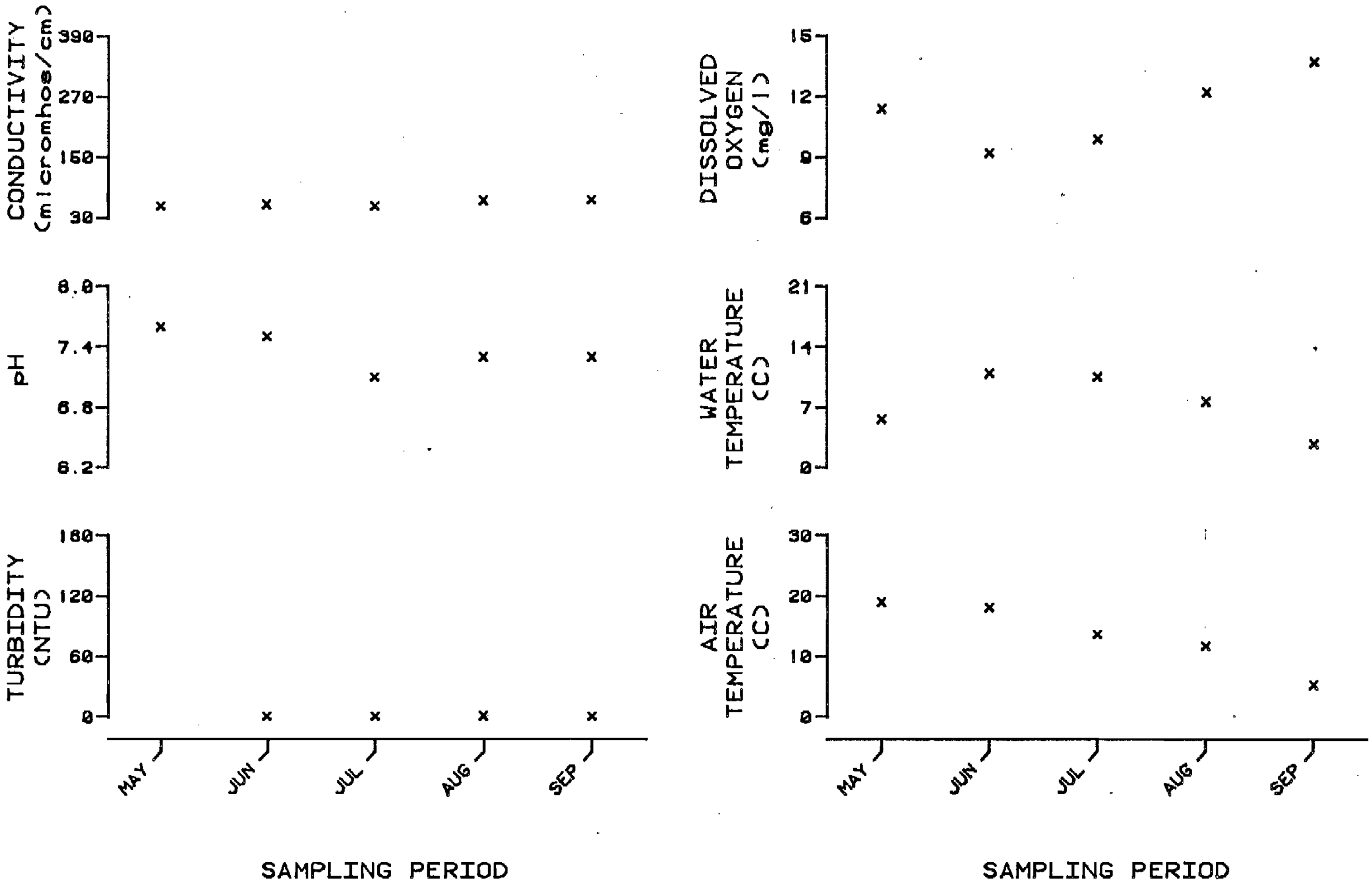


Figure E.5.69. Physiochemical parameters versus time (May-September, 1981)
for Kosina Creek - Site 3
(R.M. 202.4, Geographic Code 31N08E15BCA)

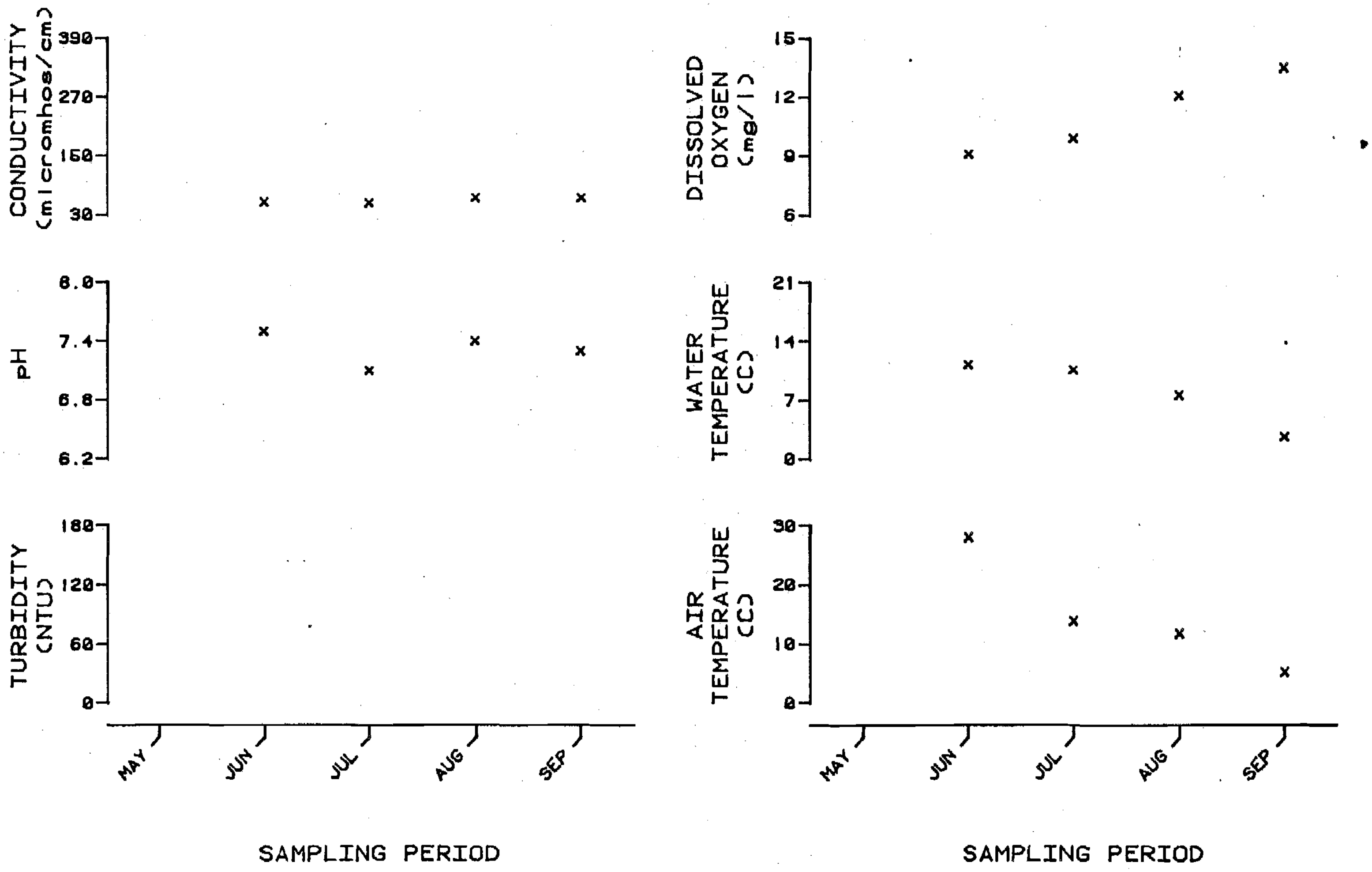


Figure E.5.70. Physiochemical parameters versus time (May-September, 1981)
for Kosina Creek - Site 4
(R.M. 202.4, Geographic Code 31N08E15CBA)

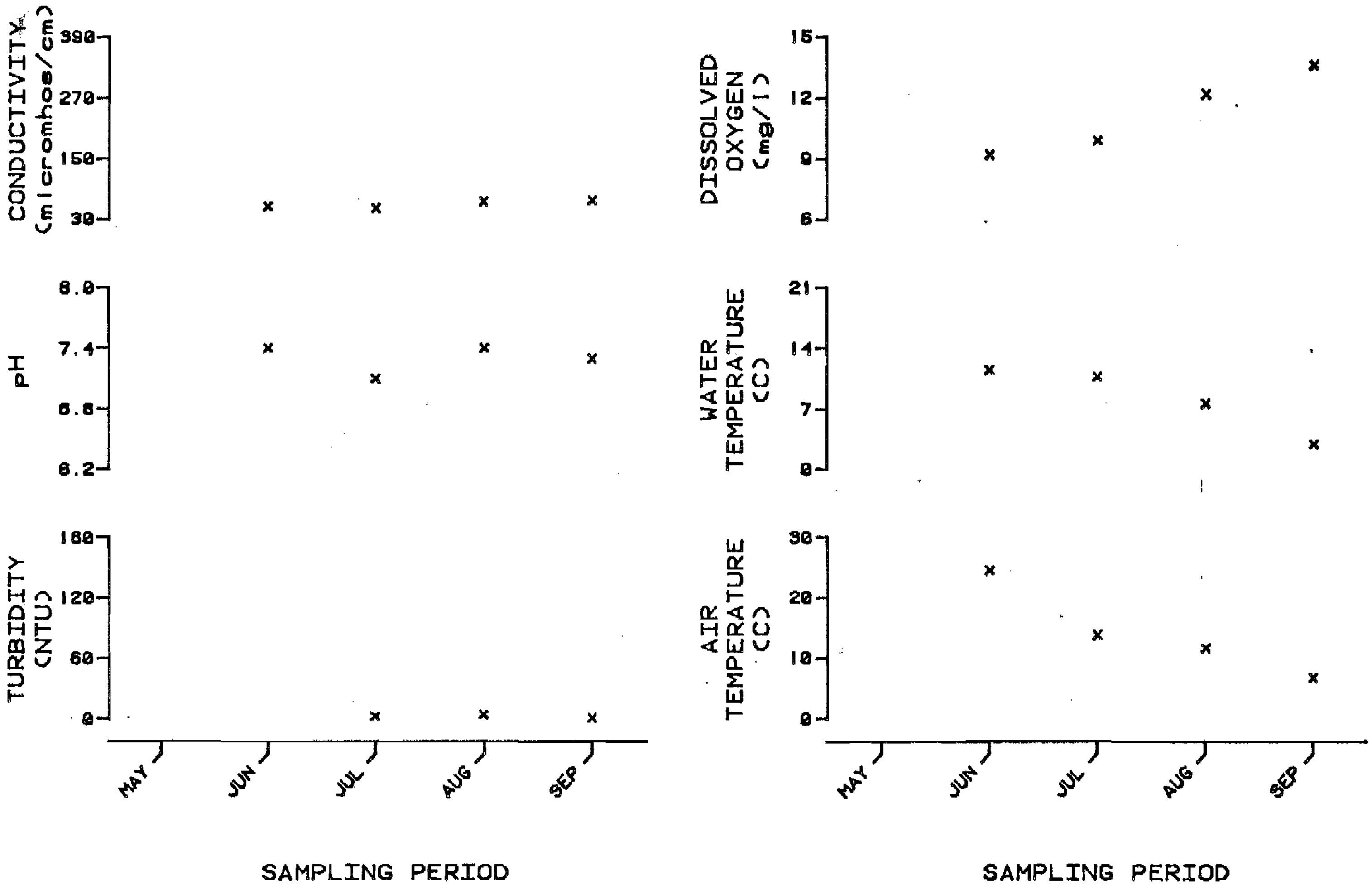


Figure E.5.71. Physiochemical parameters versus time (May-September, 1981) for Kosina Creek - Site 5 (R.M. 202.4, Geographic Code 31N08E15CCA)

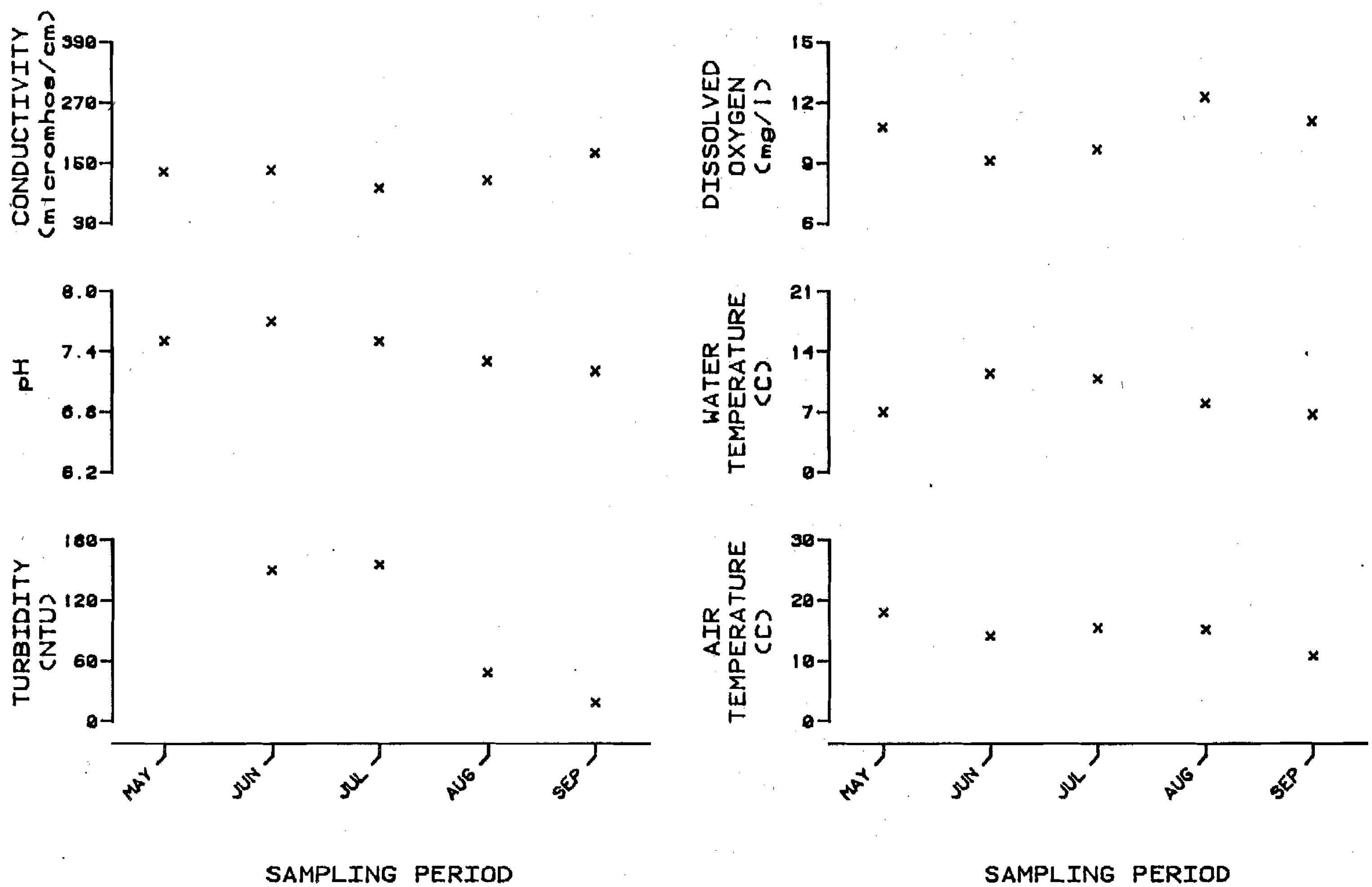


Figure E.5.72. Physiochemical parameters versus time (May-September, 1981) for Mainstem Susitna 50' upstream of Jay Creek (R.M. 203.9, Geographic Code 31N08E13BCC)

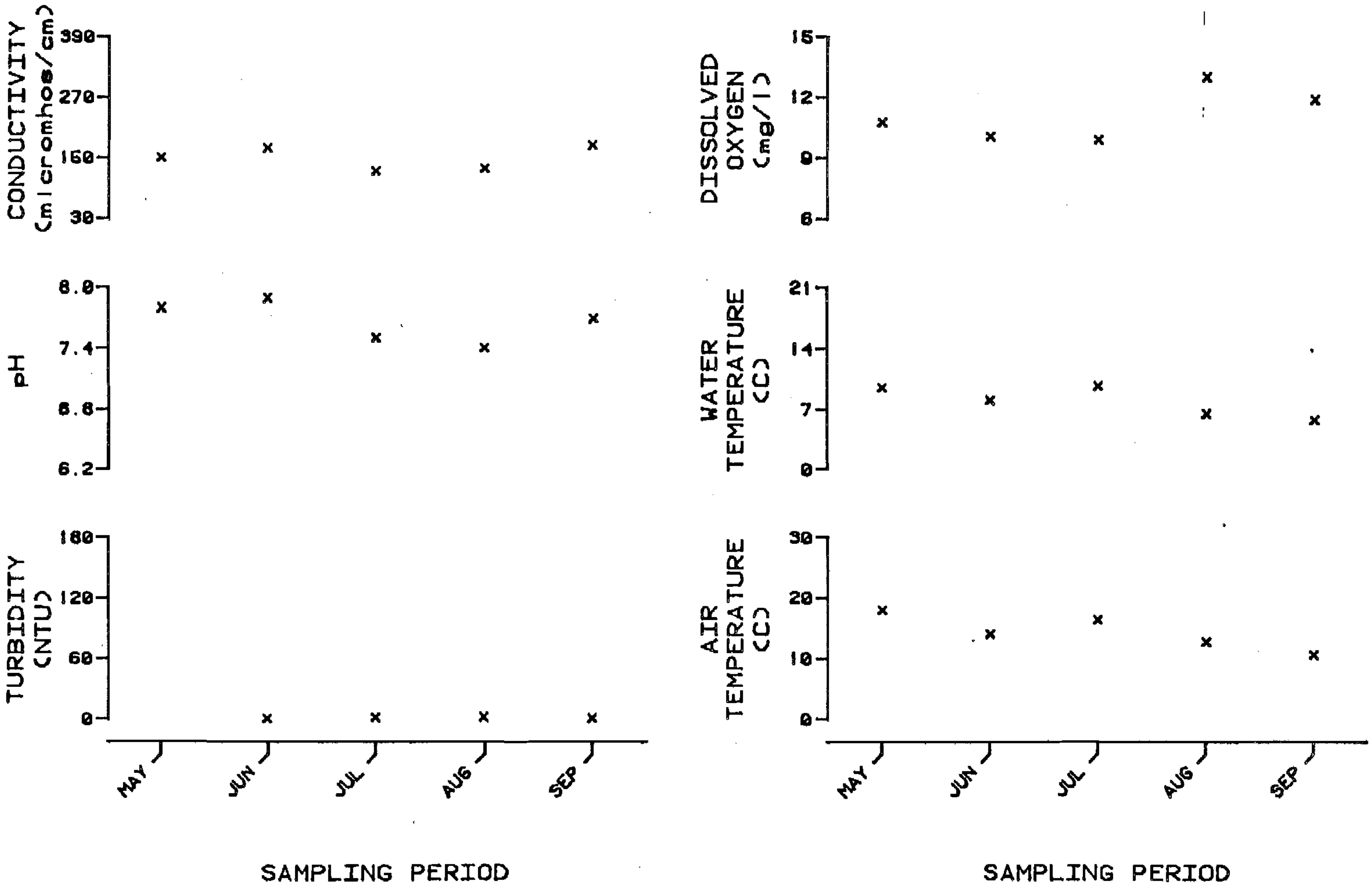


Figure E.5.73. Physiochemical parameters versus time (May-September, 1981) for Jay Creek - Site 1 (R.M. 203.9, Geographic Code 31N08E13BCC)

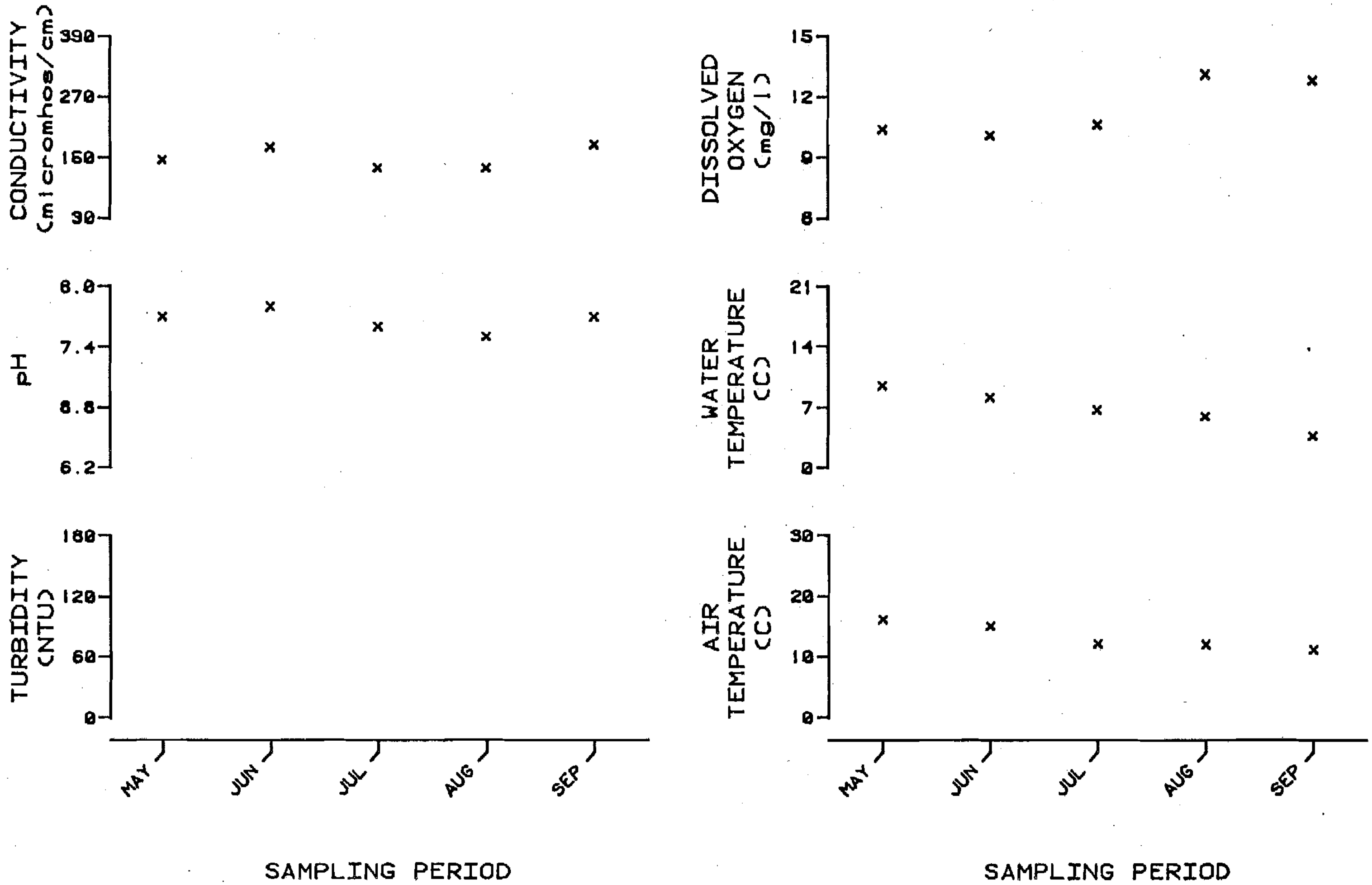


Figure E.5.74. Physiochemical parameters versus time (May-September, 1981) for Jay Creek - Site 2 (R.M. 203.9, Geographic Code 31N08E13BCA)

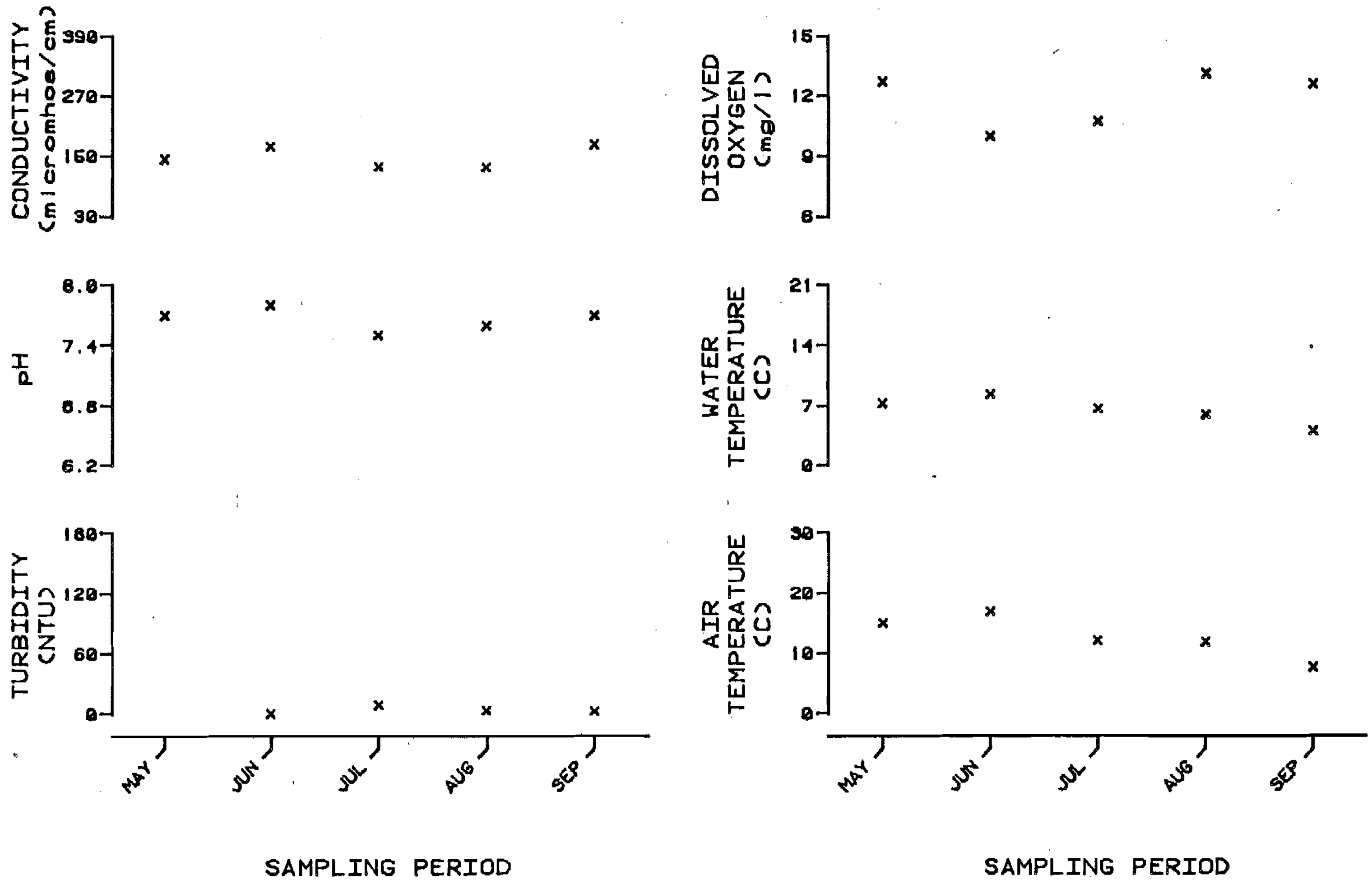


Figure E.5.75. Physiochemical parameters versus time (May-September, 1981) for Jay Creek - Site 3 (R.M. 203.9, Geographic Code 31N08E13BAC)

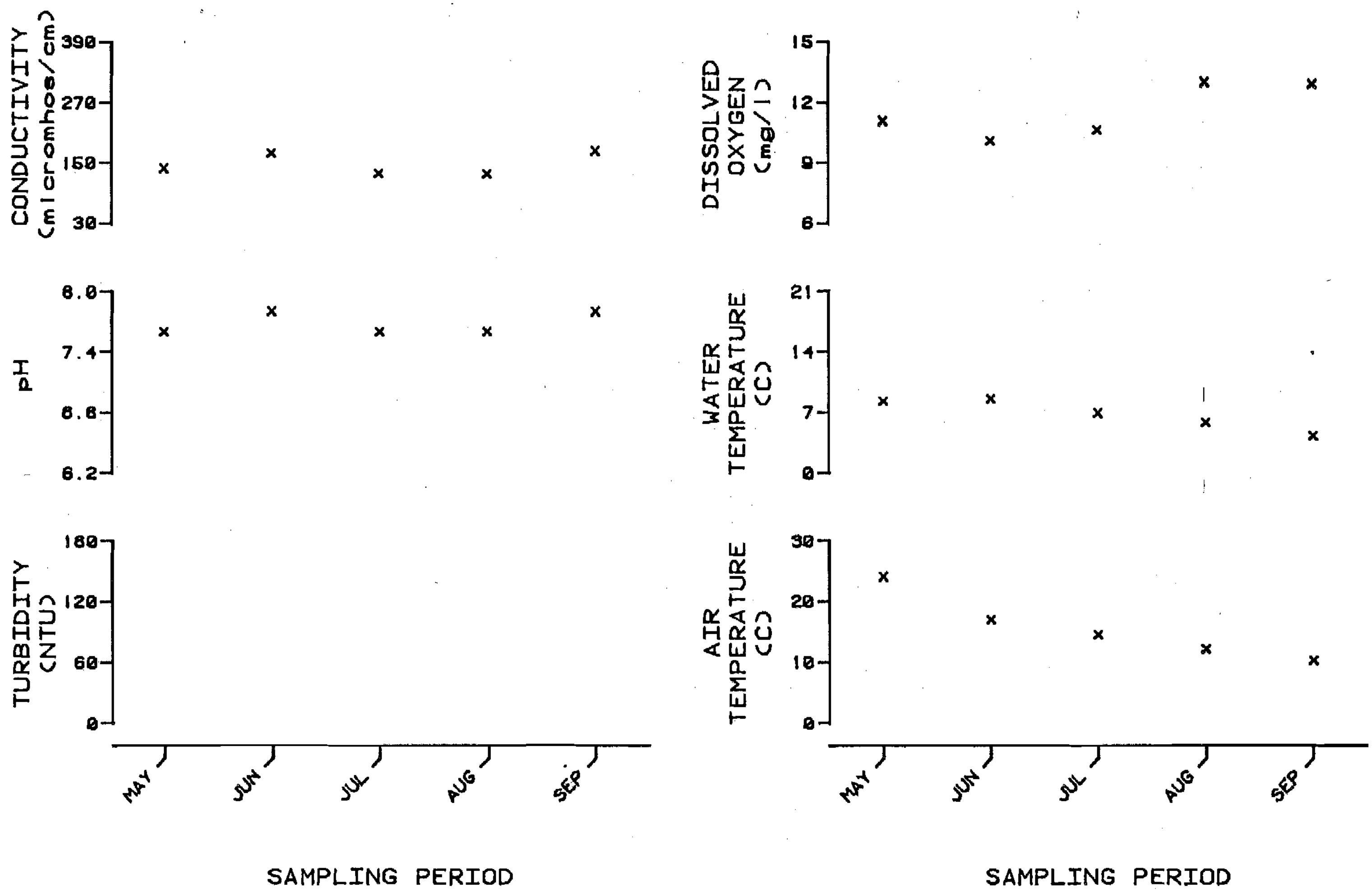


Figure E.5.76. Physiochemical parameters versus time (May-September, 1981)
for Jay Creek - Site 4
(R.M. 203.9, Geographic Code 31N08E13BAA)

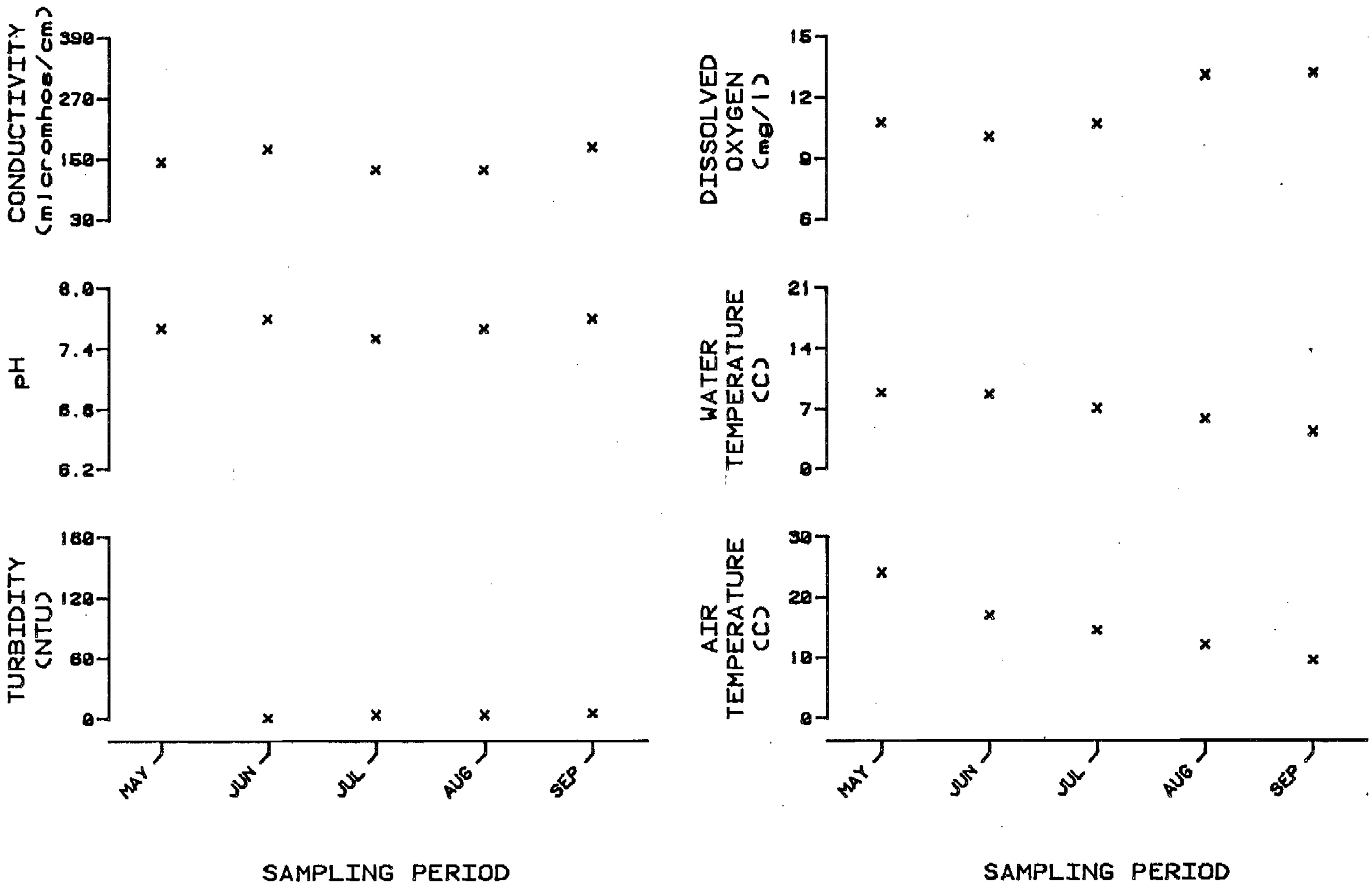


Figure E.5.77. Physiochemical parameters versus time (May-September, 1981)
for Jay Creek - Site 5
(R.M. 203.9, Geographic Code 31N08E12DCB)

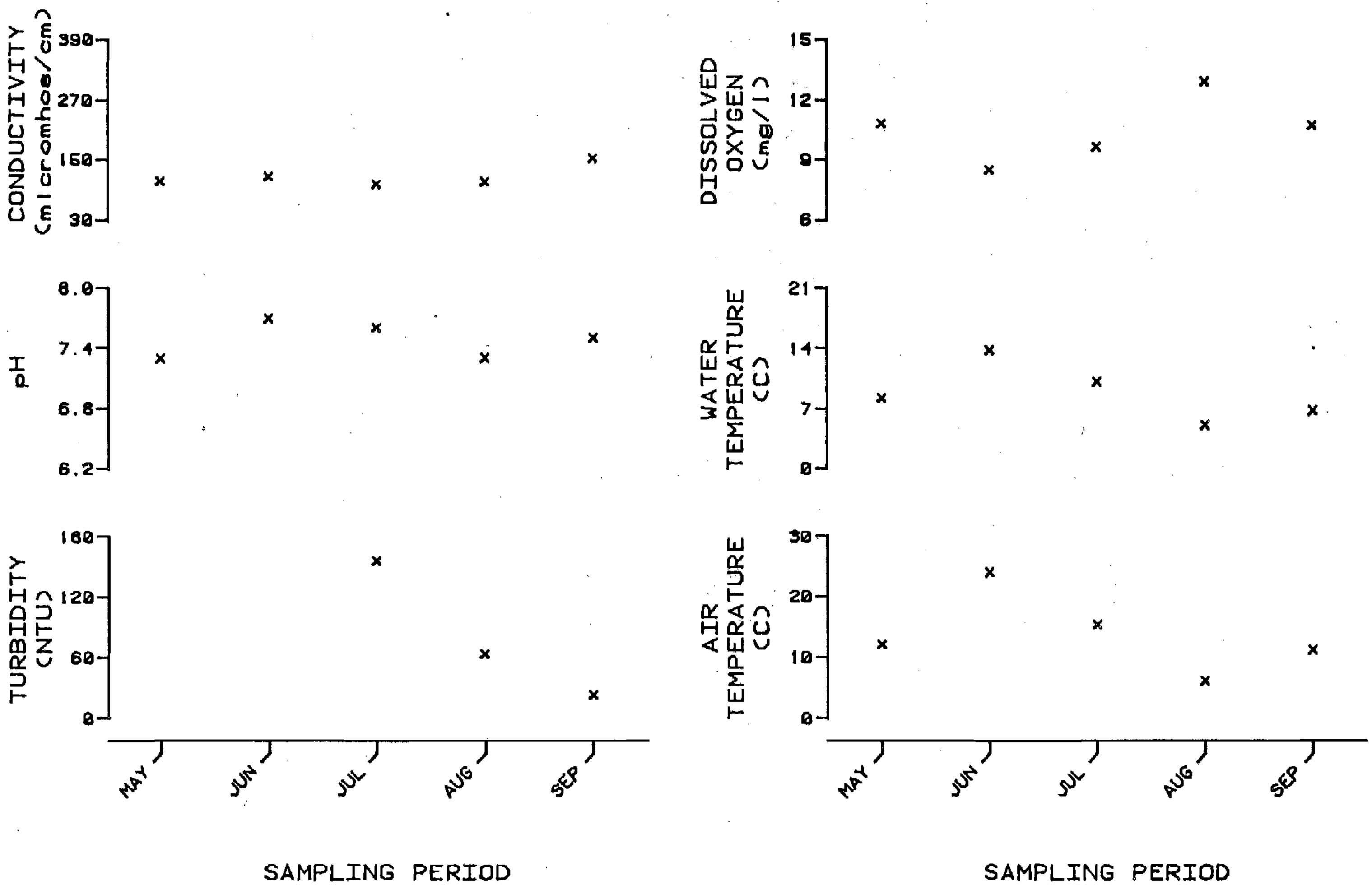


Figure E.5.78. Physiochemical parameters versus time (May-September, 1981) for Mainstem Susitna 50' upstream of Goose Creek (upper) (R.M. 224.9, Geographic Code 30N11E32DBC)

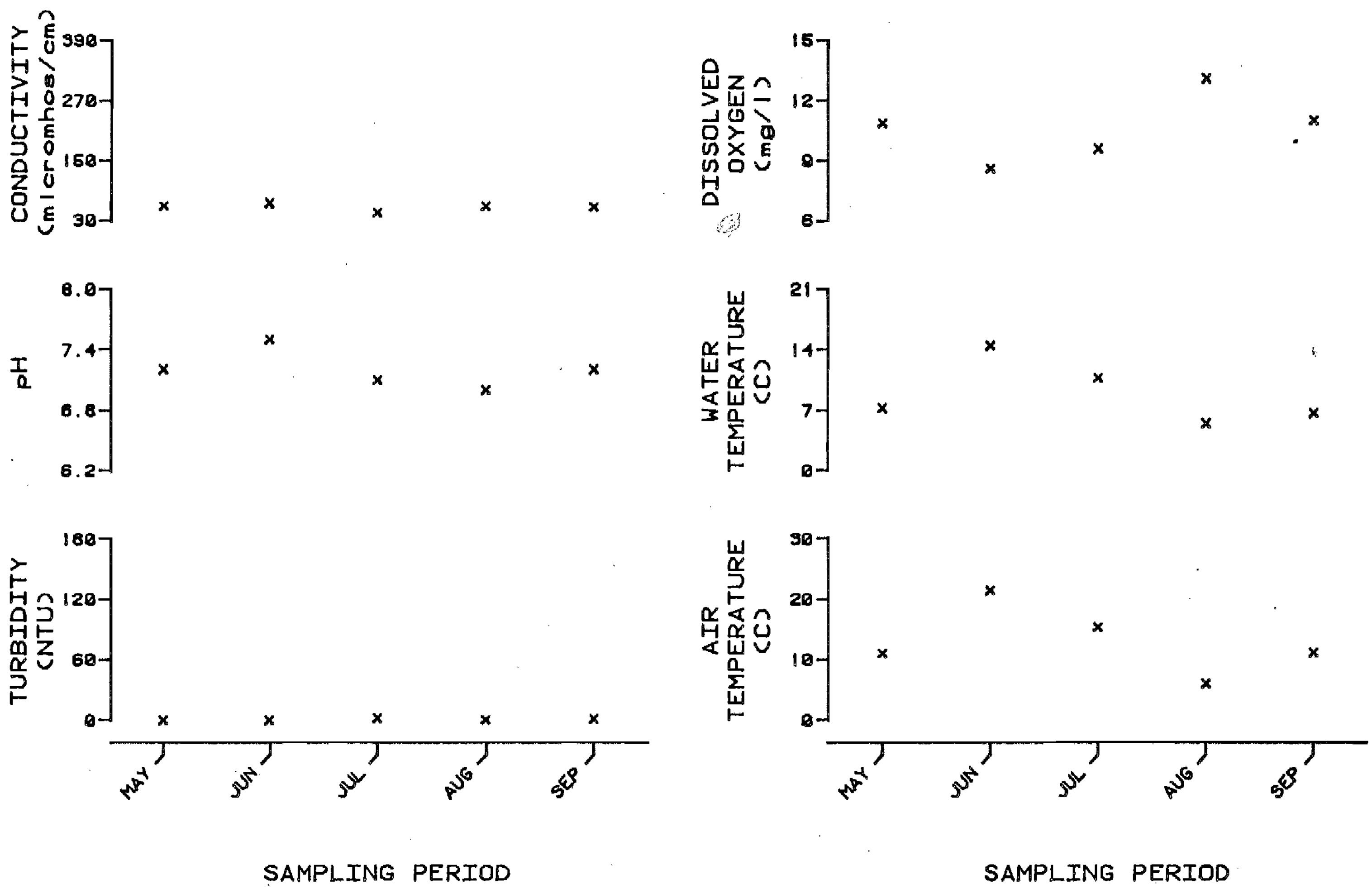


Figure E.5.79. Physiochemical parameters versus time (May-September, 1981) for Goose Creek (upper) - Site 1 (R.M. 224.9, Geographic Code 30N11E32DBC)

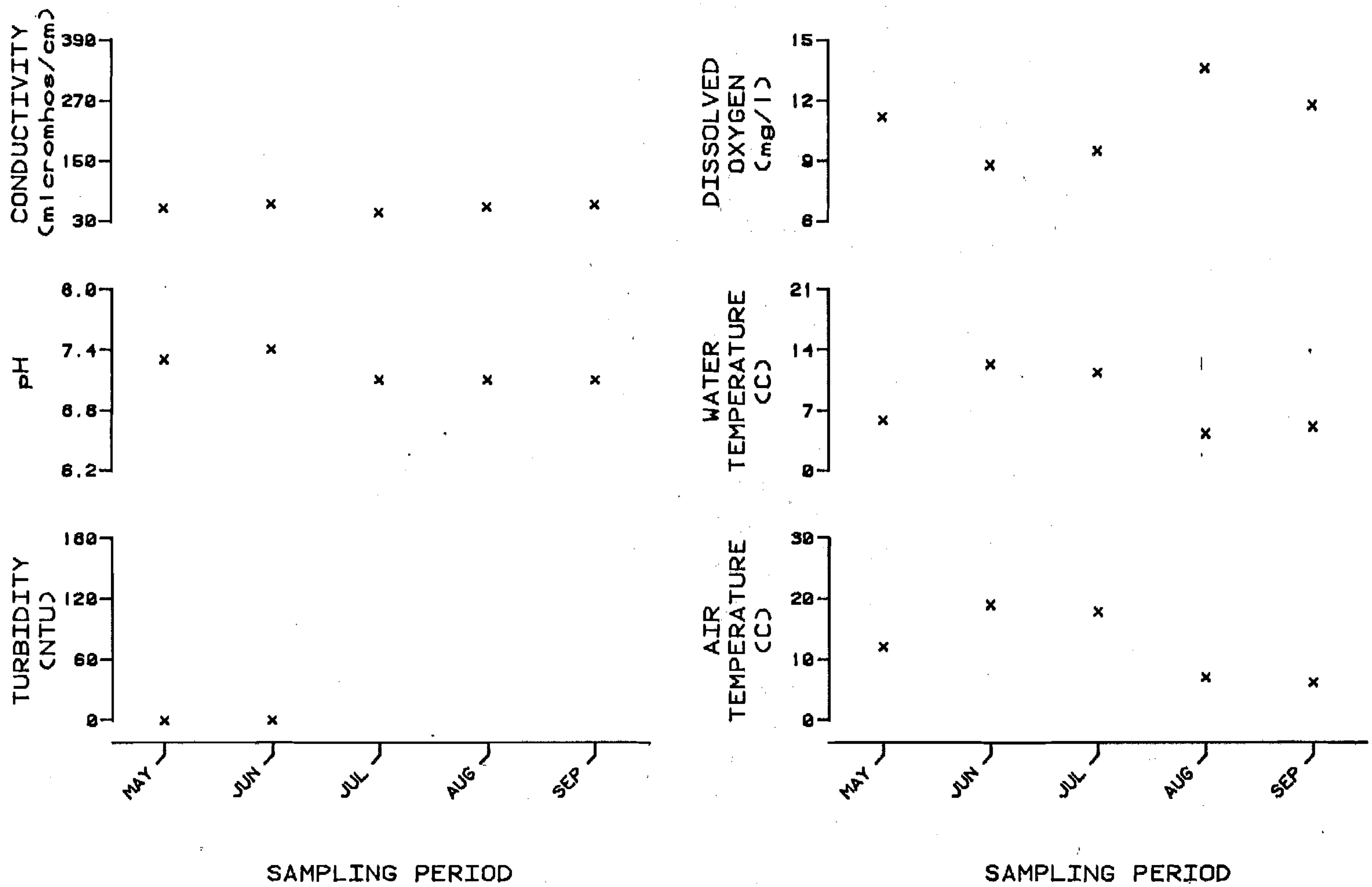


Figure E.5.80. Physiochemical parameters versus time (May-September, 1981) for Goose Creek (upper) - Site 2 (R.M. 224.9, Geographic Code 30N11E32CDA)

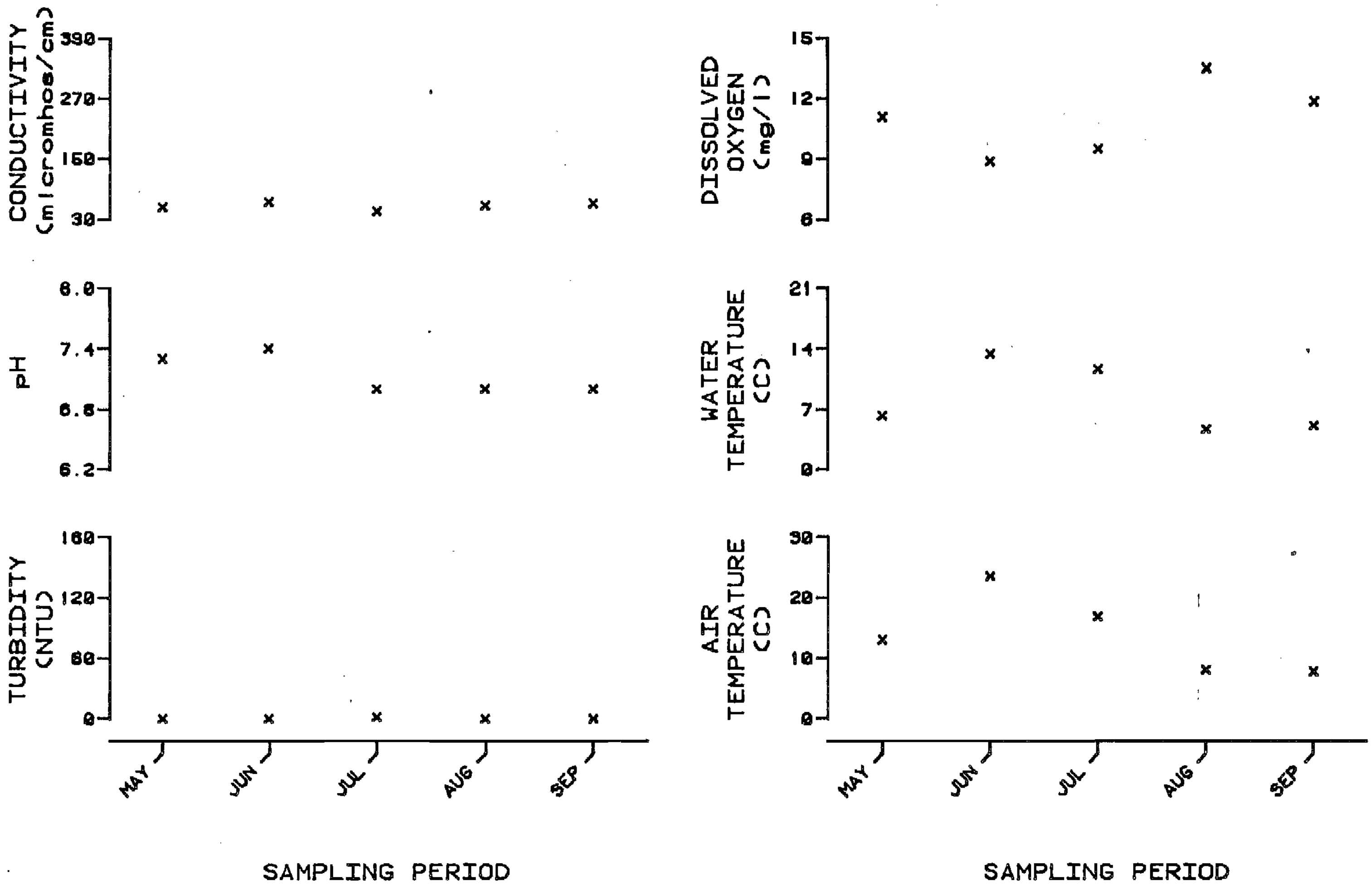


Figure E.5.81. Physiochemical parameters versus time (May-September, 1981) for Goose Creek (upper) - Site 3 (R.M. 224.9, Geographic Code 30N11E32CDC)

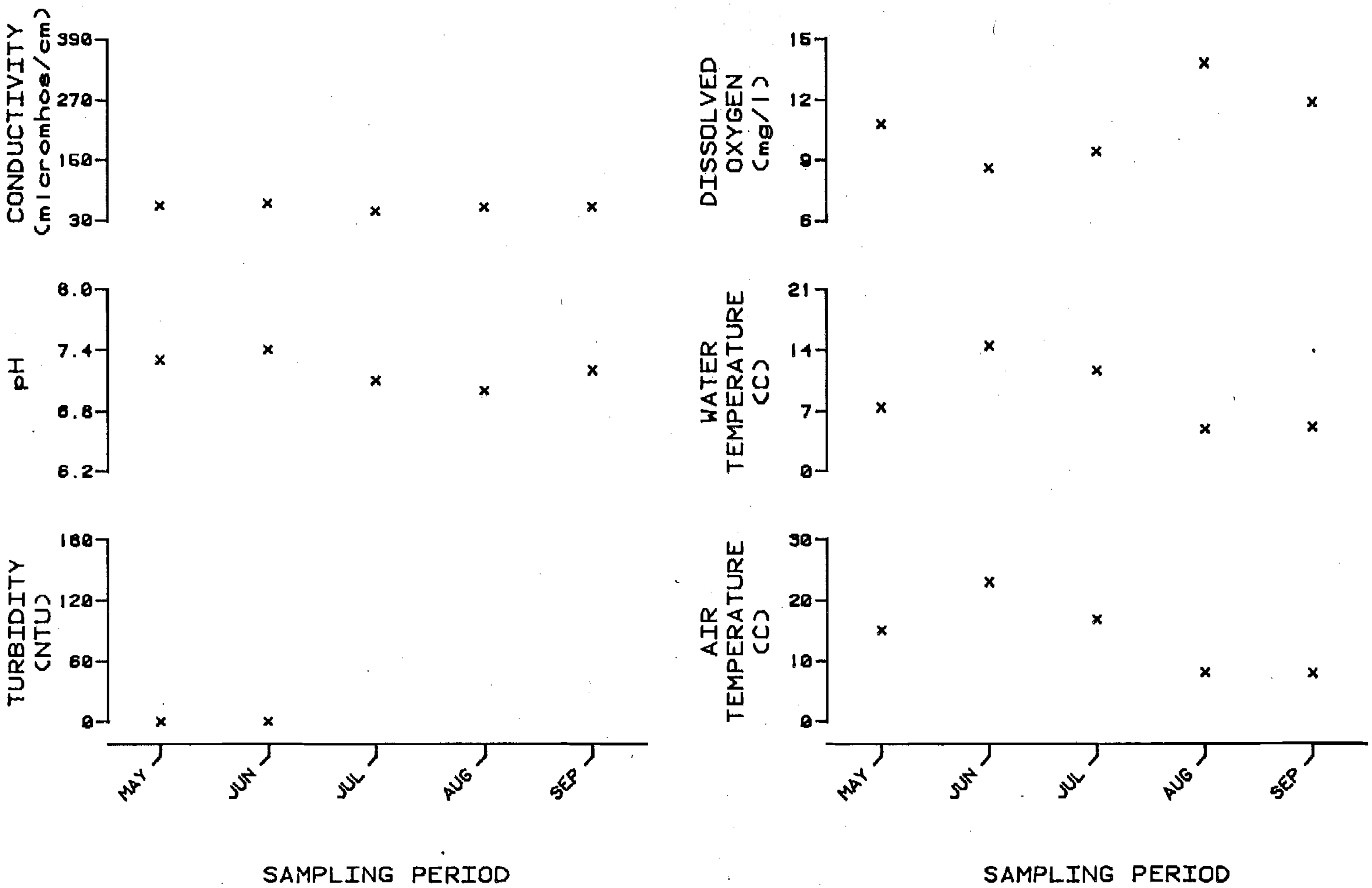


Figure E.5.82. Physiochemical parameters versus time (May-Septemer, 1981) for Goose Creek (uppar) - Site 4 (R.M. 224.9, Geographic Code 29N11E05BBC)

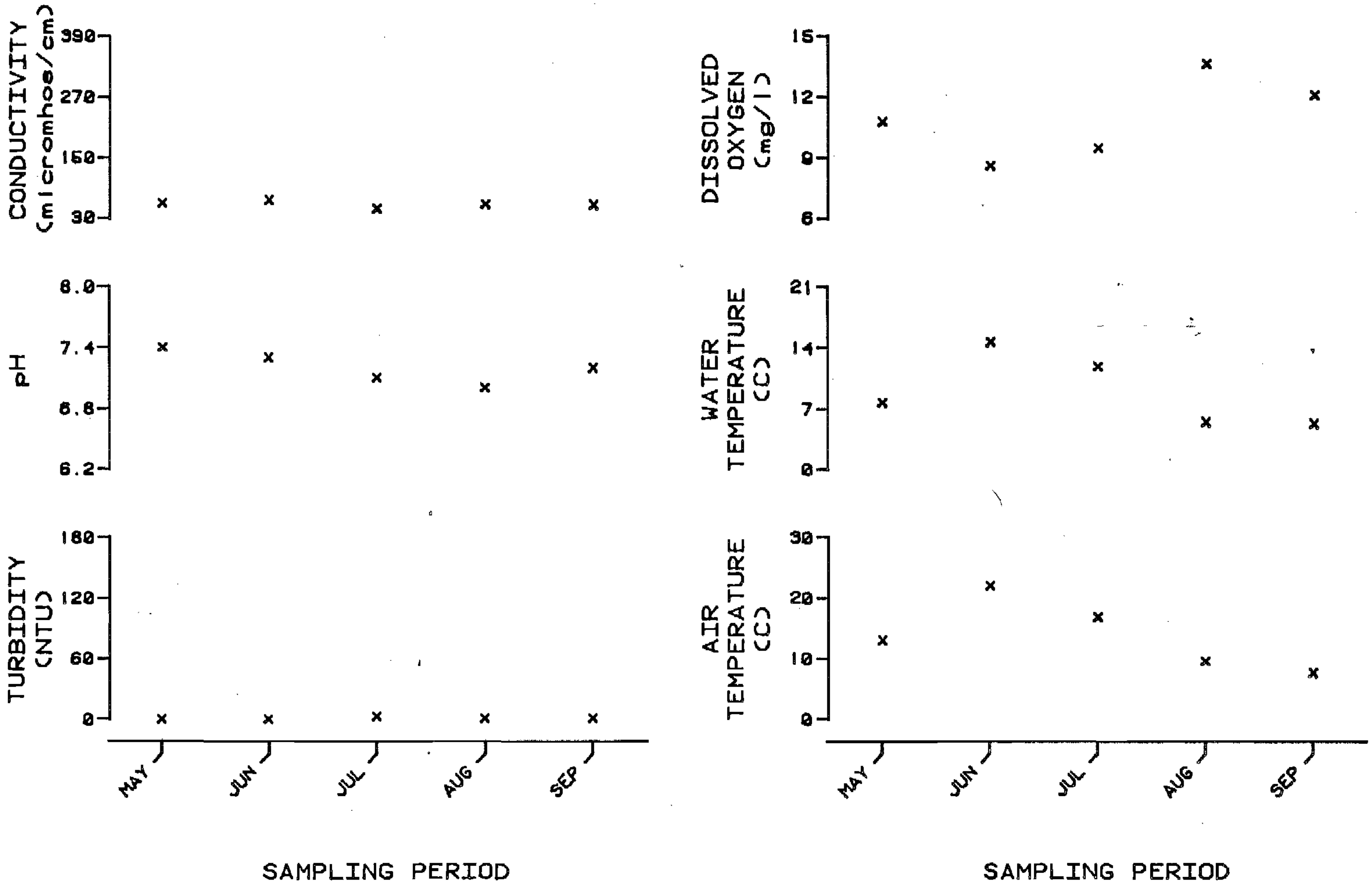


Figure E.5.83. Physiochemical parameters versus time (May-September, 1981) for Goose Creek (upper) - Site 5 (R.M. 224.9, Geographic Code 29N11E05BCB)

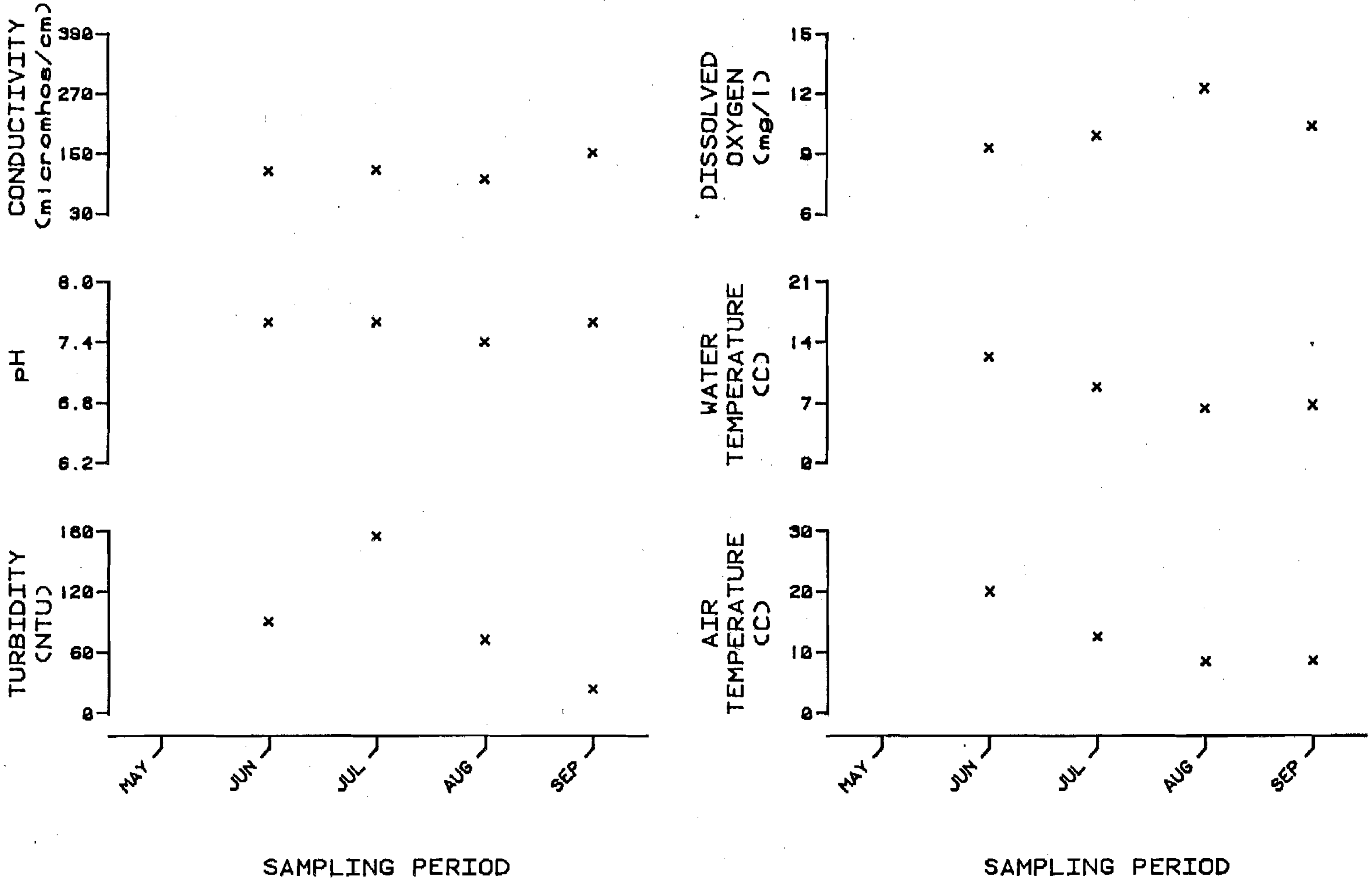


Figure E.5.84. Physiochemical parameters versus time (May-September, 1981) for Mainstem Susitna 50" upstream of Oshetna River (R.M. 226.9, Geographic Code 30N11E34CCD)

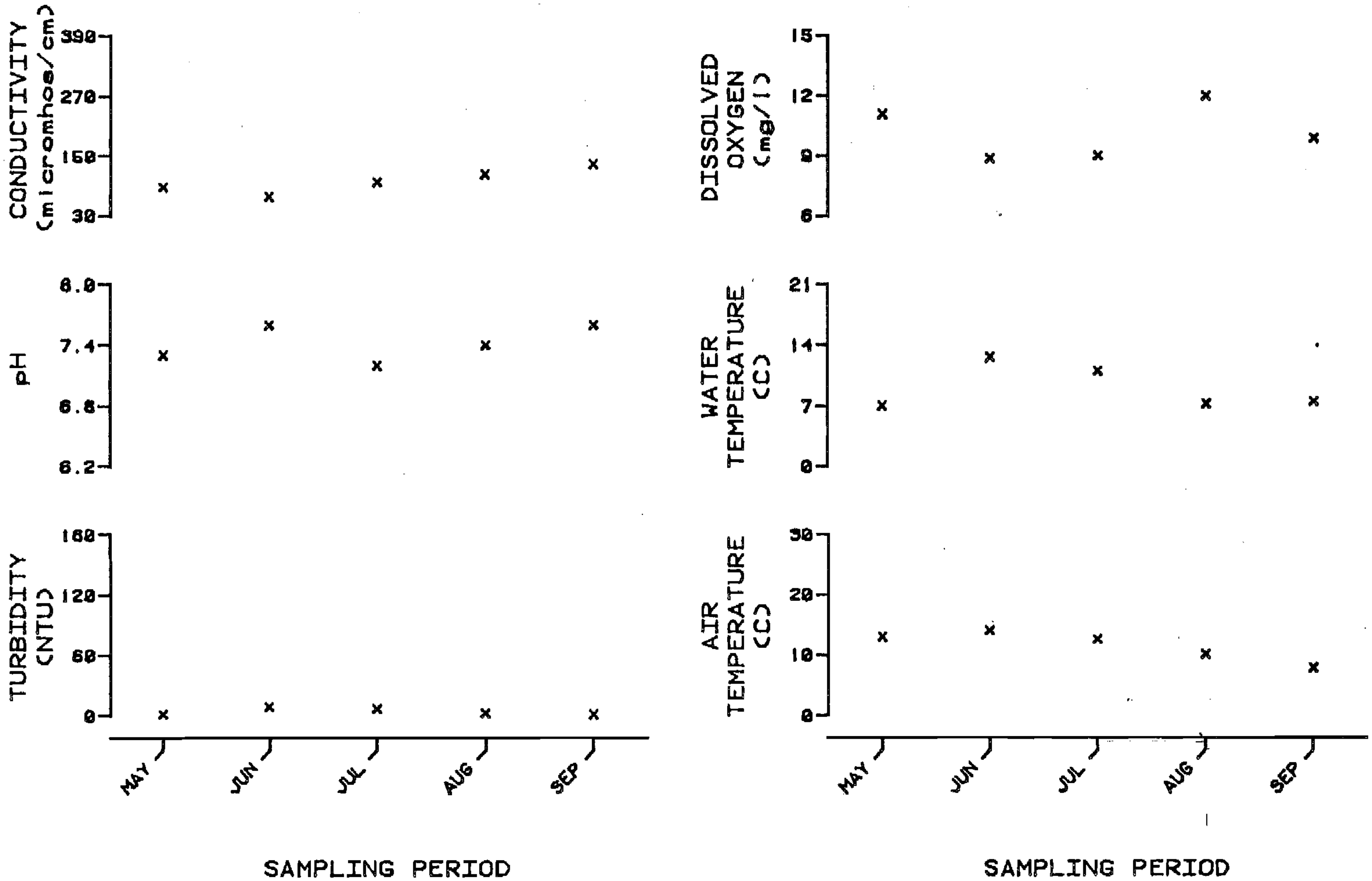


Figure E.5.85. Physiochemical parameters versus time (May-September, 1981) for Oshetna River - Site 1 (R.M. 226.9, Geographic Code 30N11E34CCD)

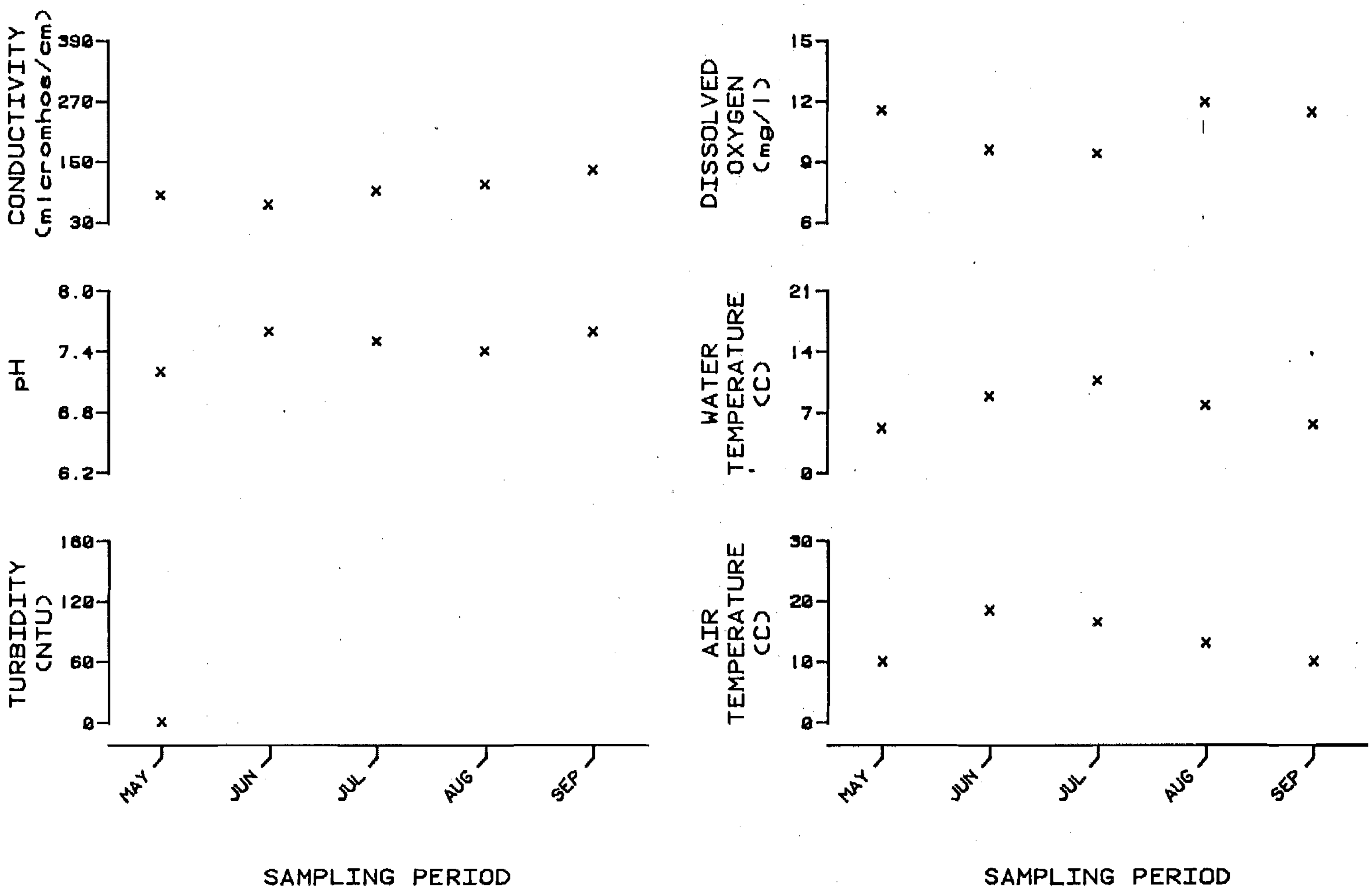


Figure E.5.86. Physiochemical parameters versus time (May-September, 1981) for Oshetna River - Site 2 (R.M. 226.9, Geographic Code 29N11E03BAB)

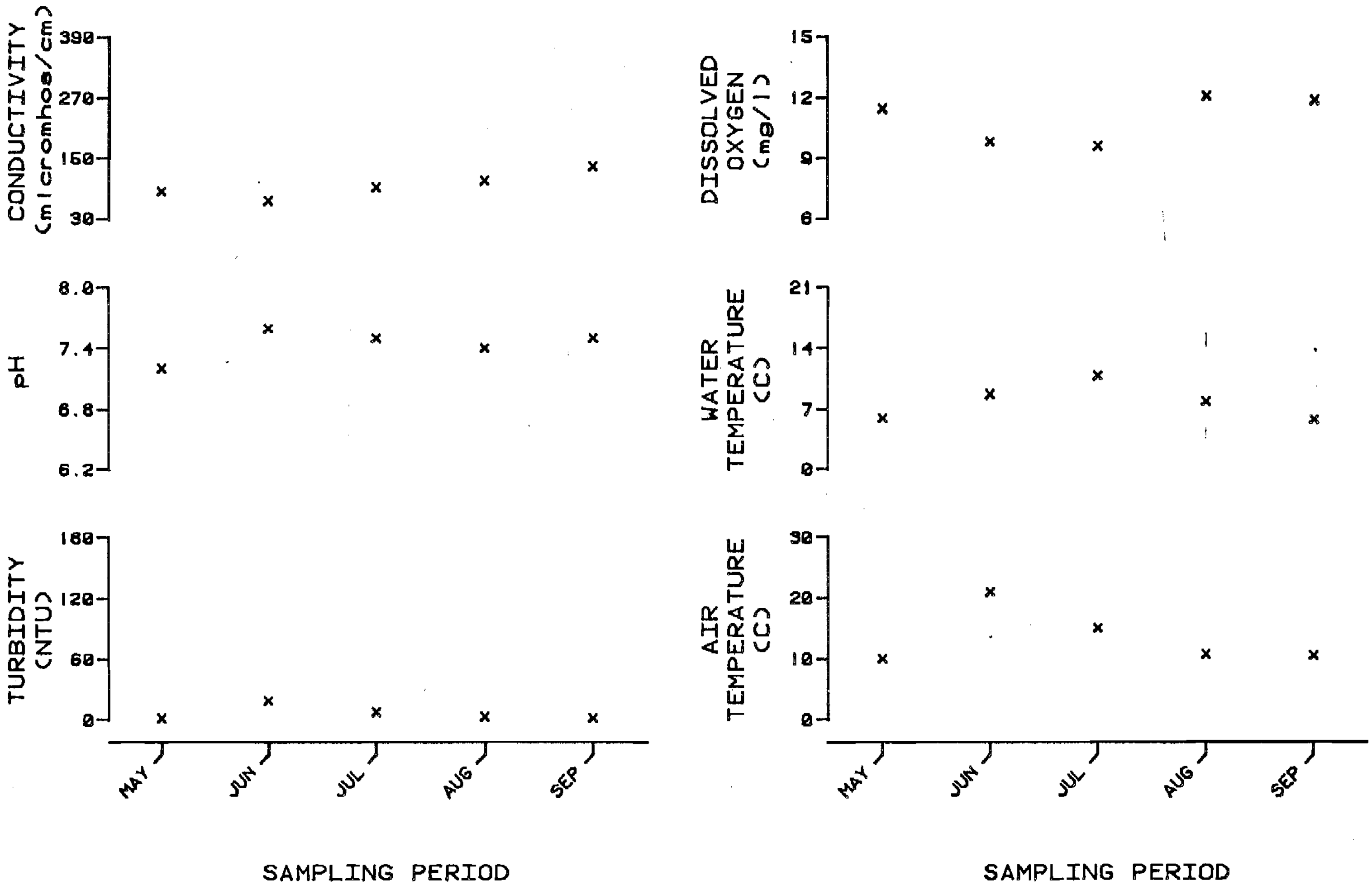


Figure E.5.87. Physiochemical parameters versus time (May-September, 1981) for Oshetna River - Site 3 (R.M. 226.9, Geographic Code 29N11E03BAC)

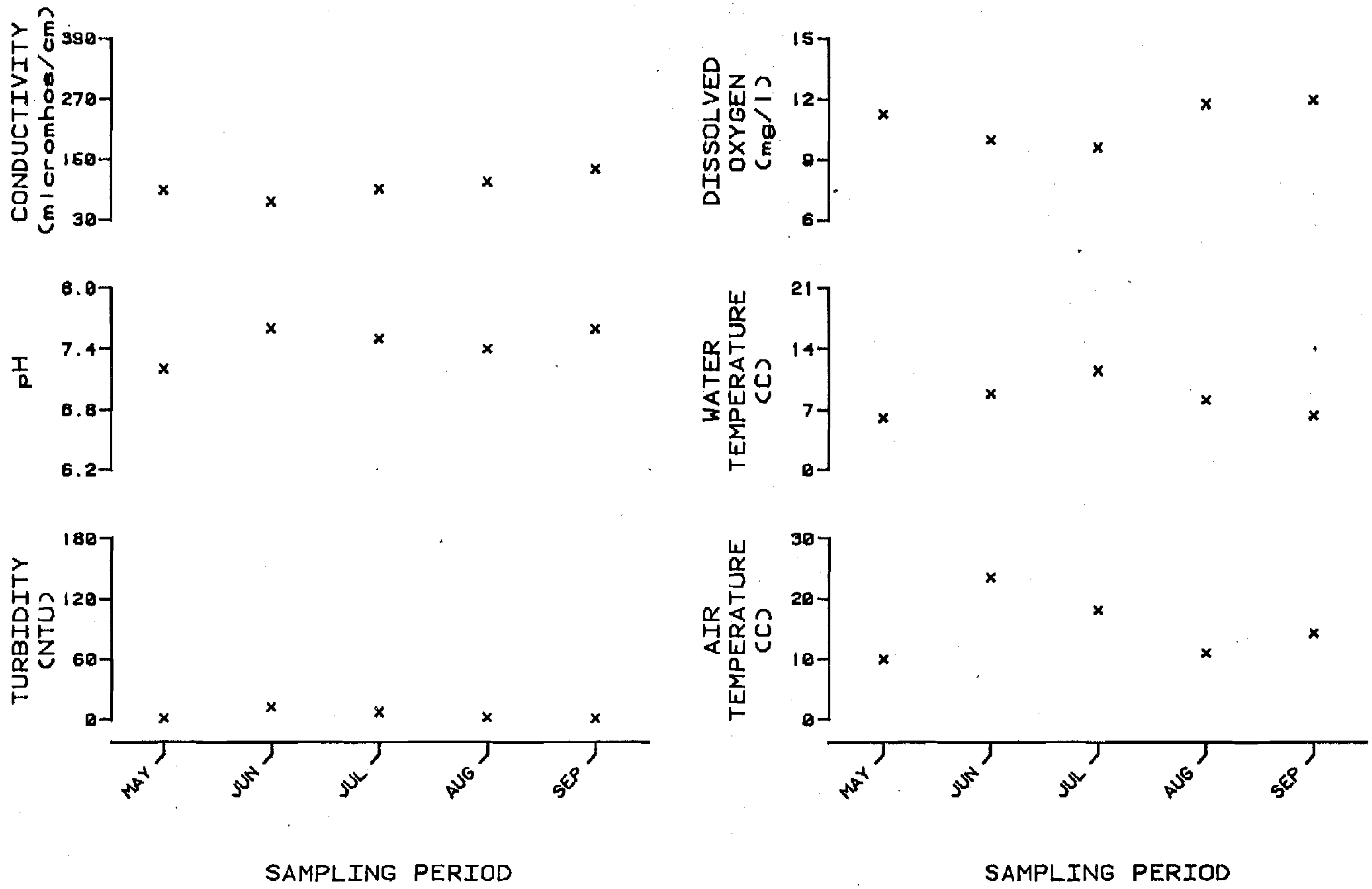


Figure E.5.88. Physiochemical parameters versus time (May-September, 1981) for Oshetna River - Site 4 (R.M. 226.9, Geographic Code 29N11E03ACB)

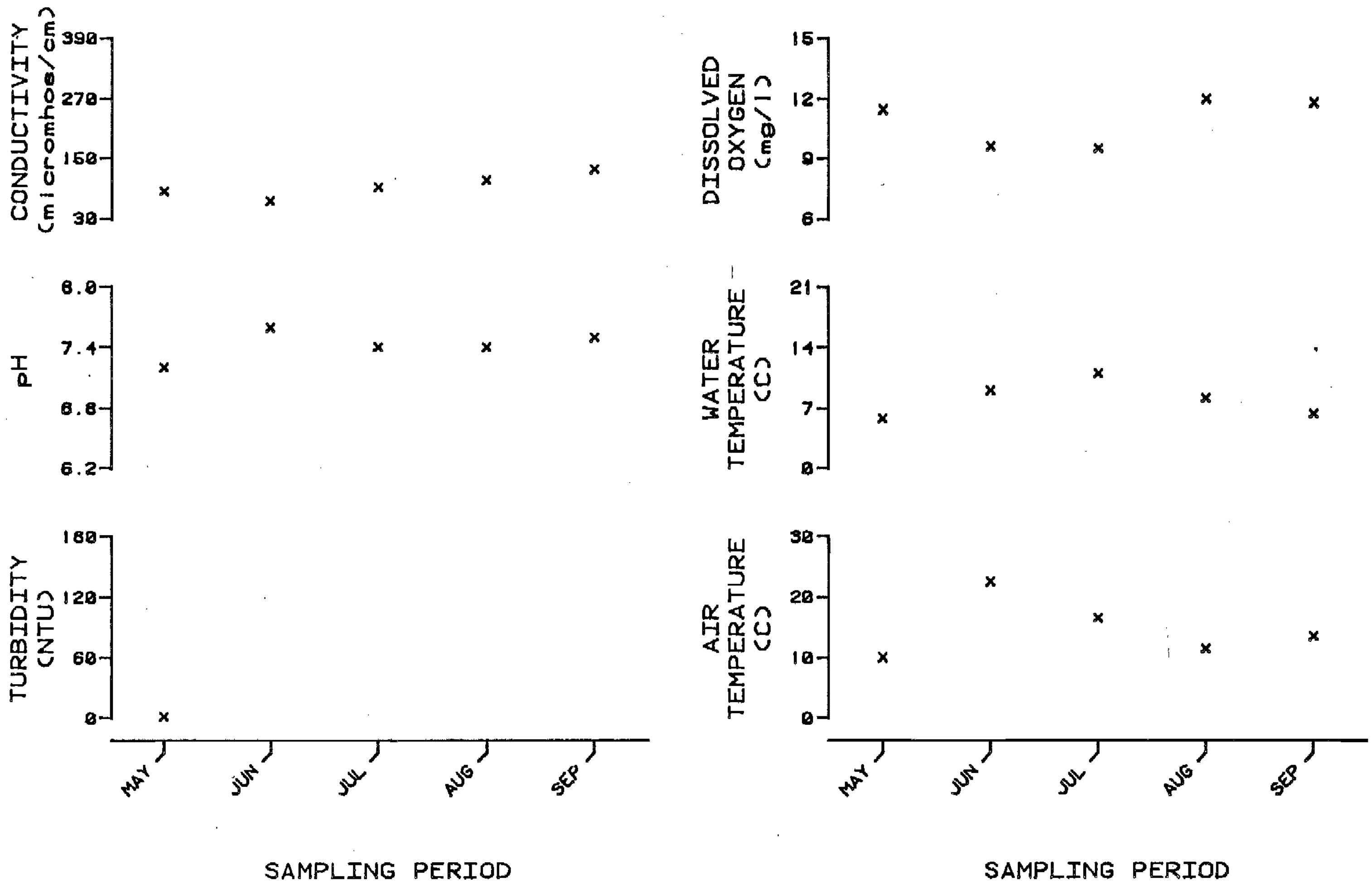


Figure E.5.89. Physiochemical parameters versus time (May-September, 1981)
for Oshetna River - Site 5
(R.M. 226.9, Geographic Code 29N11E03ACC)

Table E.5.4. Location and period of record for thermographs installed in Susitna River drainage. Summer 1981.

	LOCATION	R.M.	T.R.M.	PERIOD OF RECORD	GEOGRAPHIC CODES
1.	Alexander Creek	10.1	0.5	6/9-10/9	15N07W05CBC
2.	Above Alexander Creek	10.1		6/6-7/15	15N07W05CDB
3.	Yentna River	30.1	2.0	6/5-9/14	17N07W01CAB
4.	Above Yentna River	32.3		6/6-10/9	17N06W07CDB
5.	Deshka River	40.6	1.2	6/10-10/9	19N06W26CBB
6.	Above Deshka River	40.6		--*	19N06W35ACA
7.	Little Willow Creek	50.5	1.0	6/24-9/30	20N05W23CBC
8.	Above Little Willow Creek	50.5		6/24-9/29	20N05W27BAC
9.	Kashwitna River	61.0	0.2	--*	21N05W13AAA
10.	Above Kashwitna River	61.2		8/30-9/27	21N05W13ABA
11.	Montana Creek	77.2		6/12-9/30	23N04W07AAB
12.	Above Montana Creek	77.5		6/12-8/29	23N04W06CAA
13.	Sunshine (Park's Bridge)	83.8		6/2-7/14	24N05W15BAD
14.	Cache Creek Slough	95.5		--*	26N05W35ADC
15.	Talkeetna River	97.0	1.0	6/21-10/2	26N05W24BDA
16.	Chulitna River	98.0		6/20-10/6	26N05W15DAA
17.	Talkeetna Base Camp	103.0		6/20-10/7	27N05W26DDD
18.	Fourth of July Creek	131.3		--*	30N03W03DAC
19.	Above Fourth of July Creek	131.3		6/16-9/28	30N03W03DAB
20.	Gold Creek	136.8		7/24-8/15	31N02W20BAA
21.	Above Gold Creek	136.8		7/24-9/29	31N02W20BAA
22.	Indian River	138.7		7/18-9/29	31N02W09CDA
23.	Above Indian River	138.7		7/19-9/23	31N02W09DCB
24.	Slough 19 (Intragravel)	140.0		--*	31N11W10DBB
25.	Slough 19	140.0		8/27-9/15	31N11W10DBB
26.	Slough 21 (Intragravel)	142.0		8/27-9/29	31N11W02AAA
27.	Slough 21	142.0		8/29-9/29	31N11W02AAA
28.	Portage Creek	148.8		--*	32N01W25CAC
29.	Above Portage Creek	148.8		7/17-10/3	32N01W25CDA

* no data collected
R.M. = River Mile
T.R.M. = Tributary River Mile

LARGE MAP
"SUSITNA RIVER
DRAINAGE BASIN
Thermograph &
Staff Gage Locations
1981

CANNOT
BE SCANNED

Figure E.5.90.
Susitna River drainage.
Thermograph and staff
gage sites 1981.

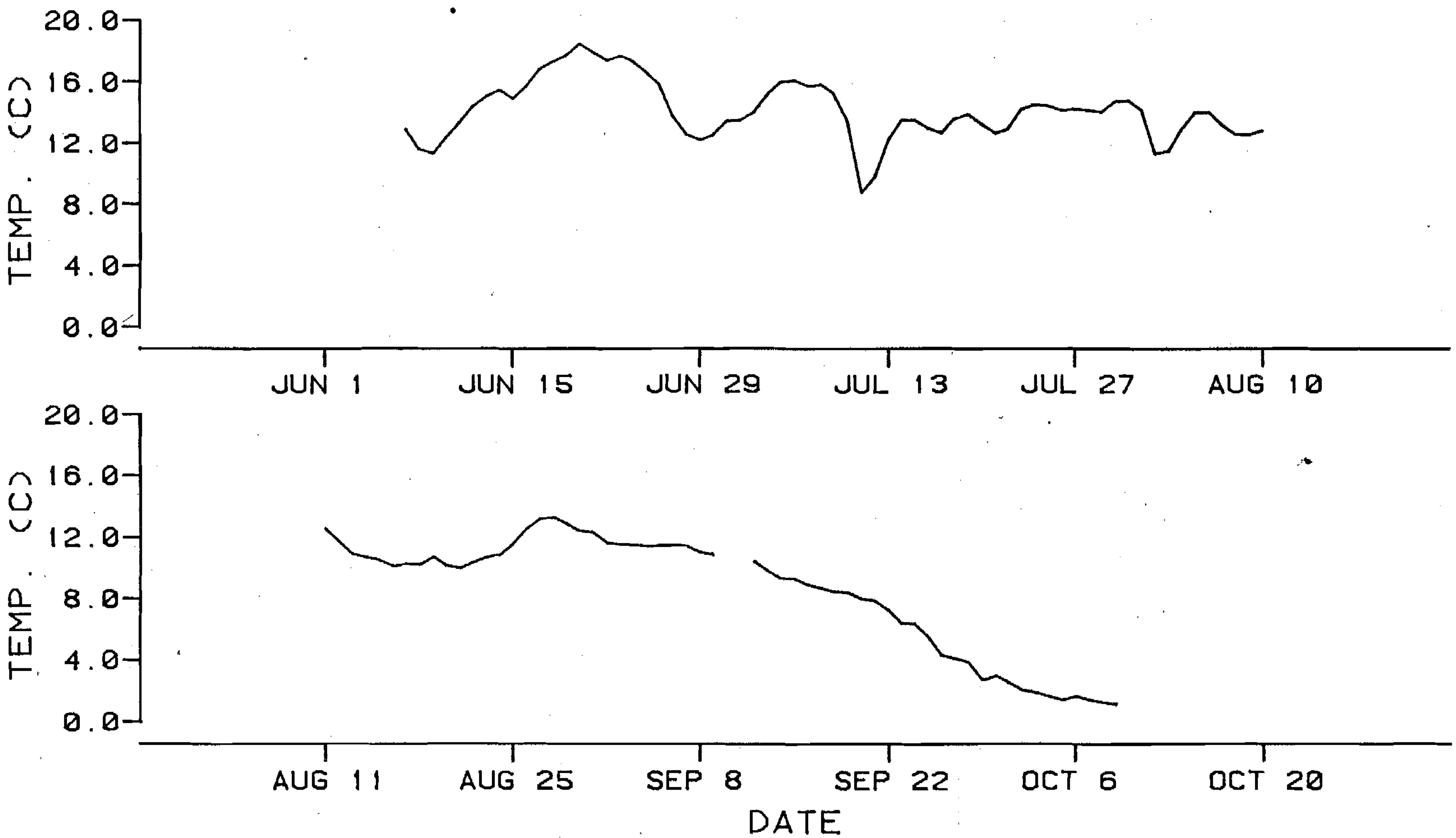


Figure E.5.91. Water temperature versus time for Alexander Creek (R.M. 10.1, 15N07W05CBC).

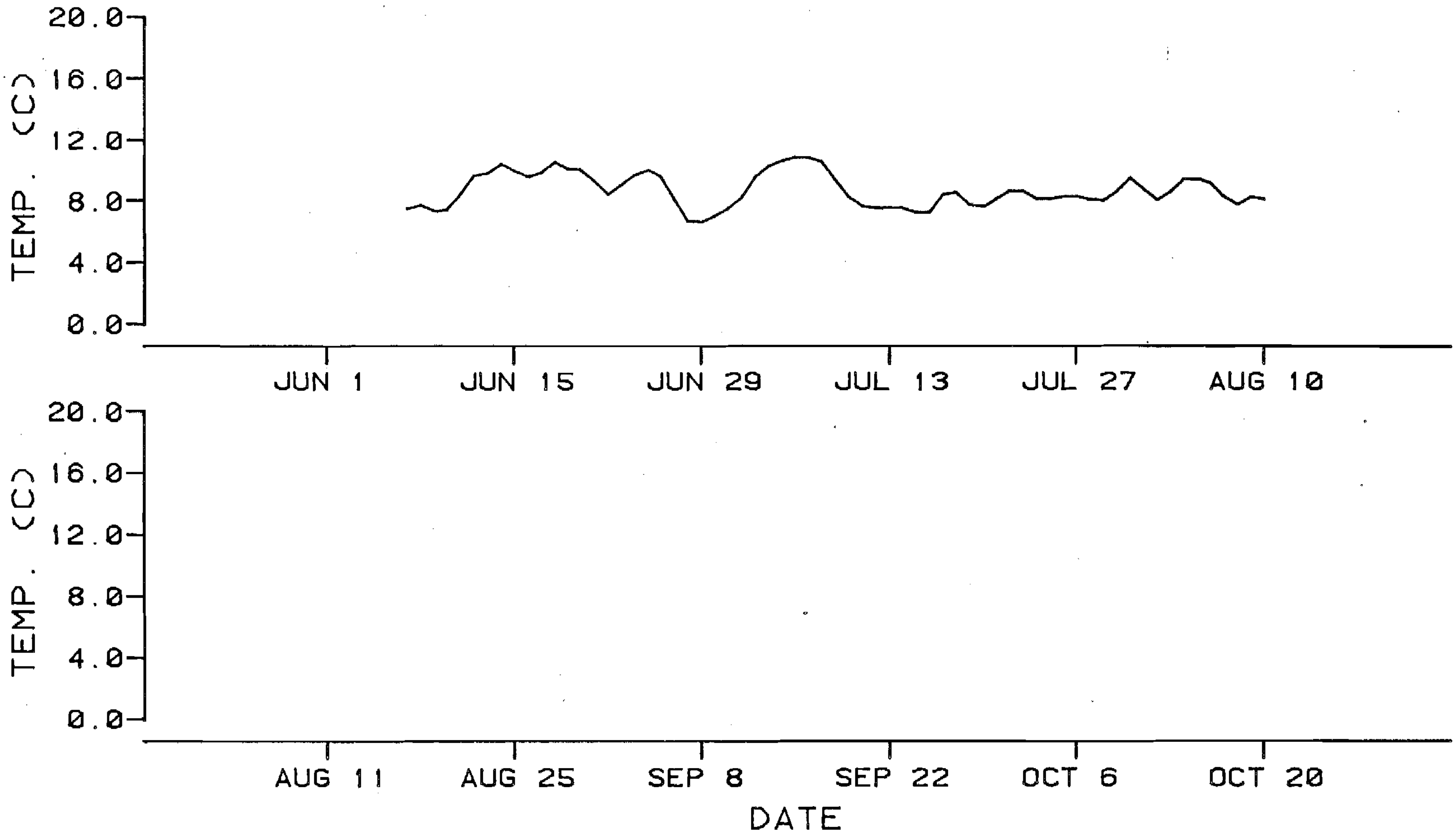


Figure E.5.92. Water temperatures versus time for the mainstem Susitna River above Alexander Creek (R.M. 10.1, 15N07W05CDB).

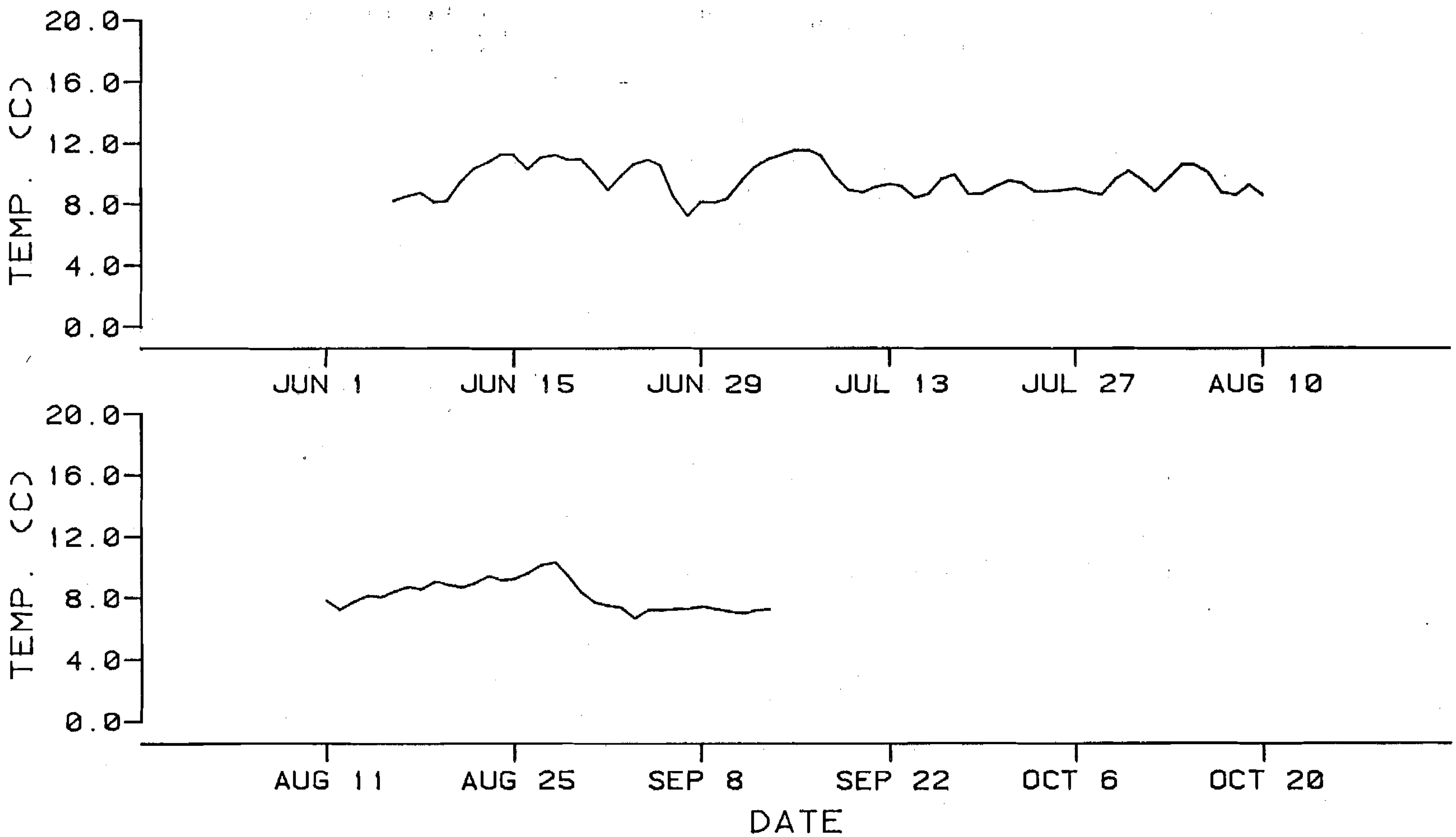


Figure E.5.93. Water Temperature versus time for the Yentna River (R.M. 30.1, 17N07W01CAB).

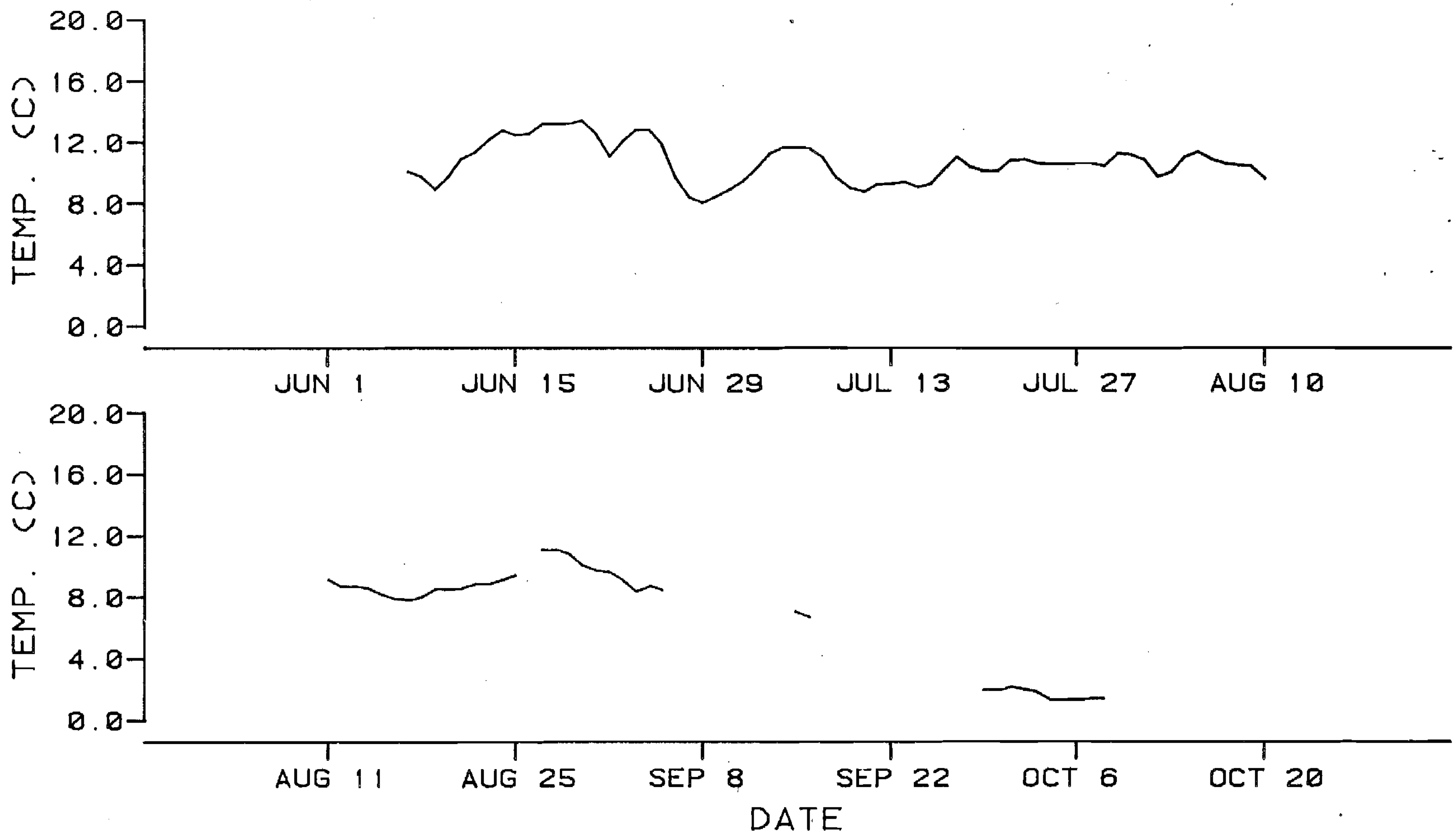


Figure E.5.94. Water temperature versus time for the mainstem Susitna River above the Yentna River (R.M. 32.3, 17N06W07CDB).

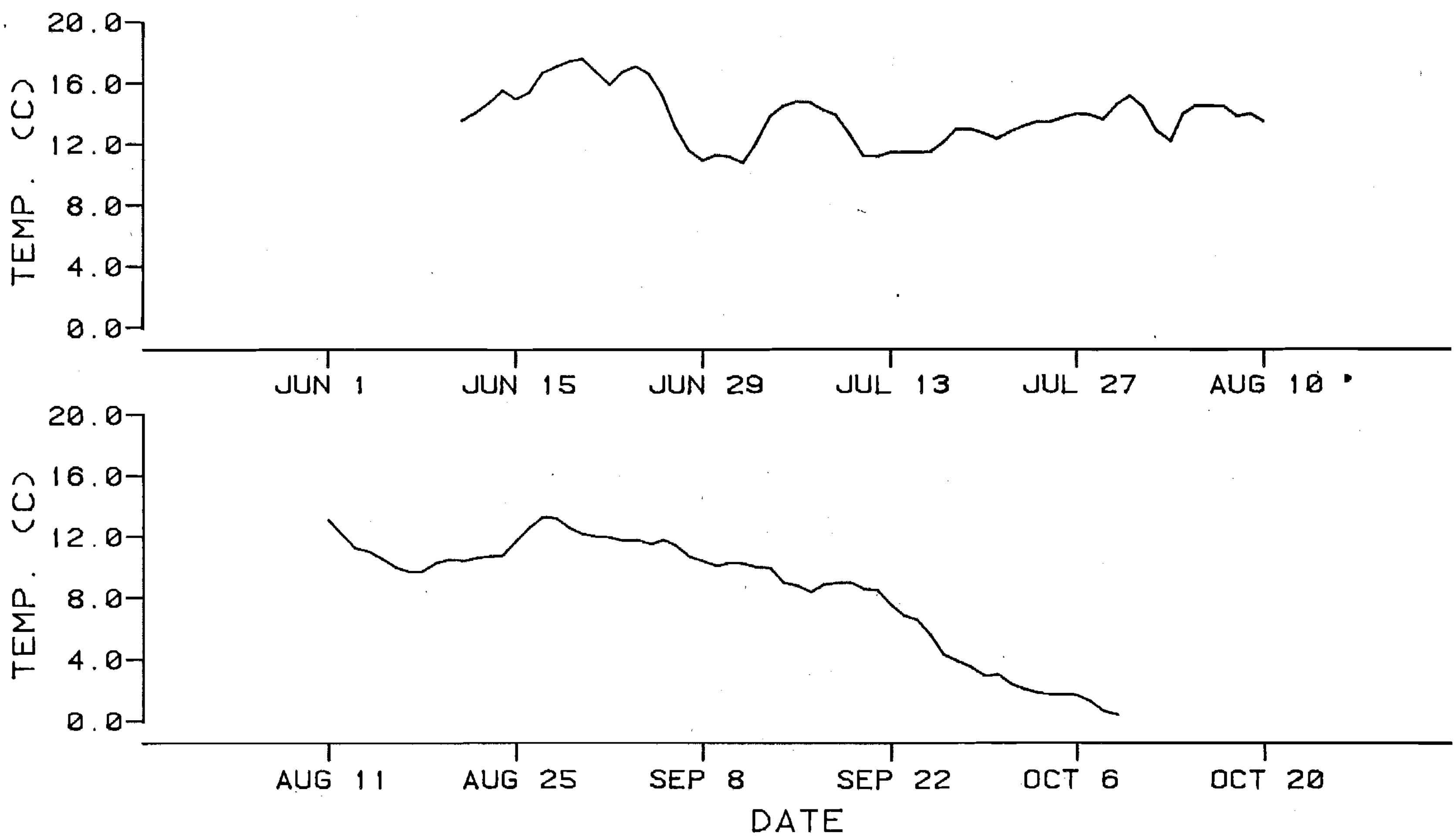


Figure E.5.95. Water temperature versus time for the Deshka River (R.M. 40.6, 19N06W26CBB).

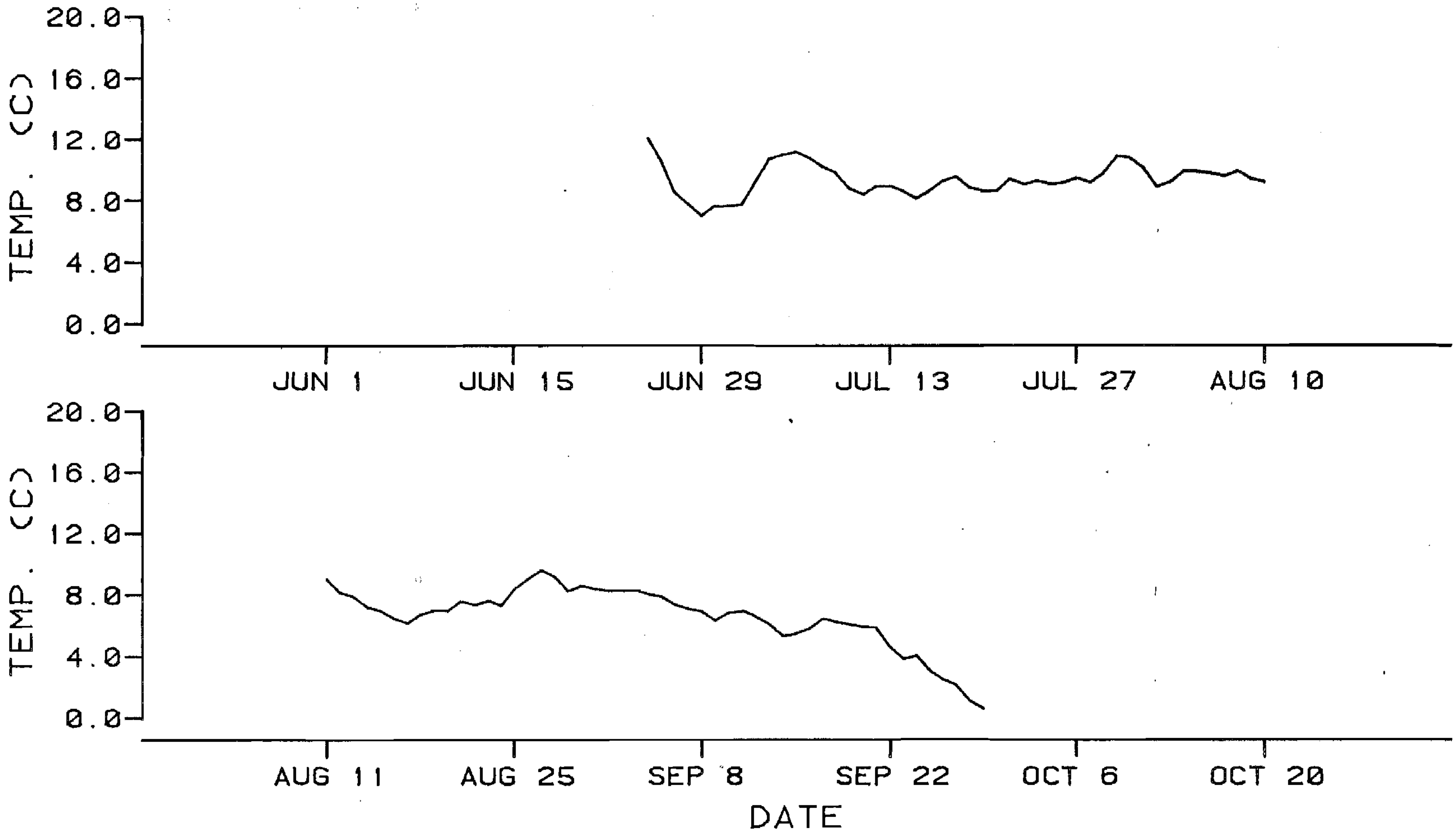


Figure E.5.96. Water temperature versus time for Little Willow Creek (R.M. 50.5, 20N05W23CBC).

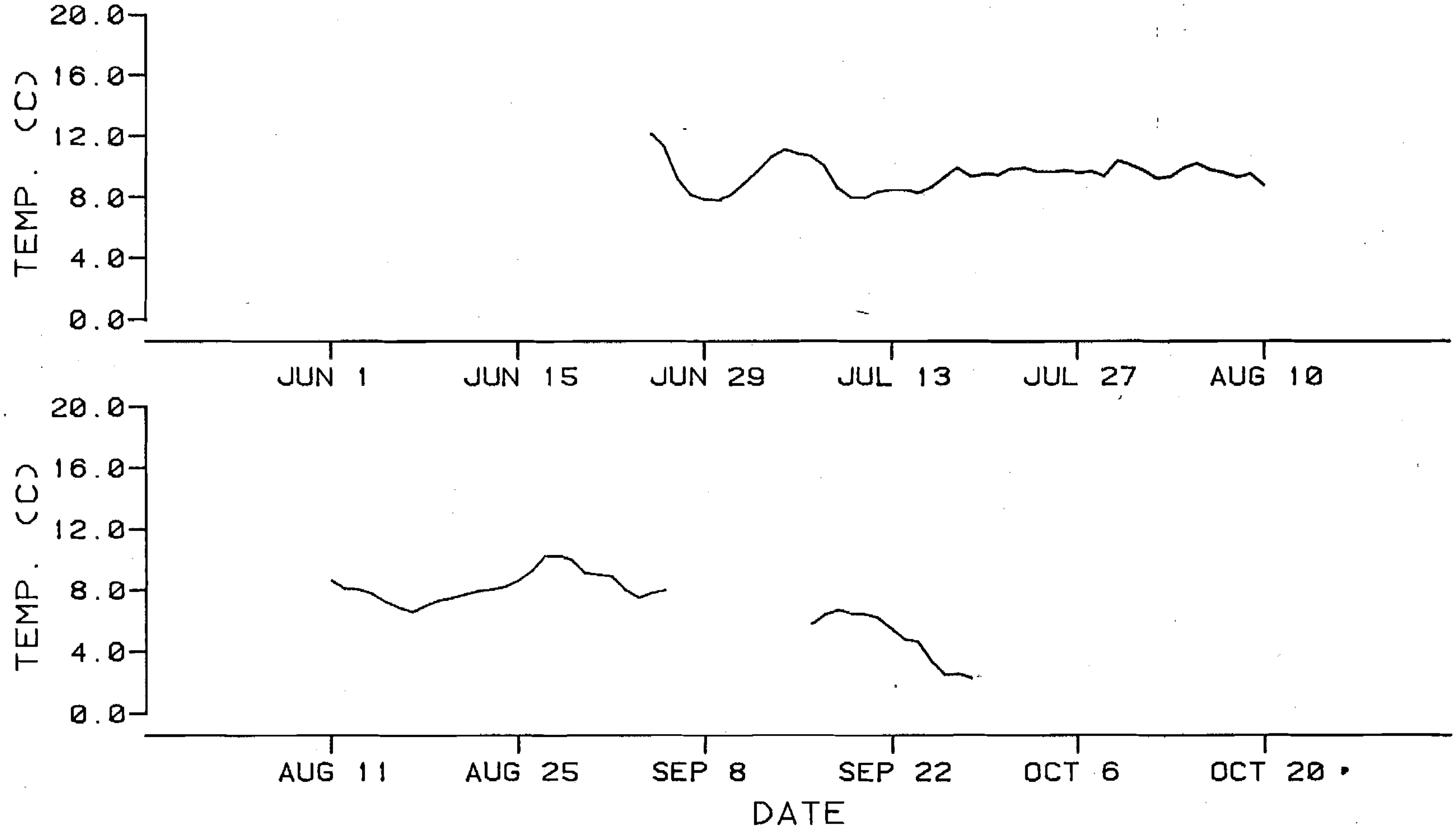


Figure E.5.97. Water temperature versus time for the mainstem Susitna River above Little Willow Creek (R.M. 50.5, 20N05W27BAC).

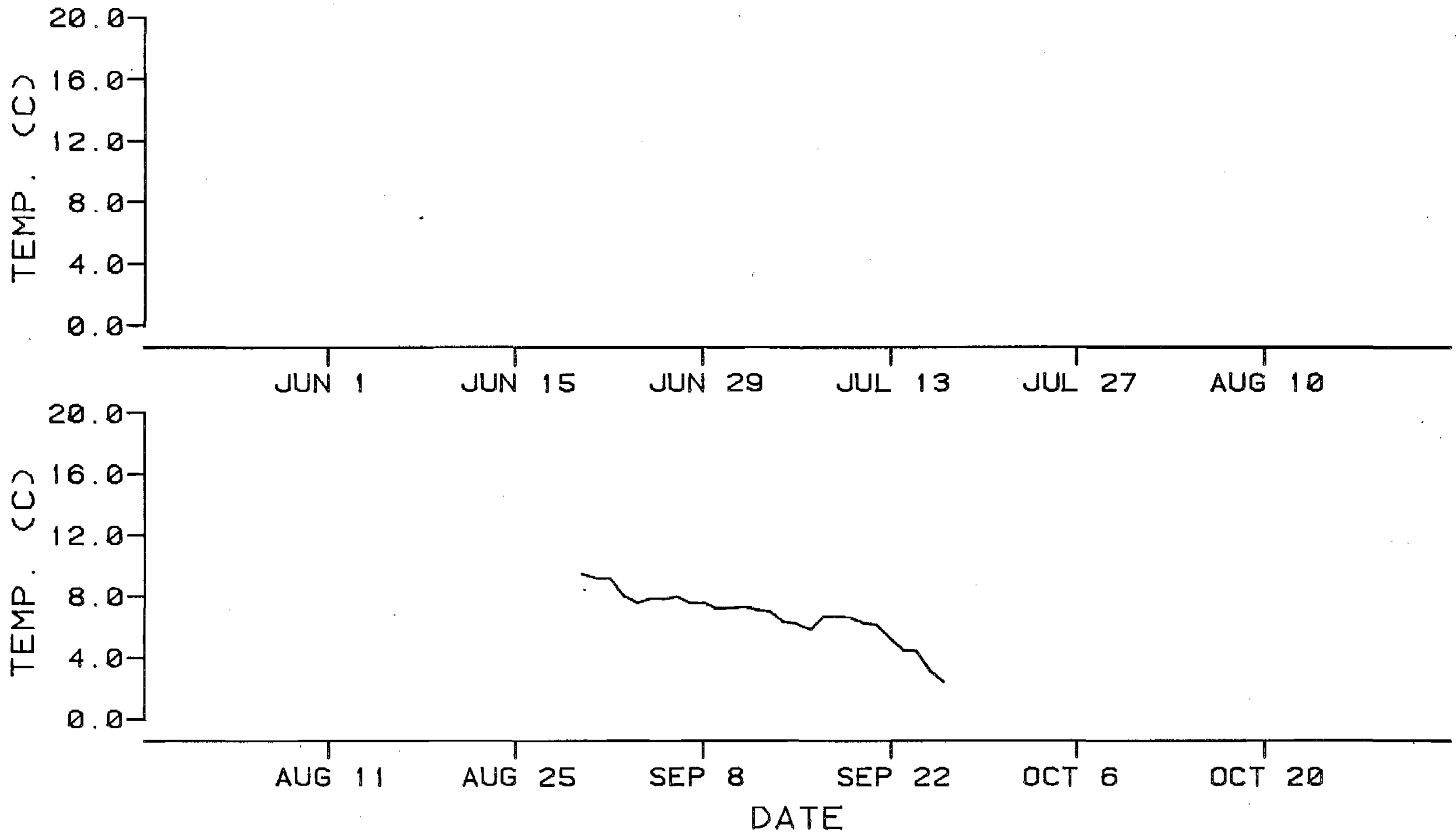


Figure E.5.98. Water temperature versus time for the mainstem Susitna River above Kashwitna River (R.M. 61.2, 21N05W13ABA).

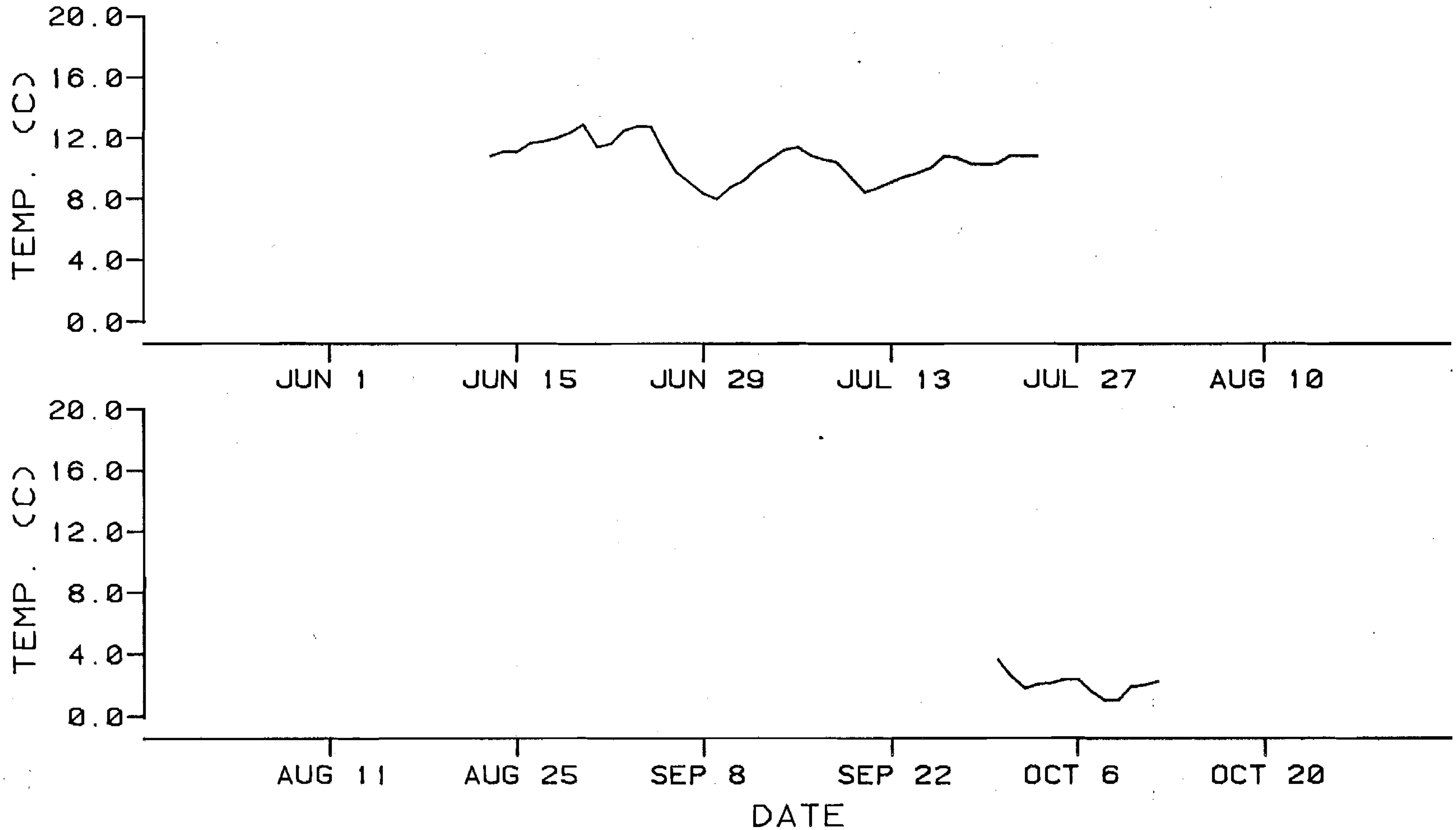


Figure E.5.99. Water temperature versus time for Montana Creek (R.M. 77.2, 23N04W07AAB).

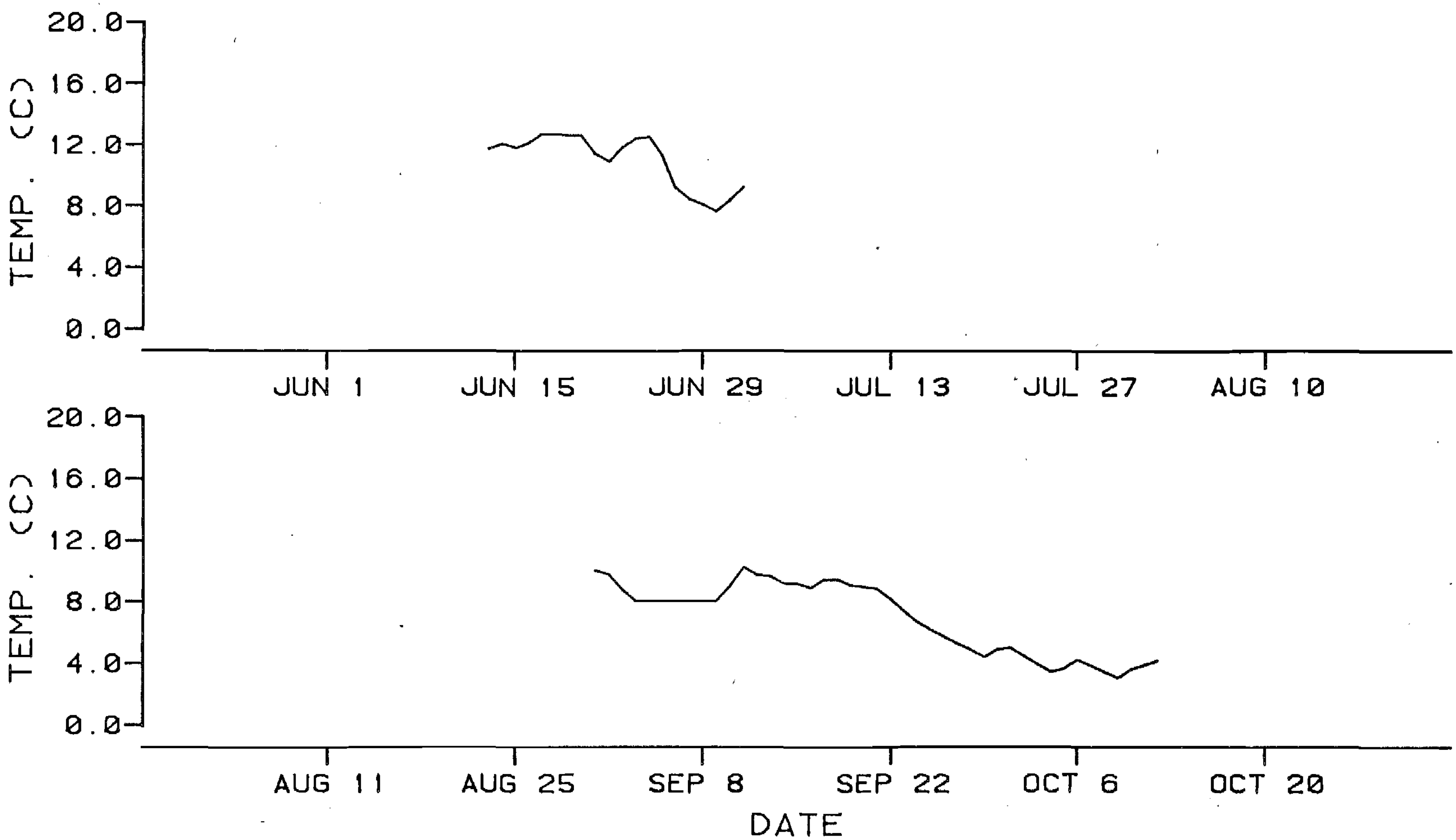


Figure E.5.100. Water temperature versus time for the mainstem Susitna River above Montana Creek (R.M. 77.5, 23N04W06CAA).

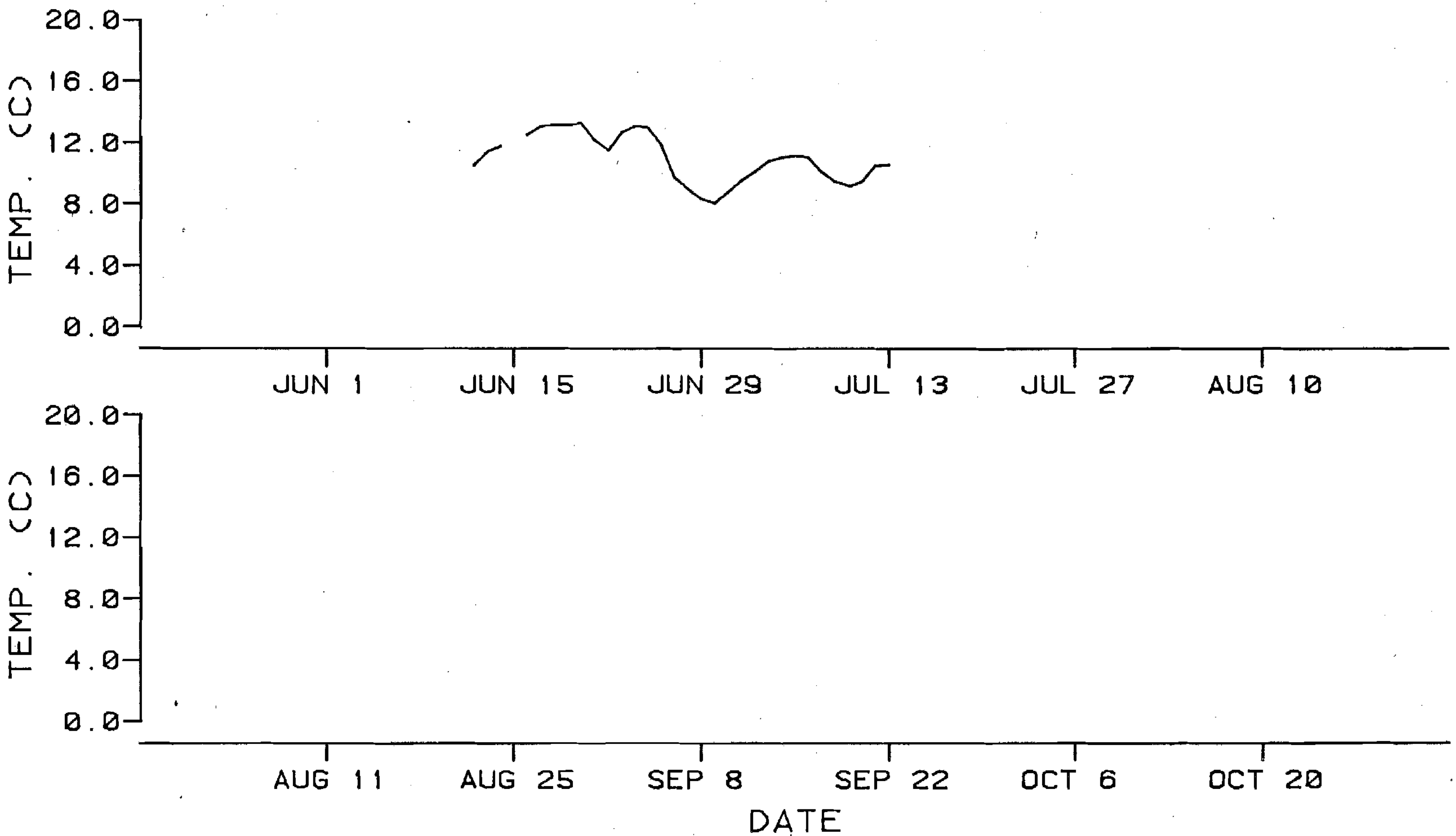


Figure E.5.101. Water temperature versus time for the mainstem Susitna River at the Parks Highway Bridge (R.M. 83.8, 24N05W15BAD).

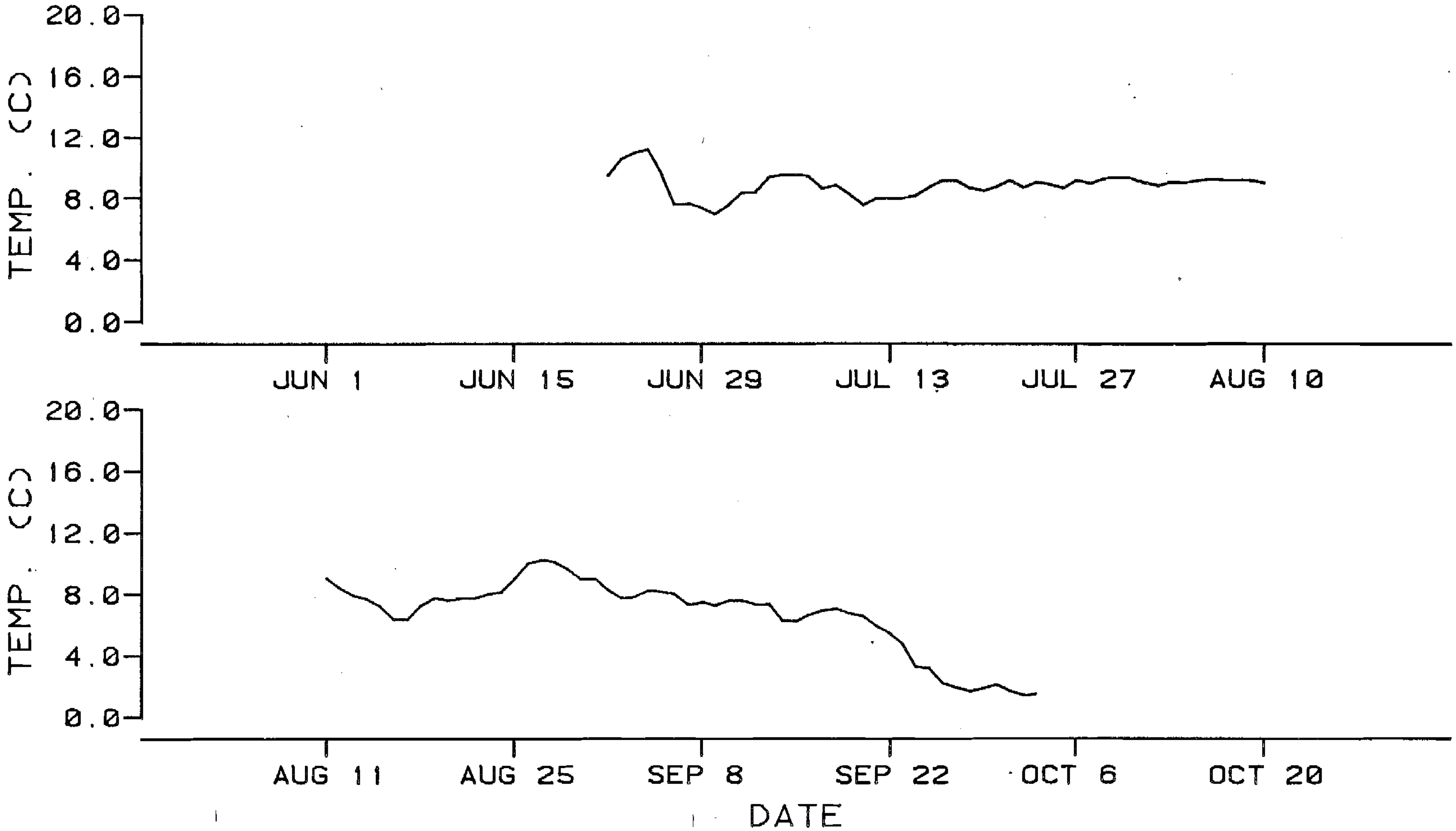


Figure E.5.102. Water temperature versus time for the Talkeetna River (R.M. 97.0, 26N05W24BDA).

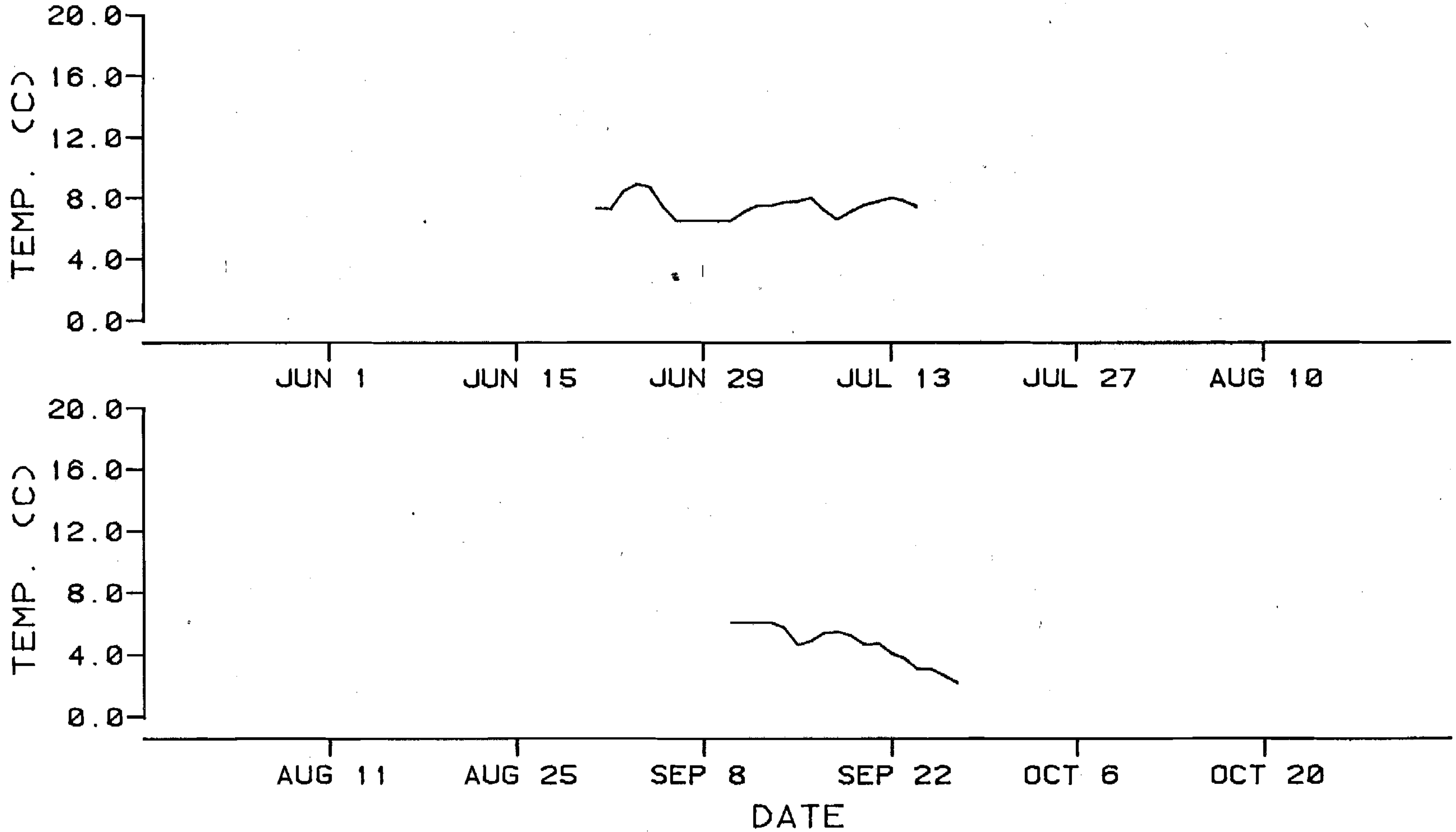


Figure E.5.103. Water temperature versus time for the Chulitna River (R.M. 98.0, 26N05W15DAA).

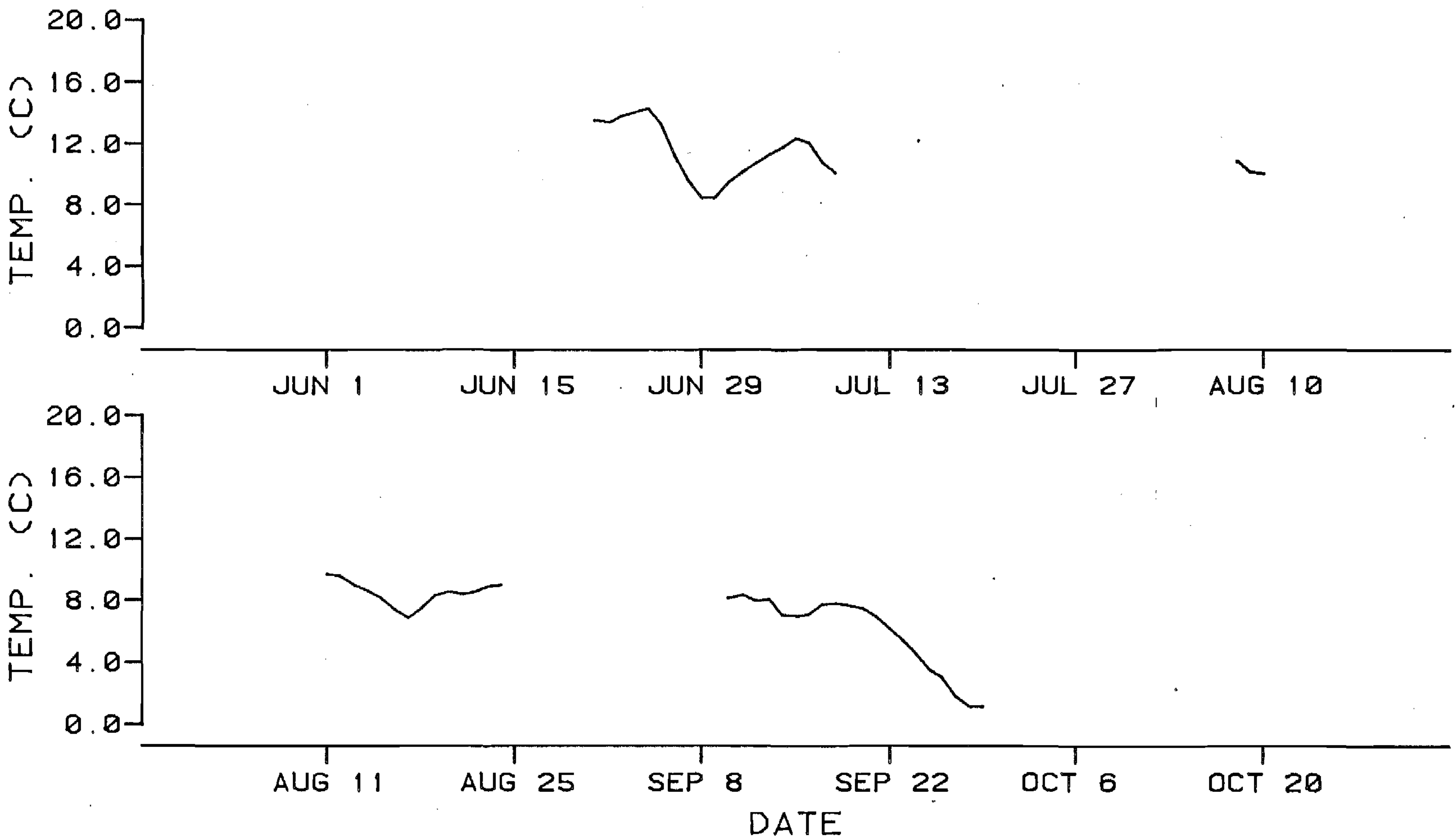


Figure E.5.104. Water temperature versus time for the mainstem Susitna River at the AA Talkeetna fishwheel camp (R.M. 103, 27N05W26DDD).

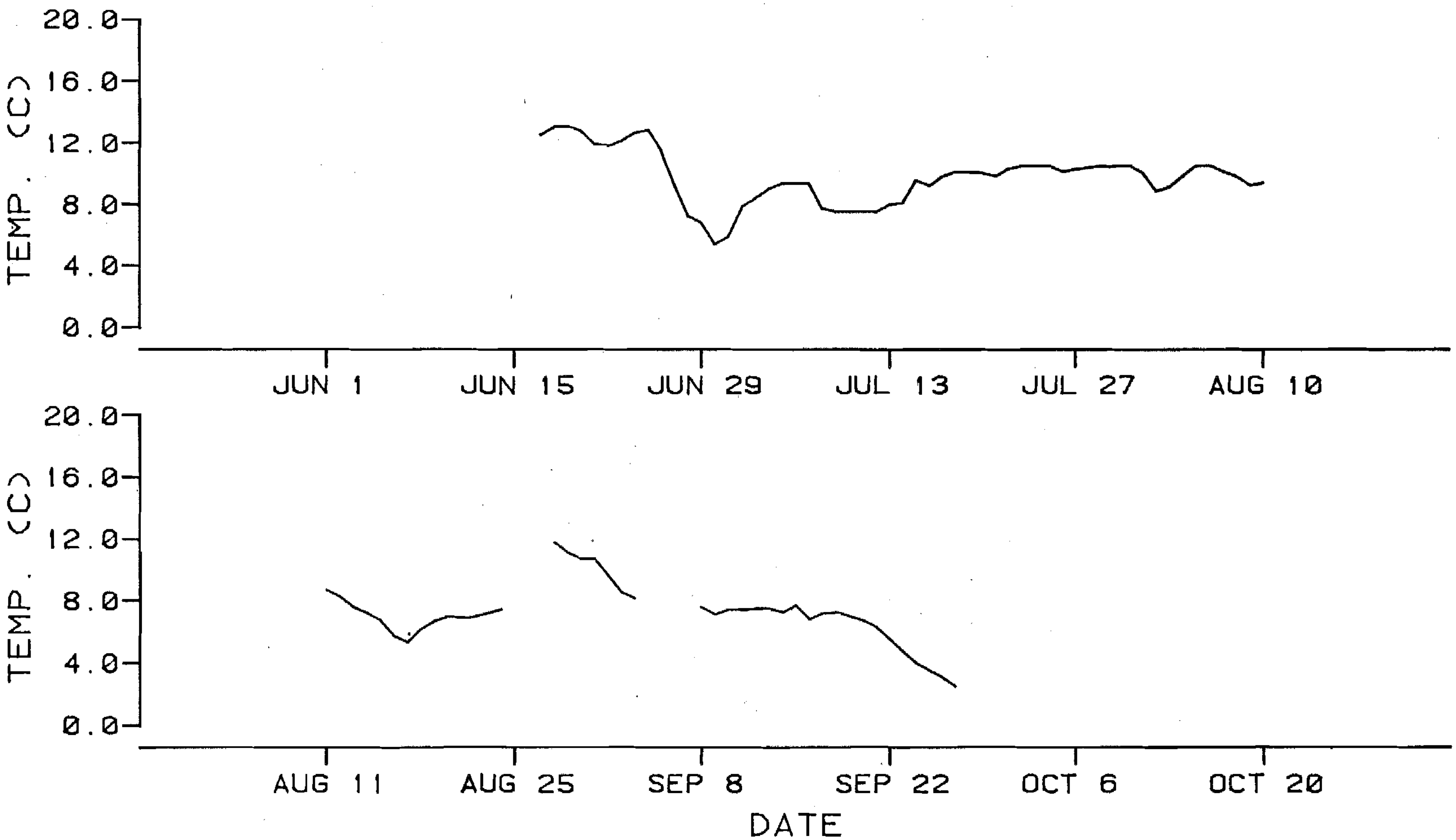


Figure E.5.105. Water temperature versus time for the mainstem Susitna River above Fourth of July Creek (R.M. 131.3, 30N03W03DAB).

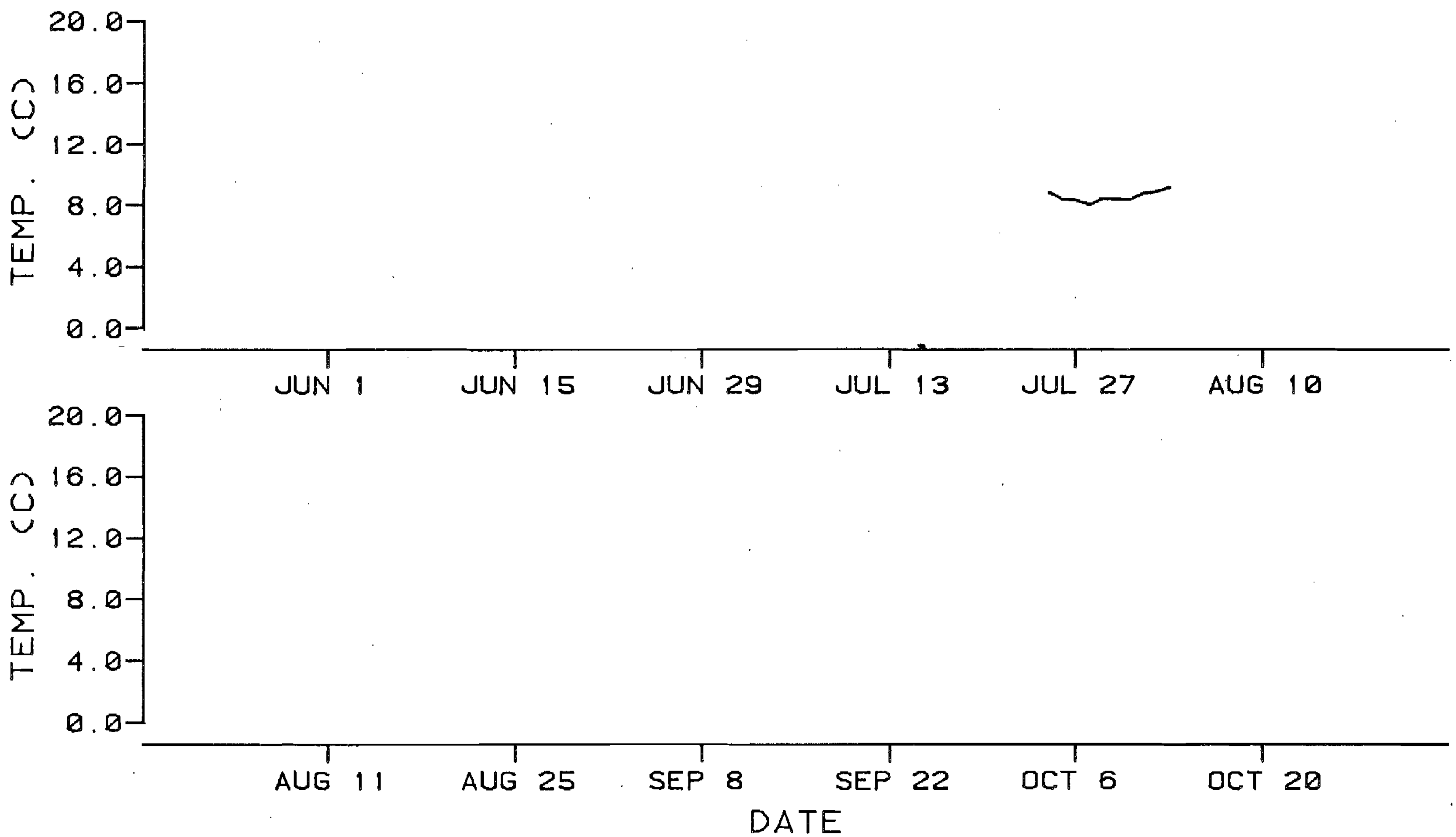


Figure E.5.106. Water temperature versus time for Gold Creek (R.M. 136.8, 31N02W20BAA).

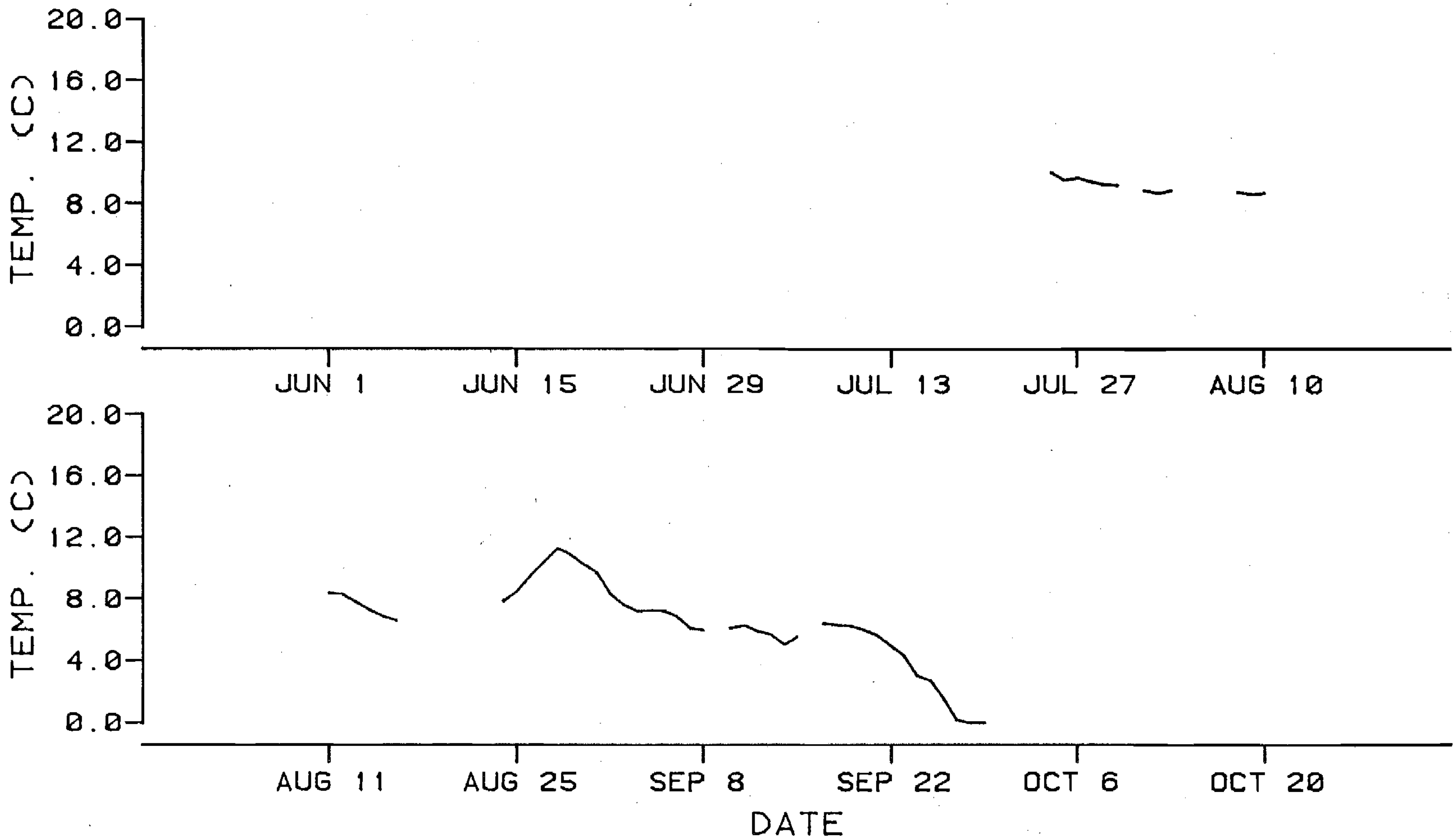


Figure E.5.107. Water temperature versus time for the mainstem Susitna River above Gold Creek (R.M. 136.8, 31N02W20BAA).

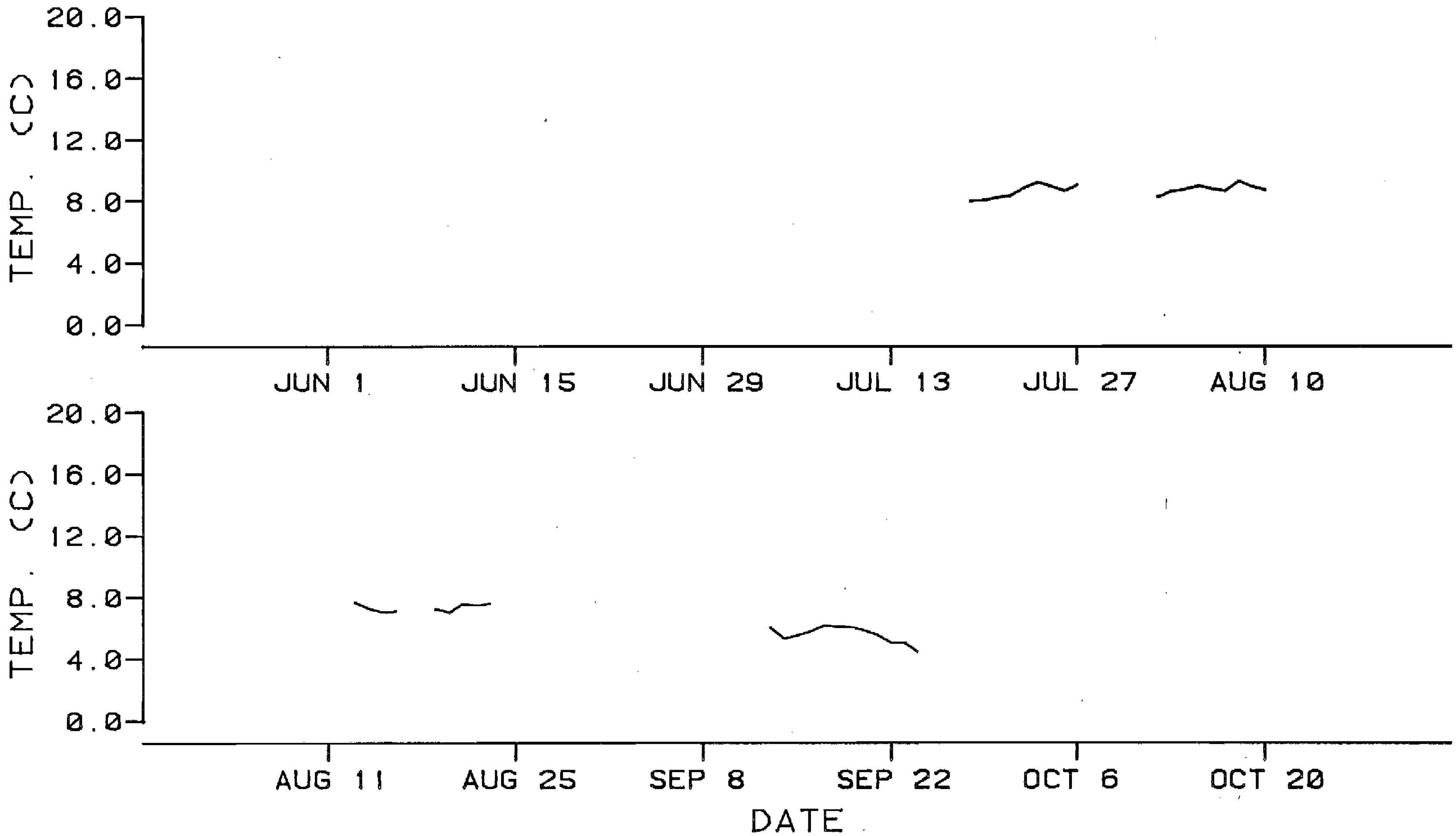


Figure E.5.108. Water temperature versus time for Indian River (R.M. 138.7, 31N02W09CDA).

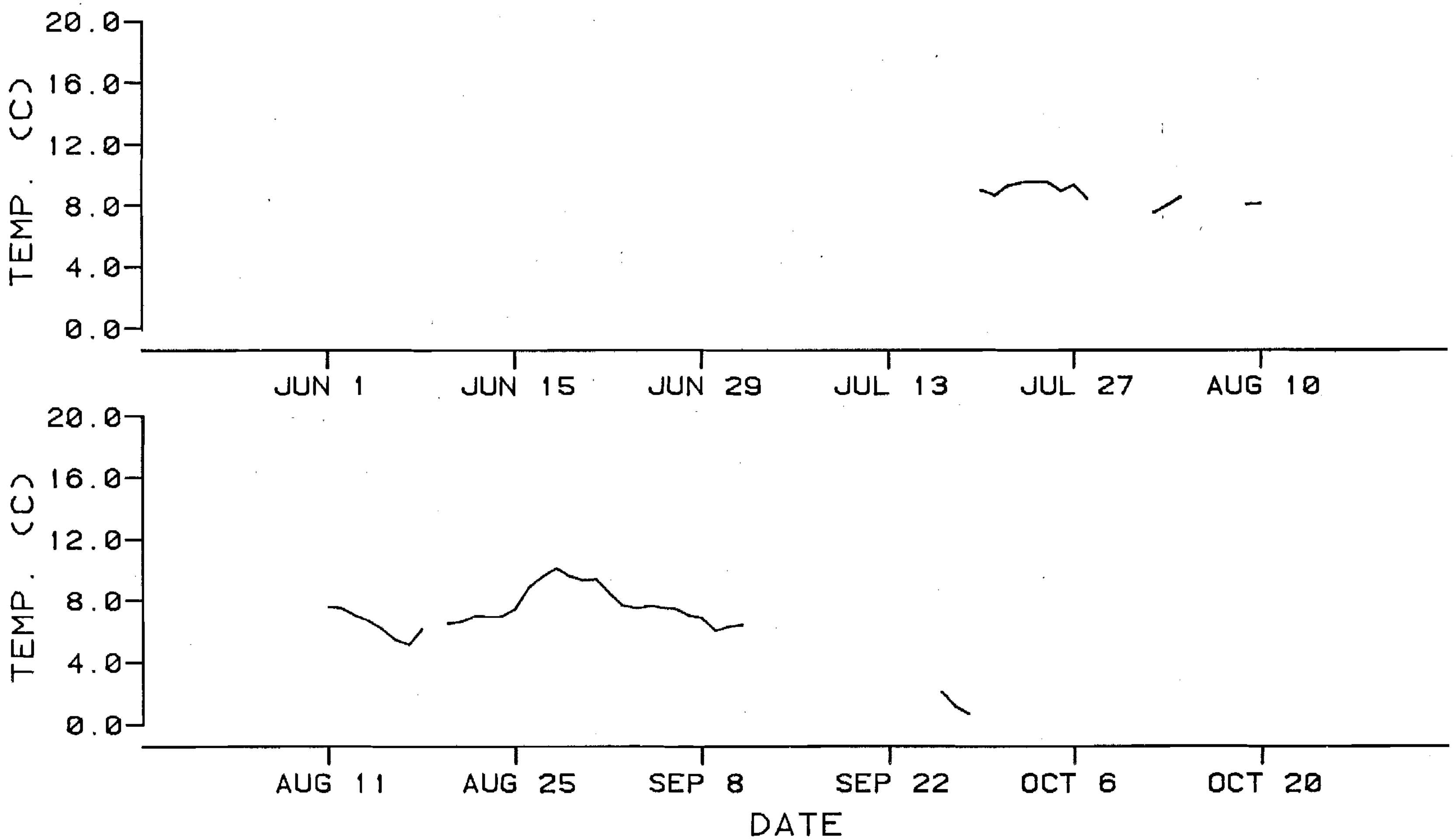


Figure E.5.109. Water temperature versus time for the mainstem Susitna River above Indian River (R.M. 138.7, 31N02W09DCB).

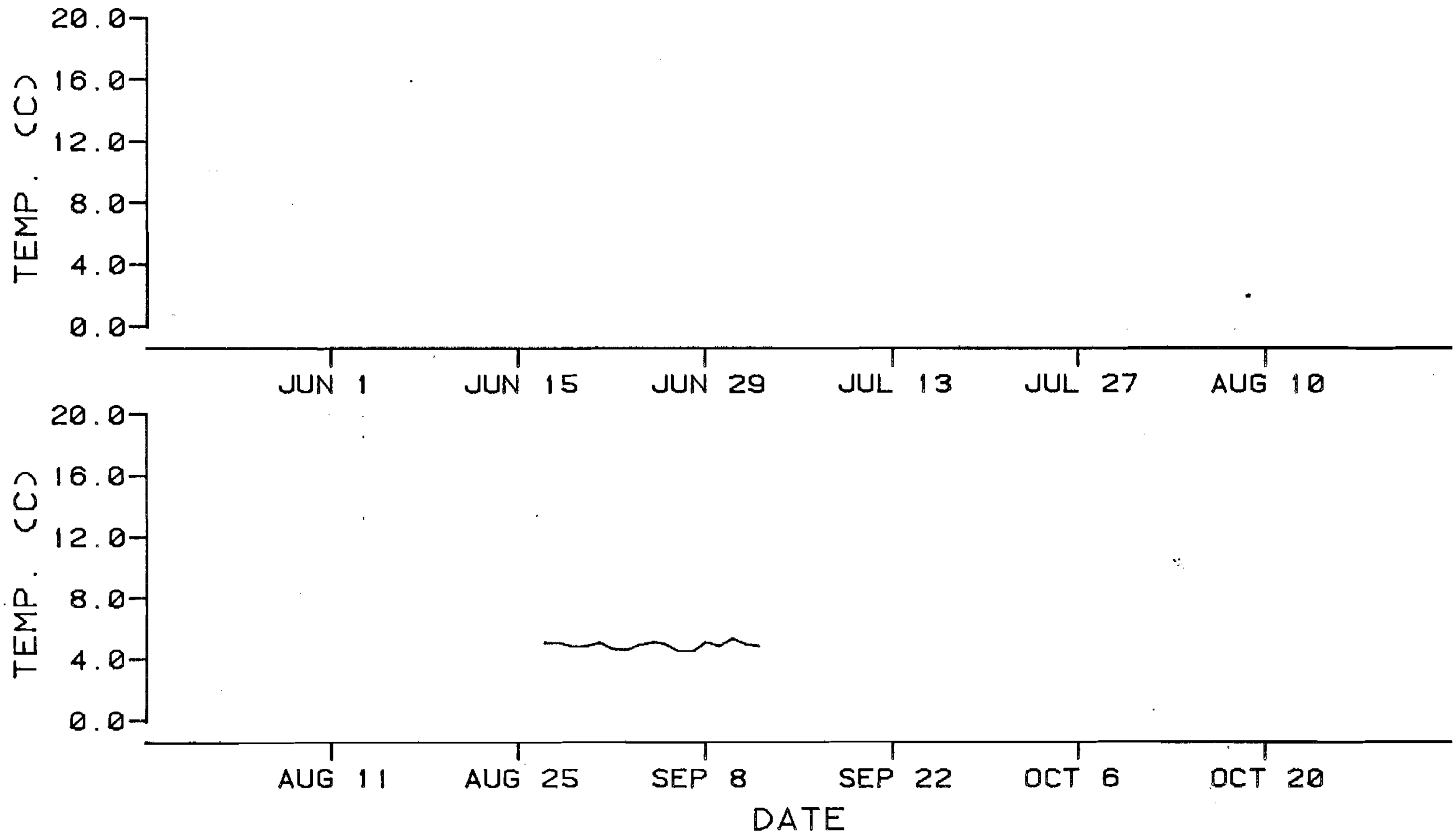


Figure E.5.110. Water temperature versus time for Slough 19 (R.M. 140.0, 31N11W10DBB).

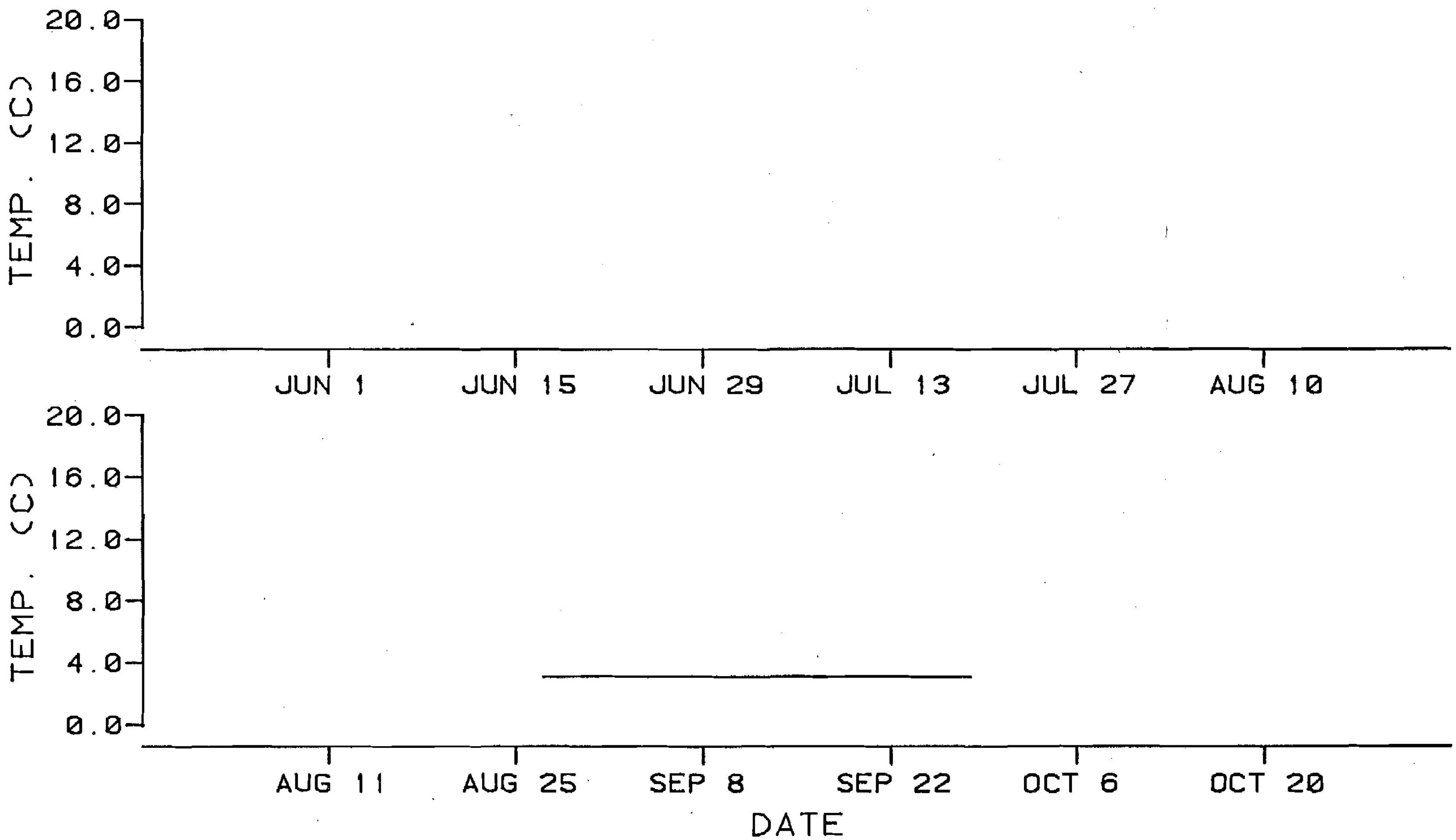


Figure E.5.111. Intergravel temperature versus time for Slough 21 (R.M. 142.0, 31N11W02AAA).

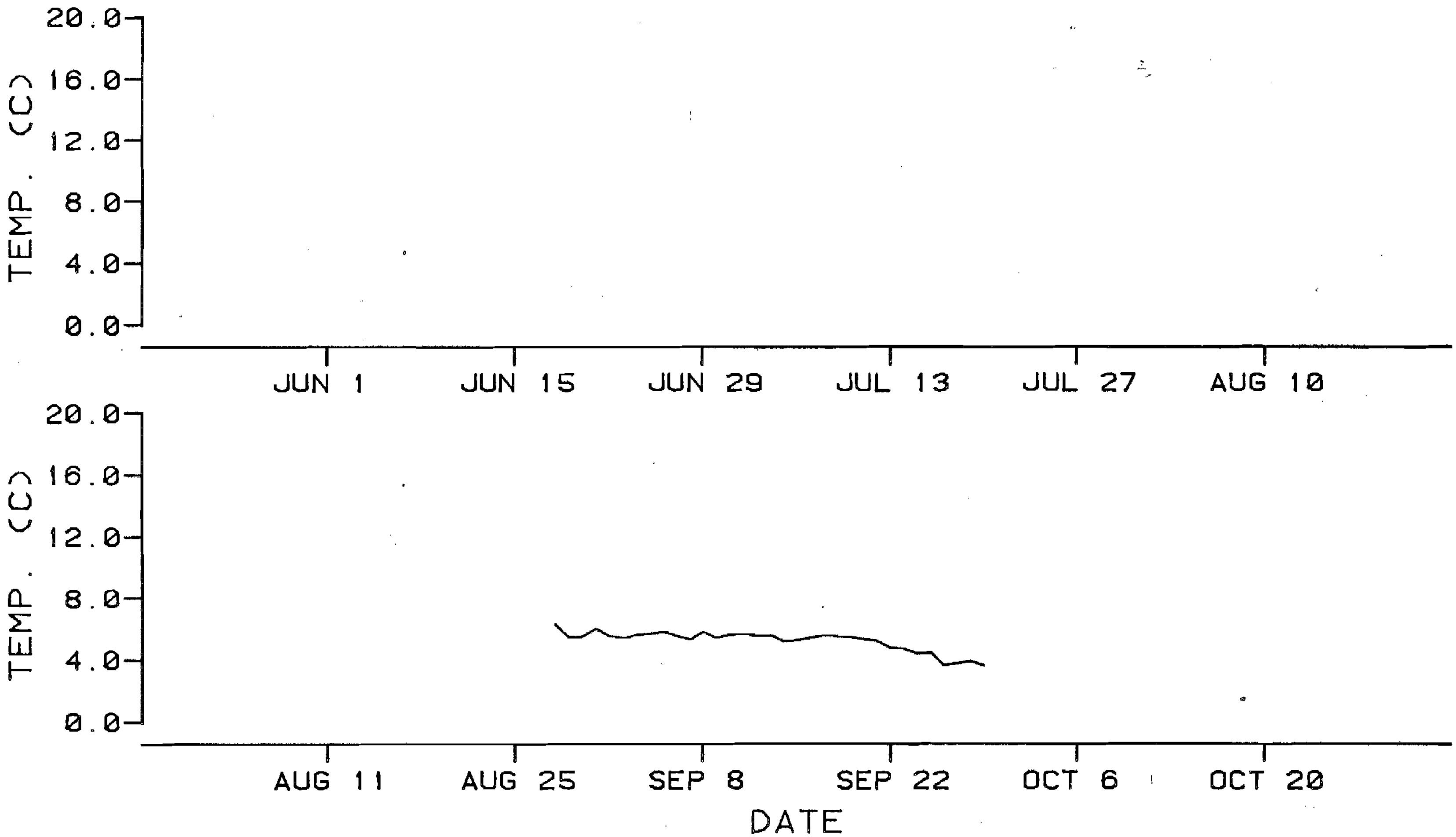


Figure E.5.112. Water temperature versus time for Slough 21 (R.M. 142.0, 31N11W02AAA).

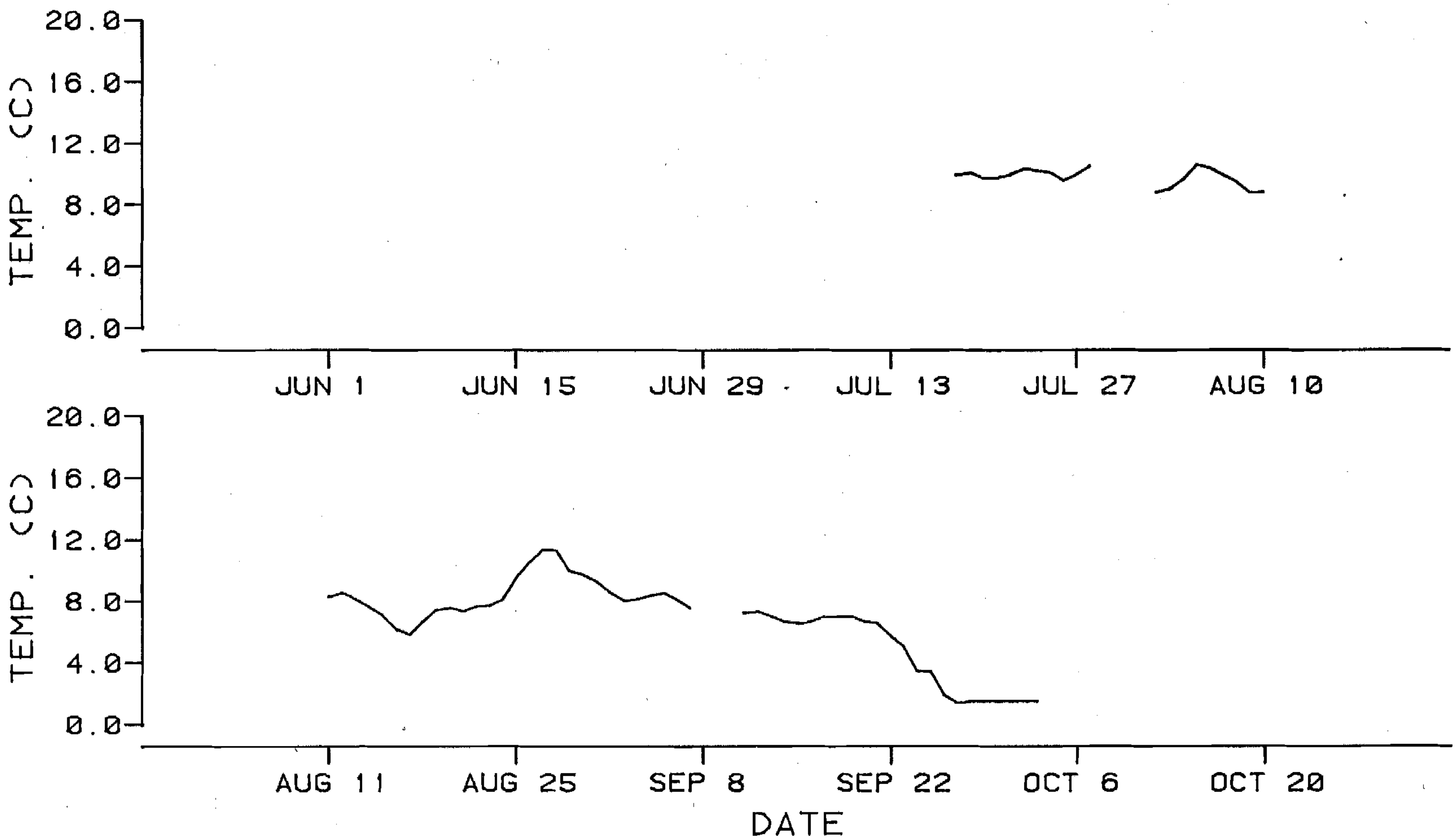


Figure E.5.113. Water temperature versus time for the mainstem Susitna River above Portage Creek (R.M. 148.8, 32N01W25CDA).

Table E.5.5. Location of staff gages installed in the Susitna River drainage. Summer 1981.

LOCATION	STAFF GAGE #	RIVER MILE	GEOGRAPHIC CODE
Fish Creek	YE011A	7.0	15N07W27AAC
Alexander Creek Site A	YE021B	10.1	15N07W06DCA
	YE021A		
Alexander Creek Site B	YE031A	10.1	16N07W32CCB
Alexander Creek Site C	YE041A	10.1	16N07W30ACD
	YE041B		
	YE042A		
Anderson Creek	YE051B	23.8	17N07W29DDD
	YE051A		
	YE052A		
Kroto Slough Mouth	YE061A	30.1	17N07W01DBC
	YE061B		
	YE061C		
	YE061D		
Mid-Kroto Slough	YE071A	36.3	18N06W16BBC
	YE071B		
	YE072A		
Mainstem Slough	YE081A	31.0	17N06W05CAB
	YE082A		
	YE083A		
	YE081B		
	YE082B		
	YE083A		
Deshka River Site A	YE091A	40.6	19N06W35BDA
	YE091B		
	YE092A		
	YE092B		
Deshka River Site B	YE101A	40.6	19N06W26BCB
	YE101B		
	YE101C		
	YE101D		
Deshka River Site C	YE111A	40.6	19N06W14BCA
	YE111B		
	YE112A		
Lower Delta Island	YE121A	44.0	19N05W19ACB
	YE122A	44.0	19N05W19ADC
	YE123A	45.0	19N05W17BCD
	YE124A	45.0	19N05W17BCB
Little Willow Creek	YE131A	50.5	29N05W27AAD
	YE132A	50.5	29N05W23CBC
	YE133A	50.5	29N05W27BAC
Rustic Wilderness	SU011A	58.1	21N05W25CBD
	SU011B		
	SU011C		
Kashwitna River	SU021A	61.0	21N05W13AAA
	SU022A		

Table E.5.5 (Continued)

LOCATION	STAFF GAGE #	RIVER MILE	GEOGRAPHIC CODE
Caswell Creek	SU031A	63.0	21N04W06BDD
	SU031B		
	SU031C		
Slough West Bank	SU041A	65.6	22N05W27ADC
	SU041B		
	SU041C		
Sheep Creek Slough	SU051A	66.1	22N04W30BAB
	SU051B		
Goose Creek (Lower) 1	SU061A	72.0	23N04W31BBC
	SU061B		
Goose Creek (Lower) 2	SU071A	73.1	23N04W30BBB
	SU072A		
	SU073A		
	SU072B		
	SU073B		
	SU073C		
Mainstem West Bank	SU081A	74.4	23N05W13BCC
	SU081B		
	SU081C		
Montana Creek	SU091A	77.0	23N04W07ABA
	SU092A		
	SU093A		
Rabideux Creek	SU101A	83.1	23N05W16DDA
Mainstem 1	TA011A	84.0	24N05W10DCC
	TA011B		
Sunshine Creek	TA021A	85.7	24N05W14AAB
	TA021B		
Birch Creek Slough	TA031A	88.4	25N05W25DCC
	TA031B		
Birch Creek	TA041A	89.2	25N05W25ABD
	TA041B		
Cache Creek Slough	TA051A	95.5	26N05W35ADC
	TA051B		
Whiskers Creek Slough	TA071A	101.2	26N05W03ADB
	TA071B		
	TA072A		
Whiskers Creek	TA081A	101.4	26N05W03AAC
	TA081B		
Slough 6A	TA091A	112.3	28N05W13CAC
	TA091B		
	TA092A		
Lane Creek	TA101A	113.6	28N05W12ADD
	TA102A		
	TA103A		
	TA103B		
	TA103C		
	TA104A		
Mainstem 2	TA111A	114.4	28N04W06CAB
	TA111B		

Table E.5.5 (Continued)

LOCATION	STAFF GAGE #	RIVER MILE	GEOGRAPHIC CODE
Mainstem Susitna - Curry	GC011A	120.7	29N04W10BCD
	GC011B		
Susitna Side Channel	GC021A	121.6	29N04W11BBB
	GC021B		
Mainstem Susitna - Gravel Bar	GC031A	123.8	30N04W26DDD
	GC031B		
	GC031C		
Slough 8A	GC041A	125.3	30N03W30BCD
	GC042A		
Fourth of July Creek	GC051A	131.1	30N03W03DAC
	GC051B		
	GC052A		
	GC052B		
Slough 10	GC061A	133.8	31N03W36AAC
	GC061B		
	GC061C		
	GC061D		
Slough 11	GC071A	135.3	31N02W19DDD
	GC072A		
	GC071B		
Mainstem Susitna - Inside Bend	GC081A	136.9	31N02W17CDA
	GC081B		
	GC081C		
Indian River	GC091A	138.6	31N02W09CDA
	GC091B		
	GC091C		
	GC091D		
	GC092A		
	GC092B		
	GC092C		
	GC092D		
Slough 20	GC101A	140.1	31N02W11BBC
	GC101B		
	GC101C		
	GC102A		
	GC102B		
Mainstem Susitna - Island	GC111A	146.9	32N10W27DBC
	GC112A		
	GC112B		
	GC112C		
	GC112D		
Portage Creek	GC121A	148.8	32N01W25CDB
	GC121B		
	GC121C		
	GC121D		
	GC121E		
	GC122A		
	GC122B		
	GC122C		
	GC123A		

Table E.5.5 (Continued)

LOCATION	STAFF GAGE #	RIVER MILE	GEOGRAPHIC CODE
Sunshine Base Camp			
Fishwheel EB 1	SB011A	79.0	24N05W36BDC
	SB012A		
	SB012B		
Fishwheel EB 2	SB021A	81.0	24N05W25BAD
Fishwheel WB 2	SB031A	81.0	24N05W26BAA
Fishwheel WB 3	SB041A	81.0	24N05W23CCA
Talkeetna Base Camp			
East Bank Sonar	TB011A	101.0	27N05W26DDA
Upper East Fishwheel	TB021A	101.0	27N05W26DDD
Upper West Fishwheel	TB031A	101.0	27N05W26DAC
Lower East Fishwheel	TB041A	101.0	27N05W35AAA
Lower West Fishwheel	TB051A	101.0	27N05W35AAB
West Bank Sonar	TB061A	101.0	27N05W26DDB
Curry Base			
In Front of Camp	CB011A	120.0	27N04W16DBA
	CB011B		
	CB011C		
	CB011D		
Lower East Fishwheel	CB021A	120.0	29N04W16DBD
	CB021B		
West Bank Fishwheel	CB031A	120.0	29N04W10BCC

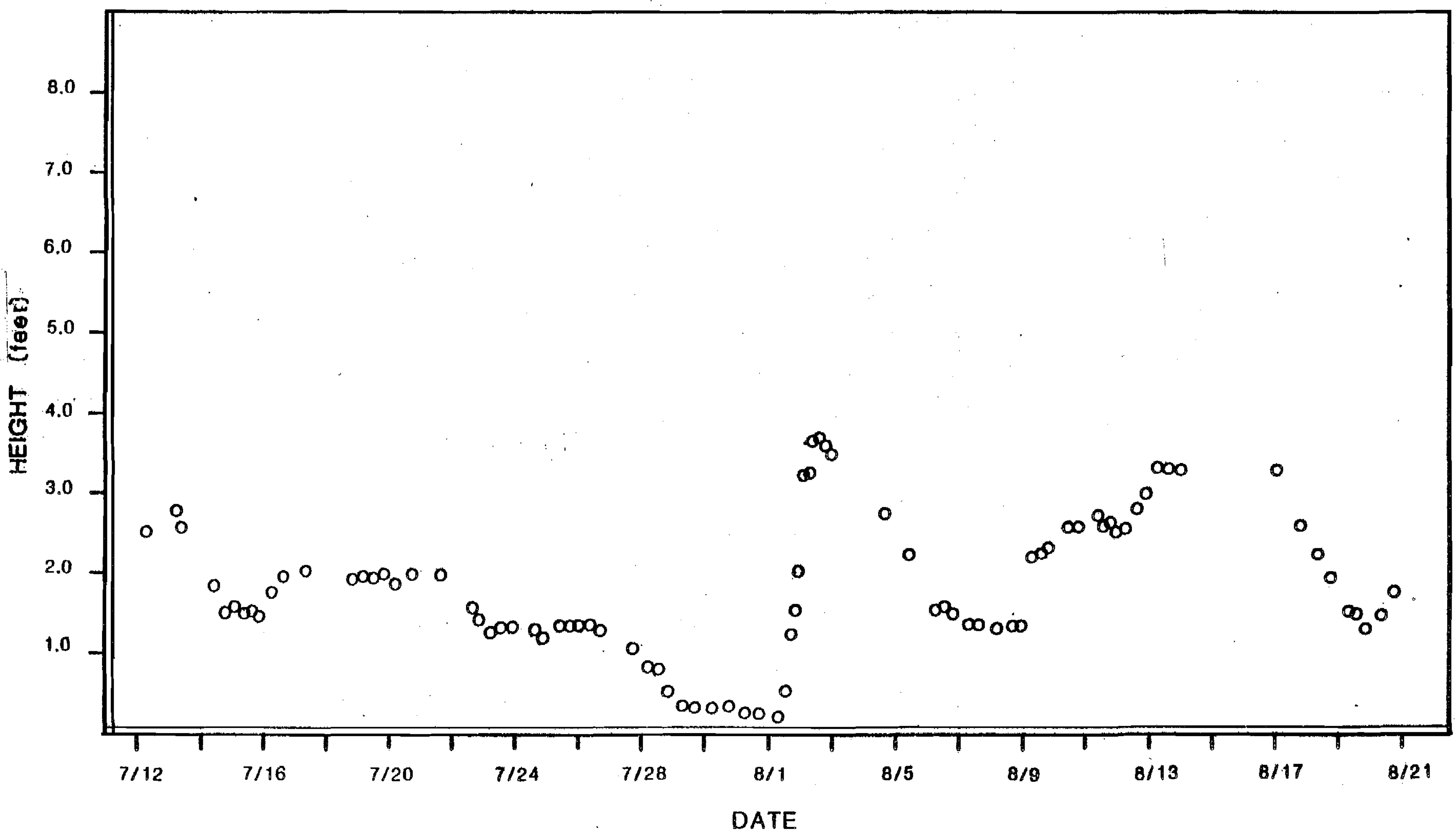


Figure E.5.114. Stage versus time for the AA Sunshine fishwheel and sonar site (RM 79.0, 24N05W36BDC).

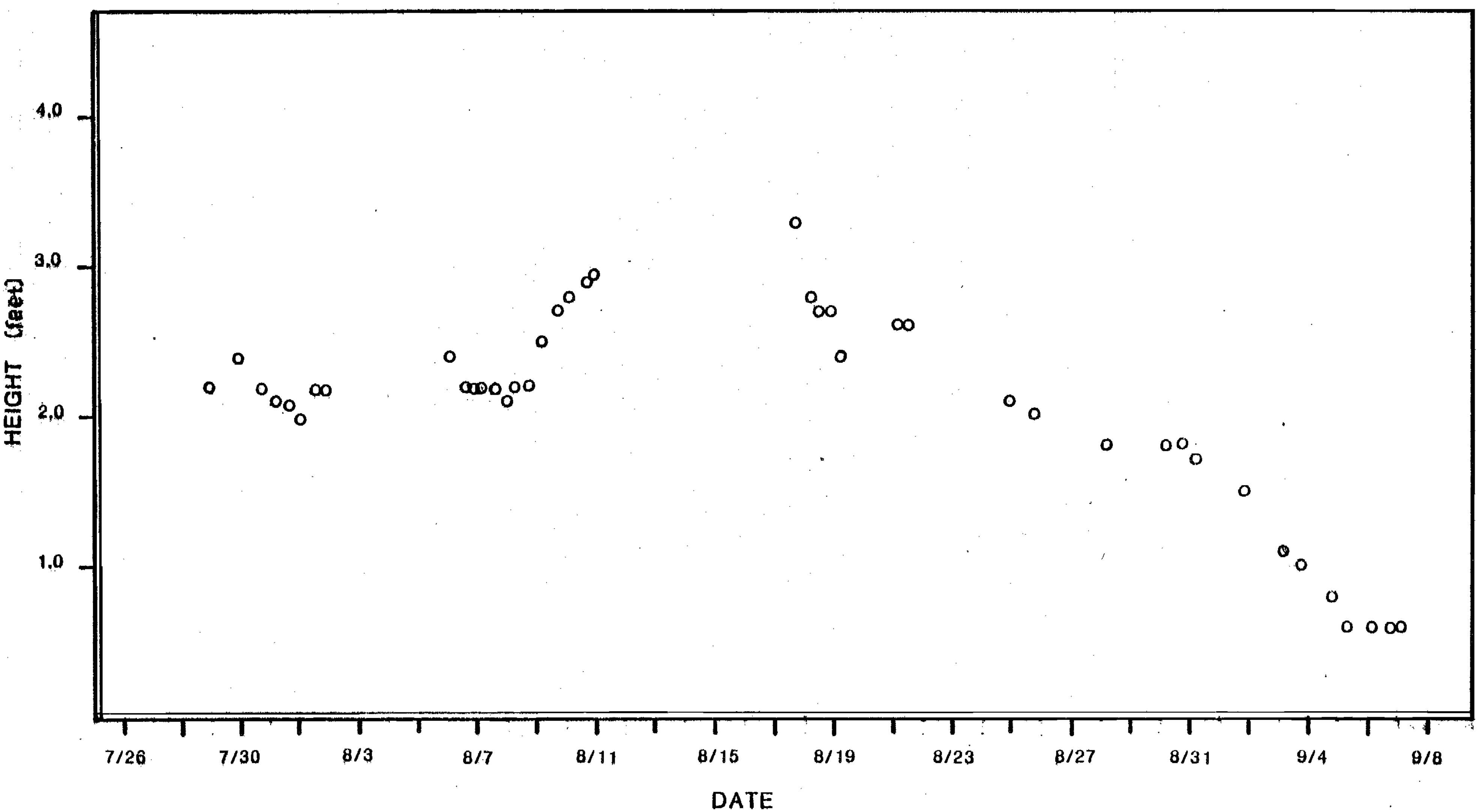


Figure E.5.115. Stage versus time for the AA Sunshine west bank fishwheel site (RM 81.0, 24N05W23CCA).

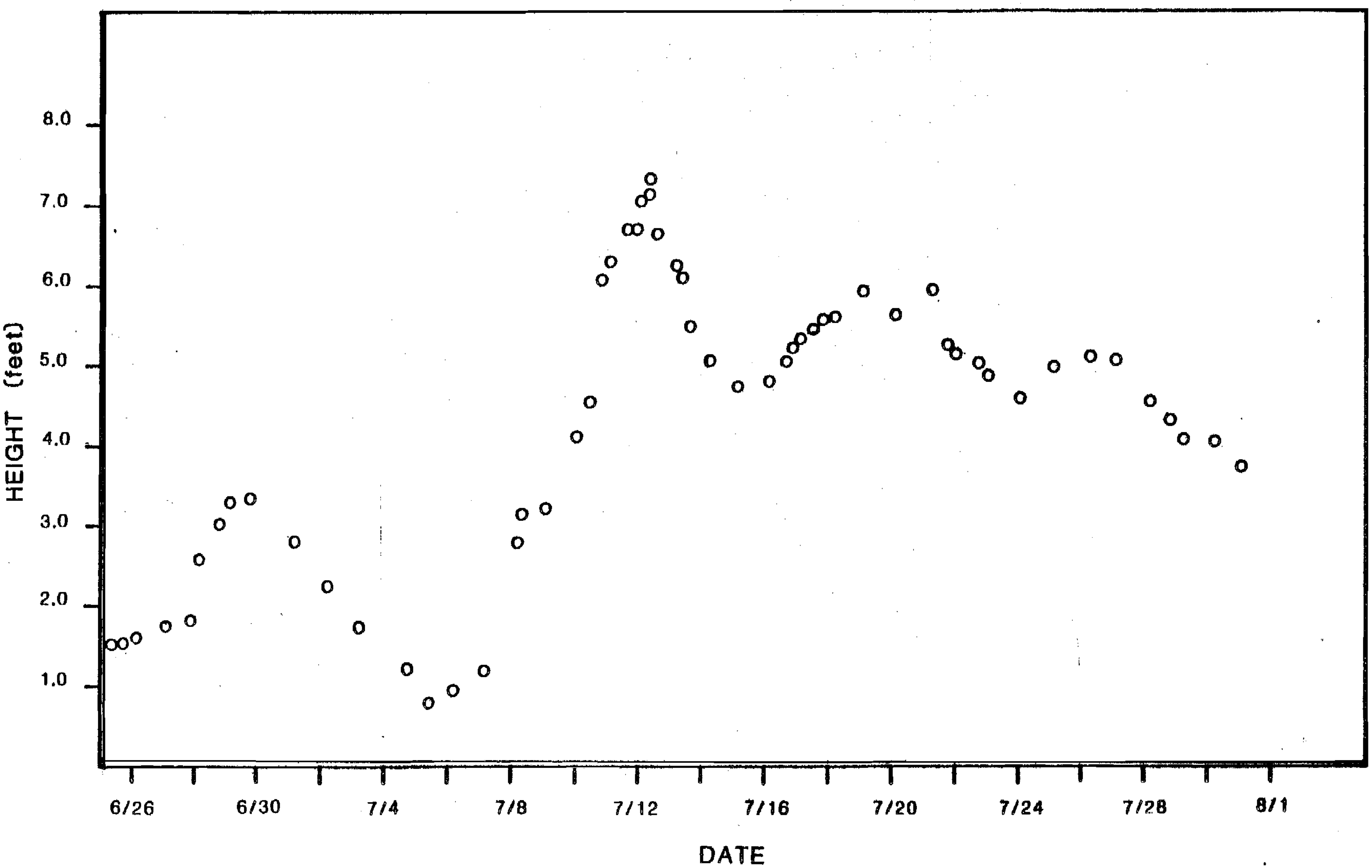


Figure E.5.116. Stage versus time for the AA Talkeetna fishwheel and sonar site (RM 101.0, 27N05W26DDA).

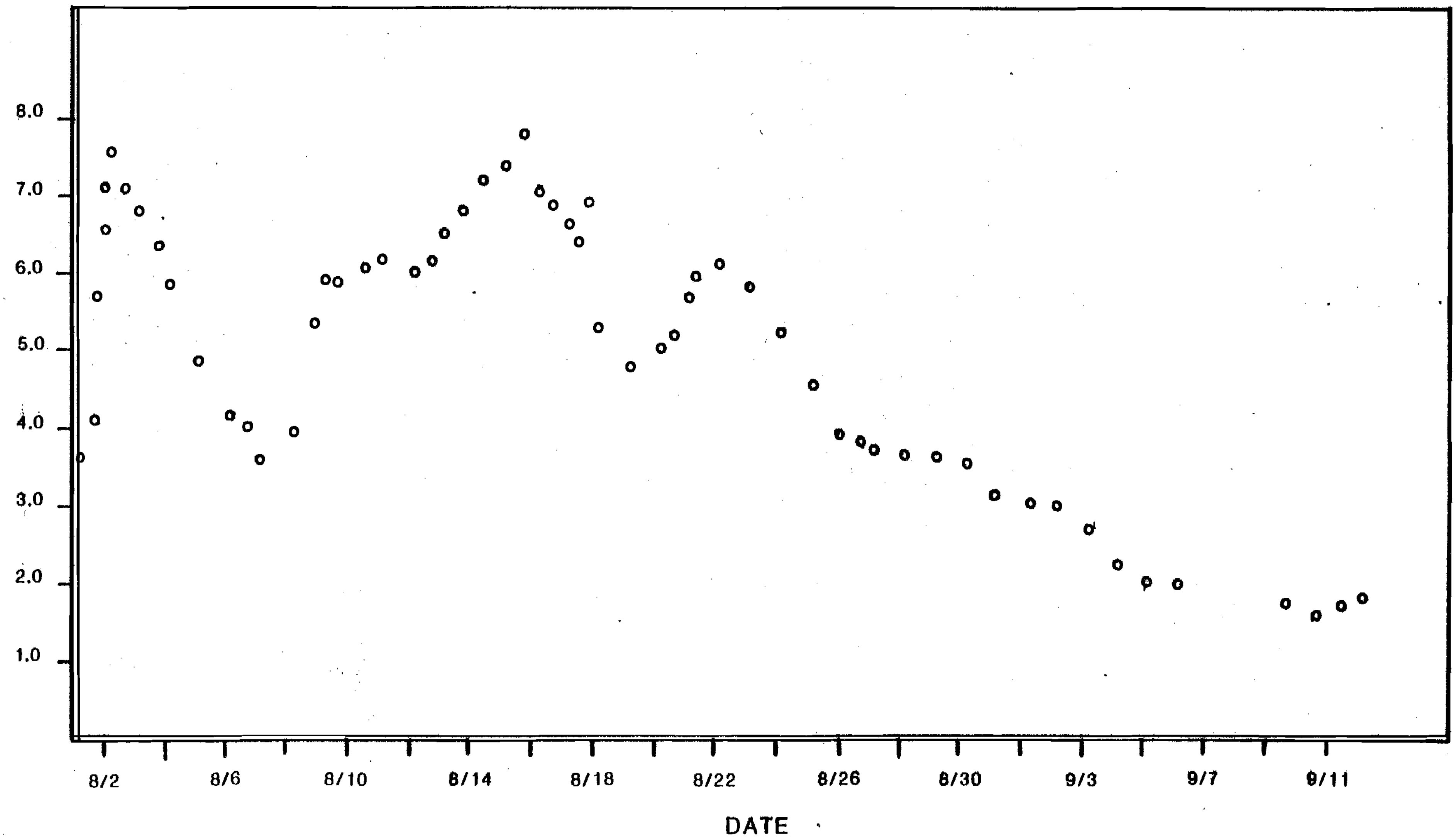


Figure E.5.116. continued.

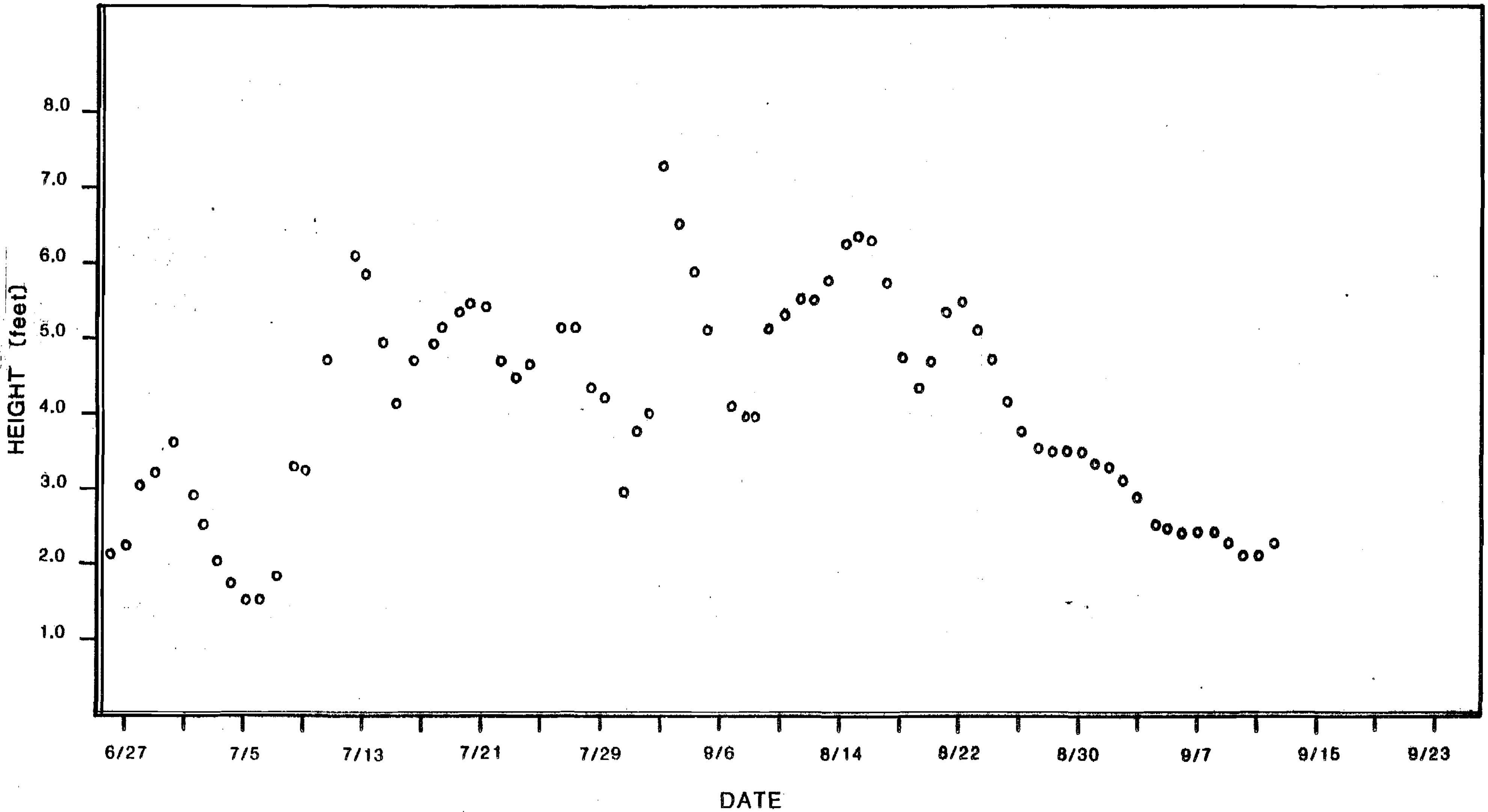


Figure E.5.117 Stage versus time for the AA Curry fishwheel site (R.M. 120.0, 27N04W16DBA).

5.1.2.5 Incidental Data

Incidental point specific and general habitat evaluation data were collected by AA and AH personnel at identified salmon spawning areas, redds and other special study areas (ADF&G 1981a, Appendix EH, Tables EH-1 - EH-6). Point specific and general habitat evaluation data were also collected at known Bering Cisco spawning areas. The latter of these data are included in the 1981 Resident and Juvenile Anadromous Fisheries Species/Subject Su Hydro report (ADF&G 1981c).

5.1.2.6 Point Specific Data

Point specific data (depth, velocity and substrate) were collected at each gear placement site. These data were collected to attempt to characterize the range of these parameters associated with the various species and life stages of fish in various habitats where they were captured. It should be noted that some of the fishery gear (i.e. minnow traps, trot lines and burbot sets) were baited and thus lured the fish into the habitat sampled. Point specific data at gear placements are presented by gear type and fish species in Appendix EI.

5.1.2.7 Winter Data

Point specific and general habitat evaluation data were collected at several sites selected for placement of the RJ sampling gear*. These data are

* Refer also to the 1981 RJ report (ADF&G 1981c).

presented in Table EJ-1, Appendix EJ. Collection of AH data was limited because sampling equipment did not arrive until late spring. Equipment used, was therefore borrowed. Unfortunately this equipment proved, more often than not, unsuited to the cold winter environment. As a result, the first winter sampling season primarily served as a training phase for developing winter techniques and defining equipment specifications which would be suited to the cold environment. Winter 1981-82 sampling will generate data to augment the data presented in this report.

5.2 Selected Habitat Evaluation

5.2.1 Methods

5.2.1.1 Physiochemical*

Water quality and discharge data were collected on a cooperative basis with the USGS at five selected habitat evaluation study sites. Sampling was timed to coincide with other USGS sampling of the mainstem Susitna River at the Gold Creek bridge. A sampling site within each selected habitat evaluation study site was chosen to ensure that a representative sample would be obtained in an area where the sampling apparatus would operate most efficiently. USGS standard sampling procedures were followed. Discharge was measured using a Price AA or pygmy flow meter. Five points along a transect, perpendicular to the

*Specific methods are presented in Appendix EG.

flow, were selected to divide the discharge into 20% increments. At each of these points, a depth integrated water sample was collected using a DH-75 sampler. These five samples were then composited using a "churn splitter", a device that thoroughly mixes the samples. Portions were withdrawn and treated appropriately for shipment to the USGS laboratory in Colorado for analysis of nutrients, sediments, cations and trace metals listed in Table 2. Field parameters (dissolved oxygen, specific conductance, pH, and temperature) were measured using a Hydrolab Model 4041 at each of the five sampling points on the transect. Substrate was categorized as shown in Table E.5.1.

Thermographs were placed in two sloughs (19 and 21) to measure surface and intragravel water temperatures. The intragravel thermographs were enclosed in weighted fry traps and buried approximately one foot beneath the surface of the substrate. Surface water temperature thermographs were enclosed in weighted fry traps and placed upon the substrate. Each was secured to the shore using 1/4 inch wire cable.

5.2.1.2 Surveying Methods

Transects were surveyed to define general hydraulic characteristics of the selected habitat study sloughs. Transects were located at the head (upstream confluence with the mainstem) and at the mouth (downstream confluence) of each slough to relate mainstem water surface elevation to the sloughs. Transects were also placed to characterize major control points, pools and riffles. Transects were marked on each bank with headpins consisting of four foot sections of 1/2 inch rebar. A 1/2 inch four foot rebar section was also installed to designate bench marks at each slough with the exception of Slough 21. A project benchmark (LRX-56) established by R&M Consultants was referenced as the Slough 21 benchmark. Headpins and benchmarks were driven into the ground, leaving approximately 3 inches above the surface in areas on the bank that were located, where possible, above the high water mark. Benchmarks were distinguished from headpins by capping them with a seal stamped ADF&G. Standard surveying techniques using a Lietz B-2 level, rod, and fiberglass tape, were employed to determine the cross sections, diagonal and longitudinal distances between each head pin and head pin elevations. Elevations were referenced to the ADF&G bench marks which were later referenced to nearby project elevation datums previously established by R & M Consultants. Cross sectional profiles were plotted for each transect to illustrate the morphology of the channel. A Topcon DMS1 Electronic Distance Measuring system and Raytheon DE-719-B depth sounder were modified for use with a boat boom suspension system (Plate 10) for surveying deep water and wide river stretches.

Substrate was photographed along each transect using a grid (Plate 3) to characterize substrate types and were referenced to the left bank head pin. Photographs were labeled and filed for later reference.

Discharge was measured along one transect in each slough. A staff gage was also installed at these discharge sites. Discharge and stage were determined in order to begin a period of record from which to develop stage discharge relationships with subsequent measurements. Staff gages were also installed in the mainstem river within the vicinity of the selected study slough

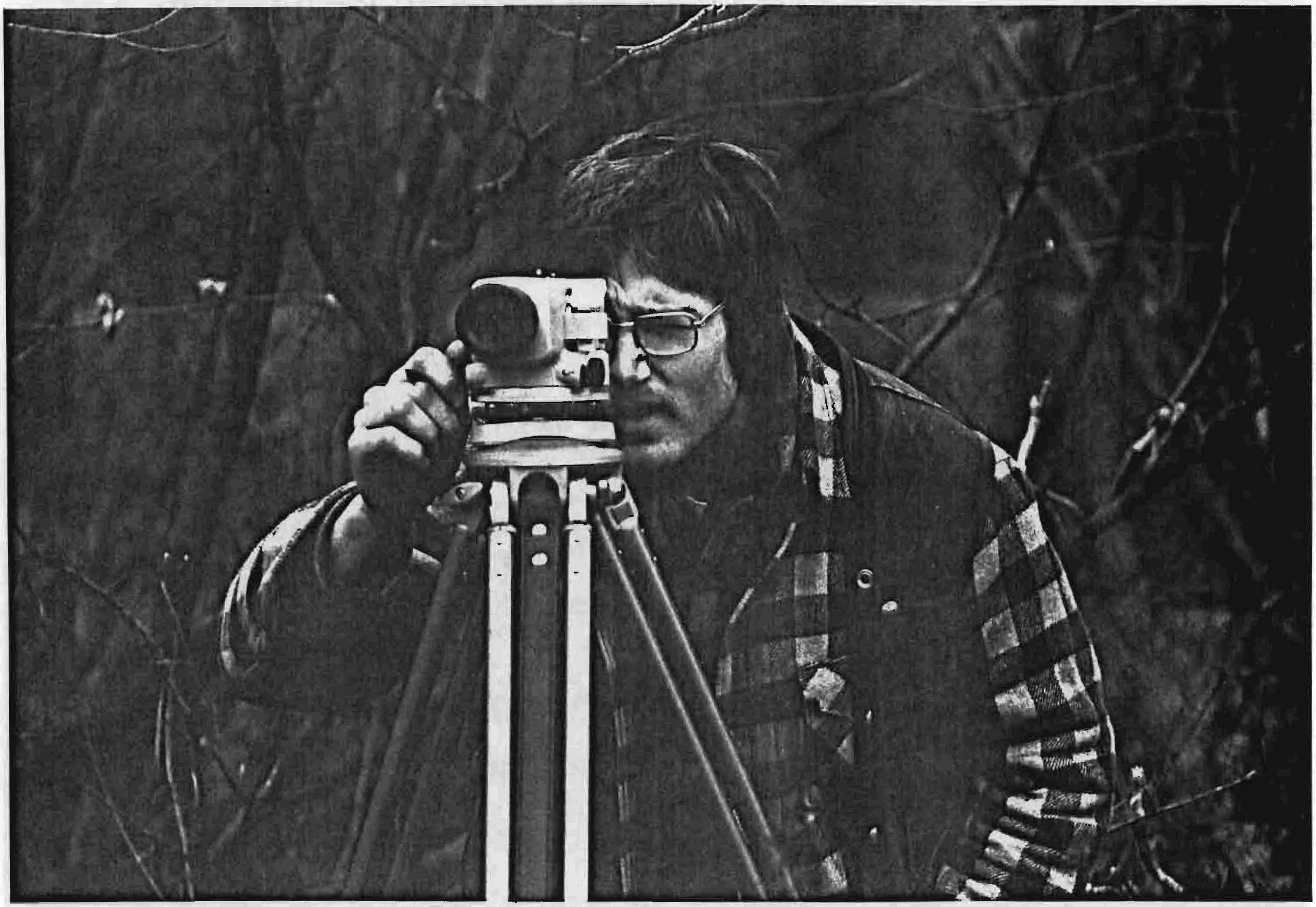


Plate 8. Use of a Leitz B-2 survey level for surveying in the selected habitat study sloughs.

Plate 9. Surveying a transect line at Slough 8A.

Plate 10. Use of an EDM distance finder for determining cross section profiles.

locations to characterize whether the aquatic habitat of the sloughs was influenced by changes in mainstem discharge.

5.1.2.3 Site Selection

The five selected habitat evaluation sites studied are sloughs located along the Susitna River from approximately five miles downstream of Sherman (R.M. 131) to approximately four miles upstream of Indian River (R.M. 138.5). These sites with their respective river miles and geographic codes are presented below:

Site	River Mile	Geographic Code
Slough 8A	125.5	30N 03W 30 BCD
Slough 9	129.0	30N 03W 16 ABC
USGS Mainstem Site @ Gold Creek Bridge	136.7	31N 11W 20 BAC
Slough 16B	138.0	31N 11W 17 ABD
Slough 19	140.0	31N 11W 10 DBB
Slough 21	142.0	31N 11W 02 AAA

The sites were selected to represent varied types of habitat and fishery activities (spawning and rearing), as determined from fishery, water quantity and quality baseline data collected by the ADF&G (1974, 1978, 1979), discussions with personnel from Acres American, Inc. and R & M Consultants, and by a reconnaissance trip to the study area in June, 1981 by ADF&G Su Hydro and USGS personnel. An additional objective was to select sites which would characterize the general hydraulic conditions of sloughs in the river above the confluence of the Talkeetna River and below Devil Canyon. Table E.5.6 illustrates the parameters chosen in selecting the sites and how each slough compared.

A comparative analysis of the parameters presented in Table E.5.6 indicates that each slough is relatively unique. An overview of the sites illustrates how slough 8A with a pH range of 7.0-7.5 and a specific conductance of 88-98 contrasted with slough 16B which had a pH range of 6.2-7.2 and a conductivity of 85 while both were sites of coho and chinook rearing. Slough 19 was selected due to its relatively high range of specific conductance (140-150), and its population of sockeye spawners and coho rearing fish. Additional chinook fry have not been observed in this slough whereas slough 21 (upstream) and slough 16B (downstream) each supported chinook fry. Slough 9 was selected because it supported high numbers of coho spawners and numbers of sockeye (spawners) and few salmonid fry. Slough 21 was chosen being a site of high numbers of chum spawners with both chinook and coho fry.

5.2.2 Findings

5.2.2.1 Site Descriptions.

Slough 21 (Appendix EA, Figure EA-77) is a forked, open channel stream approximately 0.5 miles in length with sloping 5 foot cutbanks. The main source of water is generated from the mainstem Susitna River except during periods of low discharge. At low discharge of the mainstem, the slough is fed by a small, clearwater tributary entering the northeast channel of the slough. This with ground water percolation maintains water in the main channel and

Table E.5.6. Matrix of parameters used to select the five selected habitat evaluation study sites.

Site	RM	Habitat	Chinook Spawning	Coho Spawning	Chum Spawning	Sockeye Spawning	Coho Rearing	Rearing	pH	Cond
8A	125.5	Backwater	0	0	--	--	+	+	7.0-7.5	88-98
9	129.0	Open Channel	0	+	++	-	0	+	7.0	N/A
16B	138.0	Open Channel	0	0	--	--	+	+	6.2-7.2	60-85
19	140.0	Backwater Spring Fed	0	0	--	++	0	+	7.1-7.8	140-150
21	142.0	Open Channel	0	0	+++	+	+	+	7.5	N/A

+++ very high
++ high
+ present
- low
-- very low
0 absent
N/A not available

northeast channel, while the northwest channel is dewatered. The substrate, from the mouth upstream approximately 750 feet, is composed primarily of silt sparsely interspersed with gravel and cobble. Above this portion in the main channel and northeast channel the substrate is composed of silt, gravel and rubble. It was in these channels that all spawning activity was observed. The northwest channel substrate consisted primarily of rubble and cobble interspersed with gravel. No fish were observed spawning in this site here during the sampling period. The channel was also the first to dewater. The northeast channel due to the contribution of a small tributary was never found dewatered nor was the main channel of the slough.

Slough 19 (Appendix EA, Figure EA-78) is a spring fed stream backed up at its mouth by the Susitna River which forms a pool for approximately half the length of the slough. The slough is approximately 0.2 miles long and has the unique feature of being completely spring fed. The banks are sloping five foot cutbanks in the upper portion and generally sloping throughout the lower portion. The substrate is composed of 100% silt with scant aquatic vegetation from the mouth upstream approximately 200-300 feet. Above this the substrate is primarily gravel with a layer of silt ending with cobble and rubble near the head of the slough. Sockeye were observed spawning in the slough. Redds were located by noting areas where the fish had fanned the silt to access the underlying gravel.

Slough 16B (Appendix EA, Figure EA-79) is an unobstructed channel approximately 0.4 mile in length consisting of steep cutbanks along the entire length on both sides which range from 1-5 feet in height. The substrate is fairly homogeneous throughout, consisting primarily of gravel and rubble. The main source of flow is from the mainstem Susitna River which enters the head of the slough discharging at the mouth. During periods of low mainstem discharge, groundwater percolation contributes most of the water as the head of the slough is dewatered, isolating the slough from the mainstem influence. Although spawning was not observed during our surveys, a few chum salmon carcasses were found in dewatered areas within the slough.

Slough 9 (Appendix EA, Figure EA-80) is an unobstructed channel approximately 1.2 miles long having sloping six-foot cutbanks and substrate composed of gravel, rubble and cobble. The main source of water for the slough consists of flow from the mainstem Susitna River except during periods of low discharge. Two small tributaries, which are located on the northeast and southeast banks, maintain flow in the slough during low discharge periods. They provide the entire low flow discharge.

Slough 8A (Appendix EA, Figure EA-81), is approximately 1.8 miles in length. The initial 1/4 mile from the mouth upstream is influenced by the mainstem Susitna River. Except during periods of extreme low flows, a backwater area is created in this strecth of the slough. Above this section, the flow is unobstructed except for the middle section of the slough which contains beaver dams. Slough 8A can be characterized as having sloping six-foot cutbanks and six "heads" which contribute flow from the mainstem except for periods of low mainstem discharge. During those periods, flow is generated through groundwater percolation and release from beaver dams. Sockeye and chum salmon were observed spawning in the lower stretches of the slough. Slough 8A was the longest of the 5 sloughs sampled and exhibited the greatest diversity. Transects were located only at the "head" and mouth of Sloughs 8 and 9 due to their length.

5.2.2.2 Morphometry Data

The survey data included head-pin and cross section elevations, and longitudinal, diagonal and horizontal distances. Waters edge locations and head-pin distances are illustrated in Figures E.5.118-E.5.120. Cross sectional profiles of the slough mouth and head portion were also plotted (Figures E.5.121-E.5.136) to provide a basis for illustrating the stage required from the mainstem to provide flow into the study sites. Head pin and cross section elevations are presented in Appendix EE, Tables EE-1 - EE-16. Morphometric maps (Figures E.5.137-E.5.139) were developed from the survey data in order to characterize the potential availability of wetted habitat.

5.2.2.3 Stage/Discharge Data

Stream discharge and stage measurements were recorded from June to September, 1981. Table E.5.7 illustrates the mainstem and slough stage changes versus time and discharge. Mainstem discharge, as determined from the USGS gaging station at Gold Creek, is presented in Appendix EF, Figure EF-1. Together, the two sets of data permit comparison of mainstem and study slough flows.

TRANSECT	RIGHT HEAD PIN TO RIGHT WATERS EDGE	TOP WATER WIDTH	LEFT WATERS EDGE TO LEFT HEAD PIN	TRANSECT WIDTH
1	15.6	23.8	56.0	95.4
2	7.4	28.9	52.6	88.9
3	20.8	13.8	46.5	81.1
4	35.6	43.3	25.5	104.4
5	57.5	32.5	3.8	93.8
6	60.6	21.7	8.1	90.4
7	36.2	26.2	17.1	79.5
8	15.5	53.4	14.6	83.5
9	9.4	42.4	27.2	79.0
10	35.0	29.8	7.3	72.1
11	49.2	18.6	15.0	82.8
12	21.8	29.1	25.1	76.0
13	7.5	68.8	16.0	92.3
14	32.3	42.4	3.4	78.1
15	7.8	39.1	27.0	73.9
16	14.0	37.8	30.5	82.3
17	--	dry	--	195.5

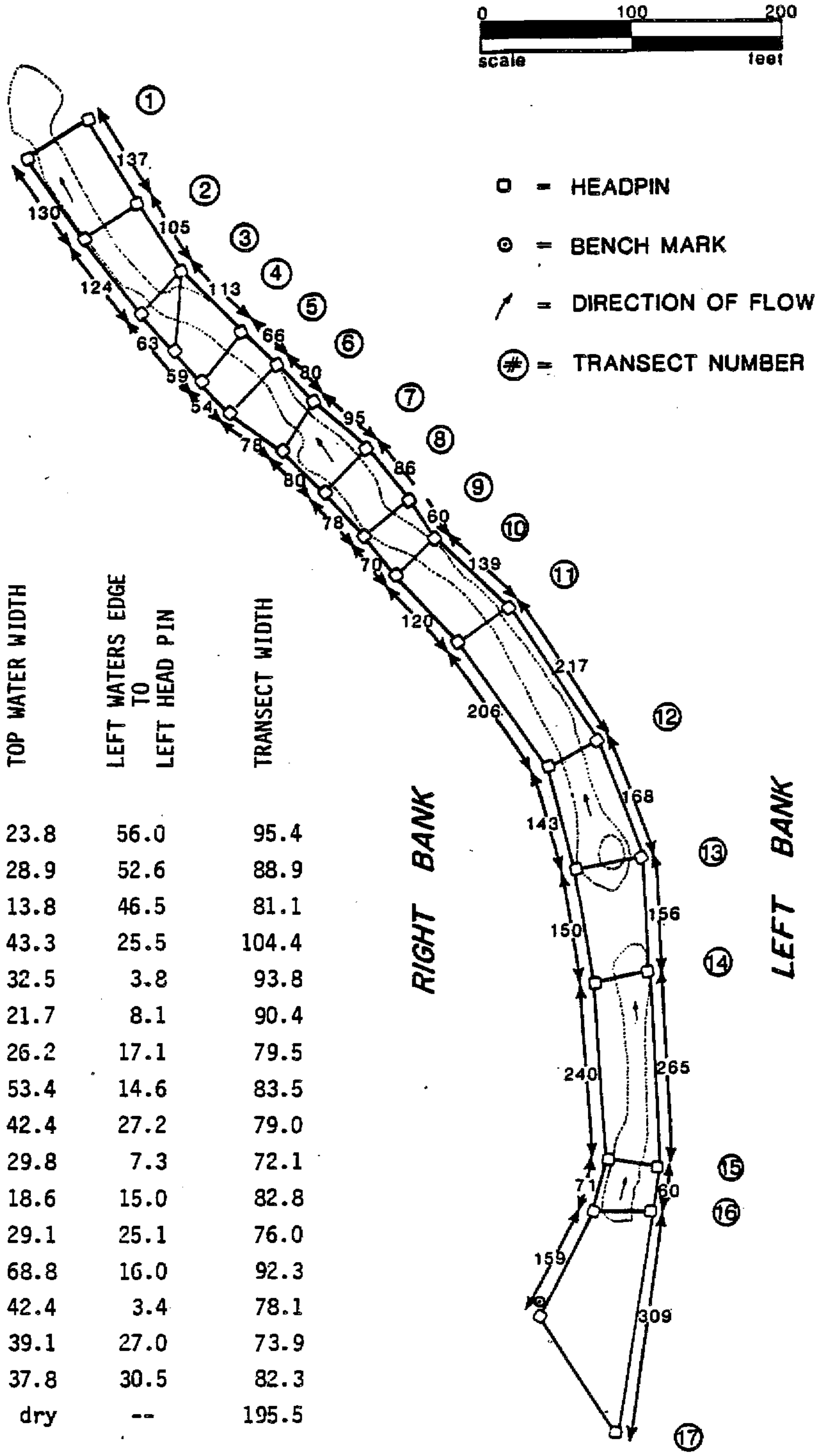
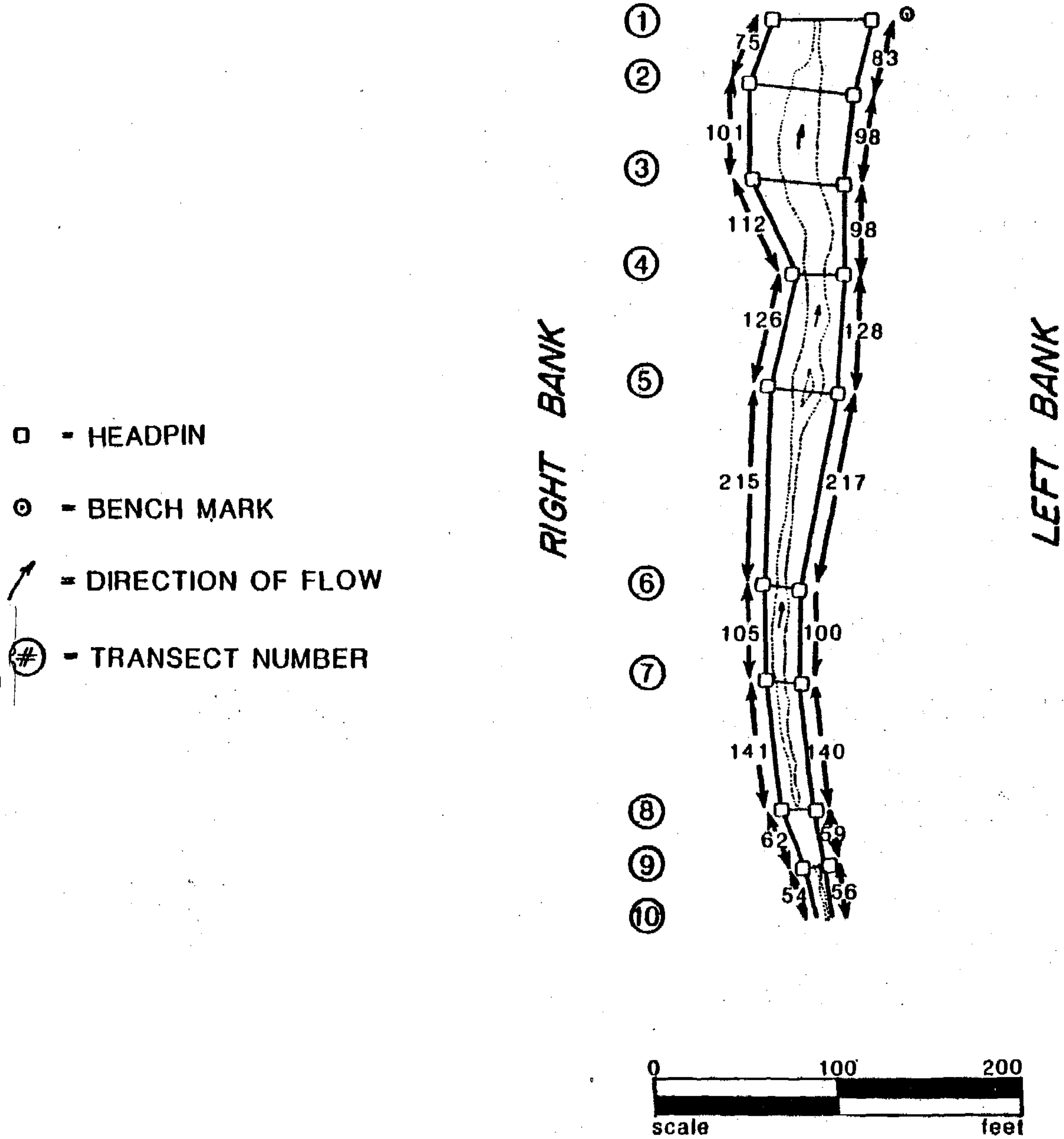
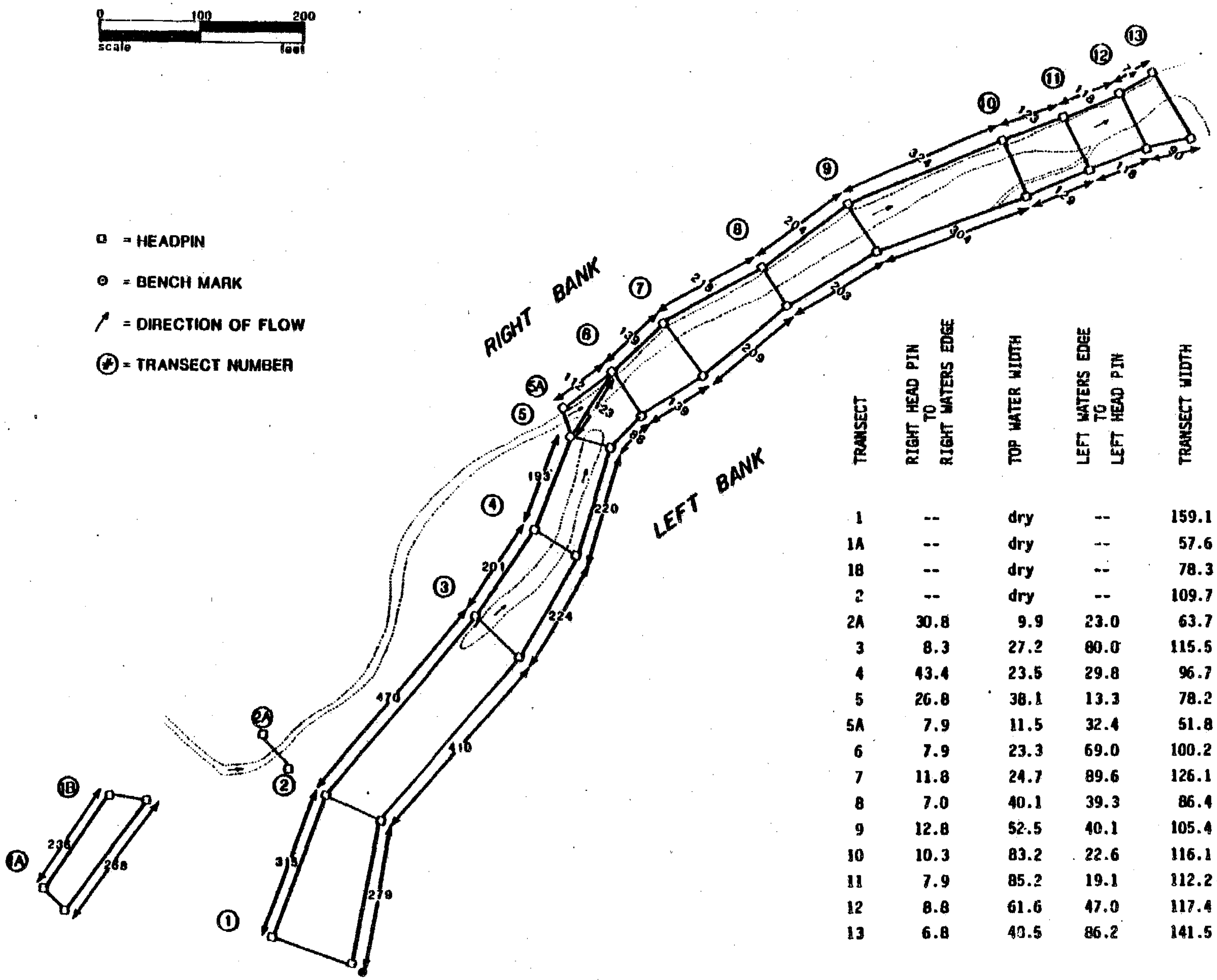


Figure E.5.118. Waters edge location and head pin distance for Slough 16 (R.M. 139, 31N11W17ABD).



TRANSECT	RIGHT HEAD PIN TO RIGHT WATERS EDGE	TOP WATER WIDTH	LEFT WATERS EDGE TO LEFT HEAD PIN	TRANSECT WIDTH
1	48.8	2.4	55.5	106.7
2	50.0	31.4	34.0	115.4
3	42.9	34.2	27.5	104.6
4	15.3	18.7	23.3	57.3
5	28.8	30.0	11.6	70.4
6	12.6	9.3	18.6	40.5
7	7.4	10.8	17.8	36.0
8	--	dry	--	35.2
9	11.0	5.5	10.1	26.6
10	6.6	3.9	5.7	16.2

Figure E.5.119 Waters edge location and head pin distance for Slough 19 (R.M. 140, 31N11W10DBB).



TRANSECT	RIGHT HEAD PIN TO RIGHT WATERS EDGE	TOP WATER WIDTH	LEFT WATERS EDGE TO LEFT HEAD PIN	TRANSECT WIDTH
1	--	dry	--	159.1
1A	--	dry	--	57.6
1B	--	dry	--	78.3
2	--	dry	--	109.7
2A	30.8	9.9	23.0	63.7
3	8.3	27.2	80.0	115.5
4	43.4	23.5	29.8	96.7
5	26.8	38.1	13.3	78.2
5A	7.9	11.5	32.4	51.8
6	7.9	23.3	69.0	100.2
7	11.8	24.7	89.6	126.1
8	7.0	40.1	39.3	86.4
9	12.8	52.5	40.1	105.4
10	10.3	83.2	22.6	116.1
11	7.9	85.2	19.1	112.2
12	8.8	61.6	47.0	117.4
13	6.8	40.5	86.2	141.5

Figure E.5.120 Waters edge location and head pin distance for Slough 21 (R.M. 142, 31N11W02AA).

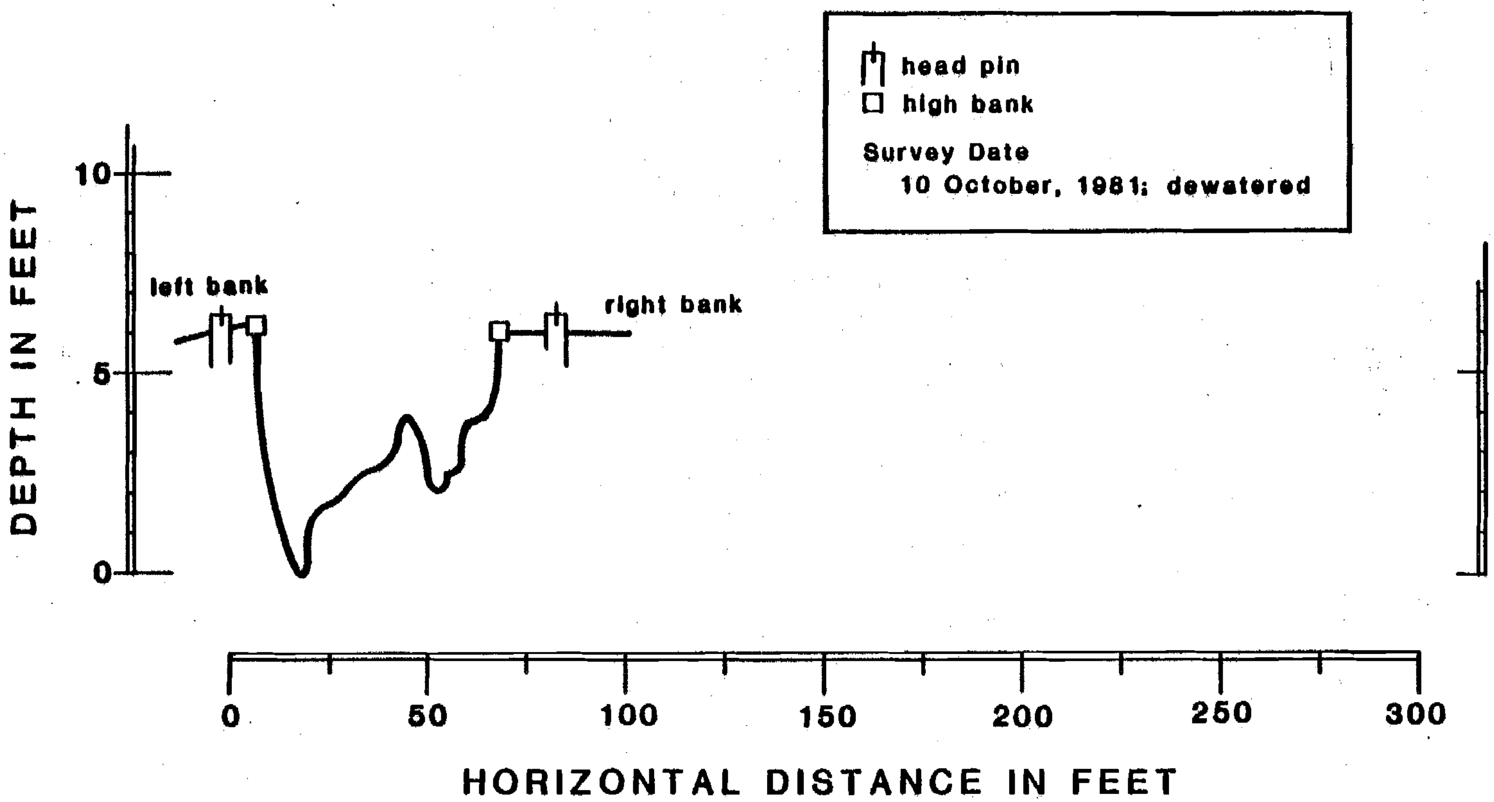


Figure E.5.121
CROSS-SECTIONAL PROFILE OF SLOUGH 8A, TRANSECT #1.
(1 vertical foot equals 10 horizontal feet)

E-5-199

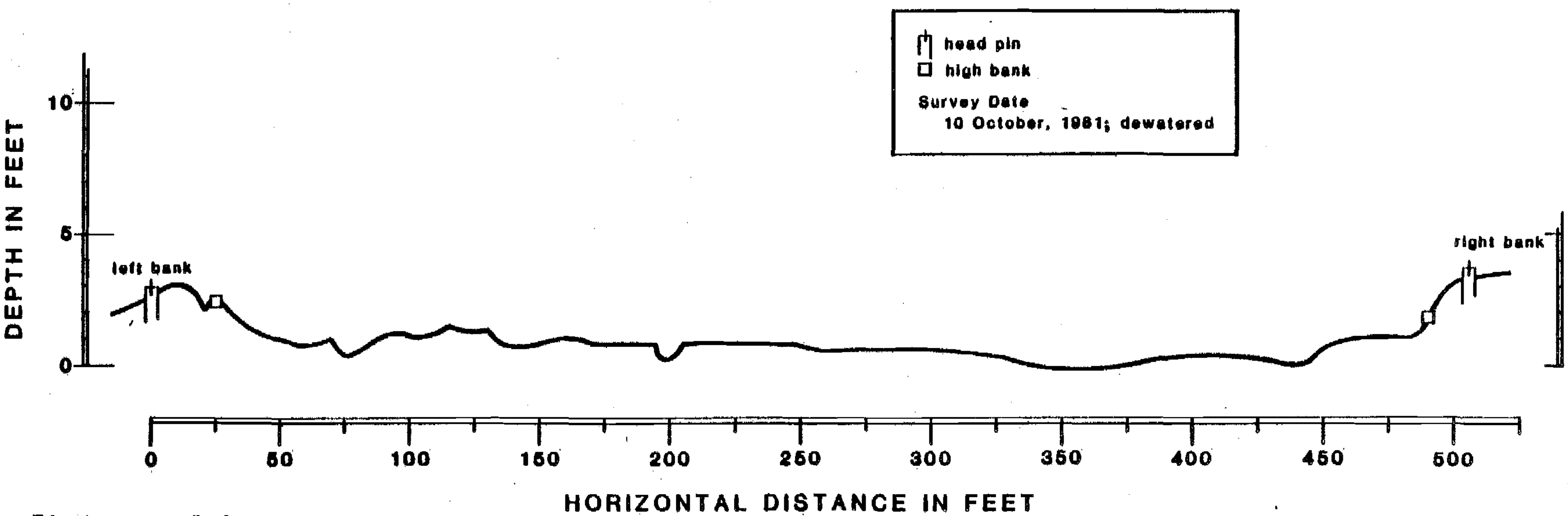


Figure E.5.122
CROSS-SECTIONAL PROFILE OF SLOUGH 8A, TRANSECT #2.
(1 vertical foot equals 10 horizontal feet)

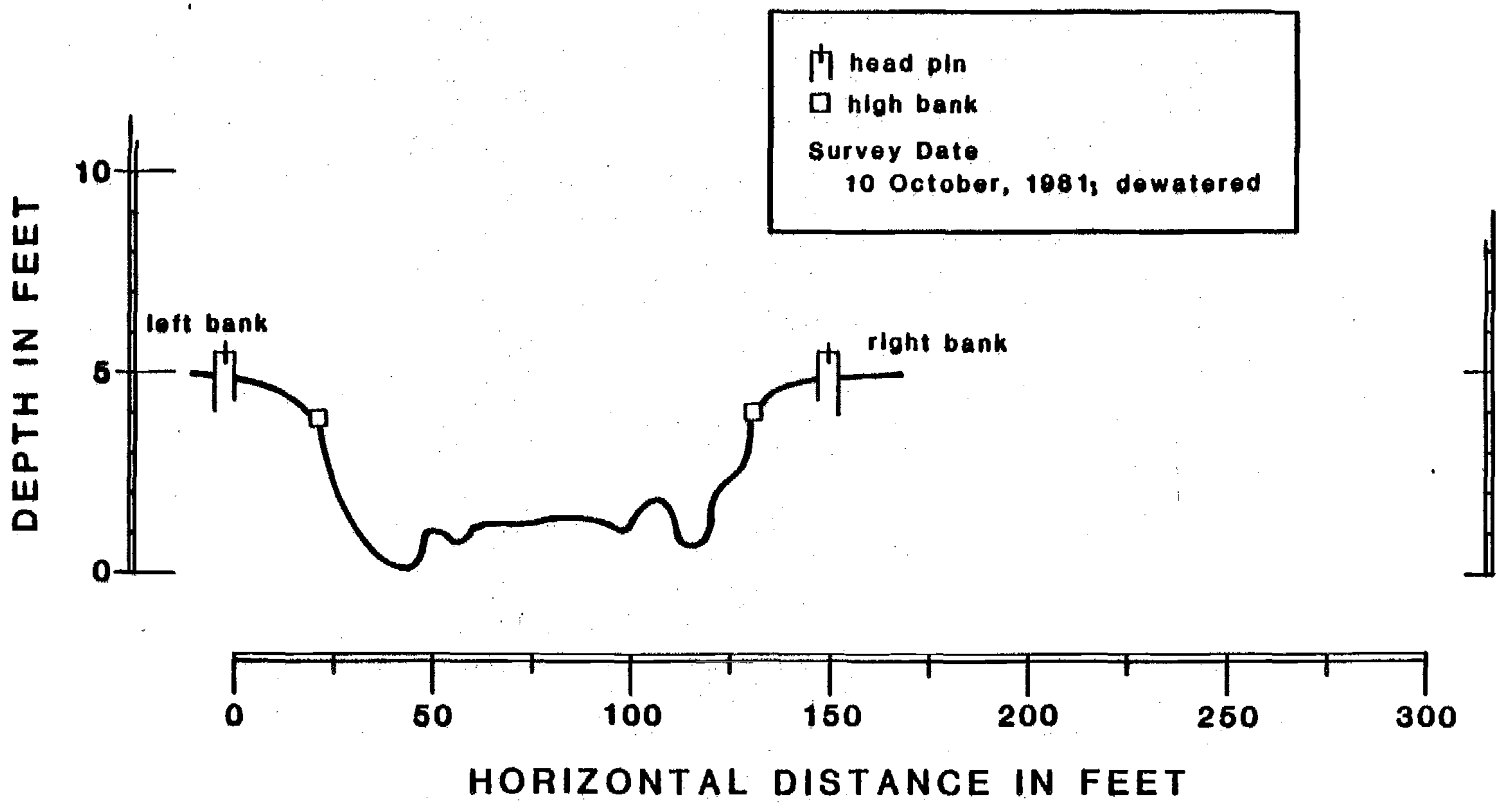


Figure E.5.123
CROSS-SECTIONAL PROFILE OF SLOUGH 8A, TRANSECT #3.
(1 vertical foot equals 10 horizontal feet)

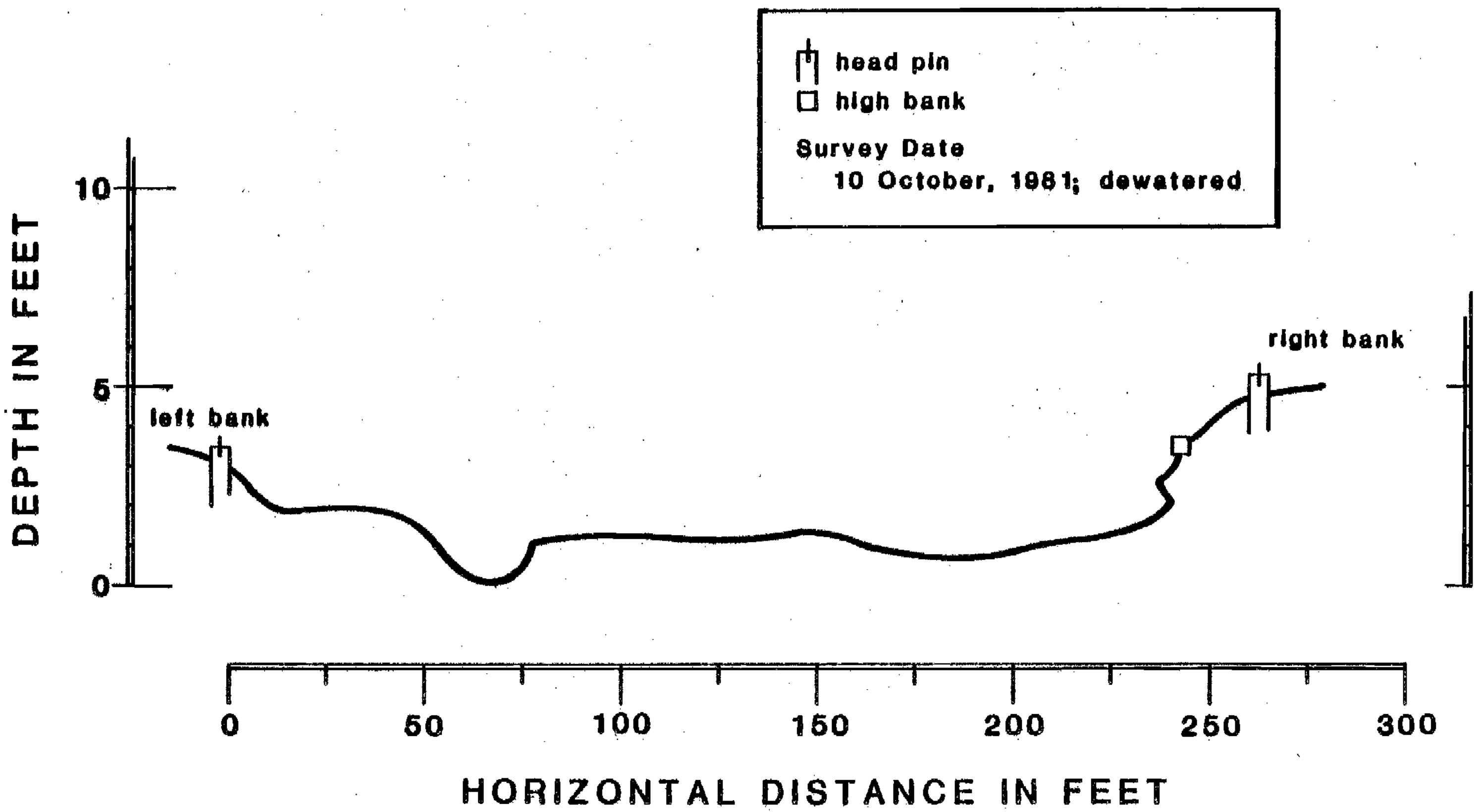


Figure E.5.124
CROSS-SECTIONAL PROFILE OF SLOUGH 8A, TRANSECT #4.
(1 vertical foot equals 10 horizontal feet)

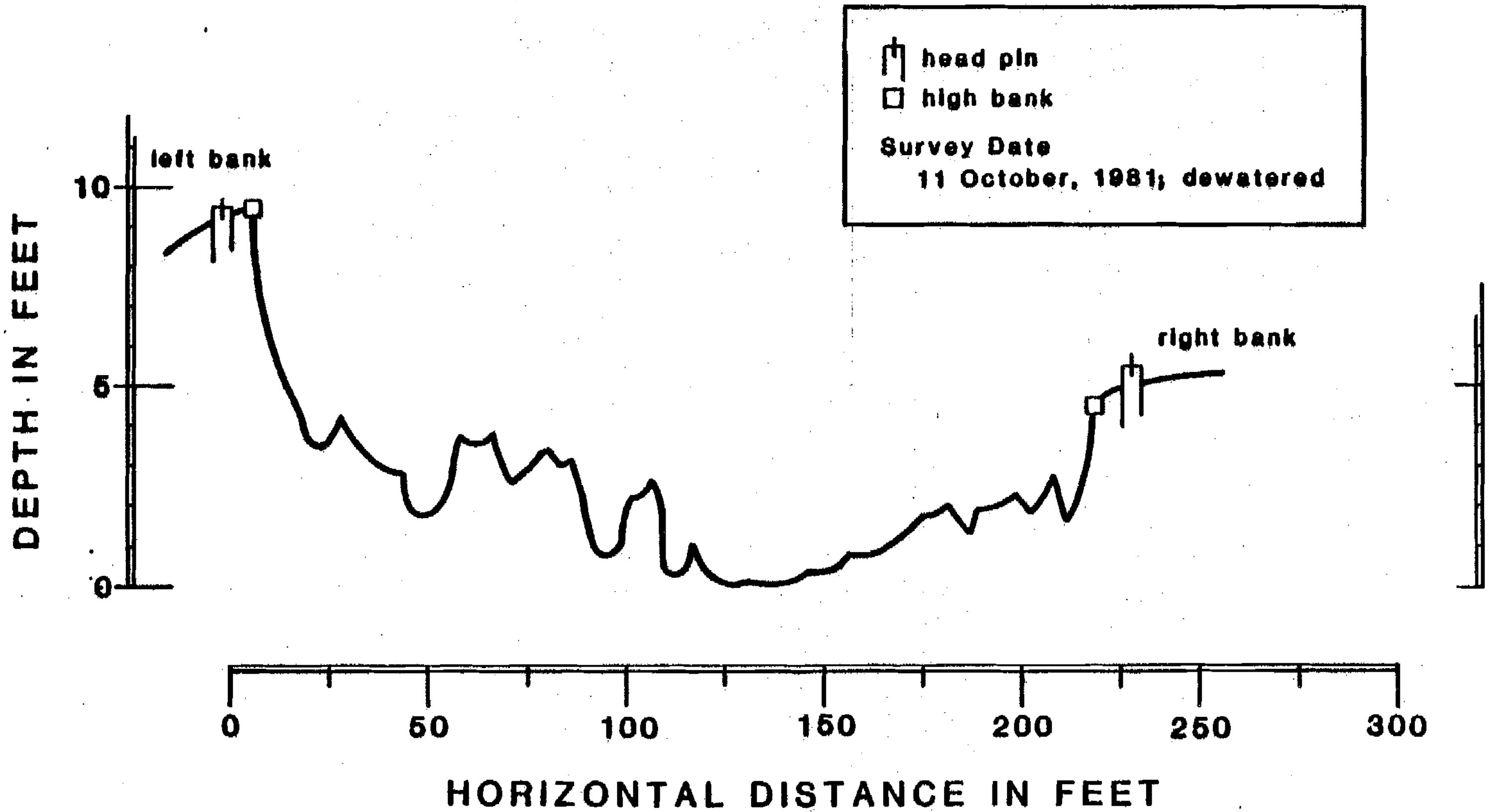


Figure E.5.125
CROSS-SECTIONAL PROFILE OF SLOUGH 8A, TRANSECT #5.
(1 vertical foot equals 10 horizontal feet)

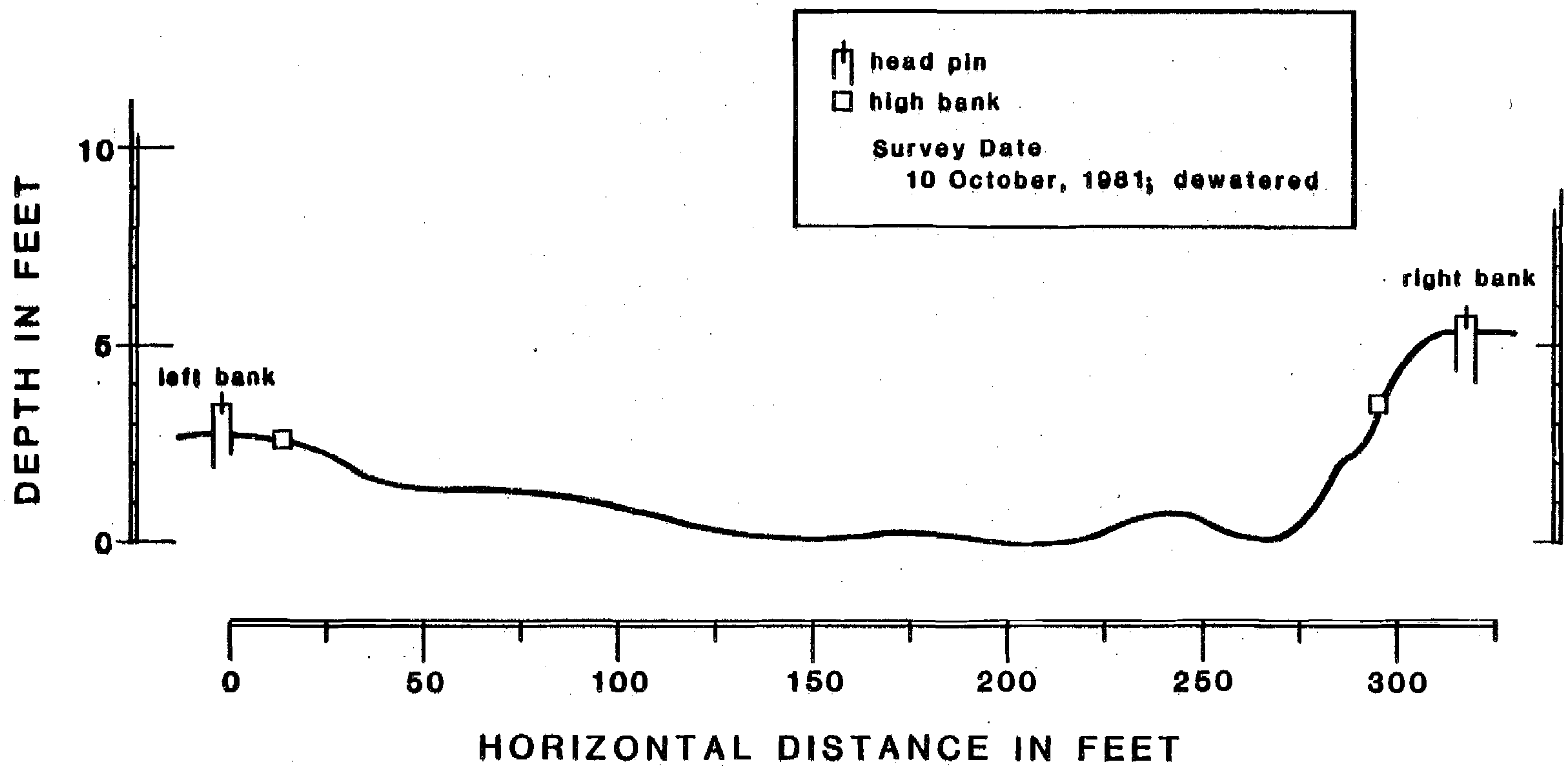


Figure E.5.126
CROSS-SECTIONAL PROFILE OF SLOUGH 8A, TRANSECT #6.
(1 vertical foot equals 10 horizontal feet)

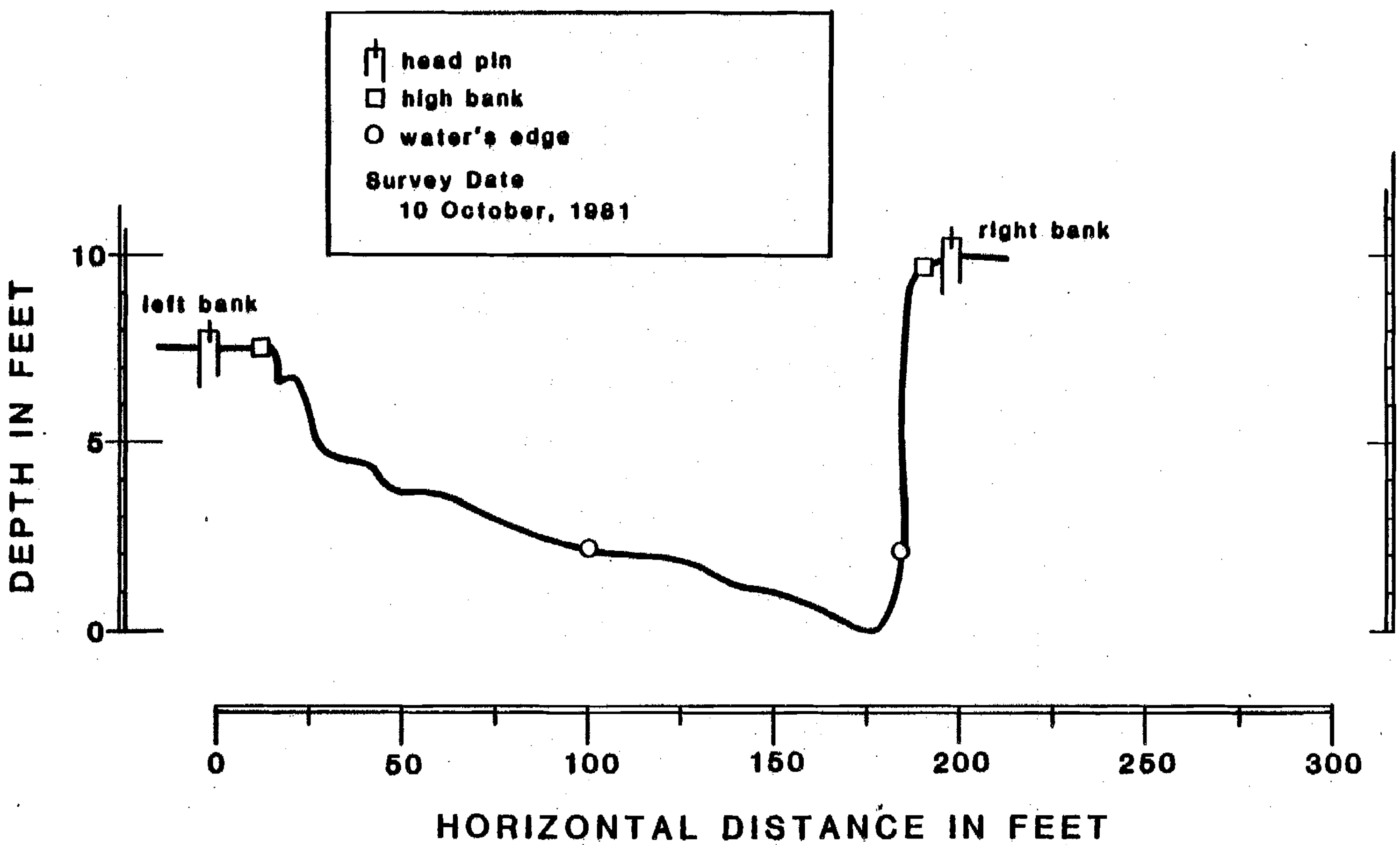


Figure E.5.127
CROSS-SECTIONAL PROFILE OF SLOUGH 8A, TRANSECT #7.
(1 vertical foot equals 10 horizontal feet)

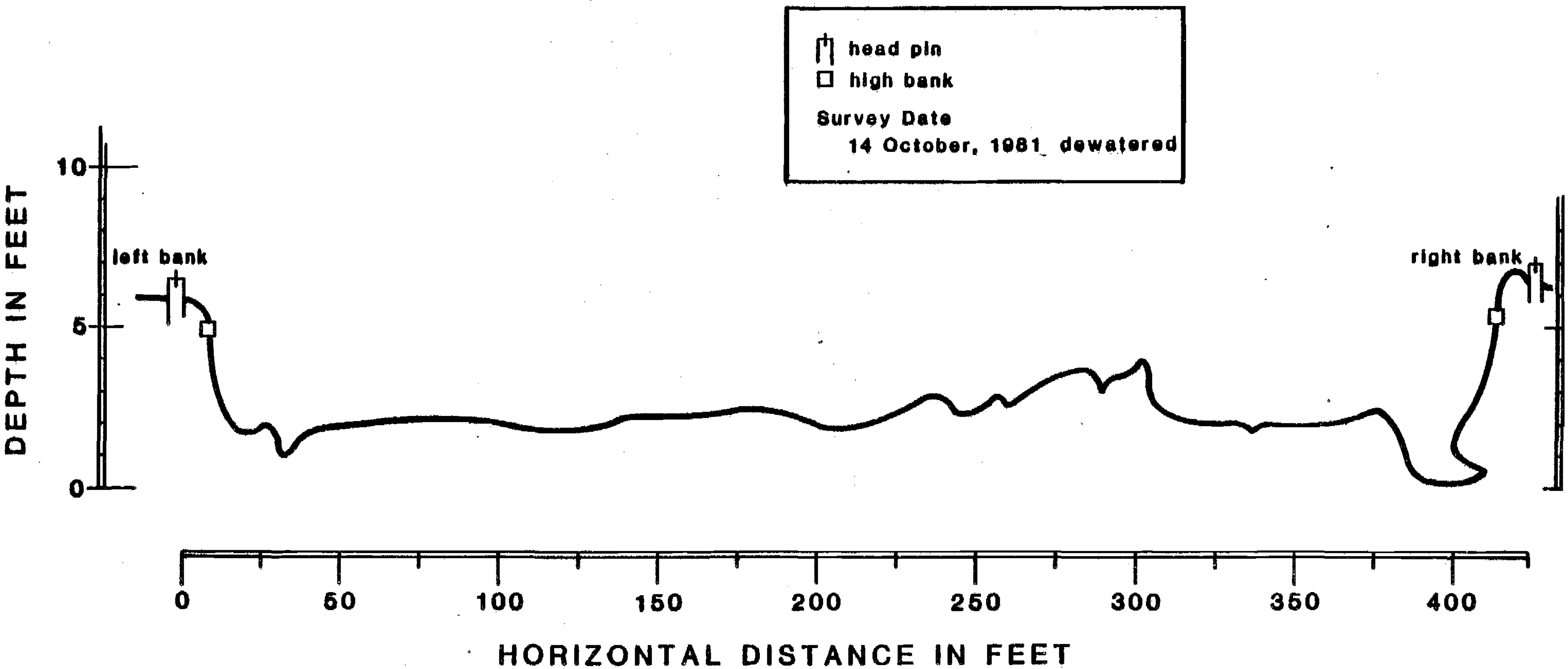


Figure E.5.128
CROSS-SECTIONAL PROFILE OF SLOUGH 9, TRANSECT #1.
(1 vertical foot equals 10 horizontal feet)

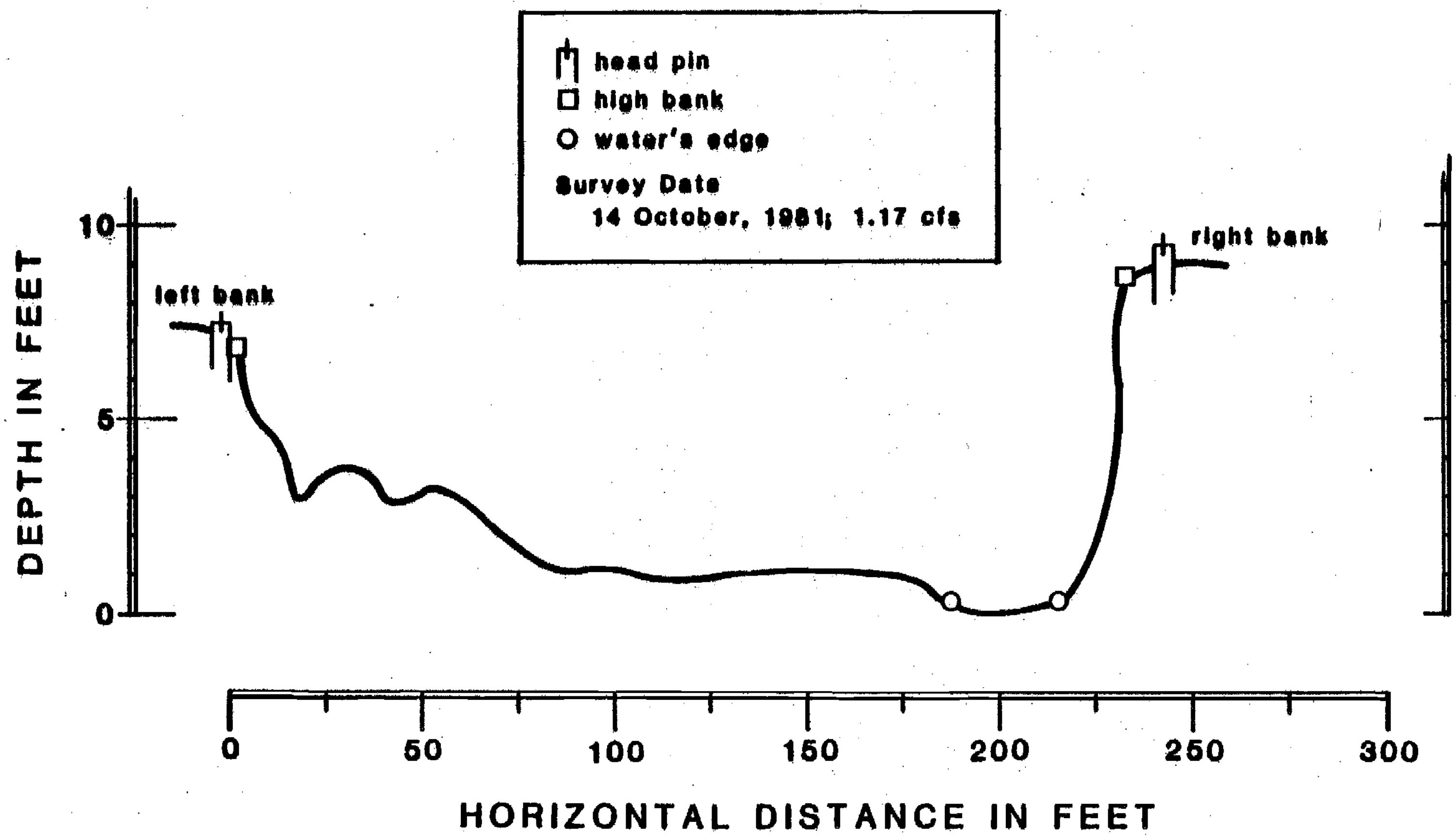


Figure E.5.129

CROSS-SECTIONAL PROFILE OF SLOUGH 9, TRANSECT #5.

(1 vertical foot equals 10 horizontal feet)

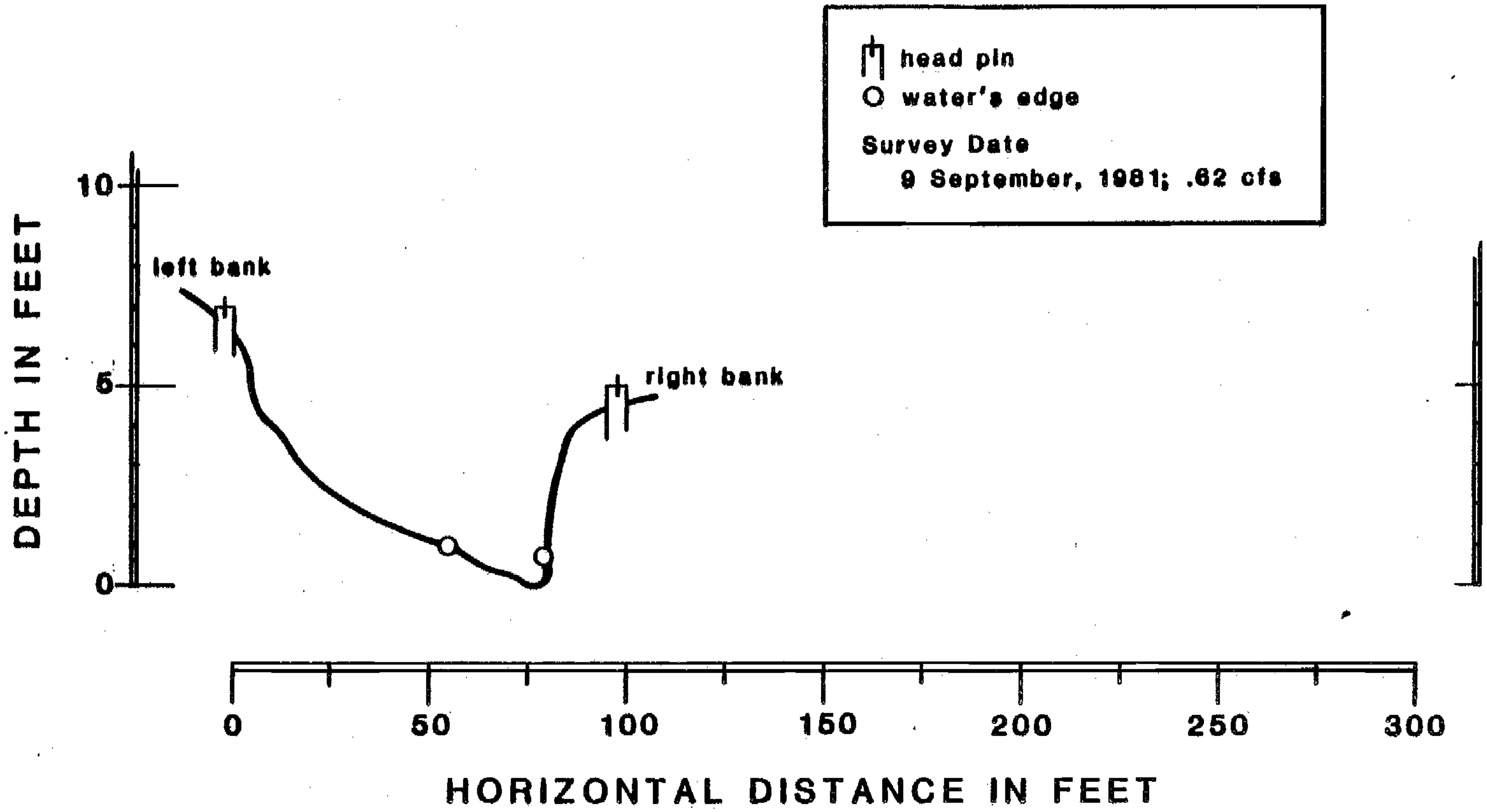


Figure E.5.130
CROSS-SECTIONAL PROFILE OF SLOUGH 16B, TRANSECT #1.
(1 vertical foot equals 10 horizontal feet)

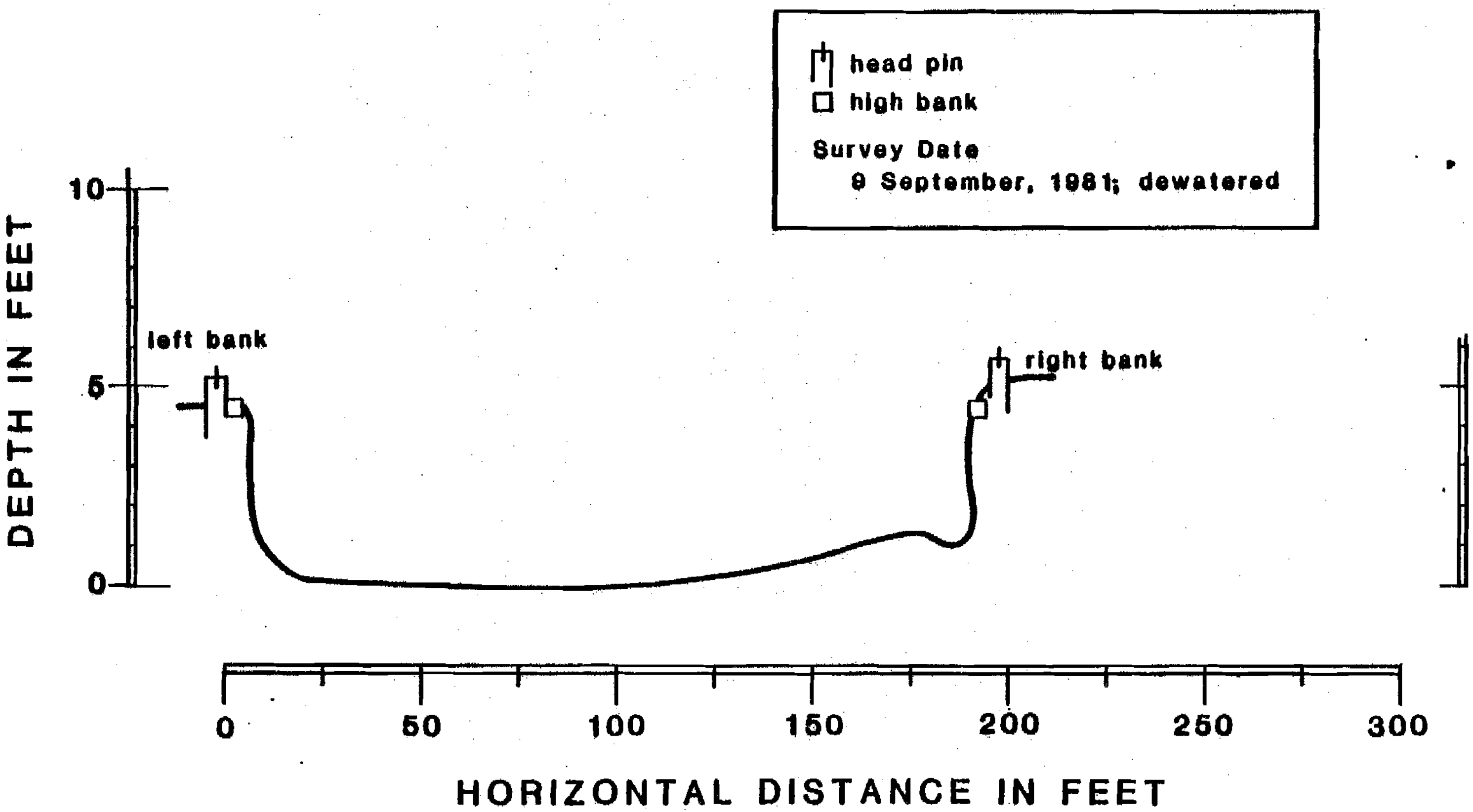


Figure E.5.131
CROSS-SECTIONAL PROFILE OF SLOUGH 16B, TRANSECT #17.
(1 vertical foot equals 10 horizontal feet)

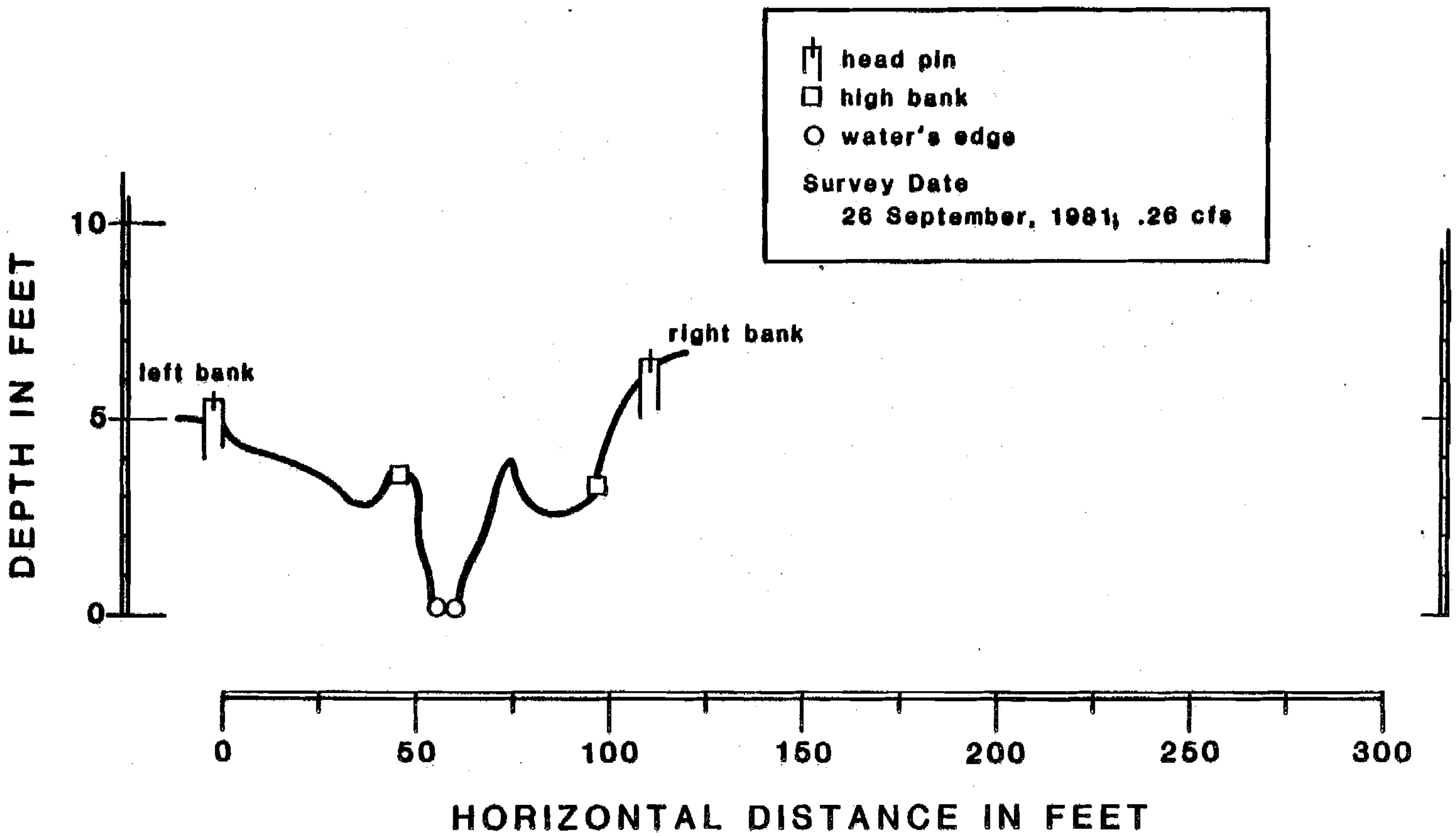


Figure E.5.132
CROSS-SECTIONAL PROFILE OF SLOUGH 19, TRANSECT #1.
(1 vertical foot equals 10 horizontal feet)

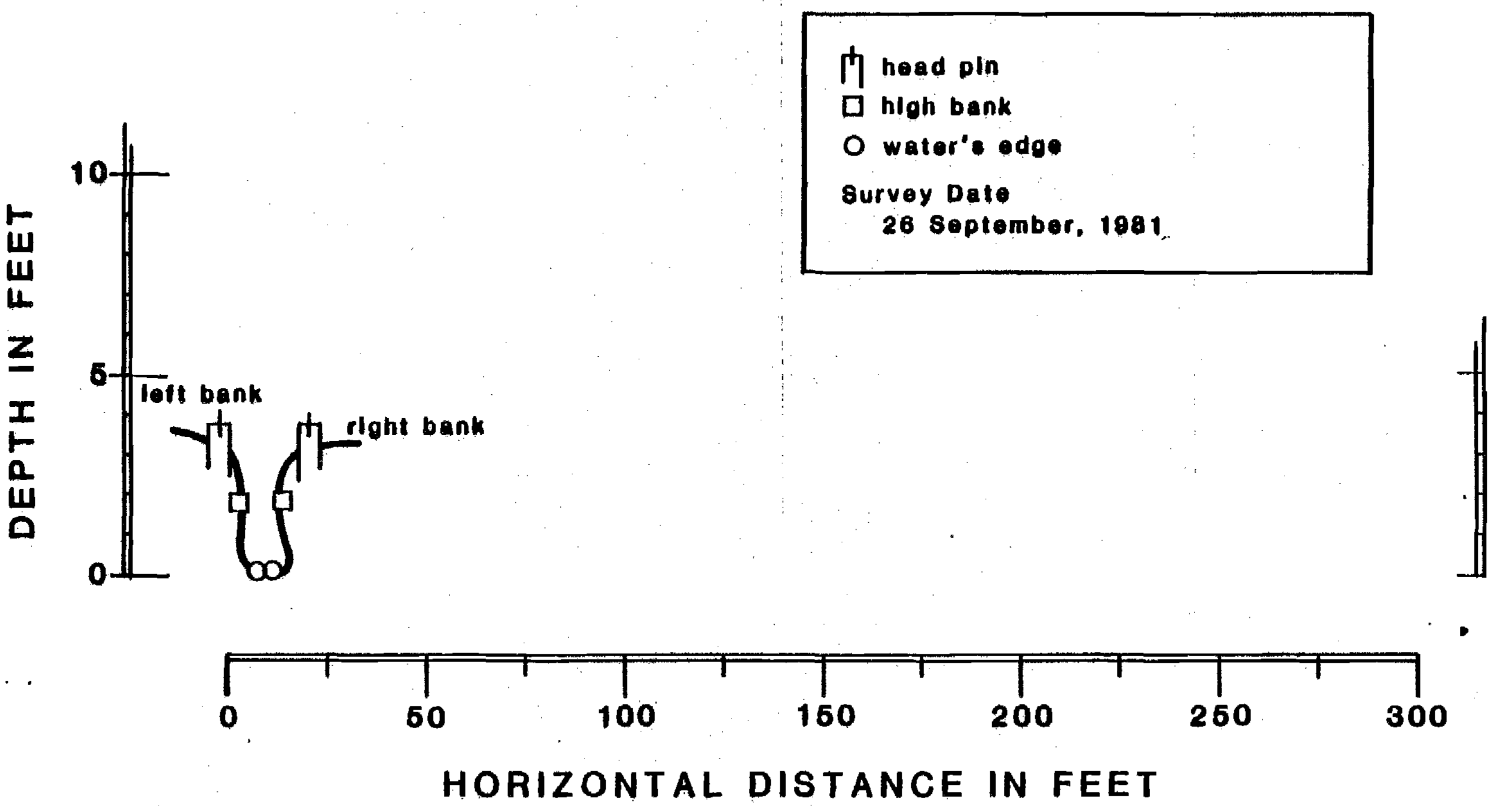


Figure E.5.T33
CROSS-SECTIONAL PROFILE OF SLOUGH 19, TRANSECT #10.
(1 vertical foot equals 10 horizontal feet)

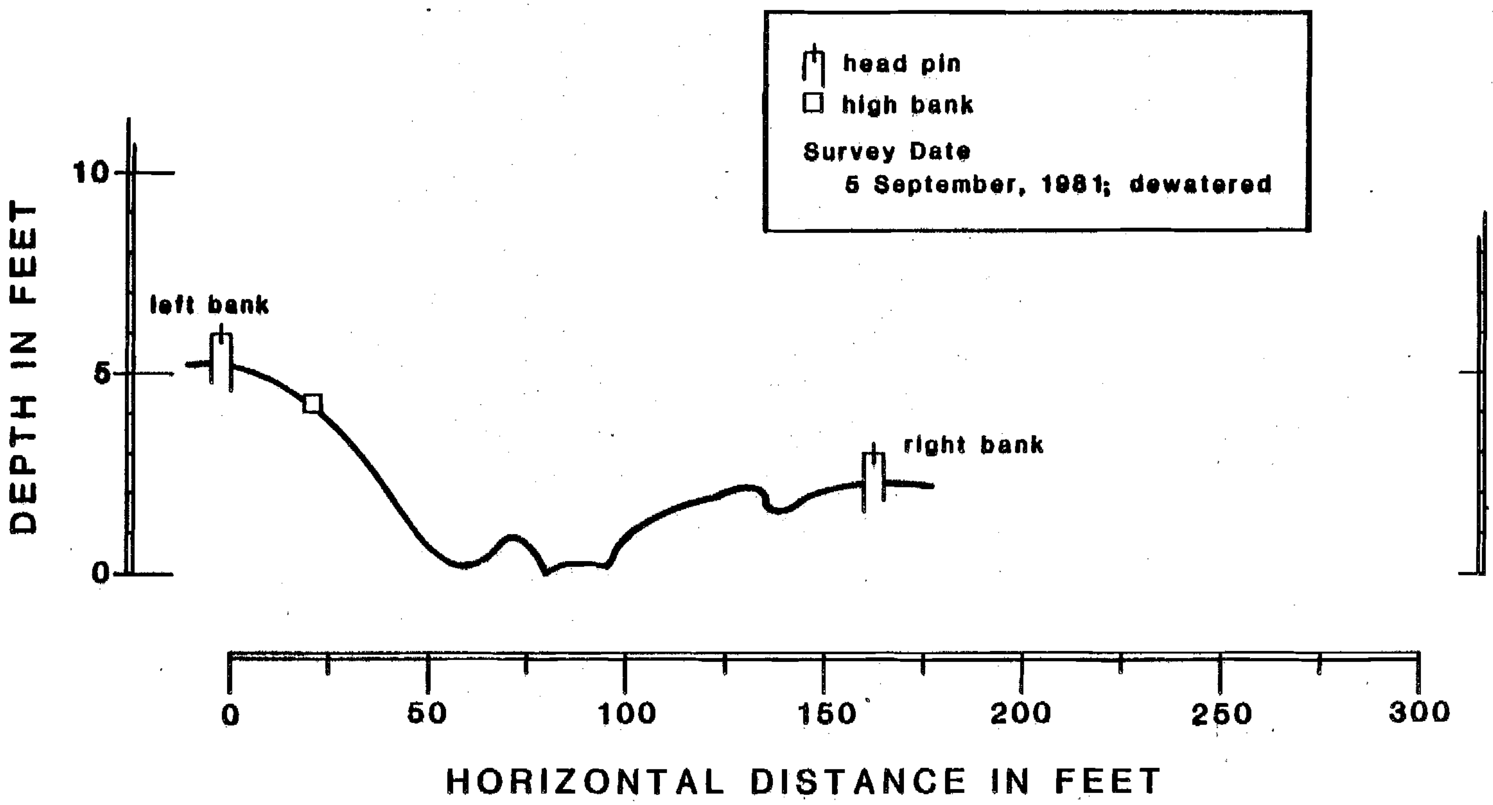


Figure E.5.134
CROSS-SECTIONAL PROFILE OF SLOUGH 21, TRANSECT #1.
(1 vertical foot equals 10 horizontal feet)

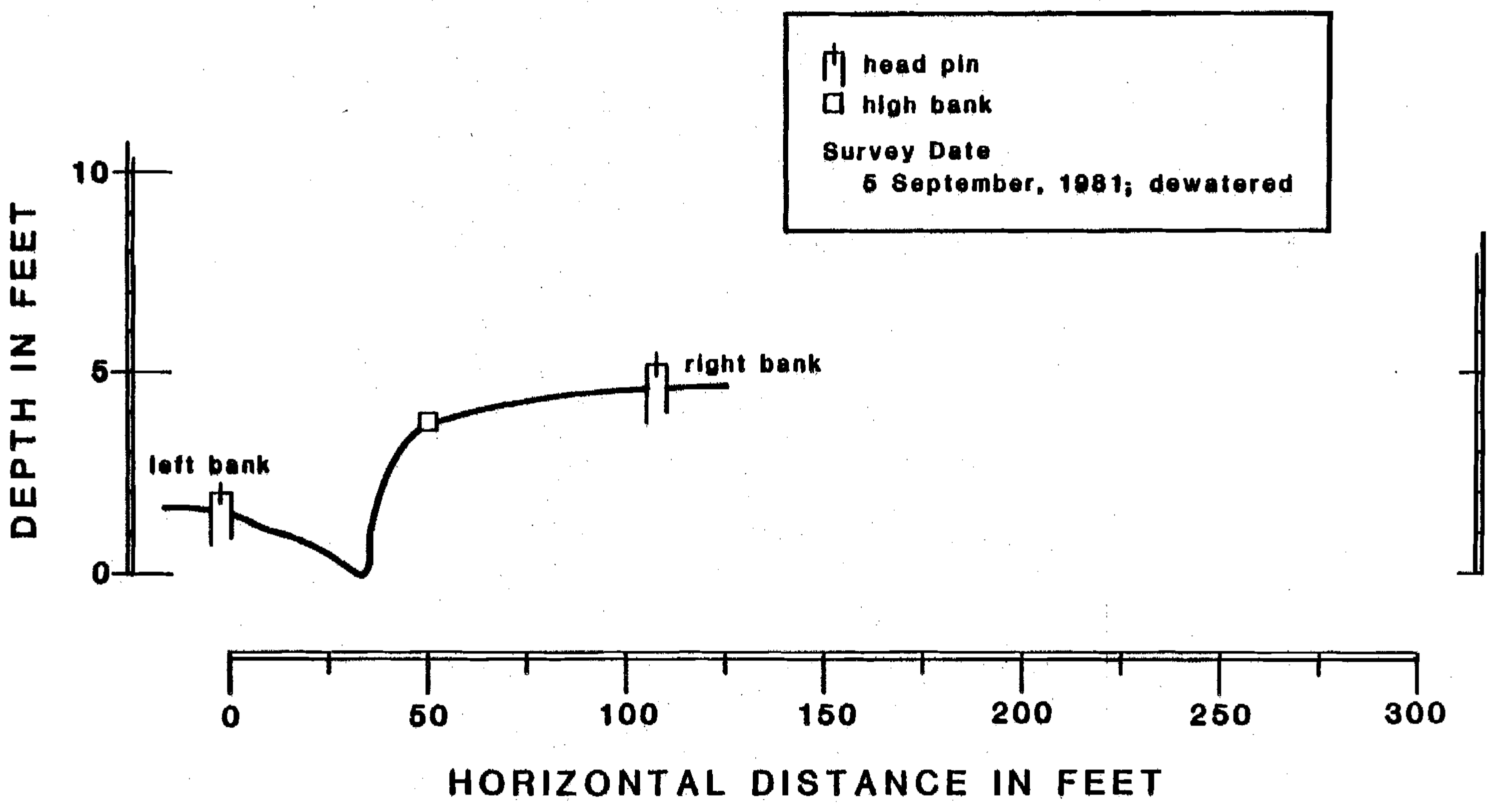


Figure E.5.135
CROSS-SECTIONAL PROFILE OF SLOUGH 21, TRANSECT #1-A.
(1 vertical foot equals 10 horizontal feet)

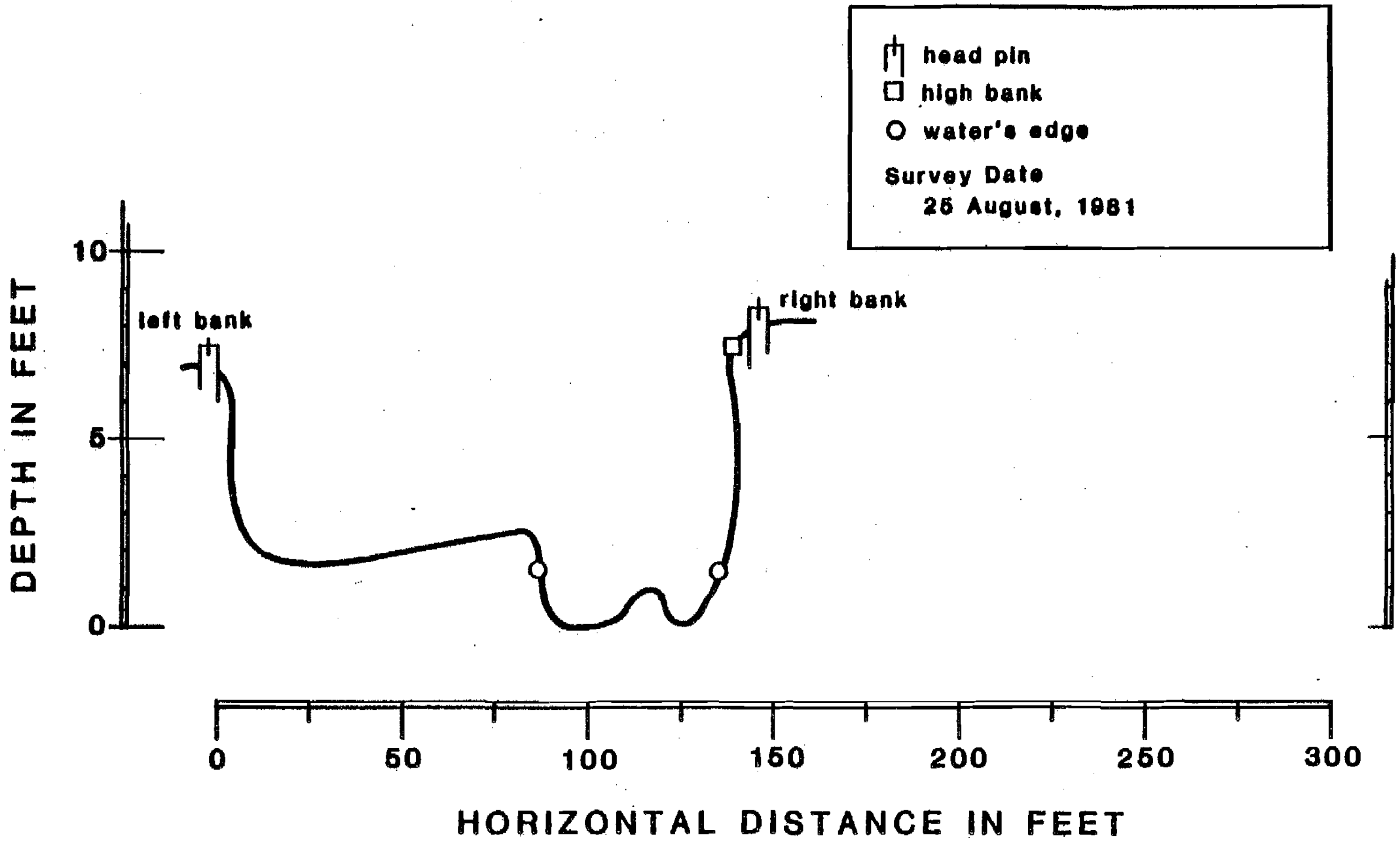


Figure E.5.136
CROSS-SECTIONAL PROFILE OF SLOUGH 21, TRANSECT #13.
(1 vertical foot equals 10 horizontal feet)

CANNOT
BE SCANNED

Figure E.5.90.
Susitna River drainage.
Thermograph and staff
gage sites 1981.

Table E.5.7. Selected habitat study hydraulic data.

Slough 8A	Slough Gage	Mainstem Gage	Slough Discharge (cfs)	Mainstem at Gold Creek Discharge (cfs)
6/25/81	N/A[1]	N/A	6.36	17,100
7/21/81	N/A	N/A	551.0	40,800
9/30/81	.56	N/A	2.76	N/A
10/9/81	.53	N/A	N/A	10,100
10/10/81	.52	N/A	N/A	9,700

Slough 9	Slough Gage	Mainstem Gage	Slough Discharge (cfs)	Mainstem at Gold Creek Discharge (cfs)
6/24/81	N/A	N/A	2.86	16,600
7/21/81	N/A	N/A	714.0	40,800
9/30/81	.70	N/A	1.46	N/A
10/12/81	.68	N/A	N/A	8,160
10/13/81	.69	N/A	N/A	7,620
10/14/81	.70	N/A	3.87-transect 5	7,290
10/14/81	.70	N/A	1.17-transect 3	7,290
10/15/81	.70	N/A	N/A	7,440

Slough 16B	Slough Gage	Mainstem Gage A	Mainstem Gage B	Slough Discharge (cfs)	Mainstem at Gold Creek Discharge (cfs)
6/23/81	1.16	1.66	N/A	.671	16,500
7/22/81	2.22	1.90	N/A	503.0	35,900
9/9/81	1.10[2]	1.02[2]	N/A	.62	14,500
9/10/81	1.10	1.02	N/A	N/A	14,200
9/16/81	1.07	.13	N/A	N/A	11,300
9/17/81	1.06	.13	1.44[3]	N/A	11,300
9/18/81	1.06	.13	1.26	.56	10,800
9/24/81	1.06	N/A	1.16	N/A	10,400
9/27/81	1.03	N/A	.52	N/A	8,890
9/28/81	1.03	N/A	.46	.325	N/A
9/29/81	1.02	N/A	.30	N/A	N/A

Table E.5.7. (Continued)

Slough 19	Slough Gage	Mainstem Gage A	Mainstem Gage B	Slough Discharge (cfs)	Mainstem at Gold Creek Discharge (cfs)
6/23/81	2.0	N/A	N/A	.227 transect 5	16,500
7/22/81	3.33+1.29	N/A	N/A	0.000 transect 5	35,900
8/5/81	3.33+ .95	2.76	N/A	N/A	32,300
8/25/81	3.33+ .56	N/A	N/A	N/A	28,600
9/6/81	N/A	1.12			15,700
9/15/81	1.16	.54	N/A	N/A	11,800
9/18/81	1.10	.34	N/A	N/A	10,800
9/24/81	1.10	.28	N/A	N/A	10,400
9/25/81	1.10	.24	N/A	.29 transect 1	10,100
9/26/81	1.09	.13	N/A	.26 transect 1	9,560
9/27/81	1.07	0.00	1.71[3]	N/A	8,890
9/28/81	1.06	N/A	N/A	N/A	N/A
9/29/81	1.07	N/A	1.59	.23 transect 1	N/A
9/29/81	N/A	N/A	N/A	.038 transect 5	N/A

Slough 21	Slough Gage	Mainstem Gage	Slough Discharge (cfs)	Mainstem at Gold Creek Discharge (cfs)
6/23/81	N/A	N/A	3.2 near transect 8	16,500
6/24/81	1.40	2.03	---	16,600
7/22/81	2.05[3]	N/A	142.0 near transect 10	35,900
7/23/81	---	3.3+.2[3]	---	33,700
8/5/81	2.50[3]	3.0	---	32,300
8/27/81	N/A	N/A	.56 tributary	24,200
8/27/81			2.10-transect 5A	24,200
8/27/81			5.12-transect 7	24,200
9/5/81	N/A	N/A	6.3-transect 11	16,000
9/6/81	1.13	1.83		15,700
9/15/81	1.07	.86		11,800
9/17/81	1.06	.76		11,300
9/24/81	1.04	.49		10,400
9/29/81	1.01	N/A	.428 near transect 6	N/A
9/29/81	N/A	N/A	2.57-transect 11	

1 N/A - Data not available.
2 New gage, previous gages were washed out.
3 Two gages were used as the mainstem water level was dropping. Gage B was located parallel to A but further offshore.

5.2.2.4 Physiochemical Data

Water Quality

Provisional water quality data for the sloughs and mainstem Susitna River at the Gold Creek USGS gaging station for June, July, and September 1981 have been obtained from the USGS. These provisional data are presented in Table E.5.8. A portion of the September 1981 sediment data for the mainstem Susitna at Gold Creek are not presently available.

Thermographs

Two sets of thermographs were installed to obtain surface water and intragravel temperature data. The instruments installed in Slough 19 were removed by a bear; thus, only one set of data was obtained. The data illustrate diurnal temperature fluctuations, ranging from 4.5 - 8.5°C, of the surface water and a constant temperature (3.0°C) of the intragravel water. The intragravel temperatures were consistently 2°C below the lowest temperature of the surface water (see Figure E.5.137).

Table E.5.8. USGS provisional water quality data summary

Parameter	Date[a]	Slough 8A	Slough 9	Slough 16B	Slough 19	Slough 21	Susitna River at Gold Creek
Physical and Field Parameters							
*Water Temperature[b] °C	June	15.5	14.2	14.0	--[c]	10.7	--
	July	11.2	10.9	9.0	9.8	11.3	10.5
	Sept.	3.5	5.6	4.8	1.8	2.4	.4
Air Temperature °C	June	21.0	20.1	--	--	23.0	--
	July	16.0	14.0	15.5	--	--	--
	Sept.	8.0	7.5	--	3.0	--	--
Streamflow (discharge) cfs	June	6.4	2.9	.67	.23	3.2	16,800
	July	551.0	714.0	503.0	.00	142.0	42,500
	Sept.	2.8	1.5	.32	.04	.43	8,540
*Specific Conductance field umho/cm	June	140	145	71	146	226	--
	July	117	124	72	127	130	--
	Sept.	135	113	64	150	205	172

[a] Sloughs were sampled on 3 consecutive days in each month as follows:

	8A	9	16B	19	21
June	25	24	23	23	24
July	21	21	22	22	22
Sept	30	30	28	29	29

[b] Parameters marked with an * are averages of transect point measurements.

[c] -- data not available.

Table E.5.8 (Continued)

Parameter	Date	Slough 8A	Slough 9	Slough 16B	Slough 19	Slough 21	Susitna River at Gold Creek
Specific Conductance Lab umho/cm	June	153	158	70	143	233	141
	July	118	124	71	132	132	114
	Sept.	132	113	64	162	217	170
*Dissolved Oxygen mg/l	June	10.8	10.6	10.8	9.4	10.7	10.8
	July	11.4	11.4	11.7	10.4	11.3	11.7
	Sept.	12.1	11.3	11.5	9.5	10.3	--
*Percent D.O. saturation	June	108	103	107	76	98	104
	July	104	105	102	90	105	104
	Sept.	94	93	88	98	76	--
*pH (field)	June	6.9	6.8	6.4	6.5	7.0	7.4
	July	--	--	--	--	--	7.7
	Sept.	7.6	7.4	7.1	7.3	7.7	6.5
pH (lab)	June	7.4	7.5	7.2	7.2	7.6	7.5
	July	7.6	7.7	7.3	7.0	7.7	7.7
	Sept.	7.4	6.7	6.6	7.2	7.0	7.2
Alkalinity (field) mg/l $CaCO_3$	June	--	39	24	50	62	--
	July	41	39	24	52	47	35
	Sept.	43	34	26	62	62	--
Alkalinity (lab) mg/l $CaCO_3$	June	47	33	24	52	63	45
	July	41	39	24	52	47	35
	Sept.	42	36	26	62	61	44
Turbidity NTU	June	.90	.60	.50	.40	.40	100
	July	130	130	43	2.5	150	170
	Sept.	1.1	.60	.60	.50	.50	5.5

Table E.5.8 (Continued)

Parameter	Date	Slough 8A	Slough 9	Slough 16B	Slough 19	Slough 21	Susitna River at Gold Creek
Sediments, suspended mg/l	June	1	2	1	1	5	327
	July	*220	*417	*107	8	*356	--
	Sept.	1	1	1	2	4	--
Sediments, discharge suspended tons/day	June	.02	.02	0	0	.04	14,800
	July	327	804	145	0	136	--
	Sept.	0	0	0	0	0	--
Solids, residue at 180°C mg/l	June	88	100	51	94	137	79
	July	70	75	41	81	78	74
	Sept.	82	69	42	95	119	101
Solids, sum of constituents mg/l	June	93	91	47	90	130	83
	July	61	68	43	89	68	65
	Sept.	71	71	48	94	120	80
Solids, dissolved tons/day	June	1.5	.78	.09	.06	1.1	3,580
	July	104	145	55.7	.0	29.9	8,490
	Sept.	.62	.28	.04	.01	.14	2,330
Solids, dissolved tons/acre-foot	June	.12	.14	.07	.13	.19	.11
	July	.10	.10	.06	.11	.11	.10
	Sept.	.11	.09	.06	.13	.16	.14
Percent suspended sedument fewer than .062 mm sieve diameter.	June	--	--	--	--	--	70
	July	*84	*55	*54	--	*81	--
	Sept.	--	--	--	--	--	--

Table E.5.8 (Continued)

Parameter	Date	Slough 8A	Slough 9	Slough 16B	Slough 19	Slough 21	Susitna River at Gold Creek
Major Constituents							
Hardness mg/l $CaCO_3$	June	57	56	32	69	83	57
	July	48	50	30	61	54	51
	Sept.	54	45	30	72	77	60
Hardness, non-carbonate mg/l $CaCO_3$	June	10.0	23.0	8.0	17.0	20.0	12
	July	7.0	11.0	6.0	9.0	7.0	16
	Sept.	12.0	9.0	4.0	10.0	16.0	16
Bicarbonate, incremental titration mg/l $CaCO_3$	June	--	--	--	--	--	--
	July	--	--	--	--	--	--
	Sept.	53	42	32	75	75	--
Carbonate, incremental titration mg/l $CaCO_3$	June	--	--	--	--	--	--
	July	--	--	--	--	--	--
	Sept.	0	0	0	0	0	--
Calcium, dissolved mg/l	June	18	18	10	23	27	19
	July	16	17	10	20	18	17
	Sept.	17	14	9.4	24	25	19
Magnesium, dissolved mg/l	June	2.8	2.7	1.6	2.7	3.9	2.2
	July	1.9	1.9	1.3	2.6	2.1	2.1
	Sept.	2.8	2.4	1.6	3.0	3.5	3.0
Sodium, dissolved mg/l	June	6.8	8.2	2.5	2.5	12.0	4.4
	July	3.0	3.0	1.8	1.8	3.4	3.8
	Sept.	6.1	5.6	2.6	3.0	11.0	7.4
Sodium, percent mg/l	June	20	24	14	7	23	14
	July	12	11	11	6	12	13
	Sept.	19	21	15	8	23	21

Table E.5.8 (Continued)

Parameter	Date	Slough 8A	Slough 9	Slough 16B	Slough 19	Slough 21	Susitna River at Gold Creek
Sodium, adsorption ratio	June	.4	.5	.2	.1	.6	.3
	July	.2	.2	.1	.1	.2	.2
	Sept.	.4	.4	.2	.2	.5	.4
Potassium, dissolved mg/l	June	1.5	1.4	.9	1.0	2.1	2.0
	July	1.6	1.6	.9	1.6	1.9	1.6
	Sept.	1.1	.9	.9	1.1	2.1	1.5
Chloride, dissolved mg/l	June	9.1	16	1.3	.9	20	5.6
	July	2.9	2.9	.9	.6	3.7	12
	Sept.	7.7	6.9	1.5	.9	17.0	11
Sulfate, dissolved mg/l	June	11.0	9.0	4.7	13.0	14.0	17
	July	1.0	11.0	6.0	14.0	3.1	1.0
	Sept.	6.0	5.0	5.0	9.0	10.0	5.0
Fluoride, dissolved mg/l	June	.0	.1	.1	.1	.1	.0
	July	.0	.0	.1	.0	.0	.1
	Sept.	.1	.1	.1	.1	.1	.1
Silica, dissolved mg/l	June	9.7	11.0	10.0	10.0	11.0	5.5
	July	6.6	6.6	6.2	10.0	6.6	6.2
	Sept.	0.0	10.0	10.0	10.0	11.0	6.1

Table E.5.8 (Continued)

Parameter	Date	Slough 8A	Slough 9	Slough 16B	Slough 19	Slough 21	Susitna River at Gold Creek
Nutrients							
Nitrogen, total mg/l N	June	1.9	1.9	.92	2.3	.94	.54
	July	.76	.79	.75	2.1	.66	.52
	Sept.	1.7	1.7	.66	2.0	1.1	.62
Nitrogen, total mg/l NO_3	June	8.5	8.4	4.1	10.0	4.2	2.4
	July	3.4	3.5	3.3	9.3	2.9	2.3
	Sept.	7.4	7.3	2.9	9.0	4.9	2.7
Nitrogen, dissolved mg/l N	June	1.8	1.6	1.0	2.0	1.0	.48
	July	--	.68	--	2.2	.66	.55
	Sept.	1.5	1.7	.59	1.9	1.0	.60
Nitrogen, total organic mg/l N	June	.53	.82	.50	.88	.37	.34
	July	.40	.54	.31	.45	.44	.10
	Sept.	--	.41	.17	.44	.18	.28
Nitrogen, dissolved organic mg/l N	June	.45	.51	.55	.62	.49	.34
	July	.44	.48	--	.41	.43	.21
	Sept.	.36	.44	.10	.49	.19	.34
Nitrogen, dissolved ammonia mg/l N	June	.07	.11	.10	.10	.09	.08
	July	.10	.13	.13	.32	.14	.24
	Sept.	.15	.14	.16	.13	.11	.09
Nitrogen, dissolved ammonia mg/lNH_4	June	.09	.14	.13	.13	.12	.10
	July	.13	.17	.17	.41	.18	.31
	Sept.	.19	.18	.21	.17	.14	.12
Nitrogen, total ammonia mg/l N	June	.08	.10	.09	.07	.10	.14
	July	.15	.18	.15	.26	.13	.33
	Sept.	--	.15	.16	.19	.20	.17

Table E.5.8 (Continued)

Parameter	Date	Slough 8A	Slough 9	Slough 16B	Slough 19	Slough 21	Susitna River at Gold Creek
Nitrogen, ammonia + dissolved organics mg/l N	June	.52	.62	.65	.72	.58	.42
	July	.54	.61	--	.73	.57	.45
	Sept.	.51	.58	.26	.62	.30	.43
Nitrogen, ammonia + total suspended organics mg/l N	June	.09	.30	0	.23	0	.06
	July	.01	.11	--	0	0	0
	Sept.	.07	0	.07	.01	.08	.02
Nitrogen, ammonia + total organics mg/l N	June	.61	.92	.59	.95	.47	.48
	July	.55	.72	.46	.71	.57	.43
	Sept.	.58	.56	.33	.63	.38	.45
Nitrogen, total nitrate and nitrite mg/l N	June	1.3	.97	.33	1.3	.47	.06
	July	.21	.07	.29	1.4	.09	.09
	Sept.	1.1	1.1	.33	1.4	.73	.17
Nitrogen, dissolved nitrate and nitrite mg/l N	June	1.3	.99	.36	1.3	.45	.06
	July	--	.07	.33	1.5	.09	.10
	Sept.	1.0	1.1	.33	1.3	.72	.17
Phosphorus, total mg/l P	June	<.05	<.01	<.01	<.01	<.01	.12
	July	.27	.48	.14	<.01	.38	.02
	Sept.	<.01	<.01	<.01	<.01	<.01	.02
Phosphorus, total mg/l PO_4	June	.15	<.03	<.03	<.03	<.03	.37
	July	.83	1.5	.43	<.03	1.2	.06
	Sept.	--	--	--	--	--	.06
Phosphorus, dissolved mg/l P	June	.03	<.01	<.01	<.01	<.01	.02
	July	<.01	<.01	<.01	<.01	<.01	<.01
	Sept.	<.01	<.01	<.01	<.01	<.01	.01
Carbon, dissolved organic mg/l C	June	1.9	2.1	1.4	1.3	2.0	2.8
	July	13.0	9.0	3.3	6.2	6.0	18.0
	Sept.	1.5	1.7	1.9	2.2	1.1	--

Table E.5.8 (Continued)

Parameter	Date	Slough 8A	Slough 9	Slough 16B	Slough 19	Slough 21	Susitna River at Gold Creek
Carbon, total suspended organics mg/l C	June	--	.2	--	.2	.2	.9
	July	.2	.5	0	0	.3	--
	Sept.	.1	.1	.1	.1	.1	--

Table E.5.8 (Continued)

Parameter	Date	Slough 8A	Slough 9	Slough 16B	Slough 19	Slough 21	Susitna River at Gold Creek
Trace Metals							
Arsenic, total ug/l As	June	1	1	1	2	2	6
	July	2	5	4	1	5	7
	Sept.	2	1	1	2	2	--
Arsenic, total suspended ug/l As	June	0	0	0	1	1	5
	July	0	3	2	0	3	5
	Sept.	1	0	0	1	1	--
Arsenic, dissolved ug/l AS	June	2	1	1	1	1	1
	July	2	2	2	1	2	2
	Sept.	1	1	1	1	1	--
Barium, total recoverable ug/l Ba	June	0	0	0	0	100	200
	July	200	200	100	100	300	300
	Sept.	100	200	100	100	100	--
Barium, suspended recoverable ug/l Ba	June	0	0	0	0	100	200
	July	200	200	70	50	300	300
	Sept.	100	200	100	100	0	--
Barium, dissolved ug/l Ba	June	90	0	0	0	0	0
	July	40	40	30	50	40	0
	Sept.	0	0	0	0	100	--
Cadmium, total recoverable ug/l Cd	June	0	0	2	0	<1	0
	July	0	0	0	<1	0	5
	Sept.	0	0	0	0	<1	--
Cadmium, suspended recoverable ug/l	June	--	0	2	0	0	--
	July	--	--	--	--	--	4
	Sept.	0	0	0	0	<1	--

Table E.5.8 (Continued)

Parameter	Date	Slough 8A	Slough 9	Slough 16B	Slough 19	Slough 21	Susitna River at Gold Creek
Cadmium, dissolved ug/l Cd	June	<1	0	0	0	5	<1
	July	<1	<1	<1	<1	<1	<1
	Sept.	0	0	<1	0	0	--
Chromium, total recoverable ug/l Cr	June	0	10	0	0	0	40
	July	30	30	20	20	40	30
	Sept.	0	10	10	10	10	--
Chromium, suspended recoverable ug/l Cr	June	0	10	0	0	0	40
	July	20	20	10	10	30	20
	Sept.	0	10	10	10	10	--
Chromium, dissolved ug/l Cr	June	10	0	0	0	0	0
	July	10	10	10	10	10	10
	Sept.	0	0	0	0	0	--
Cobalt, total recoverable ug/l Co	June	2	0	0	0	2	8
	July	5	6	2	0	7	11
	Sept.	0	0	0	0	1	--
Cobalt, suspended recoverable ug/l	June	--	0	0	0	1	--
	July	--	--	--	--	--	11
	Sept.	0	0	0	0	1	--
Cobalt, dissolved ug/l Co	June	<3	0	0	0	1	<3
	July	<3	<3	<3	<3	<3	0
	Sept.	0	0	0	0	0	--
Copper, total recoverable ug/l Cu	June	3	2	4	2	2	31
	July	20	23	10	3	23	190
	Sept.	6	4	5	4	4	--
Copper, suspended recoverable ug/l Cu	June	1	1	1	0	0	27
	July	12	20	4	0	18	190
	Sept.	5	3	3	2	3	--

Table E.5.8 (Continued)

Parameter	Date	Slough 8A	Slough 9	Slough 16B	Slough 19	Slough 21	Susitna River at Gold Creek
Copper, dissolved ug/l Cu	June	2	1	3	2	2	4
	July	8	3	6	7	5	5
	Sept.	1	1	2	2	1	--
Iron, total recoverable ug/l Fe	June	20	40	50	40	60	15,000
	July	13000	16000	5800	220	18000	19,000
	Sept.	20	90	280	260	100	--
Iron, suspended recoverable ug/l Fe	June	10	0	0	0	40	15,000
	July	13000	16000	5700	140	18000	19,000
	Sept.	10	60	260	250	90	--
Iron, dissolved ug/l Fe	June	10	60	50	60	20	90
	July	48	110	52	79	97	120
	Sept.	10	30	20	10	10	--
Lead, total recoverable ug/l Pb	June	0	5	3	3	15	18
	July	3	3	3	3	2	47
	Sept.	4	1	1	2	4	--
Lead, suspended recoverable ug/l Pb	June	0	5	3	3	15	18
	July	0	1	3	2	0	47
	Sept.	2	0	0	0	0	--
Lead, dissolved ug/l Pb	June	0	0	0	0	0	0
	July	3	2	0	1	5	0
	Sept.	2	3	4	3	5	--
Manganese, total recoverable ug/l Mn	June	10	10	10	0	0	250
	July	230	290	100	20	300	320
	Sept.	0	0	10	10	0	--

Table E.5.8 (Continued)

Parameter	Date	Slough 8A	Slough 9	Slough 16B	Slough 19	Slough 21	Susitna River at Gold Creek
Manganese, suspended recoverable ug/l Mn	June	0	10	10	0	0	250
	July	220	280	90	10	290	310
	Sept.	0	0	10	0	0	--
Manganese, dissolved ug/l Mn	June	10	0	0	0	0	4
	July	8	10	7	9	8	10
	Sept.	0	0	0	10	0	--
Mercury, total recoverable ug/l Hg	June	.1	.1	.1	.1	.2	.4
	July	.1	.1	.1	0	.2	.3
	Sept.	.1	0	0	0	0	--
Mercury, suspended recoverable ug/l Hg	June	.1	.1	.1	.1	.2	.4
	July	0	.1	0	0	.2	.1
	Sept.	.1	0	0	0	0	--
Mercury, dissolved ug/l Hg	June	0	0	0	0	0	0
	July	.1	0	.1	0	0	.2
	Sept.	0	0	0	0	0	--
Nickel, total recoverable ug/l Ni	June	3	2	2	1	6	23
	July	14	18	6	2	18	29
	Sept.	1	0	7	3	4	--
Nickel, suspended recoverable ug/l Ni	June	2	2	1	0	1	23
	July	12	18	6	0	17	29
	Sept.	1	0	7	3	4	--
Nickel, dissolved ug/l Ni	June	1	0	1	1	5	0
	July	2	0	0	3	1	0
	Sept.	0	0	0	0	0	--

Table E.5.8 (Continued)

Parameter	Date	Slough 8A	Slough 9	Slough 16B	Slough 19	Slough 21	Susitna River at Gold Creek
Selenium, total ug/l Se	June	0	0	0	1	1	0
	July	0	0	0	0	0	0
	Sept.	0	0	0	0	0	--
Selenium, total suspended ug/l Se	June	0	0	0	0	1	0
	July	0	0	0	0	0	0
	Sept.	0	0	0	0	0	--
Selenium, dissolved ug/l Se	June	0	0	0	1	0	0
	July	1	0	0	1	0	0
	Sept.	0	0	0	1	1	--
Silver, total recoverable ug/l Ag	June	0	0	1	0	0	0
	July	0	0	0	1	0	0
	Sept.	0	0	0	0	0	--
Silver, suspended recoverable ug/l Ag	June	0	0	1	0	0	0
	July	0	0	0	1	0	0
	Sept.	0	0	0	0	0	--
Silver, dissolved ug/l Ag	June	0	0	0	0	0	0
	July	0	0	0	0	0	0
	Sept.	0	0	0	0	0	--
Zinc, total recoverable ug/l Zn	June	20	40	10	10	10	60
	July	80	60	20	10	60	120
	Sept.	20	30	30	10	20	--
Zinc, suspended recoverable ug/l Zn	June	10	30	0	0	10	50
	July	80	30	10	0	40	110
	Sept.	10	10	0	10	0	--
Zinc, dissolved ug/l Zn	June	7	10	10	10	0	6
	July	4	35	10	10	17	10
	Sept.	10	20	30	0	20	--

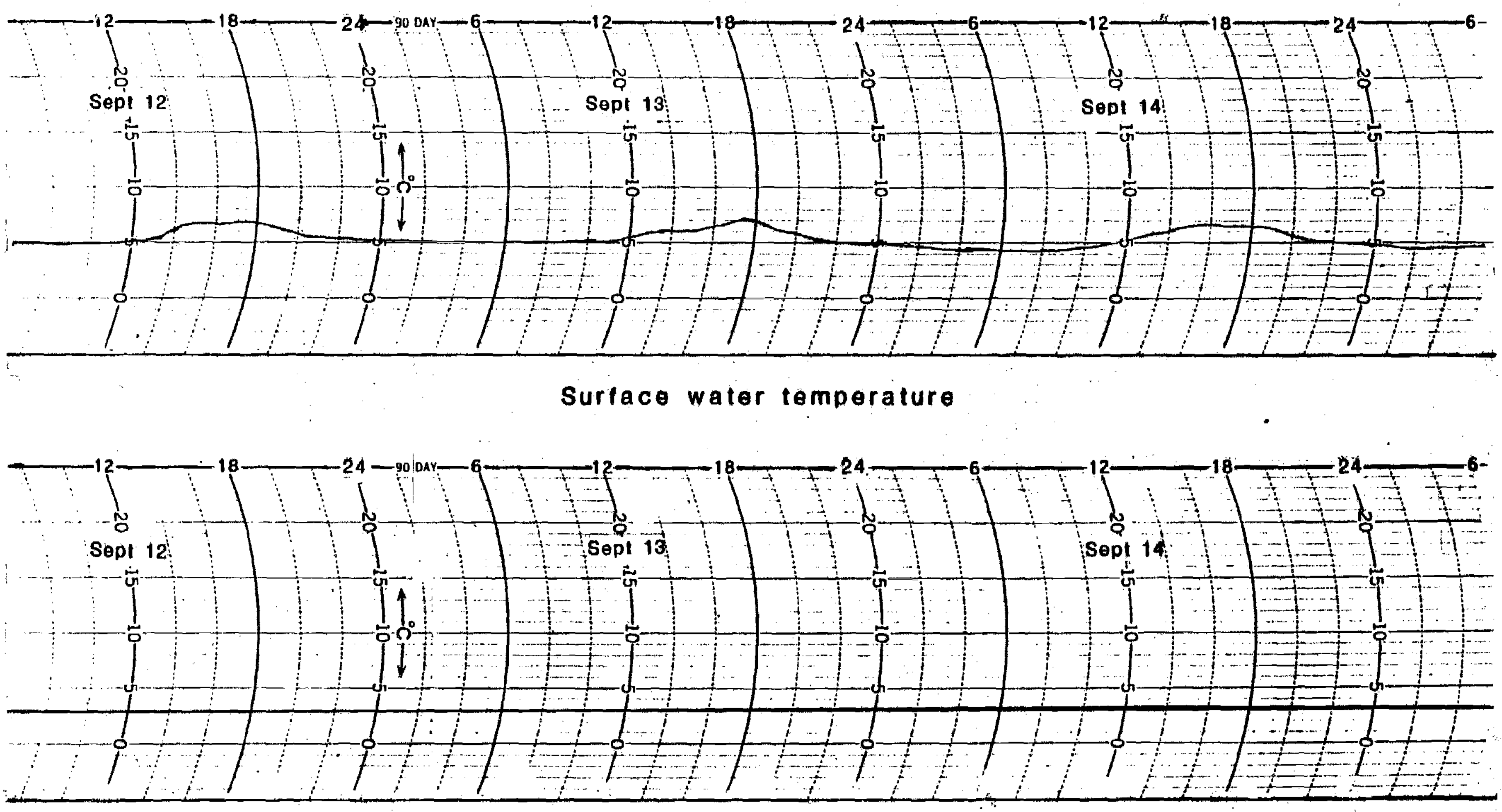


Figure E.5.140 Comparison of intragravel and surface water temperatures in Slough 21.

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