ALASKA DEPARTMENT OF FISH AND GAME
SUSITNA HYDRO AQUATIC STUDIES

REPORT NO. 3, PART I, Chapter 3

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

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FORWARD

Part I, "Basin-wide Hydrologic and Water Quality Investigations", is a compilation of the physical and chemical data collected by the ADF&G Su Hydro Aquatic Studies team during the FY 84 open water field season (May-October, 1983). In certain cases, the the 1983 data bases have been combined with the ADF&G 1981 and 1982 data bases, along with other data bases from other subcontractors (R&M Consultants and AEIDC) in order to present a most up to complete listing of currently available data. These data are arranged by data type for ease of use by user agencies.

P. I is divided into five chapters:

Chapter 1 Stage/discharge investigations of the Susitna River basin.

Chapter 2 Channel geometry investigations of the Susitna River basin.

Chapter 3 Continuous water temperature investigations of the Susitna River basin.

Chapter 4 Water quality ivestigations of the Susitna River basin.

Chapter 5 Dissolved gas concentration investigations of the Susitna River basin.

GLOSSARY FOR PART I OF REPORT # 3

Backwater Area - A body or accumulation of water with little or no velocity resulting from a hydraulic (e.g. mainstem discharge) or physical (e.g. beaver dam) barrier which occurs at the mouth of or within a side channel or slough.

Berm - The ledge or shelf at the head of a side slough or side channel that separates the side slough or channel from the mainstem Susitna River or other side channels.

Breaching - Any of the three conditions of overtopping of the head of a side channel or side slough (see also initial, intermediate, and controlling breaching discharges).

Controlling Breaching Discharge - The breaching condition in which mainstem discharges at Gold Creek are equal to or greater than the mainstem discharge required to directly govern the hydraulic characteristics within a side slough or side channel. This condition can be denoted as equalling the segment of the flow rating curve beginning with the point of inflection and beyond.

Cross Section Profile - A profile describing the cross sectional geometry of a channel.

Datapod - An instrument used to continuously measure and record various enviornmental variables e.g. air or water temperature, stage, and dissolved gas concentration (refer to Chapters 1, 2 and 5).

Discharge - Water volume passing a fixed location at a specific point in time. The term specifically refers to the moving water in the mainstem habitat.

DSM - Data Storage Module used in the datapod system to store data (refer to Chapters 1 and 2).

Flow - Water volume passing a specific location at a specific point in time. The term specifically refers to moving water in side channel, side slough, upland slough, tributary mouth, and tributary habitats.

Gaging Station - A station at a site which has been established for monitoring stage, flow and/or discharge.

Gradient - Rate of change in vertical elevation per unit horizontal distance.

Head - The upstream confluence or point of origin of a lotic water body.

Inflection Point - The point on a rating curve at which the line describing the data changes slope.

Initial Breaching Discharge - The mainstem discharge at Gold Creek which represents the initial point when mainstem water begins to enter the upstream head (berm) of a side slough or channel.

Intermediate Breaching Discharge - The range of mainstem discharges at Gold Creek representative of the conditions between the Initial and Controlling Breaching Discharges. This range occurs from immediately after mainstem surface water begins to overtop the upstream head (berm) of a side slough or side channel up to the point when the mainstem discharge begins to govern the hydraulic characteristics of the site.

Mainstem Habitat - Consists of those portions of the Susitna River that normally convey water throughout the year. Both single and multiple channel reaches are included in this habitat category. Groundwater and tributary inflow appear to be inconsequential contributors to the overall characteristics of mainstem habitat. Mainstem habitat is typically characterized by high water velocities and well armored streambeds. Substrates generally consist of boulder and cobble size materials with interstitial spaces filled with a grout-like mixture of small gravels and glacial sands. Suspended sediment concentrations and turbidity are high during summer due to the influence of glacial melt-water. Discharges recede in early fall and the mainstem clears appreciably in October. An ice cover forms on the river in late November or December.

Mean Daily Discharge - The computed mean discharge per 24 hour period for a gaging station. All USGS discharge data are in this format.

Monitoring Station - A station set up for the collection of a particular data base.

Mouth - The downstream confluence of one or more water bodies with another water body.

Overtopping - See breaching.

Peripheral Habitats - Aquatic habitats peripheral to the mainstem Susitna River habitat (e.g. side channel, side slough, upland slough, tributary mouth and/or tributary habitats.

Pool - A portion of a water course that is relatively deep and slow-moving in comparison to the rest of the water course.

Project Datum - A series of elevations tied to sea level that are used by project personnel to tie relative data bases together.

Rating Curve - A curve that is constructed from data representing two dependent variables (e.g. stage, flow or discharge data) that describes the relationship between the two variables at a site.

Riffle - A portion of a water course that is relatively shallow and fast-running in comparison to the rest of the water course.

Side Channel Habitat - Consists of those portions of the Susitna River that normally convey water during the open water season but become appreciably dewatered during periods of low mainstem discharge. Side channel habitat may exist either in well defined overflow channels, or in poorly defined water courses flowing through partially submerged gravel bars and islands along the margins of the mainstem river. Side channel streambed elevations are typically lower than the mean monthly water surface elevations of the mainstem Susitna River observed during June, July and August. Side channel habitats are characterized by shallower depths, lower velocities and smaller streambed materials than the adjacent habitat of the mainstem river.

Side Slough Habitat - is located in overflow channels between the edge of the floodplain and the mainstem and side channels of the Susitna River. It is usually separated from the mainstem and/or side channels by well vegetated bars. An exposed alluvial berm often separates the head of the slough from mainstem discharge or side channel flows. The controlling streambed/bank elevations at the upstream end of the side sloughs are slightly less than the water surface elevations of the mean monthly discharges of the mainstem Susitna River observed for June, July, and August. At intermediate and low-discharge periods, the side sloughs convey clear water from small tributaries and/or upwelling groundwater. These clear water inflows are essential contributors to the existence of this habitat type. The water surface elevation of the Susitna River generally causes a backwater to extend well up into the slough from its lower end. Even though this substantial backwater exists, the sloughs function hydraulically very much like small stream systems and several hundred feet of the slough channel often conveys water independent of mainstem backwater effects. At high discharges the water surface elevations of the mainstem river is sufficient to overtop the upper end of the slough. Surface water temperatures in the side sloughs during summer months are principally a function of air temperature, solar radiation, and the temperature of the local runoff.

Staff Gage - A device used to instantaneously monitor stage at a site.

Stage - A measure of water depth which can be converted to water, surface elevation when surveyed to a benchmark at a site. It can be converted to true water surface elevation if it is tied into project datum.

Thalweg Profile - A longitudinal profile that describes the streambed elevation of the deepest portion or middle of mainstem, tributary, slough or other riverine habitats.

Tributary Habitat - consists of the full complement of hydraulic and morphologic conditions that occur in the tributaries. Their seasonal flow, sediment, and thermal regimes reflect the integration of the hydrology, geology, and climate of the tributary drainage. The physical attributes of tributary habitat are not dependent on mainstem conditions.

Tributary Mouth Habitat - extends from the uppermost point in the tributary influenced by mainstem Susitna River or slough backwater effects to the downstream extent of the tributary plume which extends into the mainstem Susitna River or slough.

Turbid - The condition of water quality at a site when water clarity is decreased by inorganic and/or organic suspended materials. Turbidity levels often exceed 50 NTU's.

Upland Slough Habitat - differs from side slough habitat in that the upstream end of the slough does not interconnect with the surface waters of the mainstem Susitna River or its side channels even at high mainstem discharges. These sloughs are characterized by the presence of beaver dams and an accumulation of silt covering the substrate resulting from the absence of mainstem scouring discharges.

Water Surface Elevation - The elevation of the water surface.

WSEL - See water surface elevation.

Continuous Water Temperature Investigations of the Susitna River Basin

1984 Report No. 3, Chapter 3

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ABSTRACT

(To be completed)

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1.0 INTRODUCTION

1.1 Background

The Alaska Department of Fish and Game (ADF&G) Su-Hydro Aquatic Feasibility Study Team has collected surface and intragravel water temperature data on a continuous basis at selected locations throughout the Susitna River Basin since 1981. The primary intent of the data collection effort has been to characterize the seasonal intragravel and surface water temperature regimes of the mainstem Susitna River and its peripheral side channel, side slough, upland slough, tributary mouth, and tributary habitats. Although temperature data has been collected at monitoring stations from the Estuary (RM 4.5) to above the Oshetna River (RM 235.7), the monitoring effort has been concentrated on the reach of the river from the Parks Highway Bridge (RM 83.9) to the Oshetna River (RM 233.4). Results of these investigations have been used by project biologists in evaluating the effects of intragravel and surface water temperature on fish and fish habitats, and by project engineers in validating or calibrating various temperature related models.

1.2 FY 84 Objectives

The overall objective of the continuous temperature monitoring program conducted during the 1983 open water field season was to further characterize the baseline seasonal surface and intragravel water temperature regimes of mainstem and peripheral side channel, side slough, upland slough, and tributary habitats of the Susitna River Basin. This information will be used to evaluate the influences that seasonal water temperatures have on biological activity in these various habitats and to support reservoir and mainstem temperature modeling studies. Both surface and/or intragravel water temperatures were collected during the 1983 open water field season, with surface water temperature being collected at all sites and intragravel water temperature being collected only at selected sites.

2.0 METHODS

2.1 Site Selection

Locations of temperature monitoring stations established in the mainstem and its peripheral side channel, side slough, upland slough, tributary mouth, and tributary habitats during the FY 84 open water field season (May - October, 1984) are presented in Table 3-1 and Figure 3-1. Specific locations of monitoring stations within each habitat were chosen primarily to provide water temperature data representative of the area.

2.1.1 Mainstem Habitats

Temperature monitoring stations were established at 21 locations in the mainstem Susitna River from river mile 4.5 to river mile 235.7 to provide baseline continuous surface and intragravel temperature data to:

1. project biologists for use in evaluating the effect of surface water and intragravel temperature on the various fish resource and

2. project engineers for use in validating/calibrating various mainstem surface water temperature and groundwater models.

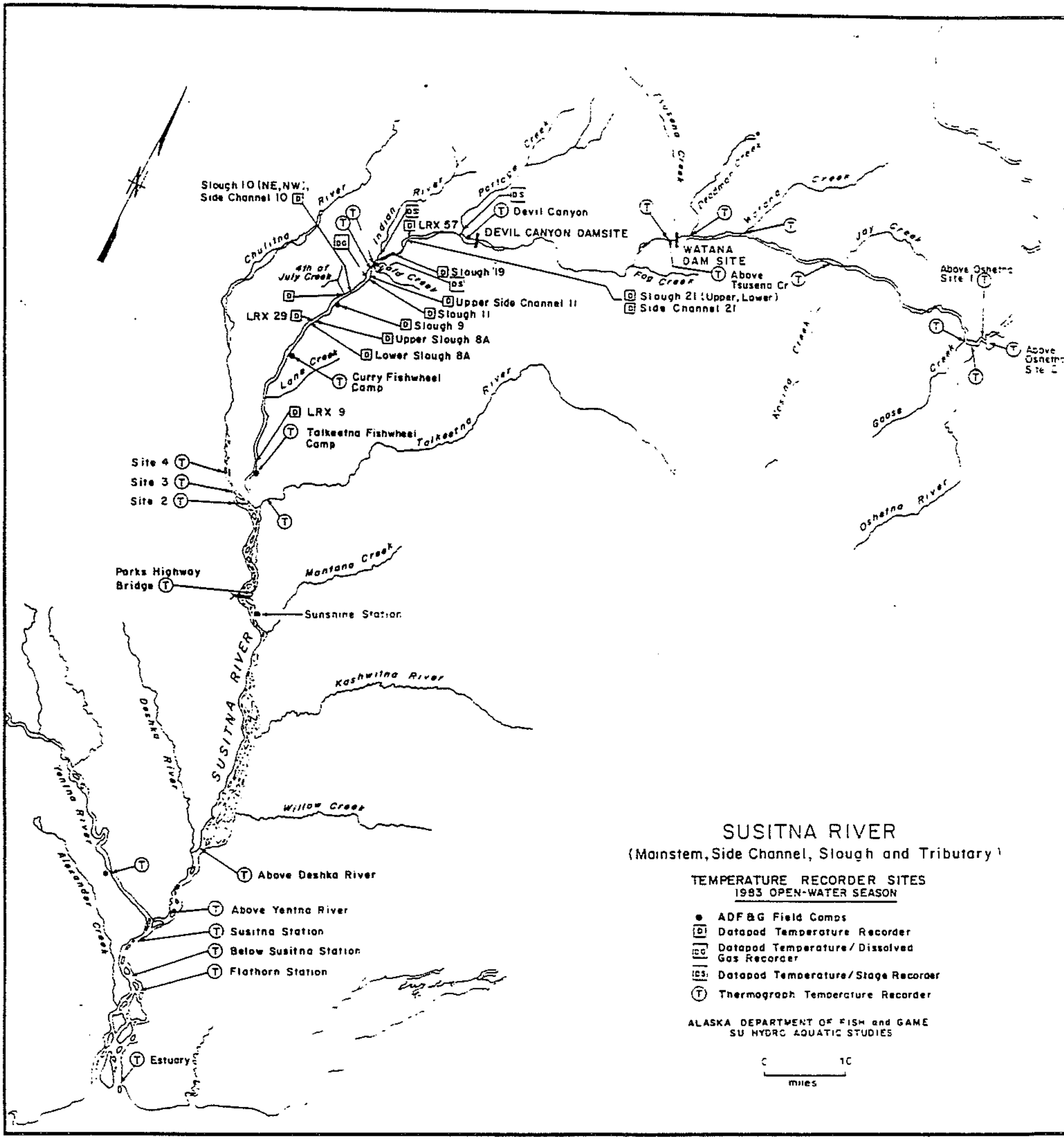

Figure 3-1 Location of temperature monitoring stations in mainstem, side channels, slough, and tributary habitats of the Susitna River during the 1983 open water season.

Table 3-1. Continuous temperature monitoring stations located in the Susitna River Basin during the 1983 open water season.

Mainstem Susitna River	River Mile	Temperature Data Type*[1]
Estuary	4.5	S
Flathorn Station	18.2	S
Below Susitna Station	20.5	S
Susitna Station	25.8	S
Above Yentna River	29.5	S
Above Deshka River	41.1	S
Parks Highway Bridge	83.9	S
Talkeetna Fishwheel Camp	103.0	S
LRX 9 (Sites 1 and 2)	103.2	S, I
Curry Fishwheel Camp	120.7	S
LRX 29	126.1	S, I
Below Gold Creek	135.8	S
Gold Creek Bridge (Site of old USGS recorder)	136.6	S
Above Gold Creek	136.8	S
LRX 57 (Sites 1 and 2)	142.3	S, I
Devil Canyon	150.1	S
Above Tsusana Creek	181.9	S
Above Oshetna River Site 1	234.9	S
Site 2	235.7	S
Side Channel		
10	133.9	S, I
Upper 11 (Sites 1 and 2)	136.3	S, I
21 (Sites 1 and 2)	141.0	S, I

[1] S = Continuous surface water temperature,
I = Continuous intragravel water temperature.

Table 3-1. (Continued)

Slough	River Mile	Temperature Data Type*[1]
Lower 8A (Sites 2 and 3)	125.6	S, I
Upper 8A (Site 2)	126.6	S, I
9 (Site 3)	128.6	S, I
10 (Northeast & Northwest Channels)	134.0	S, I
11 (Site 2)	136.3	S, I
19	140.0	S, I
Lower 21 (Site 2)	141.8	S, I
Upper 21	142.0	S, I
Tributary		
Yentna River Site 2 TRM 4.0	28.0	S
Talkeetna River Site 2 TRM 1.5	97.2	S
Chulitna River Site 2 TRM 0.6	98.6	S
Site 3 TRM 2.4		S
Site 4 TRM 4.4		S
Fourth of July Creek & Plume	131.3	I
Gold Creek Site 2 TRM 0.2	136.7	S
Indian River Site 2 TRM 1.0	138.6	S
Portage Creek Site 2 TRM 0.2	148.8	S
Tsusena Creek TRM 0.1	191.8	S
Deadman Creek TRM 0.1	186.7	S
Watana Creek TRM 0.1	194.1	S
Kosina Creek TRM 0.1	206.8	S
Goose Creek TRM 0.1	231.3	S
Oshetna River TRM 0.1	233.4	S

[1] S = Continuous surface water temperature,
I = Continuous intragravel water temperature.

2.1.2 Side Channel Habitats

Intragravel and surface water temperature monitoring stations were established at three side channel sites (Side Channel 10, Upper Side Channel 11 and Side Channel 21). These sites provided temperature data to support fishery studies and to determine relationships between intragravel and surface water temperatures.

2.1.3 Side and Upland Slough Habitats

Intragravel and surface water temperature monitoring stations were established in four side sloughs (8A, 9, 11, and 21) and two upland sloughs (10 and 19) temperature data was recorded to continue the data record, (Appendix Table 3-A-1), to determine relationships between intragravel and surface water temperatures, and/or to support fishery studies.

2.1.4 Tributary Habitats

Surface water temperature monitoring stations were established in the Chulitna, Talkeetna, Indian, and Oshetna Rivers, and Goose, Kosina, Watana, Deadman, Tsusena, Portage, and Gold Creeks to monitor stream temperatures that influence the surface water temperature regime of the mainstem Susitna River. Surface water temperatures were recorded in the Yentna River to continue the baseline record data base. An intragravel temperature monitoring station was established in Fourth of July Creek to support the ADF&G SuHydro incubation study.

2.2 Field Data Collection

Water temperatures were continuously recorded using either Peabody Ryan model J-90 submersible thermographs, or Omnidata two channel datapod recorders. The Peabody Ryan thermographs were used only at monitoring stations where surface water temperature alone was recorded. The two channel datapods were used at monitoring stations where intragravel and surface water temperatures were simultaneously recorded. Two channel datapods were also used at sites where surface water temperature was monitored in association with stage or dissolved gas.

2.2.1 Peabody Ryan Temperature Recorders (Thermographs)

The Peabody Ryan model J-90 temperature recorders (thermographs) continuously record temperatures on a 90-day strip chart. Instrument accuracy, as stated by the manufacturer, is ±0.6°C. Prior to field installation, each instrument was screened at two temperatures (0° and between 10-16°C) using a calibrated American Society for Testing and Manufacturing (ASTM) thermometer as a standard. Thermographs found in error by more than 2°C at either screening temperature were returned to the manufacturer for calibration.

Field installation procedures are outlined in the FY 84 ADF&G Su Hydro Aquatic Studies (May, 1983 - June, 1984) Procedures Manual (ADF&G 1983d).

Temperatures are measured approximately two inches above the streambed. All thermographs were checked twice each month to ensure accuracy and to detect malfunctioning instruments. Each time the thermographs were checked an instantaneous water temperature measurement was taken using a calibrated Brooklyn thermometer (accuracy ±0.1°C).

2.2.2 Omnidata Temperature Recorders (Datapods)

Omnidata model DP 2321 two channel temperature recorders (datapods) simultaneously record intragravel and surface water temperature using TP10V temperature probes. Instrument accuracy, as stated by the manufacturer, Omnidata International, is ±0.1°C. Temperature data is recorded on an ultraviolet erasable miniature electronic memory chip referred to as a data storage module (DSM). Temperatures are measured every five minutes and the mean, minimum, and maximum temperature for six-hour intervals are recorded on the DSM. Prior to installation each temperature probe was calibrated by Dryden and LaRue Engineers and assigned a correction factor.

Field installation procedures are outlined in the ADF&G Su Hydro Aquatic Studies (May, 1983 - June, 1984) Procedures Manual (ADF&G 1983d). Intragravel temperatures are measured at a depth of approximately 15 inches. Surface water temperatures are measured approximately two inches above the substrate.

All datapods were checked twice each month to ensure accuracy and to detect malfunctioning units. The temperature probes and cables were checked for physical damage, dewatering, or siltation. The operating condition of the datapod is checked by activating a short display sequence. The following information is displayed by the instrument, and recorded by the biologist: errors made in storage, number of storage used, minutes until the next recording, and current temperatures. An instantaneous surface water temperature was also measured with a calibrated Brooklyn thermometer (accuracy ±0.1°C).

Surface water temperatures recorded using a datapod temperature recorder and associated stage or dissolved gas probe were recorded on model 211SG two channel millivolt/temperature recorders. Surface water temperatures are measured and stored every hour. Accuracy of the temperature sensor associated with these units is ±0.5°C.

Field installation methods for the model 211SG two channel datapods are outlined in the FY 84 ADF&G Su Hydro Aquatic Studies (May, 1983 - June, 1984) Procedures Manual (ADF&G, 1983d). These units were also checked twice each month using methods outlined for model DP 2321 datapod.

2.2.3 Advantages and Disadvantages of the Instrumentation

The datapod temperature recorder has several favorable features not offered by the Ryan temperature recorder. The datapod allows for greater accuracy in measuring water temperatures (±0.1°C versus ±0.6°C). The datapod is also capable of monitoring temperatures at two locations or surface and intragravel temperatures simultaneously using two temperature probes. Because the Ryan temperature recorder is an immersible unit, it is subject to potential loss caused by high flow conditions or debris. The datapod recorder which houses the data storage chip is installed on land and therefore is considered safe from water or debris damage. Only the datapod probes which are immersed in the water are subject to loss or damage. The datapod data storage chip allows for a more expeditious method of data reduction compared to the strip chart of the Ryan thermograph. The advantages of the Ryan thermographs are the relative simple installation and monitoring procedures, and the availability of a strip chart recording to evaluate the temperature recordings. Disadvantages of the datapod temperature recorder include high instrument cost and complex installation and monitoring procedures. Also datapod temperature record is retrieved as tables of mean, minimum, and maximum temperatures making it difficult to detect erroneous data.

2.3 Analytical Approach

2.3.1 Peabody Ryan Temperature Recorders (Thermographs)

Using field notes as a guide, all Ryan thermograph strip charts were screened for anomolous temperatures which may have resulted from instrument failure, dewatering, or siltation. From the strip charts, a reduced temperature data base is obtained as two hour point temperatures.

comparison to temperature recorded at installation

A correction value for each strip chart was determined as the difference between the temperature obtained with a calibrated Brooklyn thermometer (accuracy ±0.1°C) and the thermograph reading at the time the strip chart was removed. (A correction value is determined at the time of strip chart removal rather than installation because response time of the recorder to actual water temperatures can vary with each installation.) The correction value was then used to correct the two-hour point temperature data base obtained from each strip chart. From these corrected data bases, daily, USGS water year weekly; and monthly minimum, mean, and maximum surface water temperatures were computer calculated.

2.3.2 Omnidata Temperature Recorders (Datapods)

Water temperature data was retrieved from the Omnidata datapods as six-hour minimum, mean, and maximum temperatures by inserting the data storage module (DSM) into an Omnidata model 217 Datapod/cassette reader. These six-hour data bases were edited and corrected for storage errors and anomolous data which may have resulted from dewatering, siltation or instrument failure. From these corrected data bases, daily, USGS water year weekly, and monthly mean, minimum, and maximum temperatures were computer calculated.

3.0 RESULTS

Results of the 1983 open water field season continuous water temperature monitoring program are presented according to the following habitat type: mainstem, side channel, slough (side and upland) and tributary.

3.1 Mainstem Habitats

Results of the 1983 open water season continuous temperature monitoring program conducted in the mainstem Susitna River are presented below according to reach of river. In addition to reach of river, those temperature stations monitored for similar objectives are grouped according to the portion of the reach of river in which they were located.

3.1.1 Lower Reach (Estuary, RM 0.0 to Parks Highway Bridge, RM 83.9)

Continuous surface water temperature data were collected at seven monitoring stations in the lower Susitna River extending from the estuary temperature station located at river mile 4.5 to the Parks Highway Bridge located at river mile 83.9 (Table 3-2). Site maps for each of these temperature stations are presented in Appendix Figures 3-A-1 to 3-A-4 and 3-A-6 to 3-A-8. Daily and monthly minimum, mean, and maximum surface water temperature for each station are presented in Appendix Tables 3-A-2 to 3-A-8. Water year weekly temperatures for the seven sites are presented in Appendix Tables 3-A-54 to 3-A-60. The

Table 3-2 Continuous surface water temperature monitoring stations located in the lower reach of the Susitna River (Estuary, RM 0.0 to Parks Highway Bridge RM 83.9) during the 1983 open water season.

Site	River Mile	Data Type
Estuary	4.5	Surface water
Flathorn Station	18.2	Surface water
Below Susitna Station	20.5	Surface water
Susitna Station	25.8	Surface water
Above the Yentna River	29.5	Surface water
Above the Deshka River	41.1	Surface water
Parks Highway Bridge	83.9	Surface water

entire period of record including previous years data for each monitoring station is presented in Appendix Table 3-A-1.

3.1.1.1 Estuary (RM 4.5) to Mainstem above the Yentna River (RM 29.5)

The temperature monitoring stations located within the Susitna River from the estuary upstream to above the Yentna River were established to collect baseline surface water temperature data and to support the evaluation of eulachon spawning habitat (Chapter 11 of this report). Temperature stations were established at the Estuary (RM 4.5), Flathorn Station (RM 18.2), Below Susitna Station (RM 20.5), Susitna Station (RM 25.8), and Above the Yentna River (RM 29.5) and were monitored only from mid-May to mid-June or mid-July (Appendix Tables 3-A-1 to 3-A-6). A plot of the mean daily surface water temperatures obtained at these temperature stations was developed (Figure 3-2). Ranges, 25th, 50th (median), and 75th percentiles of surface water temperatures collected at these stations are shown in Figure 3-3.

Surface water temperatures recorded at these monitoring stations were found to range from 4.3° (recorded at the Estuary in May) to 14.7° (recorded at Flathorn Station in June). The temperature stations located at the estuary, below Susitna Station, and above the Yentna River were removed in mid-June (Appendix Table 3-A-1) leaving only the Flathorn Station and Susitna Station. Surface water temperatures were monitored at these sites through July. During this period, daily mean temperatures were consistently warmer at the Flathorn Station.

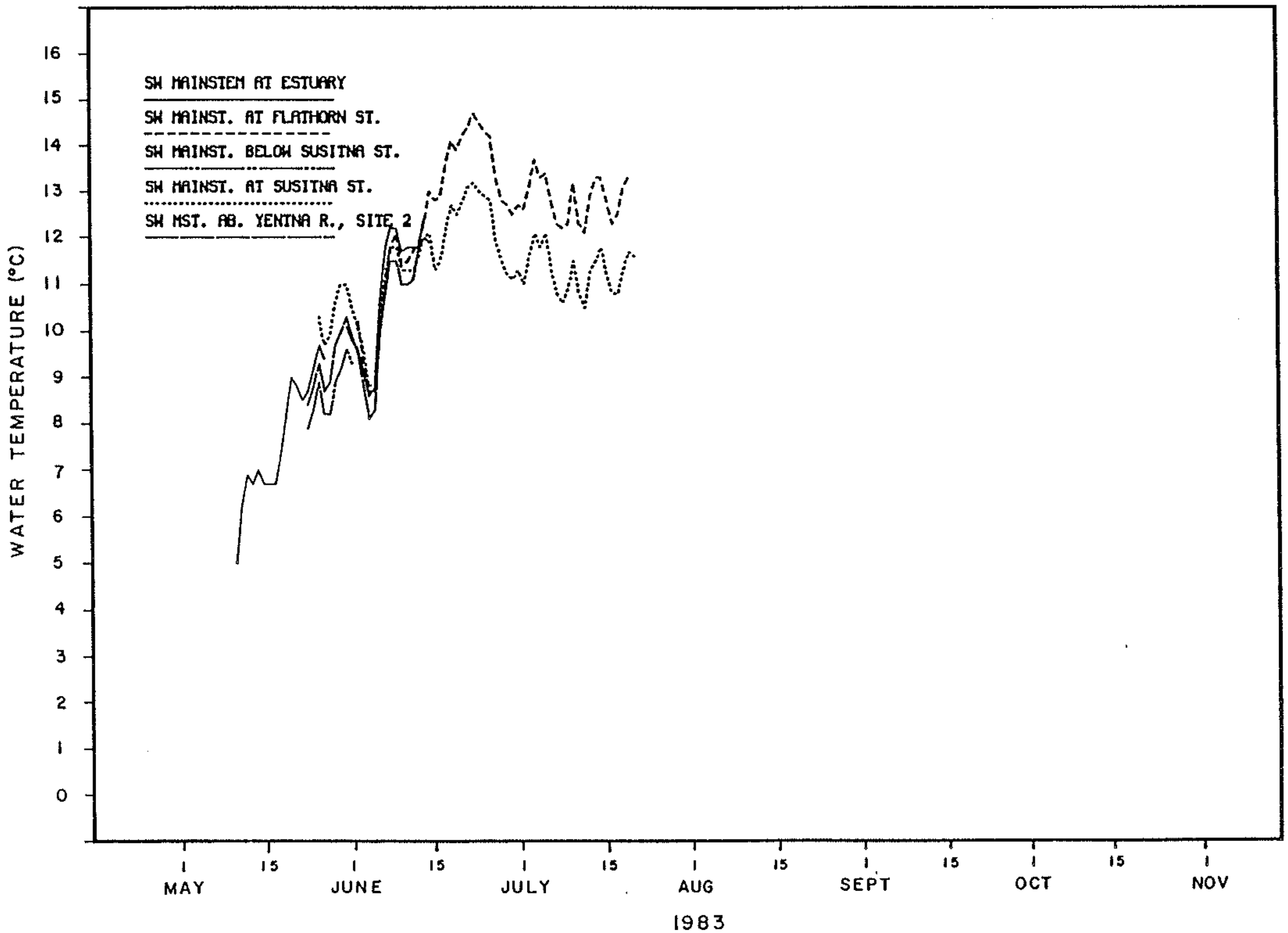

Figure 3-2 Mean daily surface water temperature for Mainstem Susitna River collected during the 1983 open water season at Flathorn Station (RM 18.2), Susitna Station (RM 25.8), and above Yentna River - Site 2 (RM 29.5).

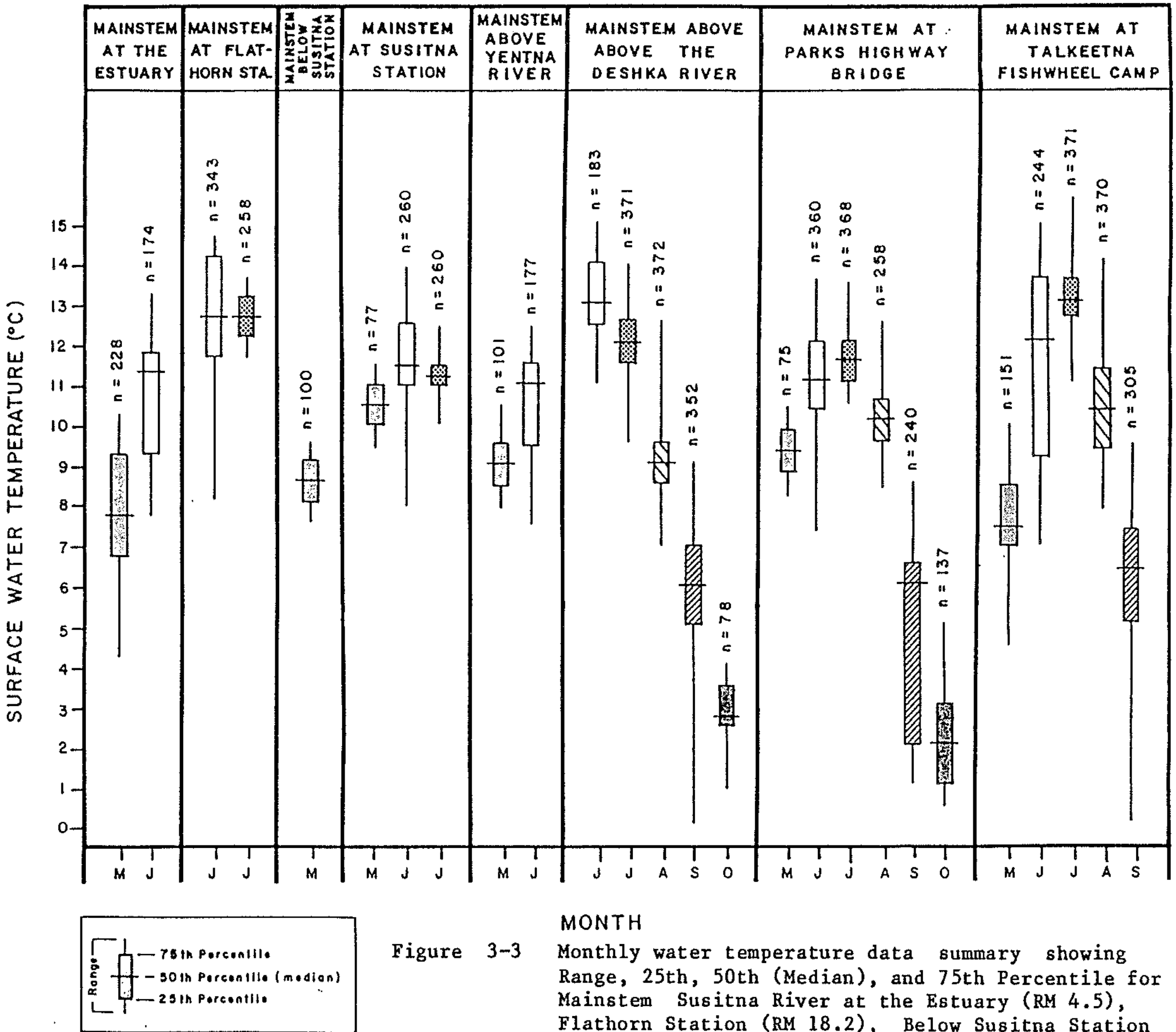

Figure 3-3 Monthly water temperature data summary showing Range, 25th, 50th (Median), and 75th Percentile for Mainstem Susitna River at the Estuary (RM 4.5), Flathorn Station (RM 18.2), Below Susitna Station (RM 20.5), Susitna Station (RM 25.8), Above Yentna River (RM 29.5), Above the Deshka River (RM 41.1), Parks Highway Bridge (RM83.9), and Talkeetna Fishwheel Camp (RM 103.0).

3.1.1.2 Above the Deshka River (RM 41.1) to Parks Highway Bridge (RM 83.9)

Surface water monitoring stations were established above the Deshka River (RM 41.1) and at the Parks Highway Bridge (RM 83.9) to collect baseline mainstem Susitna River temperature data and to determine if the Delta Islands affect mainstem surface water temperature (Appendix Tables 3-A-1, 3-A-7, and 3-A-8). Ranges, 25th, 50th (median), and 75th percentiles of surface water temperatures collected at these stations are presented in Figure 3-3. Plots of mean daily surface water temperature over time obtained from these temperature stations are presented in Figure 3-4.

Although there was a difference existed between the surface water temperatures recorded at the two stations, it is difficult to directly relate this to the influence of the Delta Islands. Mean daily surface water temperatures were found higher at the monitoring station located above the Deshka River than at the Parks Highway Bridge from mid-June until July 23 when the trend reversed. Warmer surface water temperatures were recorded at the Parks Highway Bridge monitoring station through mid-October (Figure 3-4). A gap in the data recorded at the Parks Highway Bridge from August 22 to September 10 resulted from instrument failure.

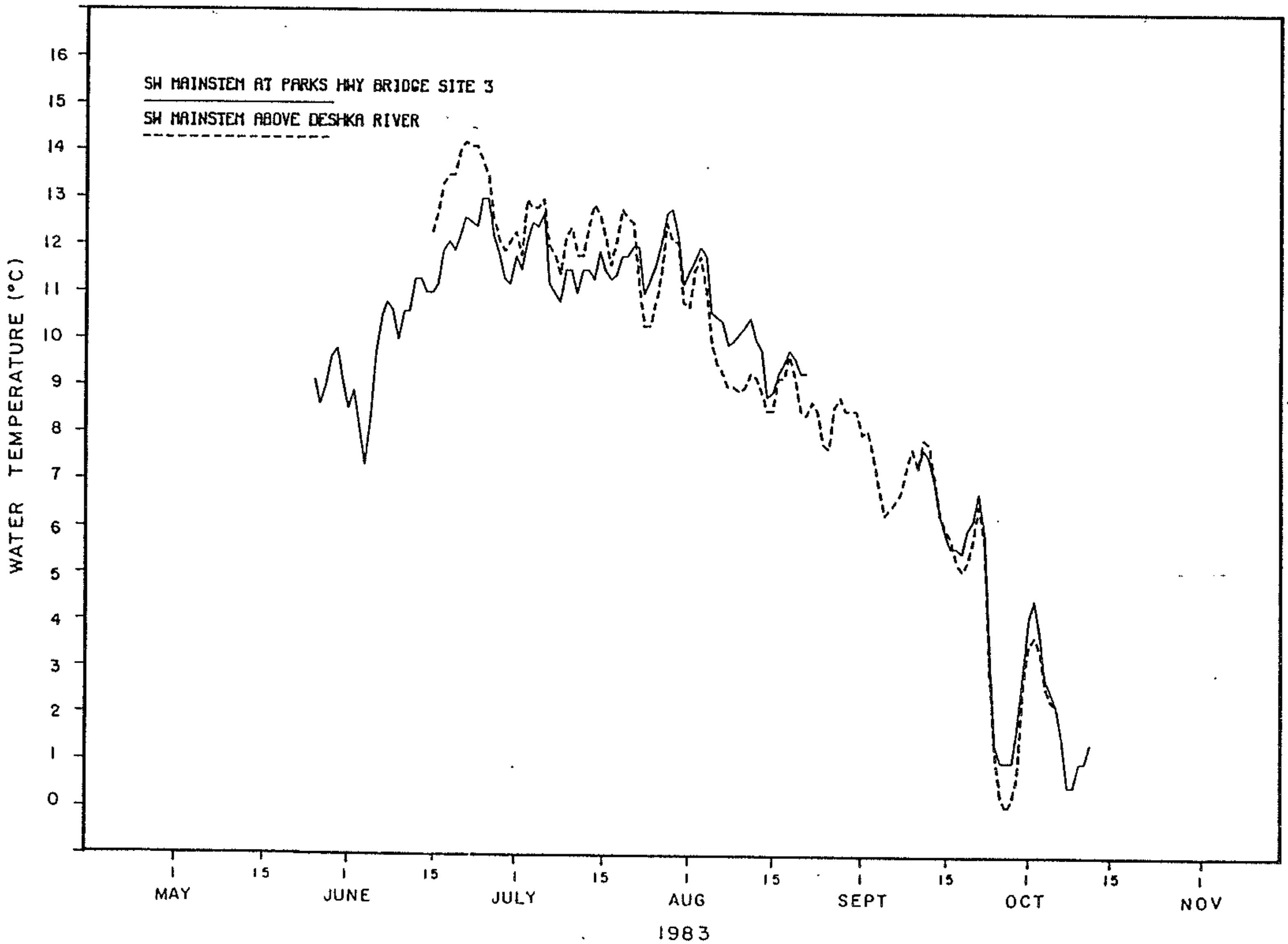

Figure 3-4 Mean daily surface water temperature for Mainstem Susitna River collected during the 1983 open water season at Parks Highway Bridge - Site 3 (RM 83.9) and Above the Deshka River (RM 40.6)

3.1.2 Middle Reach (Parks Highway Bridge, RM 83.9 to Devil Canyon, RM 150.0)

Continuous water temperature data were obtained at ten monitoring stations in the middle reach of the Susitna River from the Parks Highway Bridge located at river mile 83.9 to Devil Canyon located at river mile 150.0 (Table 3-3). Site maps of these temperature stations are presented in Appendix Figures 3-A-8, 3-A-11 to 3-A-13, 3-A-17, 3-A-18, 3-A-21, and 3-A-23. Daily and monthly minimum, mean, and maximum surface water temperature for each station are presented in Appendix Tables 3-A-8 to 3-A-19. Water year weekly temperatures are presented in Appendix Tables 3-A-60 to 3-A-71. The period of record for these monitoring stations, 1981-1983, is presented in Appendix Table 3-A-1.

3.1.2.1 Parks Highway Bridge (RM 83.9) to Talkeetna Fishwheel Camp (RM 103.0)

To determine the influence of the Chulitna River and the Talkeetna River on mainstem Susitna River temperatures, surface water temperature data collected at the monitoring station at Parks Highway Bridge (RM 83.9) which is located downstream of these tributaries, was compared to temperature data collected at the monitoring station at the Talkeetna Fishwheel Camp which is located upstream of the tributaries (RM 103.0) (Appendix Tables 3-A-1, 3-A-8, and 3-A-9). A plot of the mean daily surface water temperatures obtained at these two temperature stations is presented in Figure 3-5. Ranges, 25th, 50th (median), and 75th percentiles of surface water temperatures collected at these sites are shown in Figure 3-3.

Table 3-3 Continuous water temperature monitoring stations located in the middle reach of the Susitna River (Parks Highway Bridge, RM 83.9 to Devil Canyon, RM 150.0) during the 1983 open water season.

Site	River Mile	Temperature Data Type
Parks Highway Bridge	83.9	Surface water
Talkeetna Fishwheel Camp	103.0	Surface water
LRX 9	103.2	Surface/intragravel water
Curry Fishwheel Camp	120.7	Surface water
LRX 29	126.1	Surface/intragravel water
Below Gold Creek	135.8	Surface water
At Gold Creek Bridge	136.6	Surface water
Above Gold Creek	136.9	Surface water
LRX 57	142.3	Surface/intragravel water
Devil Canyon	150.0	Surface water

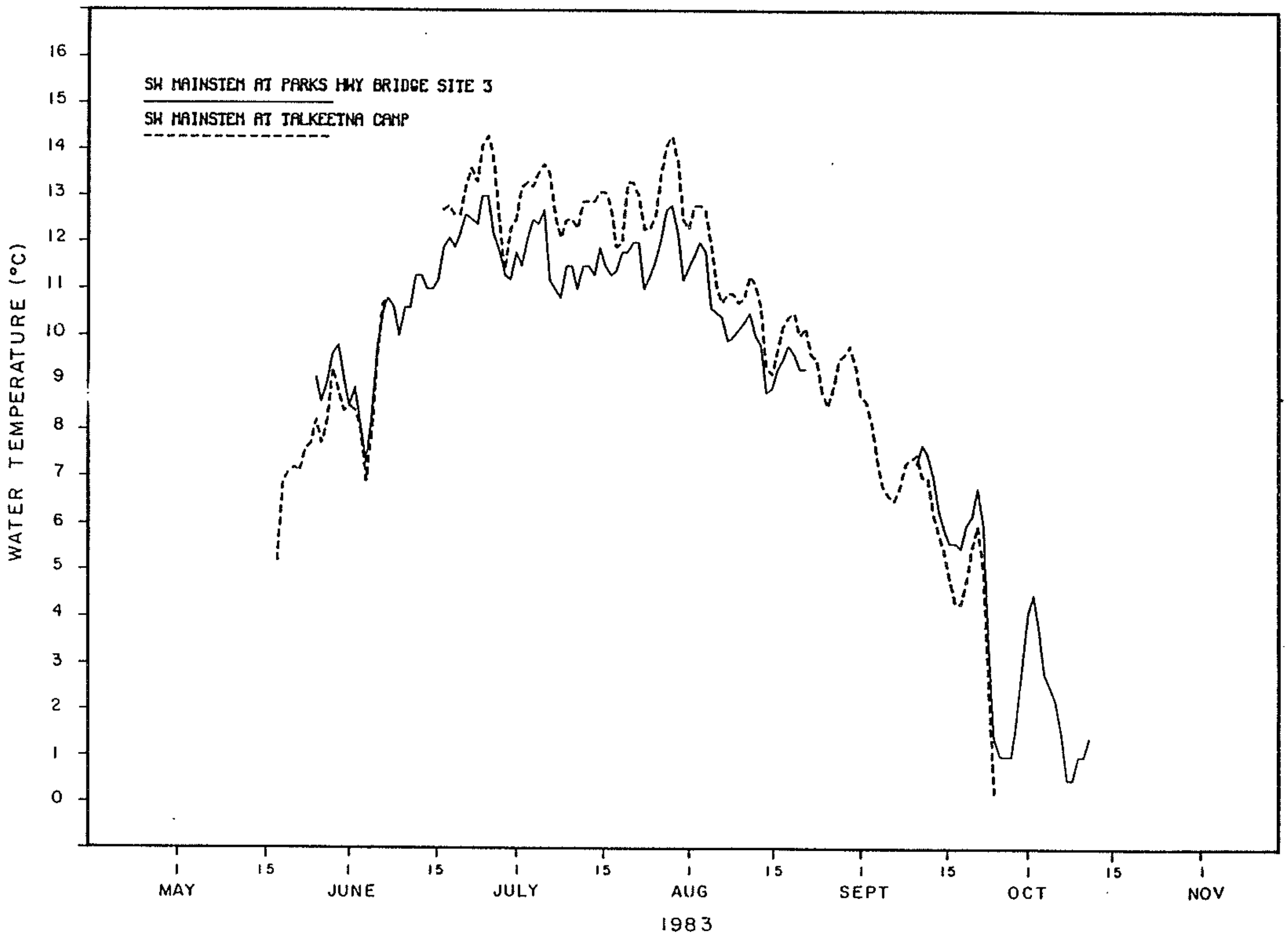

Figure 3-5 Mean daily surface water temperature for Mainstem Susitna River collected during the 1983 open water season at Parks Highway Bridge - Site 3 (RM 83.9), and at Talkeetna Fishwheel Camp (RM 103.0).

Daily mean surface water temperatures recorded at the monitoring station located at the Parks Highway Bridge (RM 83.9) were found to be lower than those recorded at the Talkeetna Fishwheel (RM 103.0) from mid-June until the latter portion of August. Both the spring (May to early June) and fall (late September) temperature trend is reversed (Figure 3-5).

3.1.2.2 Talkeetna Fishwheel Camp (RM 103.0), Curry Fishwheel Camp (RM 120.7), Above Gold Creek (RM 136.8) and Devil Canyon (RM 150.0)

Continuous surface water temperature monitoring stations established at the Talkeetna Fishwheel Camp (RM 103.0), Above Gold Creek (RM 136.8), and At Devil Canyon (RM 150.0) were plotted together, to compare temperatures in the reach of the river from Talkeetna Fishwheel to above Portage Creek (Figure 3-6). Ranges, 25th, 50th (median), and 75th percentiles of surface water temperatures collected at these sites is presented in Figures 3-7 and 3-19. Temperatures were found to range from 15.5°C in July to 0°C in late September for the 1983 open water season for this reach of the river.

Generally, temperatures increase downstream from Devil Canyon (RM 150.0) to Talkeetna Fishwheel (RM 103.0). However, in August and early September, daily mean temperatures recorded from the monitoring station located below at Devil Canyon (RM 150.0) were higher than those recorded at the monitoring station above Gold Creek (RM 136.8).

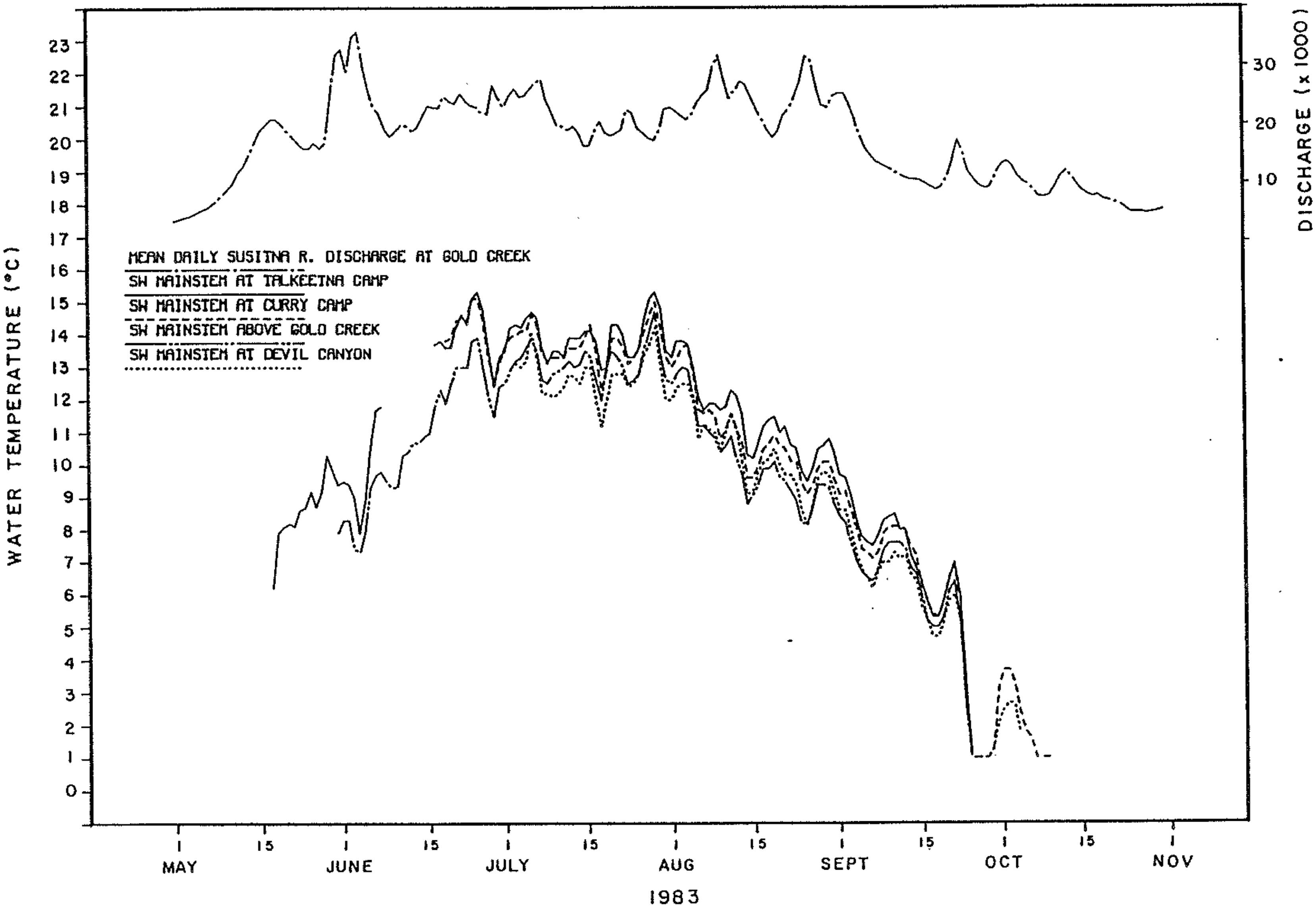

Figure 3-6 Mean daily surface water temperature for Mainstem Susitna River collected during the 1983 open water season at Talkeetna Fishwheel Camp (RM 103.0), Curry Fishwheel Camp (RM 120.7), Above Gold Creek (RM 136.8), and at Devil Canyon (RM 150.0), and mean daily Susitna River discharge at Gold Creek (USGS gaging station 1529000).

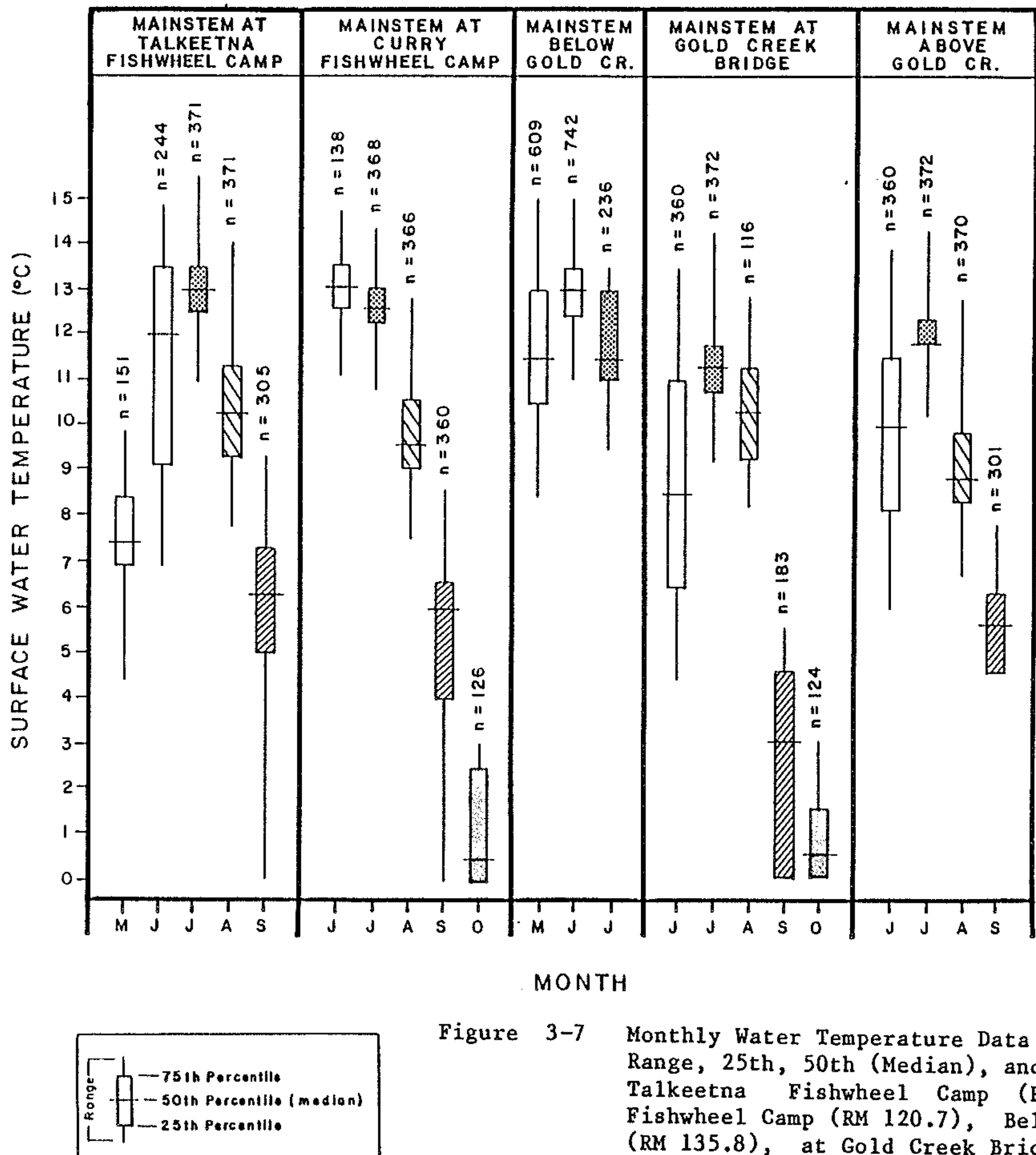

Figure 3-7 Monthly Water Temperature Data Summary Showing Range, 25th, 50th (Median), and 75th Percentile for Talkeetna Fishwheel Camp (RM 103.0), Curry Fishwheel Camp (RM 120.7), Below Gold Creek (RM 135.8), at Gold Creek Bridge (RM 136.6) and above Gold Creek (RM 136.8).

3.1.2.3 Curry Fishwheel Camp (RM 120.7), Gold Creek Bridge (RM 136.6) (site of old USGS recorder), Above Gold Creek (RM 136.8)

Mean daily mainstem surface water temperatures recorded at the temperature monitoring station at Gold Creek Bridge (RM 136.6) were compared to mean daily mainstem surface water temperatures recorded at the monitoring stations at Curry Fishwheel Camp (RM 120.7) and Above Gold Creek (RM 136.8) to determine the influence of Gold Creek tributary water temperatures on the mainstem water temperatures recorded at Gold Creek Bridge. The Curry temperature station was included in this comparison to illustrate the well mixed mainstem water temperature condition. A plot of the mean daily surface water temperatures obtained at these temperature stations is presented in Figure 3-8. The range, 25th, 50th (median), and 75th percentiles of surface water temperatures collected at these sites are presented in Figure 3-7.

Mean daily surface water temperatures recorded at the monitoring station at the Gold Creek Bridge (RM 136.6) were found to be consistently lower than those collected at the monitoring station above Gold Creek (RM 136.8) and Curry Fishwheel (RM 120.7) (Figure 3-8). Maximum temperature recorded at all three sites was 14.3° (recorded in July).

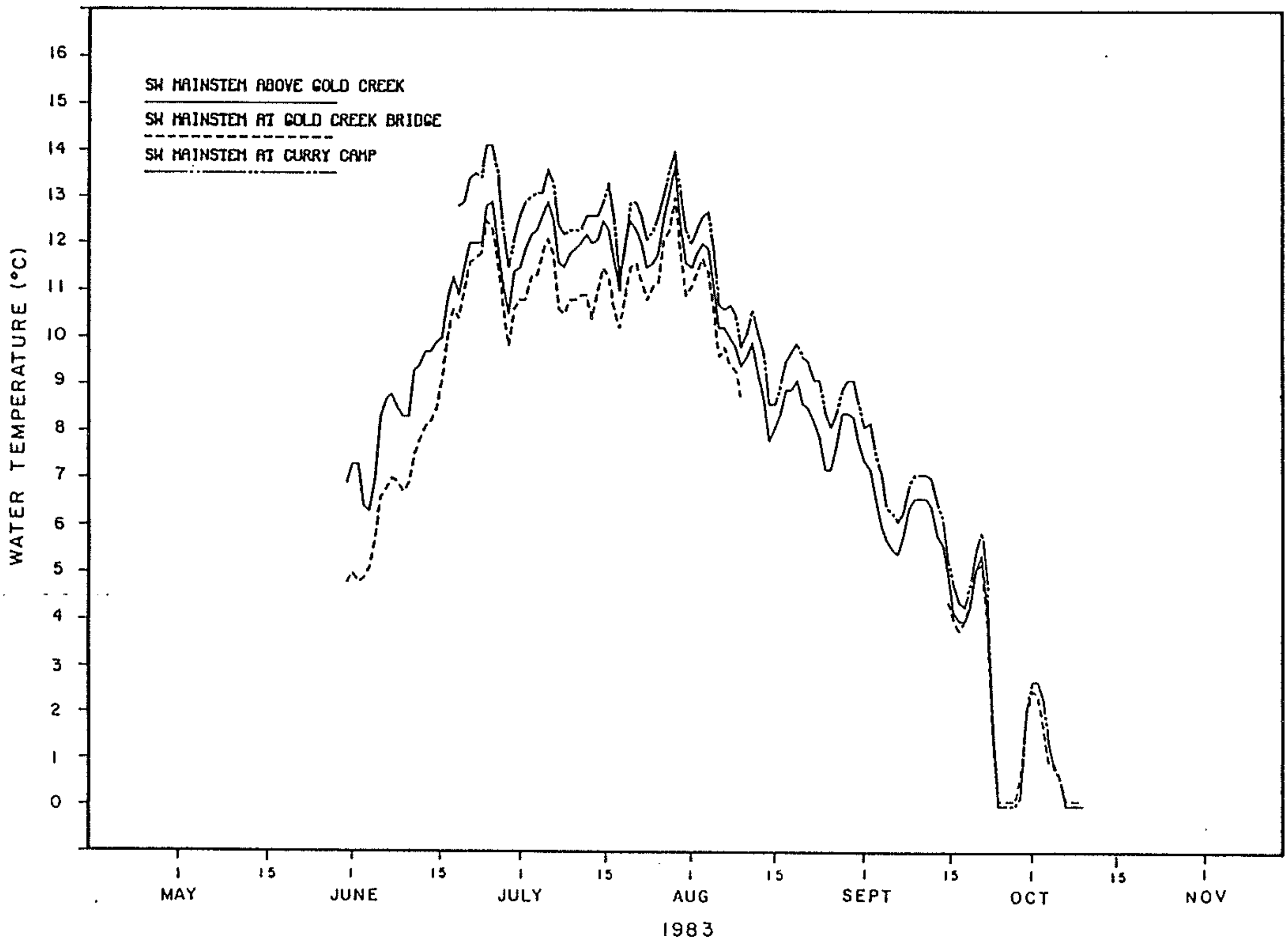

Figure 3-8 Mean daily surface water temperature for Mainstem Susitna River collected during the 1983 open water season at Curry Fishwheel Camp (RM 120.7), Above Gold Creek (RM 136.8), at Gold Creek Bridge (RM 136.6), and mean daily Susitna River discharge at Gold Creek (USGS gaging station 1529000).

3.1.2.4 Talkeetna Fishwheel Camp (RM 103.0), Curry Fishwheel Camp (RM 120.7), Below Gold Creek (RM 135.8), and Above Gold Creek (RM 136.8)

Continuous surface water temperatures recorded at the monitoring station Below Gold Creek (RM 135.8) was compared to temperatures recorded at the monitoring stations at Talkeetna Fishwheel Camp (RM 103.0), Curry Fishwheel Camp (RM 120.7) and Above Gold Creek (RM 136.8) (Appendix Tables 3-A-1, 3-A-9, 3-A-12, 3-A-14, 3-A-16).

A plot of the mean daily surface water temperatures obtained at these temperature stations is presented in Figure 3-9. The ranges, 25th, 50th (median), and 75th percentiles of the temperatures obtained at these sites are presented in Figure 3-7.

The temperature recorder at the monitoring station located Below Gold Creek (RM 135.8) was installed on June 5 to provide temperature data for the dissolved gas study. This monitoring station was removed on August 10. Temperatures collected at this monitoring station were warmer than those collected at the above Gold Creek site (RM 136.8) and sometimes warmer than temperatures recorded at the downstream sites located at Talkeetna Fishwheel Camp (RM 103.0) and Curry Fishwheel Camp (RM 120.7).

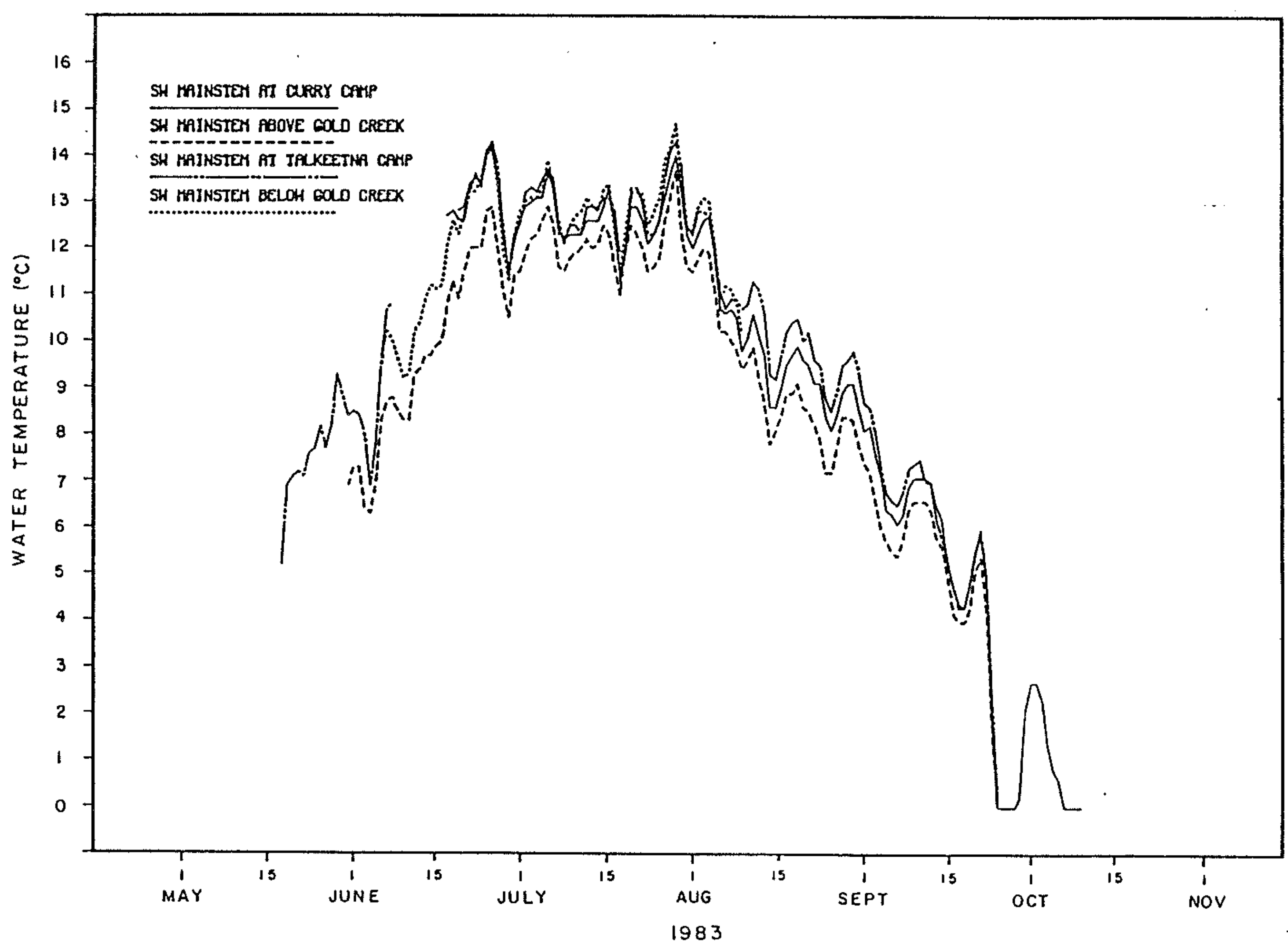

Figure 3-9 Mean daily surface water temperature for Mainstem Susitna River collected during the 1983 open water season at Curry Camp (RM 120.7), above Gold Creek (RM 136.8), at Talkeetna Camp (RM 103.0), and below Gold Creek (RM 135.8).

3.1.2.5 LRX 9 (RM 103.2), LRX 29 (RM 126.1), and LRX 57 (RM 142.3)

Surface and intragravel water temperature monitoring stations were established at LRX 9 (RM 103.3), LRX 29 (RM 126.1), and LRX 57 (RM 142.3) to determine downstream temperature trends and to compare intragravel water temperatures to surface water temperatures measured at each of these monitoring stations (Appendix Tables 3-A-1, 3-A-11, 3-A-13, 3-A-17). The ranges, 25th, 50th (median), and 75th percentiles of surface and intragravel temperatures collected at these sites are presented in Figure 3-10.

3.1.2.5.1 Surface water temperature at LRX 9 (RM 103.2), LRX 29 (RM 126.1), and LRX 57 (RM 142.3)

To compare surface water temperatures among the three sites, a plot of the mean daily surface water temperatures recorded at the temperature monitoring stations located at LRX 9 (RM 103.3), LRX 29 (RM 126.1), and LRX 57 (RM 142.3) is presented in Figure 3-11. Surface water temperatures were found to range from 16.5°C (at LRX 9) to -0.1°C (at LRX 29) during the 1983 open water field season. Surface water temperatures at LRX 9 were generally warmer than surface water temperatures recorded at LRX 29 and LRX 57.

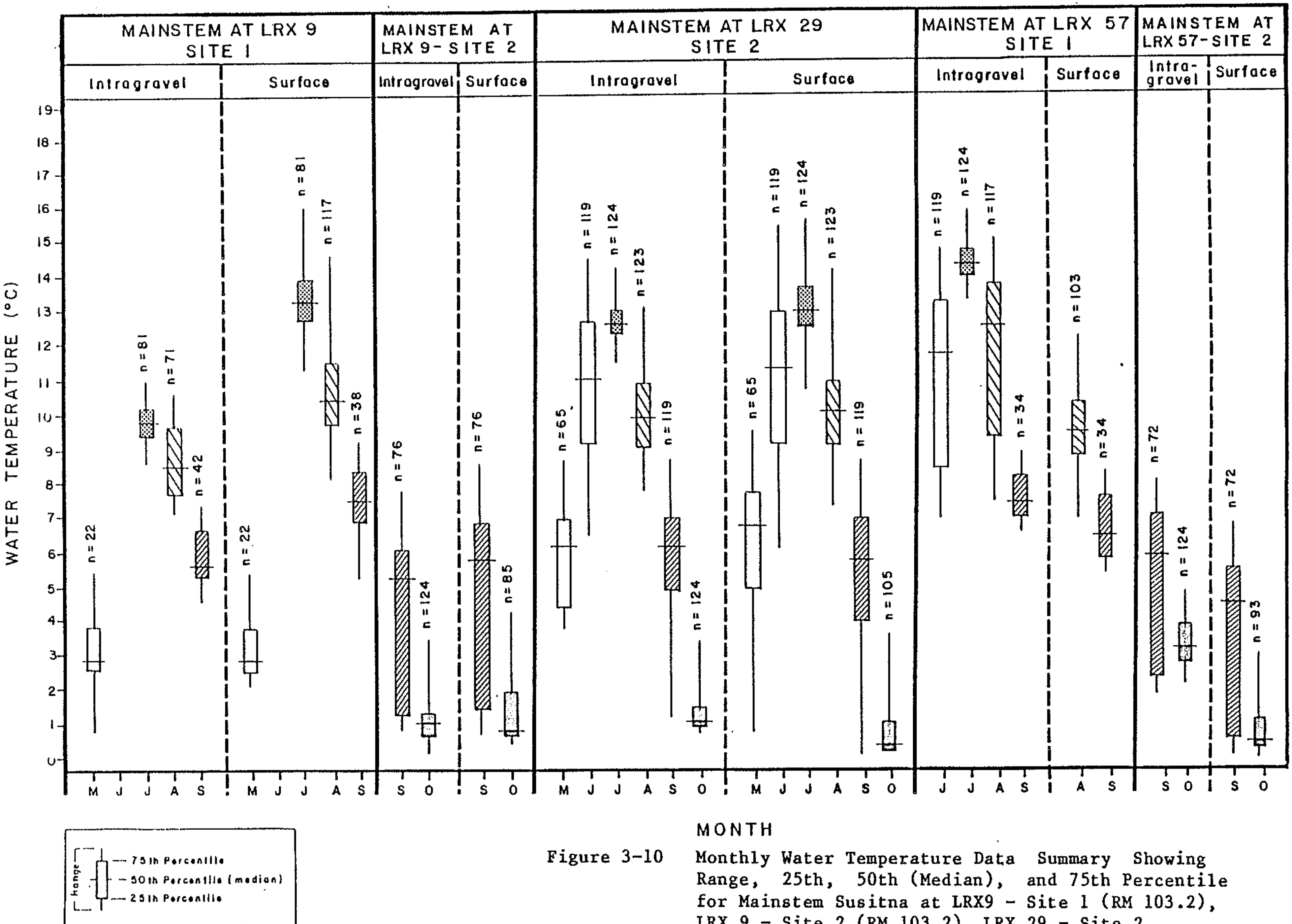

Figure 3-10 Monthly Water Temperature Data Summary Showing Range, 25th, 50th (Median), and 75th Percentile for Mainstem Susitna at LRX9 - Site 1 (RM 103.2), LRX 9 - Site 2 (RM 103.2), LRX 29 - Site 2 (RM 126.1), LRX 57 (RM 142.3), and LRX 57 - Site 2 (RM 142.3).

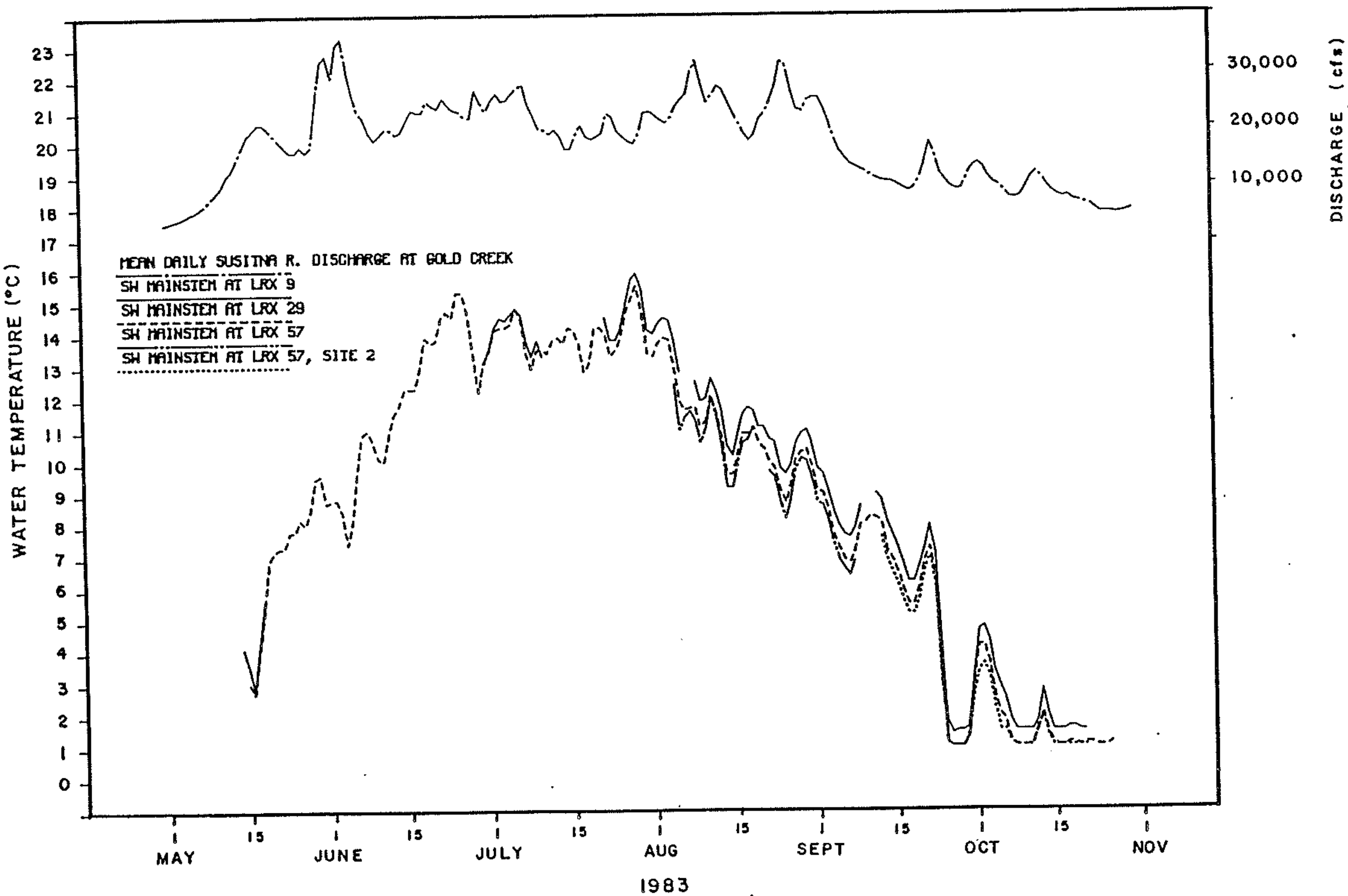

Figure 3-11 Mean daily surface water temperature for Mainstem Susitna River collected during the 1983 open water season at LRX 9 (RM 103.2), at LRX 29 (RM 126.1), and at LRX 57 (RM 142.3), and mean daily Susitna River discharge at Gold Creek (U[illegible] Ga[illegible] St[illegible]n 1[illegible]00)

3.1.2.5.2 Intragravel water temperatures at LRX 9 (RM 103.2), LRX 29 (RM 126.1), and LRX 57 (RM 142.3)

To compare intragravel water temperatures recorded at LRX 9 (RM 103.3), LRX 29 (RM 126.1) and LRX 57 (RM 142.3) a plot of mean daily intragravel temperatures recorded at the monitoring stations is presented in Figure 3-12.

Intragravel mainstem water temperatures recorded at the three monitoring stations were similar during the warming and cooling periods of the spring and early fall. However there were large variations in temperatures recorded at the sites during the summer and late fall. Generally higher temperatures were recorded at LRX 57 (RM 142.3) and lower temperatures were recorded at LRX 9 (RM 103.3).

Temperature monitoring stations at LRX 9 and LRX 57 were each relocated to new sites (LRX 9 - Site 2 and LRX 57 - Site 2) on September 13 to avoid dewatering.

3.1.2.5.3 Intragravel and surface water temperatures at LRX 9 (RM 103.2), LRX 29 (RM 126.1), and LRX 57 (RM 142.3)

A plot of mean daily intragravel and surface water temperatures at LRX 9 (RM 103.0), LRX 29 (RM 126.1), and LRX 57 (RM 142.3) which was developed

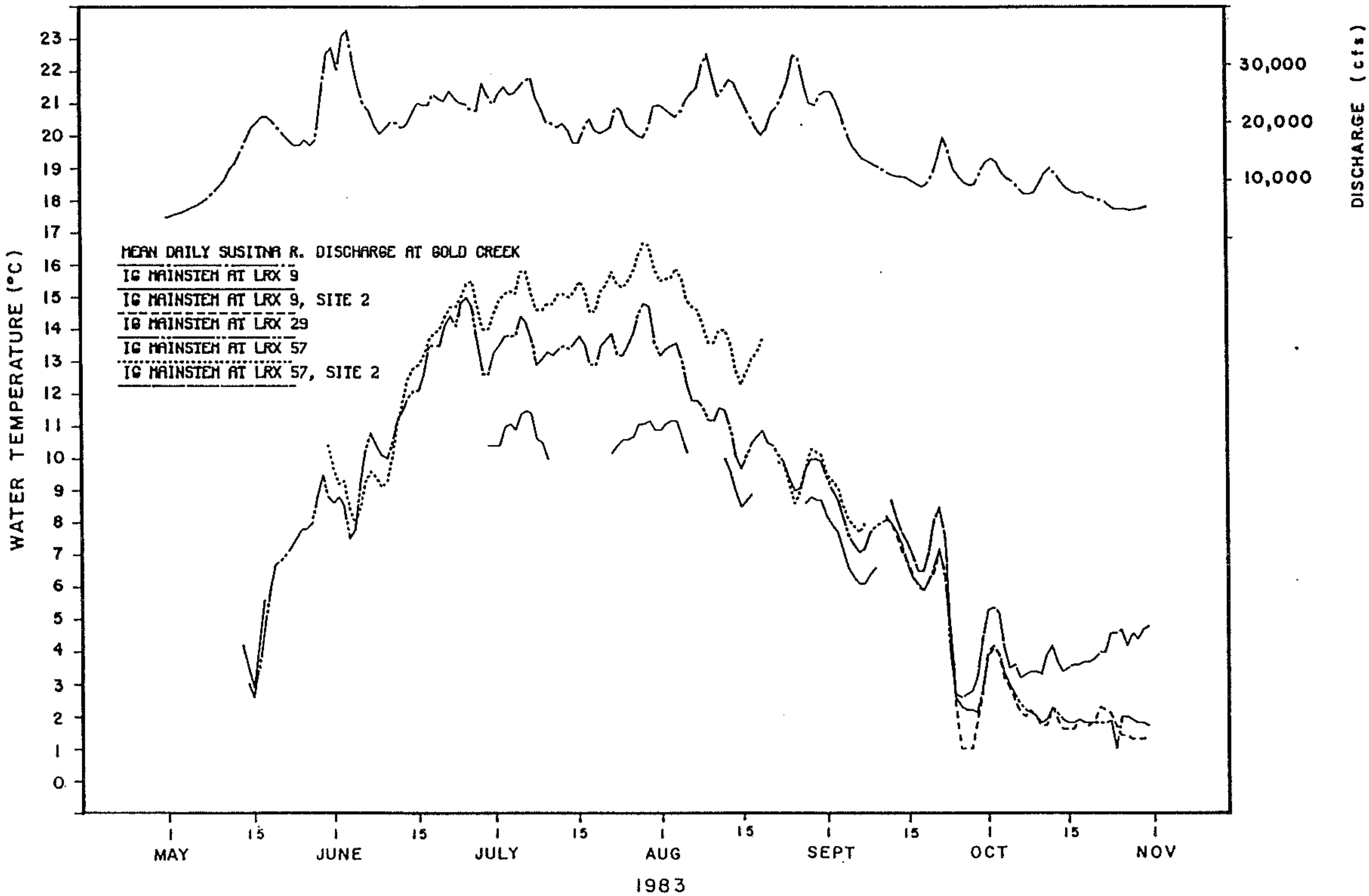

Figure 3-12 Mean daily surface water temperature for Mainstem Susitna River collected during the 1983 open water season at LRX 9 (RM 103.2), at LRX 29 (RM 126.1), and at LRX 57 (RM 142.3), and mean daily Susitna River discharge at Gold Creek (USGS Gaging Station 1529000).

to show general temperature trends among these sites is presented in Figure 3-13.

Surface water temperatures recorded at LRX 9, LRX 29, and LRX 57, and the intragravel water temperatures recorded at LRX 29 follow similar temperature trends. Intragravel temperatures recorded at LRX 9 were lower and intragravel temperatures recorded at LRX 57 were warmer than the general temperature trend.

3.1.2.5.4 Intragravel versus surface water temperature at LRX 9 (RM 103.2).

A plot of mean daily intragravel and surface water temperature recorded at LRX 9 is presented in Figure 3-14.

Surface water temperature was warmer than intragravel temperature from July to mid-September. With the occurrence of cooler fall temperatures the surface and intragravel water temperatures cool and by mid-October intragravel water temperatures are warmer than the surface water. In mid-September the probes began to dewater and were moved farther into the river to site 2. With the change of location of intragravel and surface water temperatures were similar (Figure 3-14). Gaps in the temperature data in July resulted from dewatered probes. In August the intragravel probe malfunctioned.

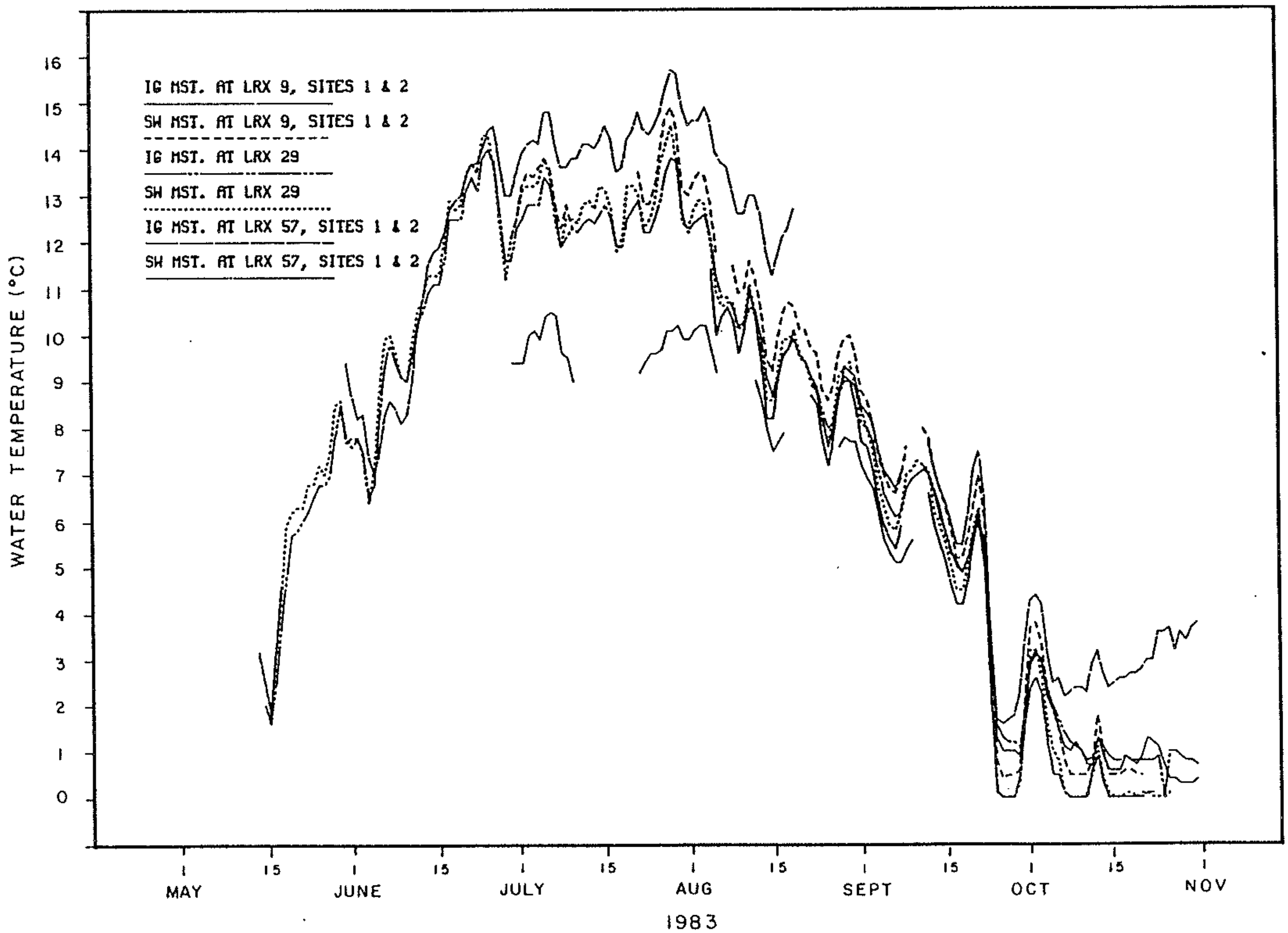

Figure 3-13 Mean daily intragravel and surface water temperature for Mainstem Susitna River collected during the 1983 open water season at LRX 9 (RM 103.2), LRX 29 (RM 126.1), and LRX57 (RM 142.3), and mean daily Susitna River discharge a[illegible] Gol[illegible]eek[illegible]GS [illegible]ing[illegible]tic[illegible]529[illegible]).

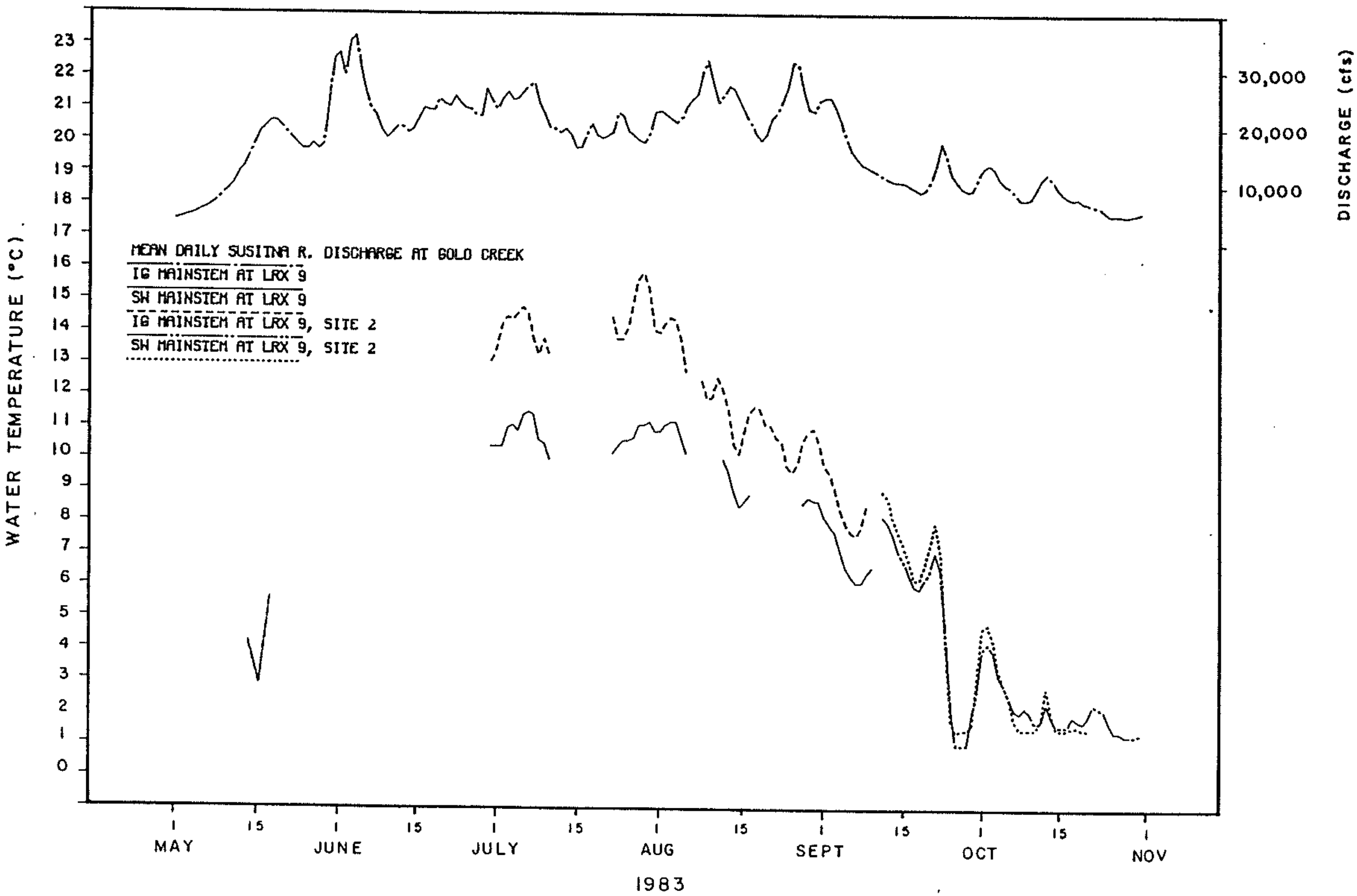

Figure 3-14 Mean daily intragravel and surface water temperature for Mainstem Susitna River collected during the 1983 open water season at LRX 9 (RM 103.2), and mean daily Susitna River discharge at Gold Creek (USGS Gaging Station 15292000).

3.1.2.5.5 Intragravel versus surface water temperature at LRX 29 (RM 126.1)

A plot of mean daily intragravel and surface water temperatures recorded at LRX 29 is presented in Figure 3-15.

Surface and intragravel water temperatures at LRX 29 were similar from mid-May until late September. In late September mean surface water temperature cooled to a minimum of -0.1°C while the minimum intragravel temperature was 1.0°C. In early October both intragravel and surface water temperature increased to 3.9°C and 3.4°C, respectively, and then declined. Throughout October intragravel temperature were warmer than surface water.

3.1.2.5.6 Intragravel versus surface water temperature at LRX 57 (RM 142.3)

A plot of intragravel and surface water temperature recorded at LRX 57 (RM 142.3) is presented in Figure 3-16.

Because of a malfunctioning probe surface water temperature was not obtained at LRX 57 until August 4. Between August 4 and September 11 intragravel temperatures were generally higher than the surface water temperatures.

The probes were relocated to Site 2 on September 11 to prevent dewatering. Mean daily intragravel temperatures in September and October at

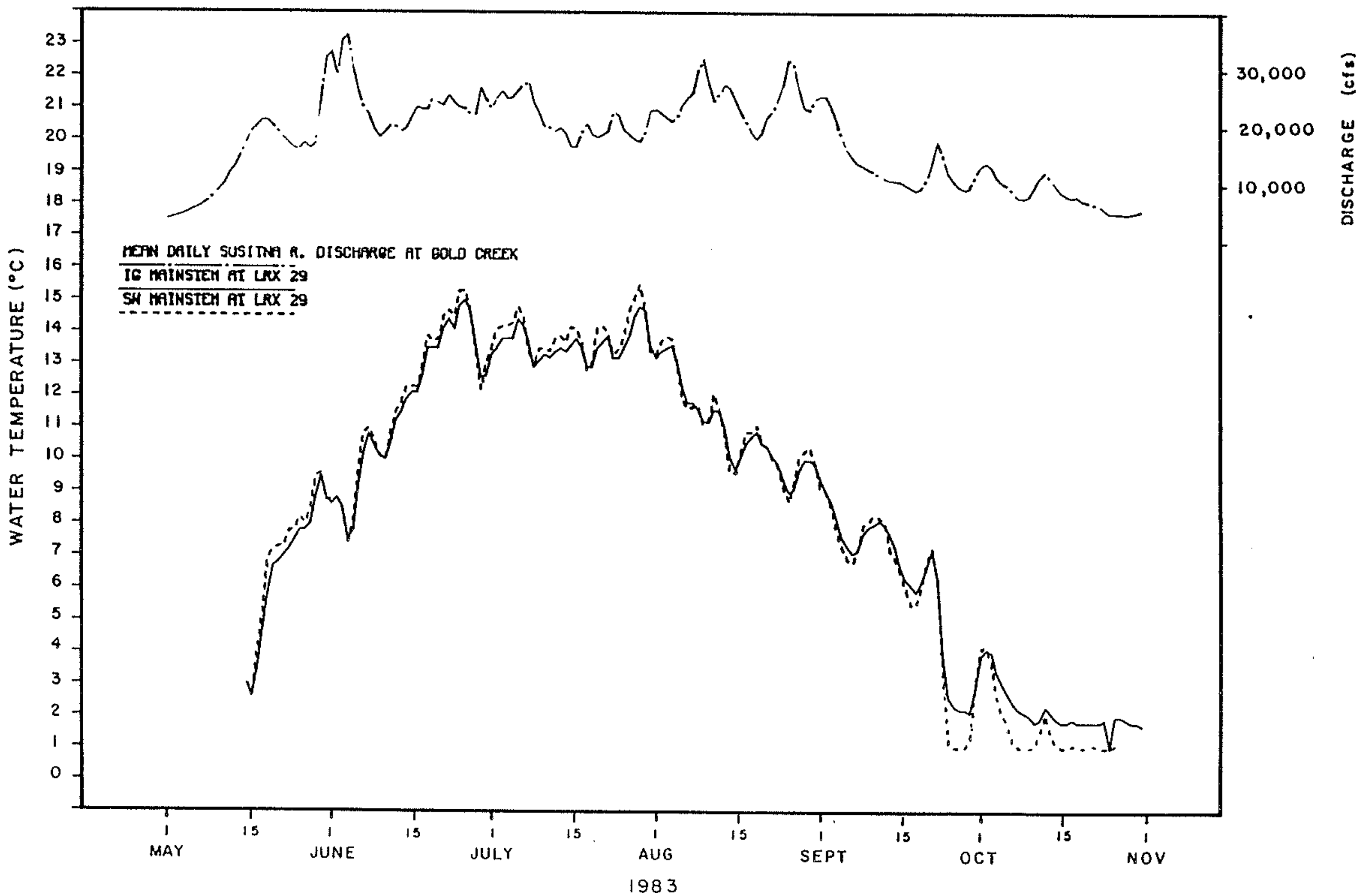

Figure 3-15 Mean daily intragravel and surface water temperature for Mainstem Susitna River collected during the 1983 open water season at LRX 29 (RM 126.1), and mean daily Susitna River discharge at Gold Creek (USGS Gaging Station 15292000).

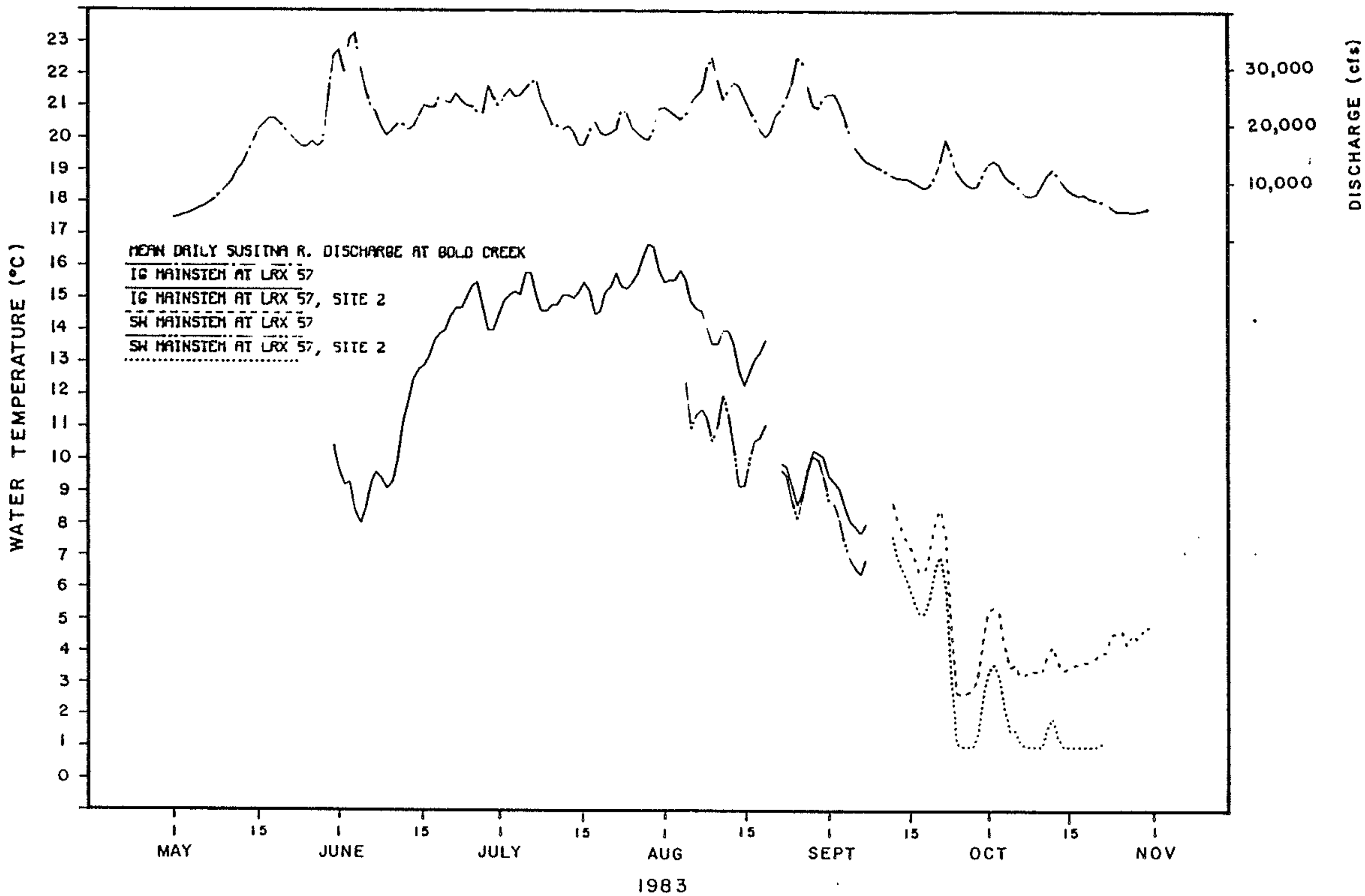

Figure 3-16 Mean daily intragravel and surface water temperature for Mainstem Susitna River collected during the 1983 open water season at LRX 57 (RM 142.3), and mean daily Susitna River discharge at Gold Creek (USGS Gaging Station 15292000).

Site 2 continued to be warmer than surface water temperatures. Mean daily water temperatures calculated for October were 3.0°C (intragravel) and 0.6°C (surface).

3.1.2.6 LRX 9 (RM 103.2) and Talkeetna Fishwheel Camp (RM 103.0)

Because the surface water temperature monitoring stations at Talkeetna Fishwheel Camp (RM 103.0) and LRX 9 (RM 103.2) were in close proximity, a comparison between surface water temperatures recorded at these sites was made (Appendix Tables 3-A-1, 3-A-9, 3-A-10, 3-A-11). A plot of mean daily surface water temperatures recorded at LRX 9 and Talkeetna Fishwheel Camp is presented in Figure 3-17.

Surface water temperatures measured at the monitoring station at LRX 9 correspond closely with Talkeetna Fishwheel Camp. The greatest difference in mean daily surface water temperature occurred on September 17 when the temperature at the monitoring station at LRX 9 was 1.0°C higher than the temperature at the monitoring station at Talkeetna Fishwheel Camp.

3.1.3 Upper Reach (Devil Canyon, RM 150.0 to above the Oshetna River, RM 235.7)

Continuous surface water temperature data was recorded at three mainstem locations (Table 3-4) in the upper reach of the Susitna River from Devil Canyon (RM 150.0) to above the Oshetna River (RM 235.7). Mainstem

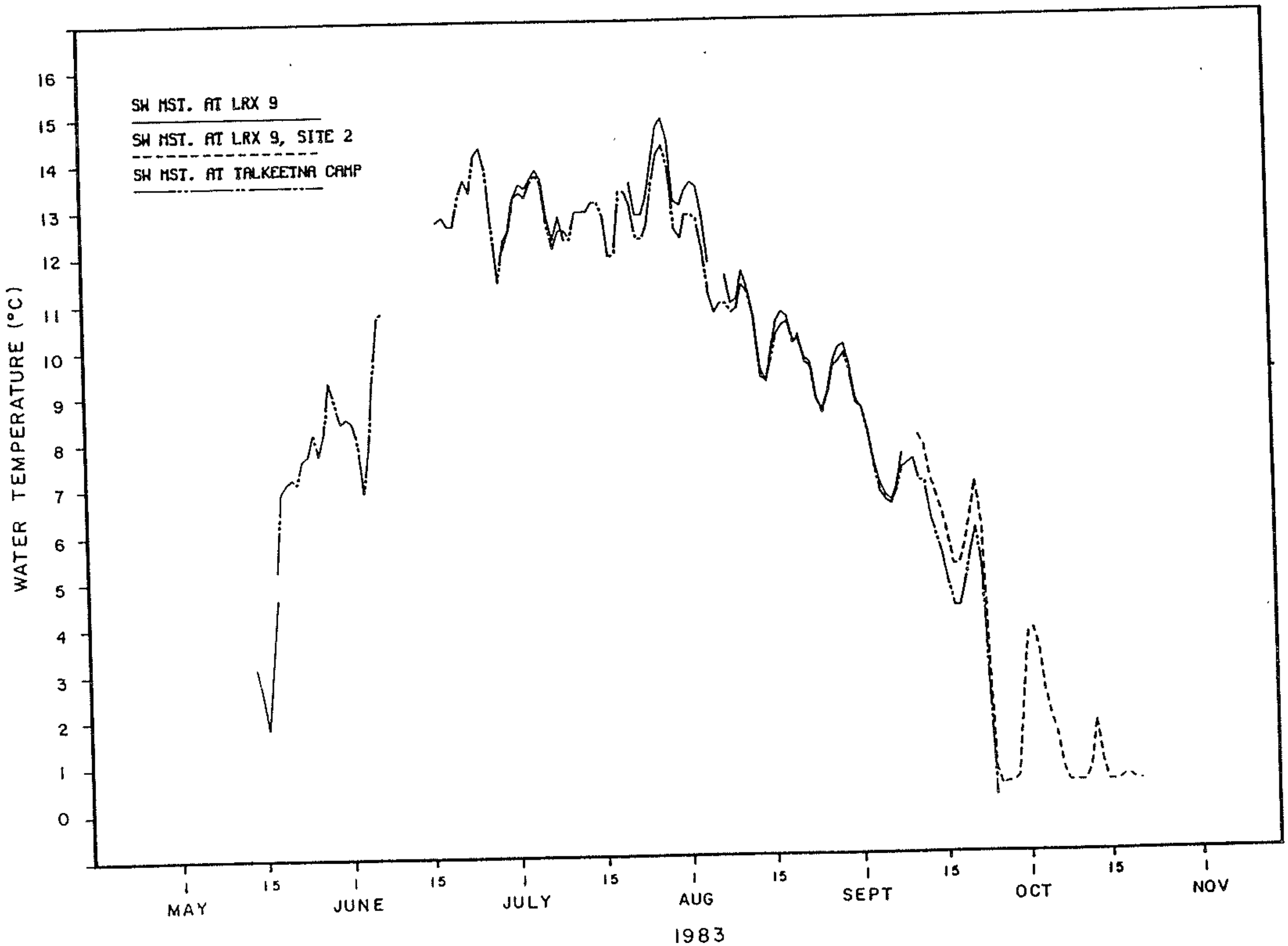

Figure 3-17 Mean daily intragravel and surface water temperature for Mainstem Susitna River collected during the 1983 open water season at LRX 9 - Site 1 and 2 (RM 103.2), and at Talkeetna Fishwheel Camp (RM 103.0).

Table 3-4 Continuous surface water monitoring temperatures stations located in the upper reach of the Susitna River (Devil Canyon, RM 150.0 to above the Oshetna River, RM 235.7) during 1983 open water season.

Site	River Mile	Temperature Data Type
Devil Canyon	150.0	Surface water
Above Tsusena Creek	181.9	Surface water
Above Oshetna River Site 1	234.9	Surface water
Site 2	235.7	Surface water

temperature monitoring stations were established at Devil Canyon (RM 150.0), above Tsusena Creek (RM 181.9), and above the Oshetna River (Site 1, RM 234.9 and Site 2, RM 235.7). Site maps for each of the temperature stations are presented in Appendix Figures 3-A-23, 3-A-24, and 3-A-30. Daily and monthly minimum, mean, and maximum surface water temperatures obtained at these monitoring stations are presented in Appendix Tables 3-A-19 to 3-A-22. This data is also presented as water year weekly temperatures in Appendix Tables 3-A-71 to 3-A-74. A plot of the mean daily surface water temperature is presented in Figure 3-18. The ranges, 25th, 50th (median), and 75th percentiles of surface water temperatures collected at these stations are shown in Figure 3-19. The period of record for this data is presented in Appendix Table 3-A-1.

A comparison of surface water temperatures recorded at the monitoring stations above the Oshetna River (RM 234.9), above Tsusena Creek (RM 181.9), at Devil Canyon (RM 150.0), and above Gold Creek (RM 136.6) shows that from late May to late July similar temperatures were recorded at the sites. From late July to late September, temperatures recorded at the above the Oshetna site were colder than those recorded at the other three locations.

No temperature data from the Devil Canyon station was available until July 2 when the instrument was installed. A gap in the temperature data recorded at the above the Oshetna site from June 22 to July 28 was due to a malfunctioning instrument. On July 28 the recorder was installed at Site 2 RM 235.7.

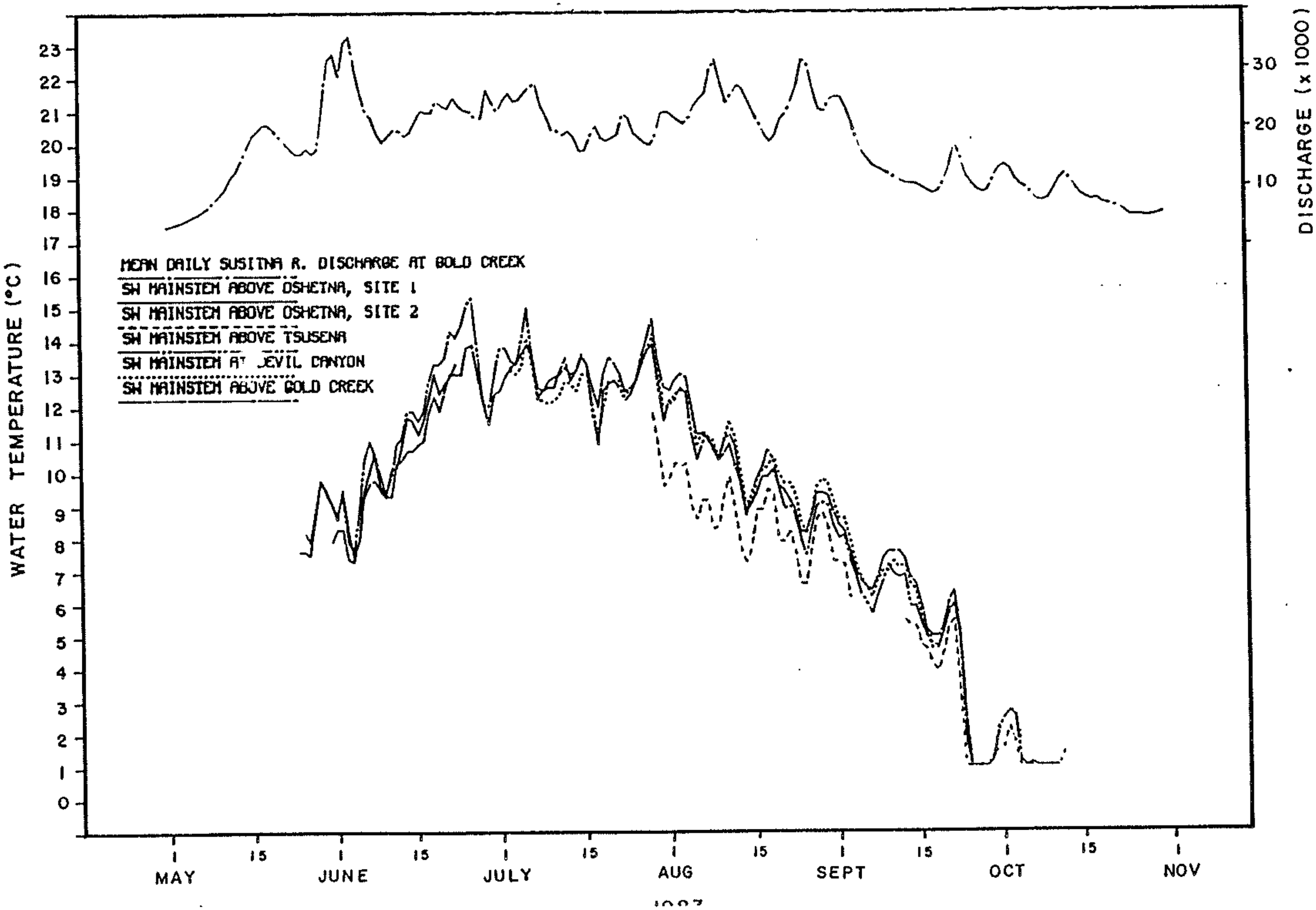

Figure 3-18 Mean daily intragravel and surface water temperature for Mainstem Susitna River collected during the 1983 open water season Above the Oshetna River - Site 1 (RM 234.9), Above the Oshetna River - Site 2 (RM 235.7), Above Tsusena Creek (RM 181.8), and at Devil Canyon (RM 181.8).

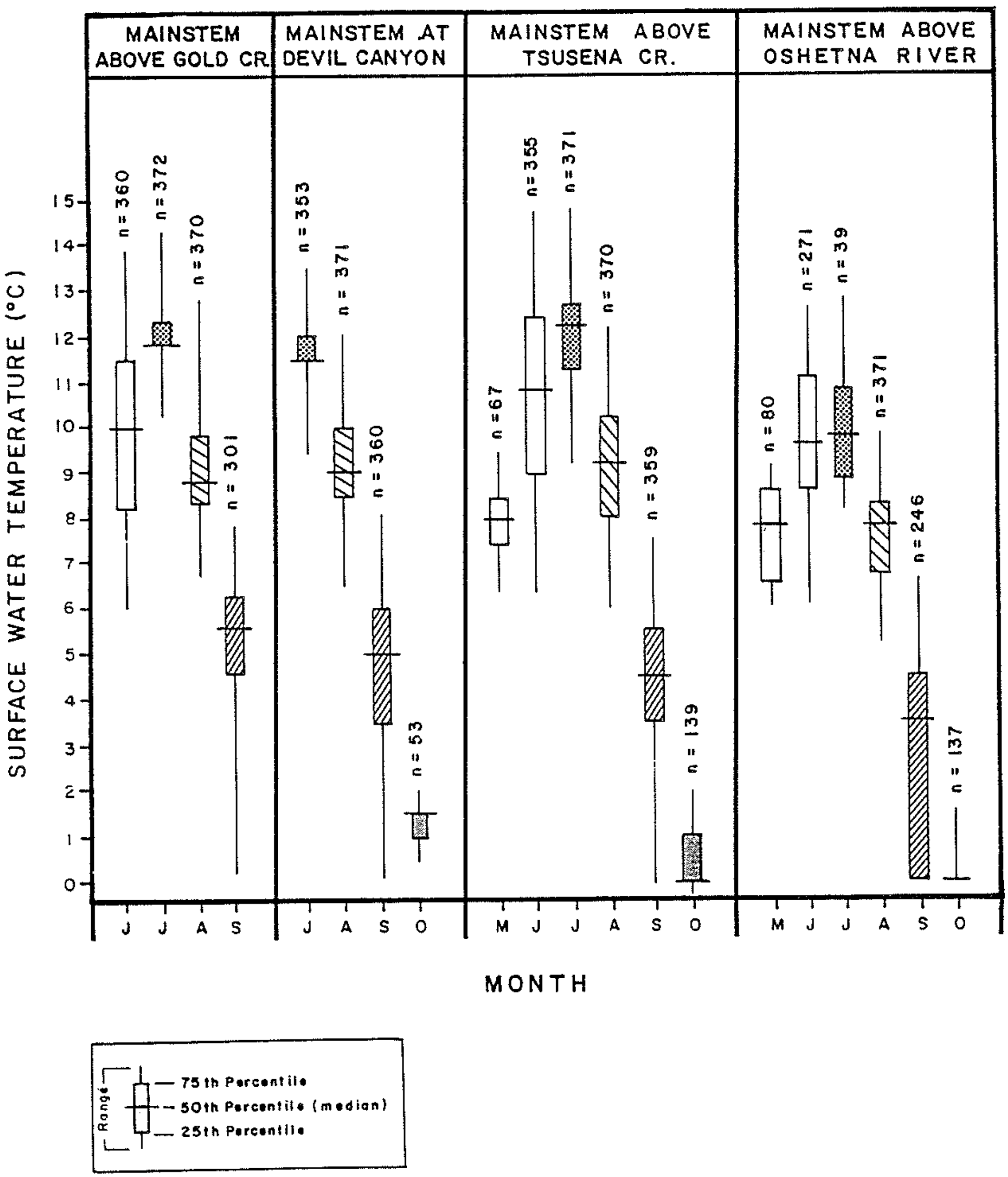

Figure 3-19 Monthly water temperature data summary showing range, 25th, 50th (median), and 75th percentile for mainstem Susitna above Gold Creek (RM 136.8), at Devil Canyon (RM 150.1), above Tsusena Creek (RM 181.8), and above Oshetna River (RM 233.4).

3.2 Side Channel Habitats

Continuous surface and intragravel water temperatures were recorded at three side channels located in the Talkeetna to Devil Canyon reach of the Susitna River during 1983 (~~Figure~~ TABLE 3-5). Stations were located at Side Channel 10 (RM 133.7), Upper Side Channel 11 (Sites 1 and 2, RM 136.3) and Side Channel 21 (RM 142.0)(Table 3-5). Site maps for each station are presented in Appendix Figures 3-A-16, 3-A-17, and 3-A-21. Daily and monthly minimum, mean and maximum surface and intragravel water temperatures are presented in Appendix Tables 3-A-23 to 3-A-27. Water year weekly intragravel and surface water temperatures are presented in Appendix Tables 3-A-75 to 3-A-79. A plot of surface and intragravel water temperature for each station is presented in Figures 3-20, 3-22, and 3-23. Ranges, 25th, 50th (median), and 75th percentiles of surface water temperatures collected at these stations are presented in Figure 3-24. The period of record for the monitoring stations, 1981-1983, is presented in Appendix Table 3-A-1.

3.2.1 Side Channel 10 (RM 133.9)

A temperature monitoring station was installed on July 17 at Side Channel 10 (RM 133.9) to monitor surface and intragravel temperatures. A review of the plot of mean daily temperatures (Figure 3-20) indicates that intragravel temperatures vary less than surface water temperatures. Intragravel temperatures were cooler than surface water temperatures from mid-July through late September (Figure 3-21). At this time a cooling trend decreased surface water temperatures but had a minimal effect on intragravel temperatures.

Table 3-5 Continuous water temperature monitoring stations located at side channels of the Susitna River during the 1983 open water season.

Site	River Mile	Data Type
Side Channel 10	133.9	Surface/intragravel water
Upper Side Channel 11 (Sites 1 and 2)	136.3	Surface/intragravel water
Side Channel 21	141.0	Surface/intragravel water

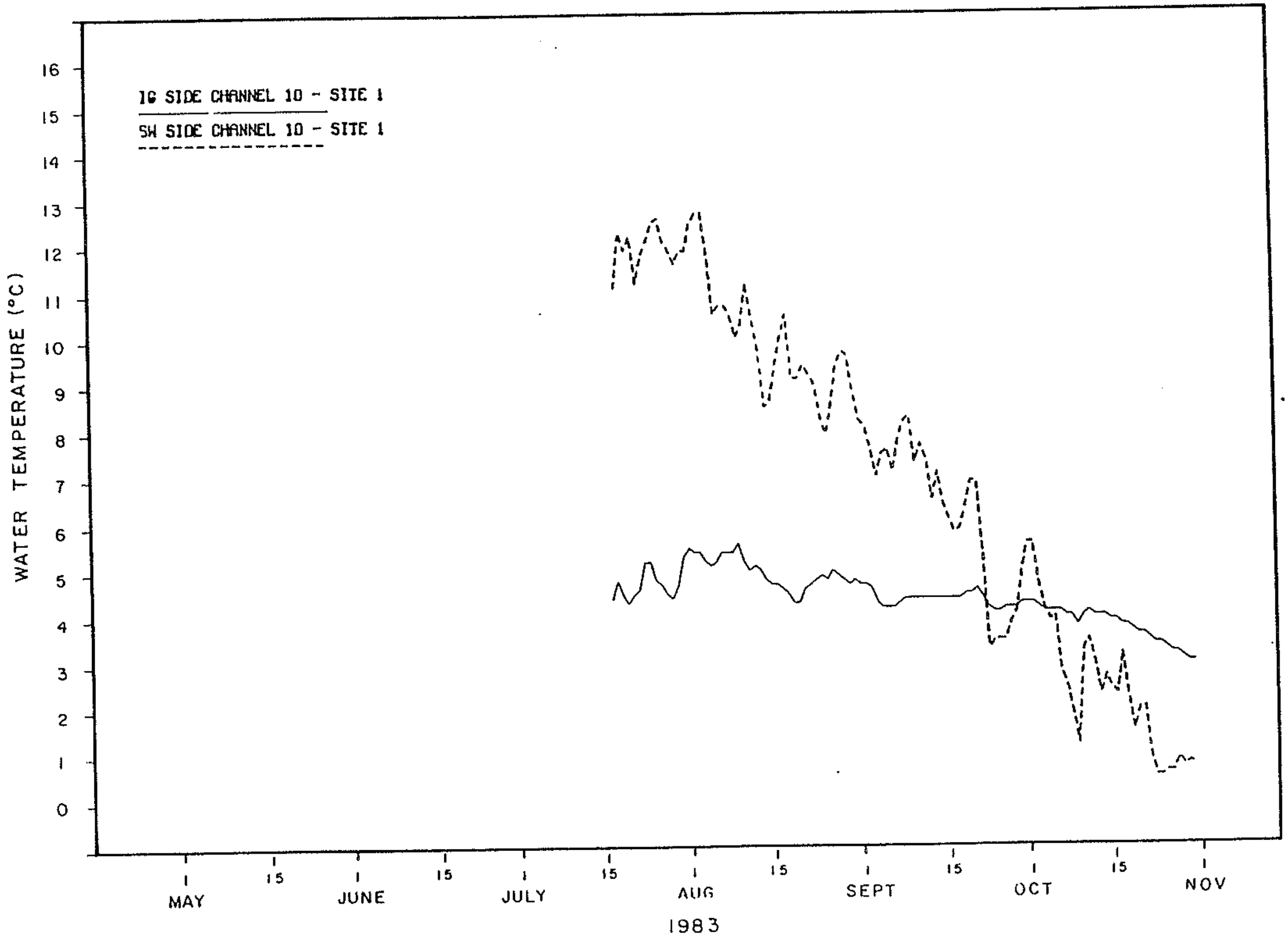

Figure 3-20 Mean daily intragravel and surface water temperatures collected at Side Channel 10 - Site 1 (RM 134.0) during the 1983 open water season.

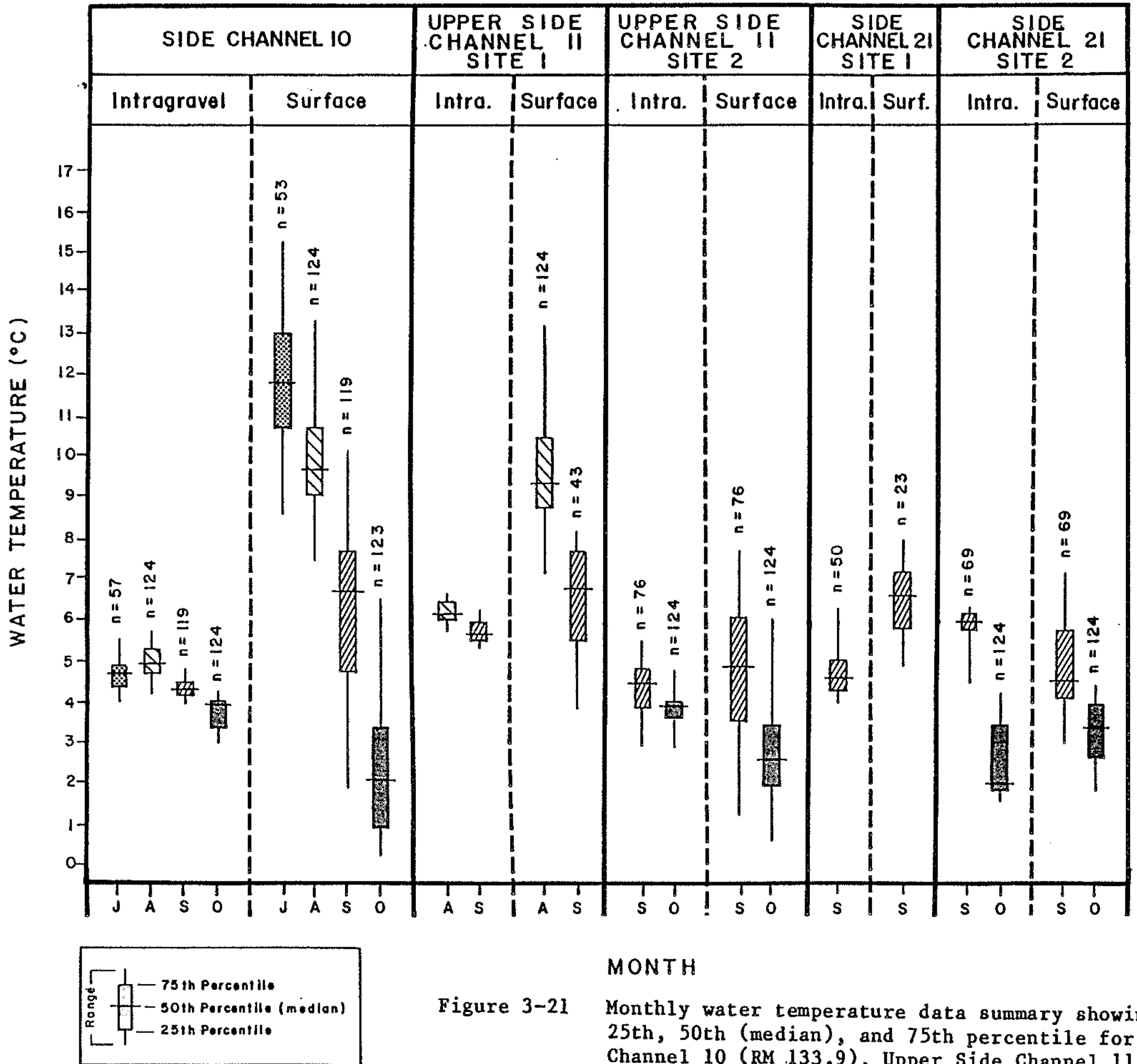

Figure 3-21 Monthly water temperature data summary showing range, 25th, 50th (median), and 75th percentile for Side Channel 10 (RM 133.9), Upper Side Channel 11 - Sites 1 and 2 (RM 136.3), and Side Channel 21 - Sites 1 and 2 (RM 141.0).

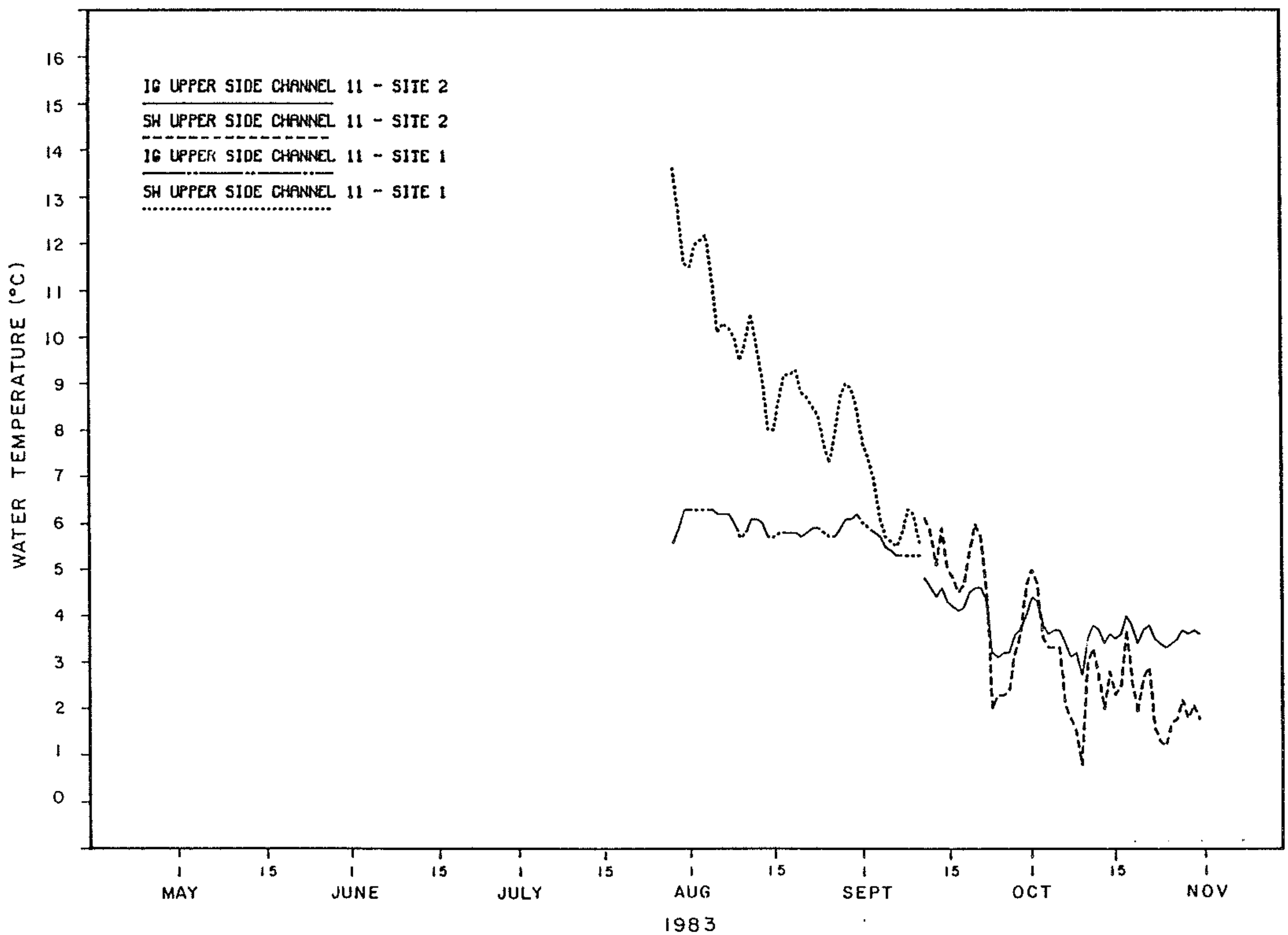

Figure 3-22 Mean daily surface and intragravel water temperature collected at Upper Side Channel 11 - Sites 1 and 2 (RM 136.3) during the 1983 open water season.

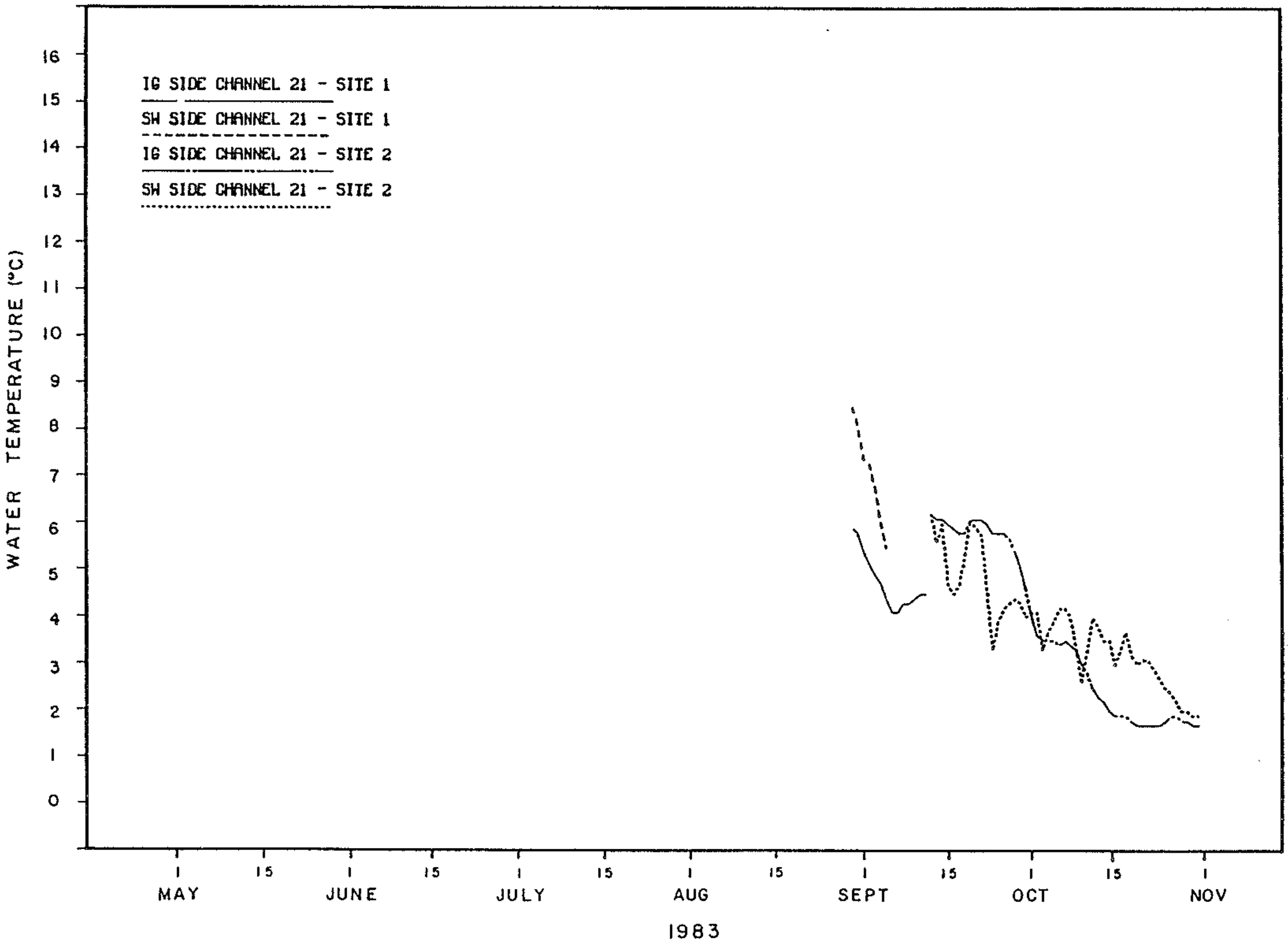

Figure 3-23 Mean daily surface and intragravel water temperature collected at Side Channel 21 - Sites 1 and 2 (RM 141.8) during the 1983 open water season.

From July 17 to October 31 surface water temperatures ranged from 0.2°C to 18.6°C while intragravel temperatures ranged between 3.0°C and 5.8°C.

3.2.2 Upper Side Channel 11 - Sites 1 and 2 (RM 136.3)

The temperature recorder at the Site 1 monitoring station in Side Channel 21 was installed on July 28 to record both surface and intragravel water temperature (Figures 3-21 and 3-22). This temperature recorder was relocated to Site 2 on September 12 to monitor an egg development site for an ADF&G egg incubation study. Minimum and maximum temperatures recorded at Site 1 are presented in Appendix Table 3-A-7. Surface water temperatures range from 3.3°C to 15.3°C, and an intragravel water temperature range from 5.2°C to 6.5°C.

Subsequent to being moved on September 12 to Site 2, the mean daily intragravel temperatures decreased from 5.3°C to 4.8°C. and mean daily surface water temperatures increased from 5.6°C to 6.1°C. At Site 2, surface water continued to be warmer than intragravel until late September when the trend was reversed. Through October intragravel temperatures were warmer than surface water temperatures (Figure 3-22). Surface water temperatures at Site 2 (September 12 to October 31) ranged from 0.6°C to 9.5°C and intragravel temperatures ranged from 2.6°C to 5.5°C.

3.2.3 Side Channel 21 - Sites 1 and 2 (RM 141.0)

The temperature monitoring station located at Site 1 in Side Channel 21 was installed on August 29 to record both surface and intragravel water temperatures. The recorder was relocated to Site 2 on September 13 to monitor an egg development site for an ADF&G incubation study. The limited available data from Site 1 shows that surface water temperature was warmer than intragravel water (Figures 3-21 and 3-23). Surface water temperatures ranged from 4.7°C to 9.2°C and intragravel temperatures varied between 3.9°C and 7.9°C.

After installation Site 2 mean intragravel water temperatures increased from 4.9°C (Site 1) to 6.2°C (Site 2). Because the surface water probe was dewatered prior to installation at Site 2 (data gap) no immediate comparisons between surface water temperatures recorded at Sites 1 and 2 can be made.

Mean intragravel water temperature was warmer than the surface water from September 13 to October 1 with a transition period occurring in early October. In late October when intragravel water is usually warmer mean surface water temperature was greater than intragravel (Figure 3-23). Surface water temperatures in Side Channel 21, Site 2 ranged from 1.6°C to 7.5°C and intragravel temperatures ranged from 1.6°C to 6.2°C.

3.3 Side and Upland Slough Habitats

Continuous surface and intragravel water temperatures were recorded at ten locations in six sloughs located in the Talkeetna to Devil Canyon reach of the Susitna River (Table 3-6). Site maps for each of these temperature stations are presented in Appendix Figures 3-A-13 to 3-A-21. Daily and monthly minimum, mean, and maximum surface and intragravel water temperatures are presented in Appendix Tables 3-A-28 to 3-A-38. Water year weekly temperatures are presented in Appendix Tables 3-A-80 to 3-A-90. The period of record for the monitoring stations, 1981-1983, is presented in Appendix Table 3-A-1.

3.3.1 Side Slough 8A (RM 125.6)

Temperature monitoring stations in Side Slough 8A were located at Lower Side Slough 8A (RM 125.6) and Upper Side Slough 8A (RM 126.6). See Appendix Figure 3-A-13 for site locations.

3.3.1.1 Lower Side Slough 8A - Sites 2 and 3 (RM 125.6)

Surface and intragravel water temperatures were recorded at Lower Side Slough 8A (Site 2) from May 1 to August 24. Surface water temperature was consistently warmer than intragravel water temperatures (Figure 3-24 and 3-25). Surface water temperature ranged from 1.3°C to 17.4°C and intragravel water temperatures varied between 3.1°C and 5.5°C. The data gap which occurs in the surface water temperature data from June 2 to July 5 was the result of siltation of the temperature probes. This

Table 3-6. Continuous water temperature monitoring stations located at side and upland sloughs of the Susitna River during the 1983 open water field season.

Site	River Mile	Habitat	Temperature Data Type
Lower Side Slough 8A Sites 2 and 3	125.6	side slough	surface/intragravel water
Upper Side Slough 8A	126.6	side slough	surface/intragravel water
Side Slough 9	128.6	side slough	surface/intragravel water
Side Slough 9	128.3	side slough	surface/intragravel water
Upland Slough 10 (NE Channel)	134.0	upland slough	surface/intragravel water
Upland Slough 10 (NW Channel)	134.0	upland slough	surface/intragravel water
Side Slough 11	135.7	side slough	surface/intragravel water
Upland Slough 19	140.0	upland slough	surface/intragravel water
Lower Side Slough 21	141.8	side slough	surface/intragravel water
Upper Side Slough 21	142.0	side slough	surface/intragravel water

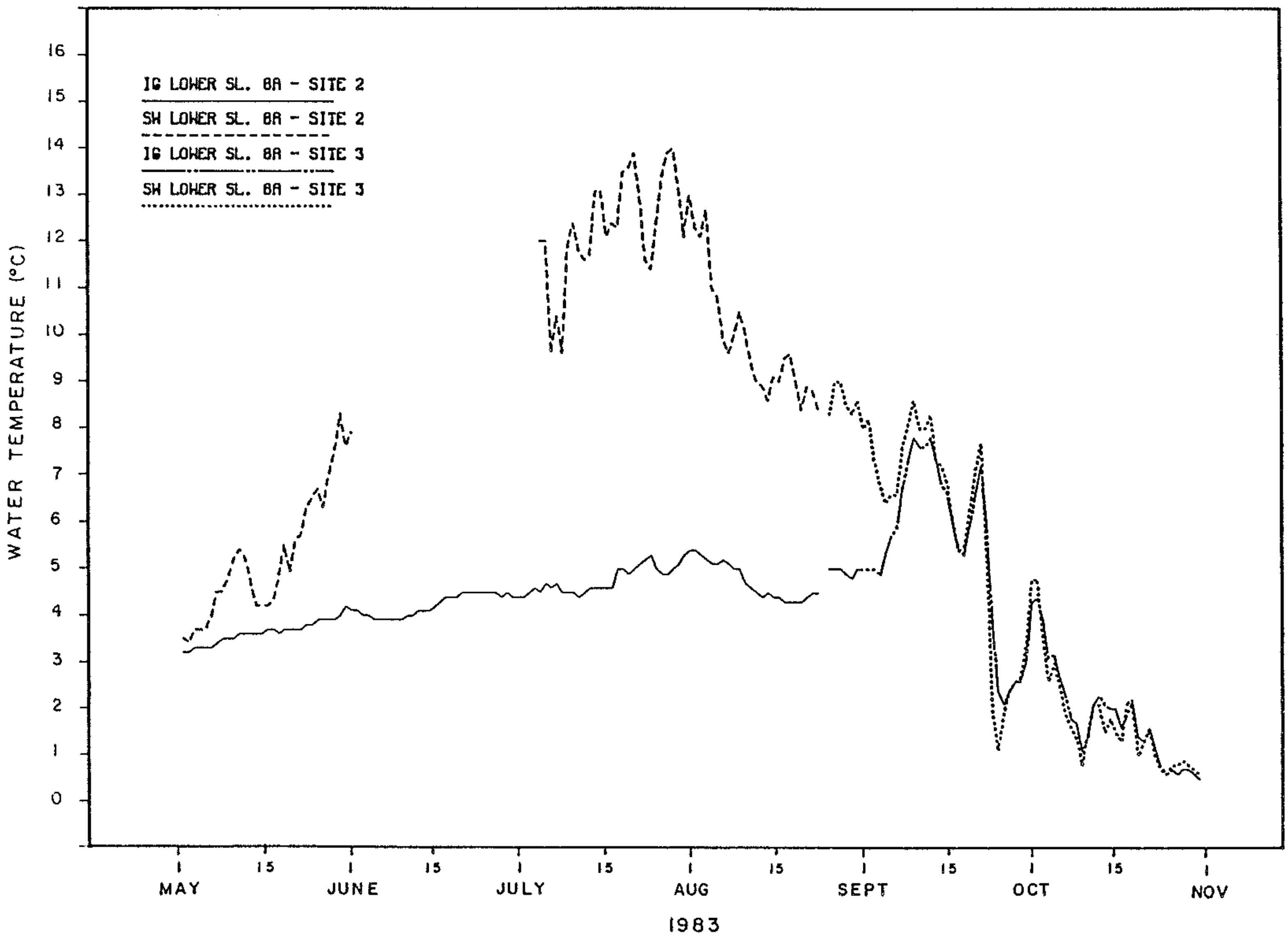

Figure 3-24 Mean daily surface and intragravel water temperature collected at Lower Slough 8A - Sites 2 and 3, (RM 125.4) during the 1983 open water season.

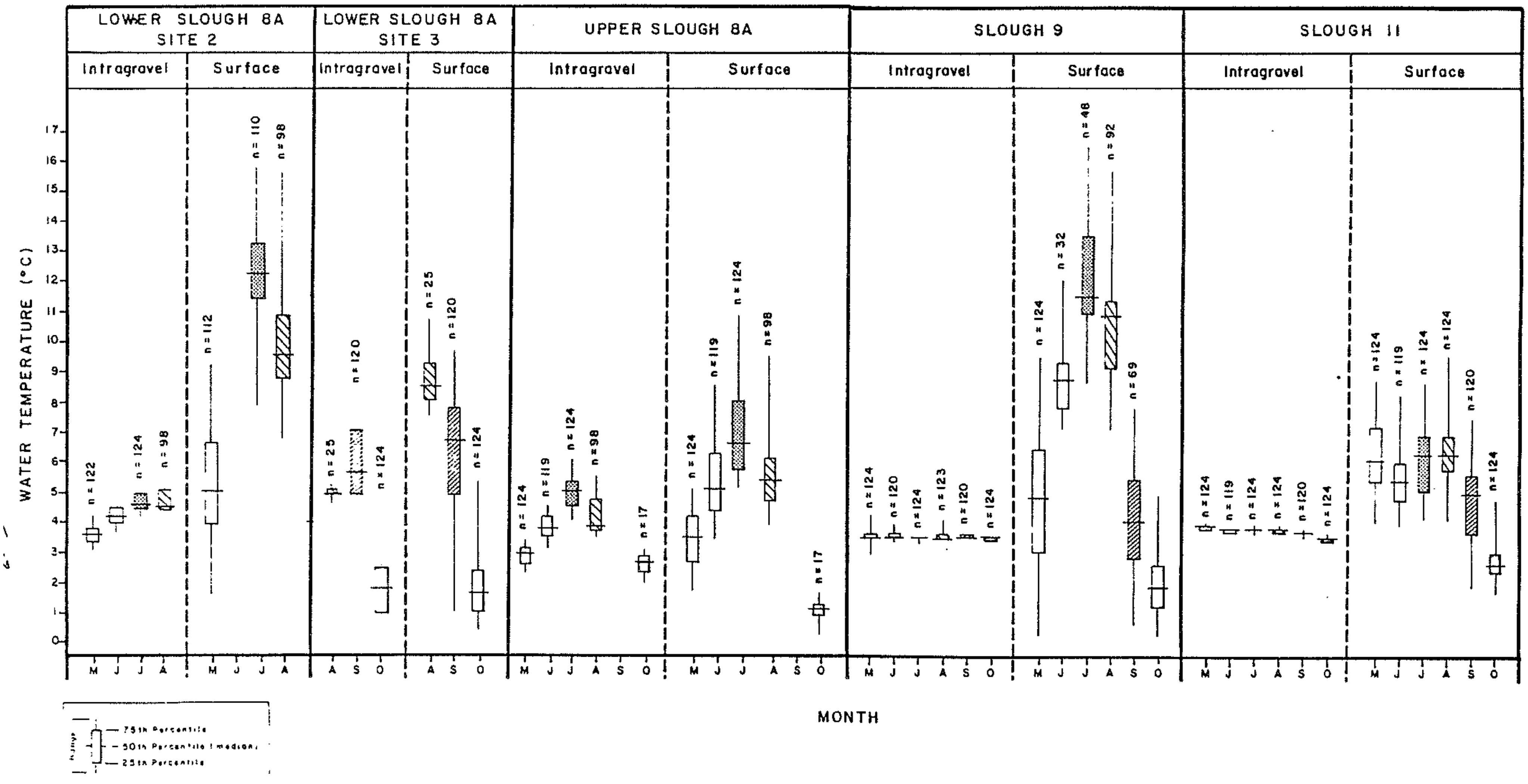

Figure 3-25 Monthly water temperature data summary showing range, 25th, 50th (median), and 75th percentile for Lower Slough 8A - Sites 2 and 3 (RM 125.6), Upper Slough 8A (RM 125.6), Slough 9 (RM 128.6), and Slough 11 (135.3).

problem was not apparent when the temperature recorder was serviced in June because of high water conditions.

On August 25 the recorder was reinstalled at Site 3 because it was felt that the new site would be more appropriate for winter data collection. Between August 25 and mid-September, mean daily surface water temperatures recorded were at times 4°C warmer than intragravel temperatures.

From mid-September through October both surface and intragravel water cooled and the temperatures recorded were similar. Mean monthly surface water temperature in September was 6.0°C while mean monthly intragravel temperature was 5.5°C. Mean monthly surface and intragravel temperatures recorded in October were 1.8°C and 1.7°C, respectively.

3.3.1.2 Upper Side Slough 8A (RM 126.6)

Surface water temperatures recorded at the monitoring station at Upper Side Slough 8A (RM 126.6) were warmer than intragravel temperatures from May to late August (Figures 3-25 and 3-26). Between May 1 and August 25 surface water temperature ranged from 1.3°C to 11.3°C while intragravel temperatures ranged from 1.2°C to 6.0°C. Maximum intragravel and surface water temperatures were recorded in July (Figure 3-26). A gap in surface and intragravel water temperature data from August 25 to October 27 resulted from a malfunctioning instrument. From October 27 to October 31 intragravel temperatures were approximately 1.5° warmer than surface water temperatures. During this time intragravel temperatures ranged from 1.7°C to 3.0°C while surface temperatures ranged from 0.0°C to 1.6°C.

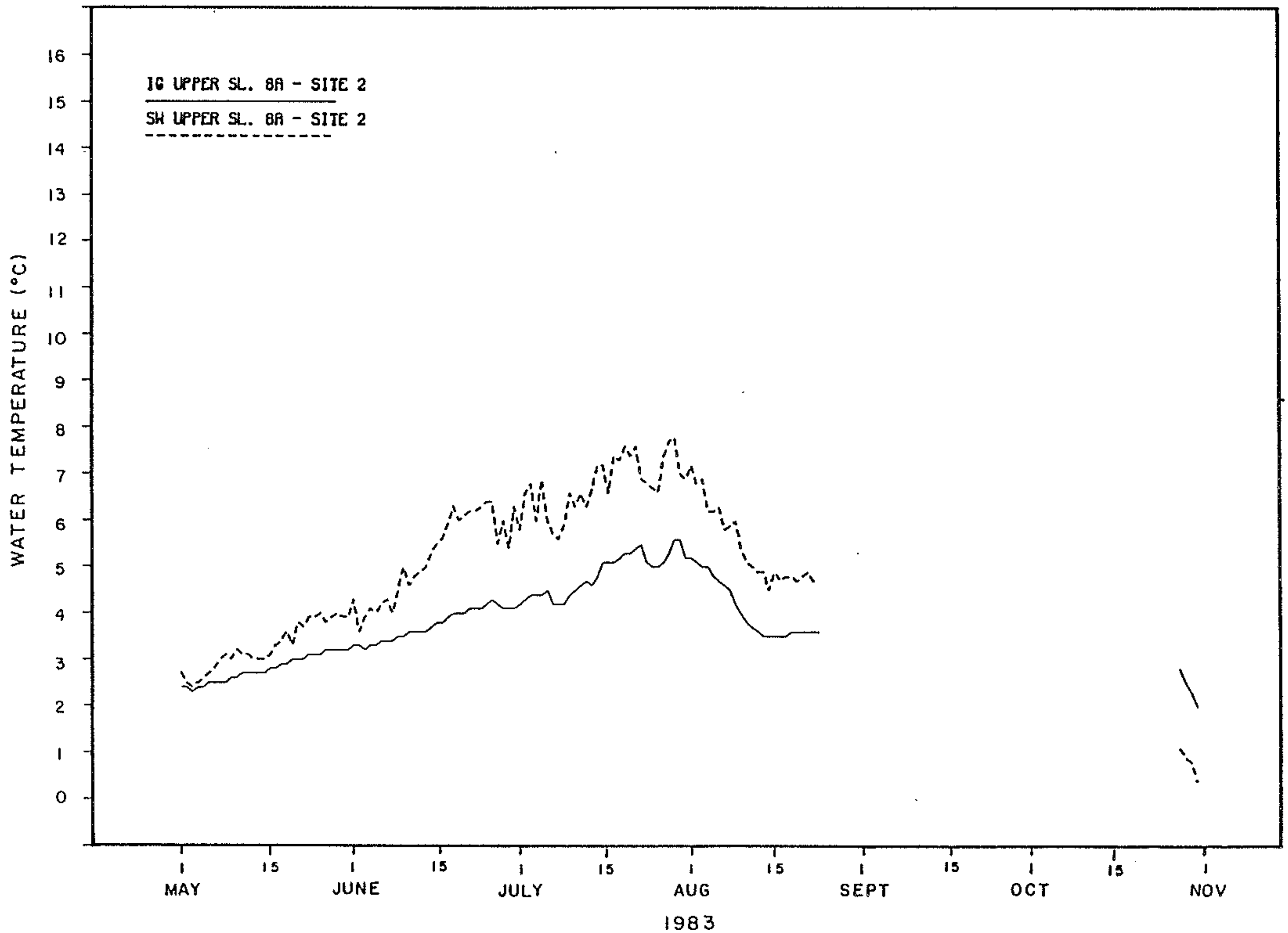

Figure 3-26 Mean daily surface and intragravel water temperature collected at Upper Slough 8A - Site 2 (RM 125.4) during the 1983 open water season.

3.3.1.3 Lower Side Slough 8A (RM 125.6) versus Upper Side Slough 8A (RM 126.6)

To determine temperature differences in Side Slough 8A, surface and intragravel temperatures recorded at the monitoring station in Lower Side Slough 8A (RM 125.6) were compared to temperatures measured at the Upper Side Slough 8A (RM 126.6) monitoring station (Figures 3-25 and 3-27). Intragravel temperatures recorded at the monitoring stations at Upper 8A and Lower 8A - Site 2 were similar. Surface water temperatures recorded at Lower 8A - Site 2 were consistently warmer than surface water temperatures recorded in Upper 8A from May through August. Due to a malfunction in the recorder located in Upper 8A from August 25 to October 27 no further comparisons were made.

3.3.2 Side Slough 9 (RM 128.6)

A review of the Slough 9 temperature plot (Figure 3-28) shows that intragravel temperatures were consistently colder than surface water temperatures and exhibited little variation. Between May 1 and October 31 intragravel temperatures ranged from 2.8°C to 4.2°C. Surface water temperatures ranged between 0.0°C and 17.8°C. Surface water temperatures began to cool in mid-September. During late September and October intragravel water temperatures was warmer than surface water temperatures. Due to siltation of the probe, several gaps in the surface water temperature data occur between July and mid-September.

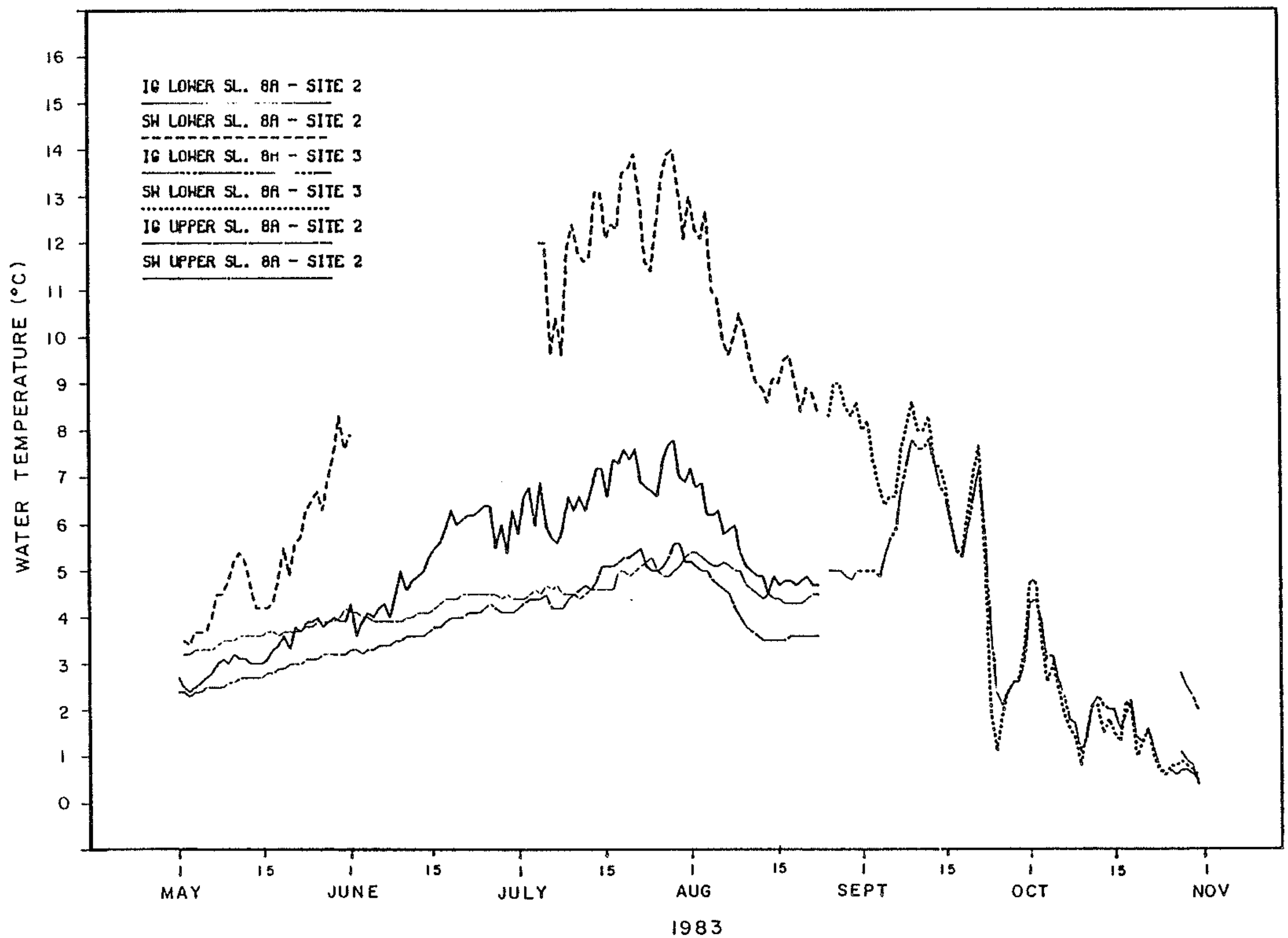

Figure 3-27 Mean daily surface and intragravel water temperature collected at Lower Slough 8A - Sites 2 and 3 (RM 125.4) and Upper Slough 8A - Site 2 (RM 126.60) during the 1983 open water season.

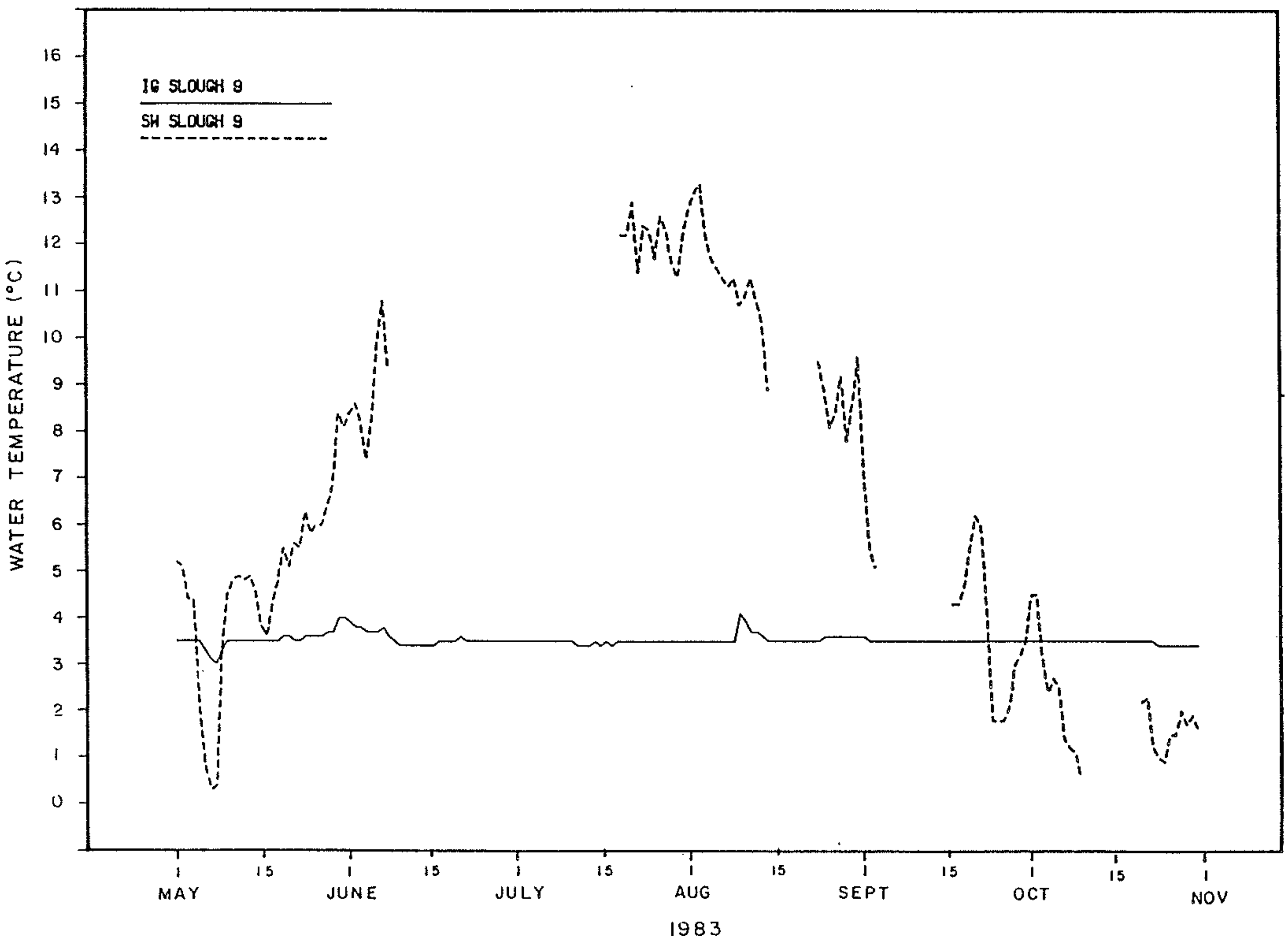

Figure 3-28 Mean daily surface and intragravel water temperature collected at Slough 9 (RM 128.6) during the 1983 open water season.

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3.3.3 Side Slough 9 Incubation Site (RM 128.3)

A thermograph temperature recorder was installed in the Slough 9 ADF&G Incubation Study Site (RM 128.3) on August 31 to record only surface water temperatures. Data was recorded until September 21 when instrument failure occurred. During this time surface water temperatures ranged from 1.0°C to 8.0°C (see Appendix Table 3-A-32).

3.3.4 Upland Slough 10 Northeast and Northwest Channels (RM 134.0)

Temperature recorders were installed at Slough 10 in both the Northeast and Northwest channels on October 19 to record surface and intragravel water temperatures (Appendix Tables 3-A-33 and 3-A-34). These temperature monitoring stations were installed to support the ADF&G egg incubation study. Because the open water season data record is brief (October 19-31), plots of these data were not developed. Mean daily surface water temperature during late October in the Northeast channel ranged from 1.5°C to 3.7°C in the Northeast channel and from 1.8°C to 3.5°C in the Northwest channel. Intragravel water temperatures ranged from 3.3°C to 4.0°C in the Northeast channel and from 3.5°C to 3.7°C in the Northwest channel.

3.3.5 Side Slough 11 (RM 135.7)

Surface and intragravel water temperature was recorded in Side Slough 11 from May 1 to October 31 (Appendix Table 3-A-1). This side slough was not observed to be breached by mainstem discharge during that time period. Between May and September surface water was warmer than intragravel water (Figure 3-29). In late September and October surface water cooled and were lower than intragravel temperatures. Between May 1 and October 31 surface water temperatures ranged from 1.1°C to 10.2°C. Intragravel temperatures were stable ranging from 3.2°C to 3.9°C. Mean monthly surface water temperature was highest in August (6.1°C) compared to 5.9°C for July, 5.3°C for June, and 6.0°C for May.

3.3.6 Upland Slough 19 (RM 140.0)

Surface and intragravel water temperatures were recorded in Upland Slough 19 from May 1 to October 31 (Appendix Table 3-A-36). A data gap caused by instrument failure occurs from May 17 to June 5. From May 1 to May 17 mean daily surface water temperature was warmer than intragravel water temperatures (Figures 3-30 and 3-31). During this period surface water temperature ranged from 1.6°C to 8.5°C while intragravel temperature ranged from 2.3°C to 4.2°C. During June, surface and intragravel water temperatures were similar, and mean monthly temperature calculated for both surface and intragravel water was 5.2°C. In July mean daily surface water temperatures increased and intragravel temperatures decreased. Surface water remained warmer until September 26 when the trend reversed. Between June 5 and October 31 surface water temperature ranged between 1.9°C and 10.0°C and intragravel temperatures ranged from 3.6°C and 7.3°C.

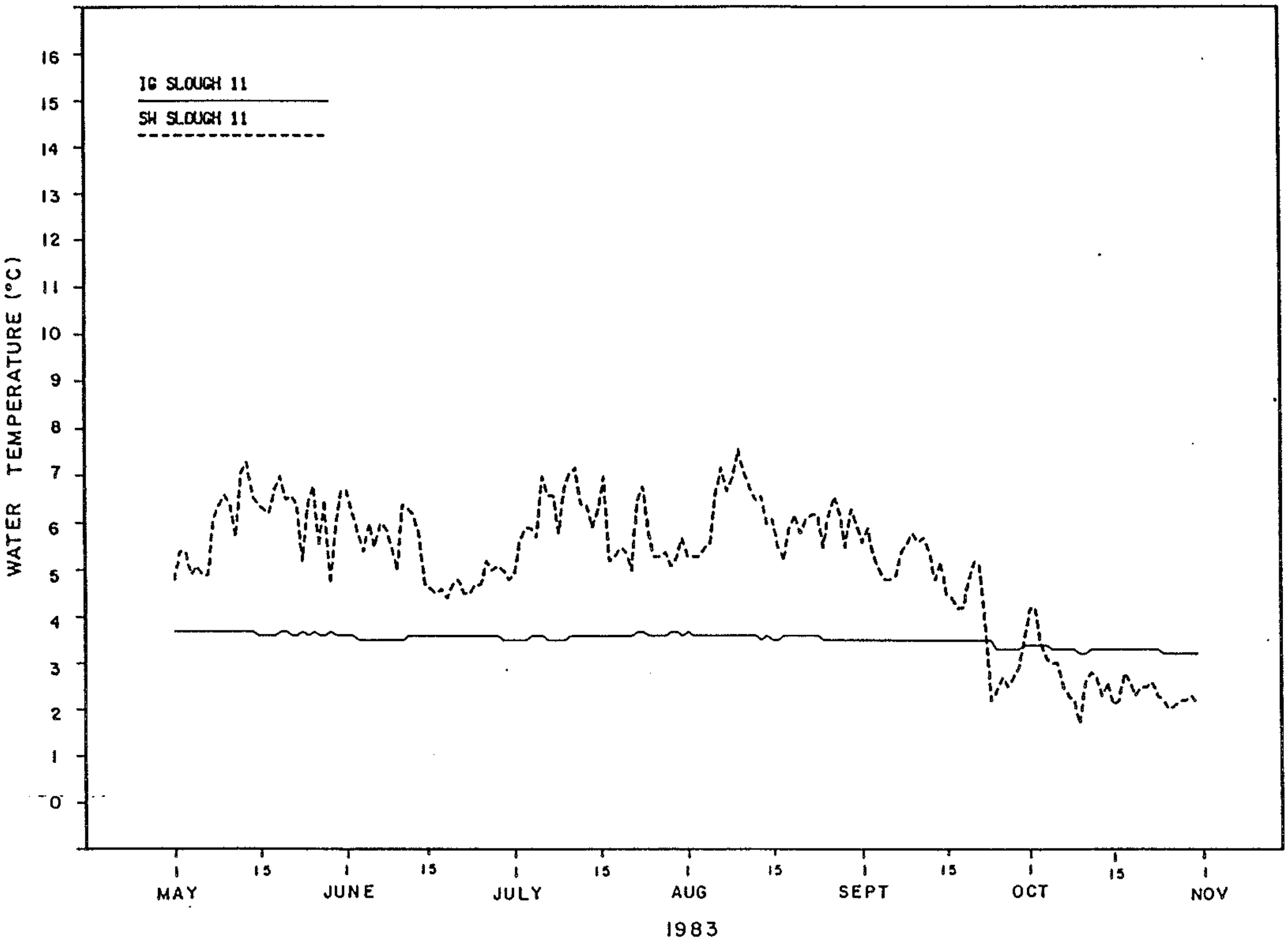

Figure 3-29 Mean daily surface and intragravel water temperature collected at Slough 11 (RM 135.3) during the 1983 open water season.

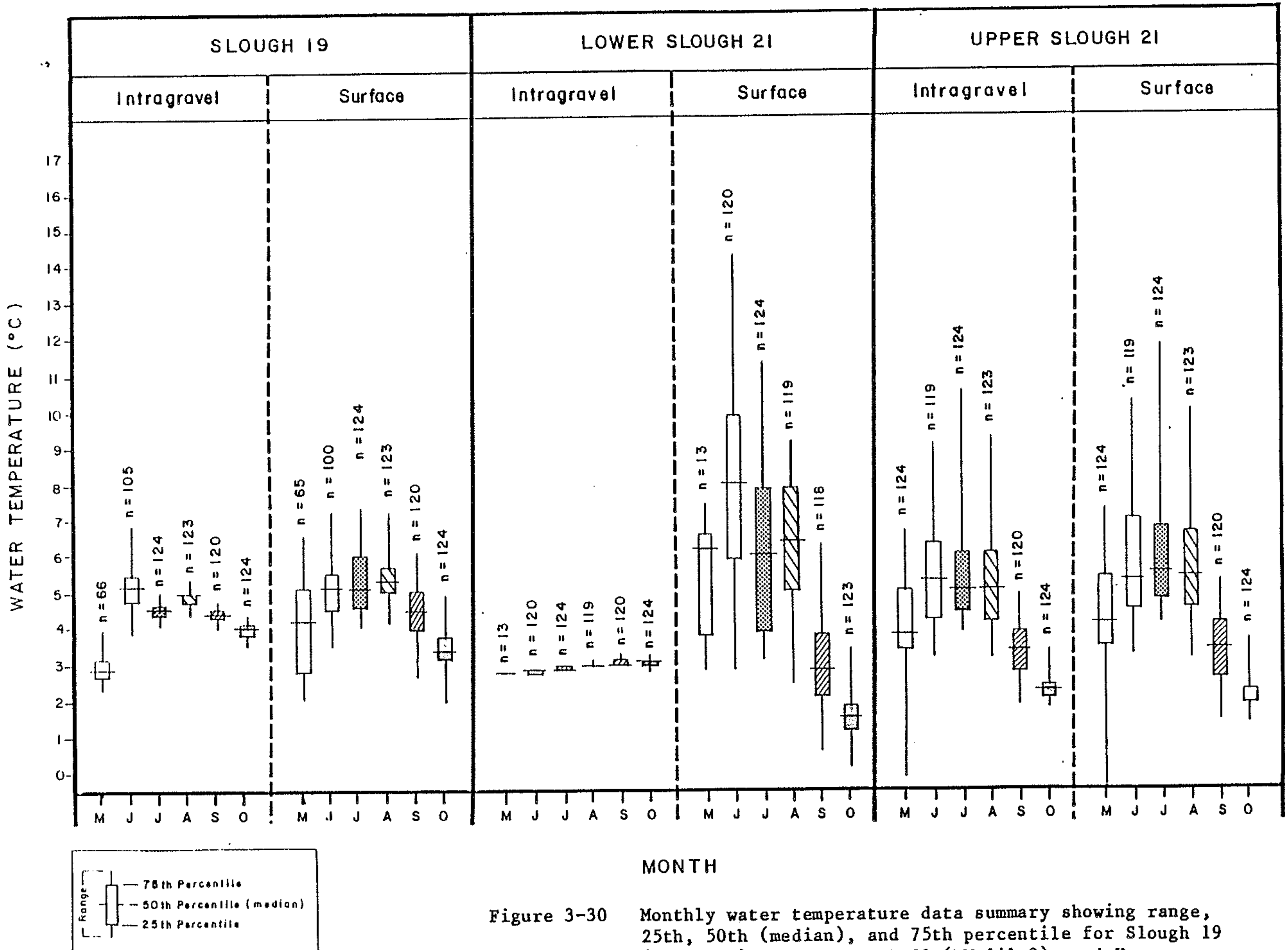

Figure 3-30 Monthly water temperature data summary showing range, 25th, 50th (median), and 75th percentile for Slough 19 (RM 140.0), Lower Slough 21 (RM 141.8), and Upper Slough 21 (RM 142.0).

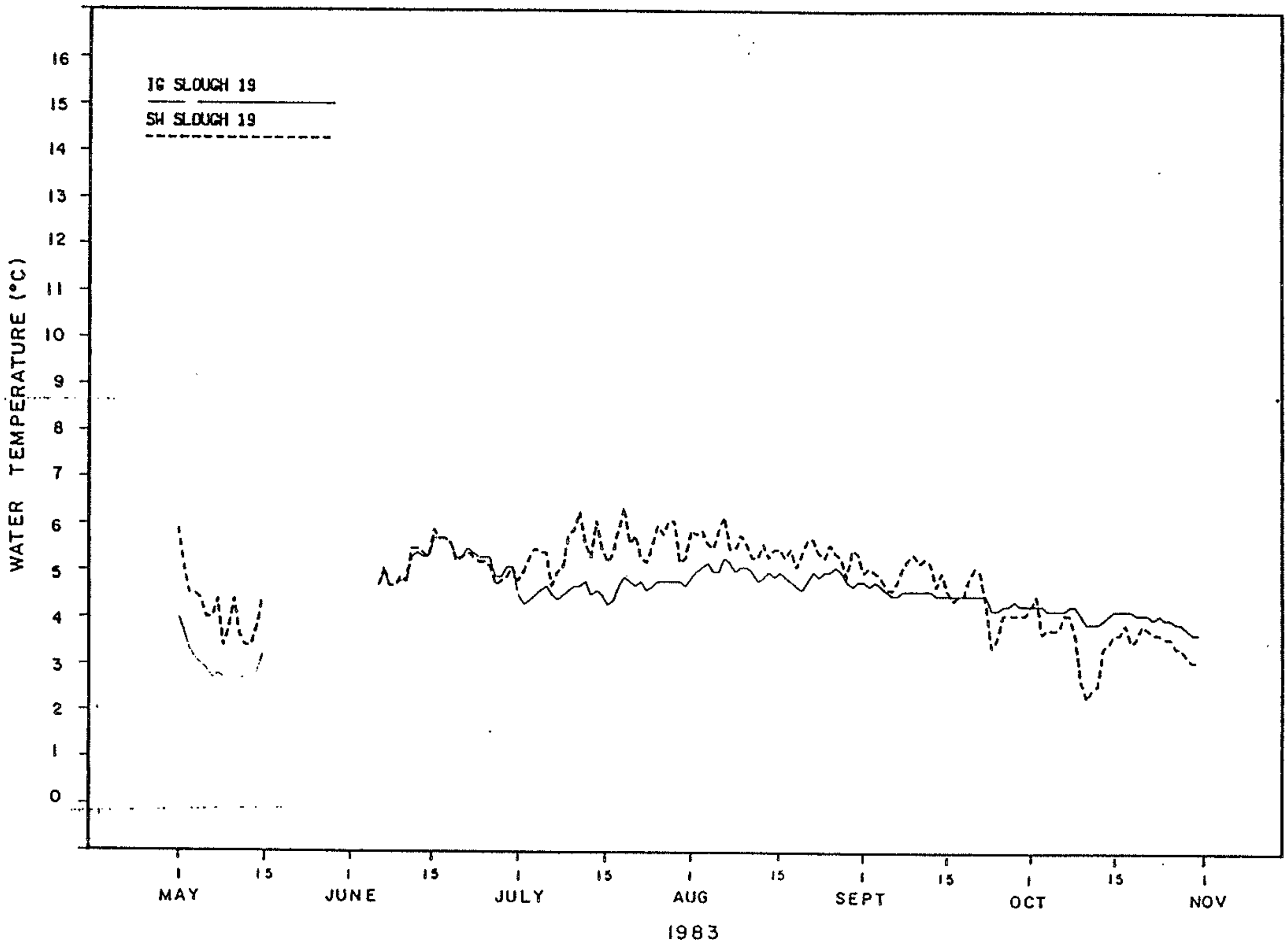

Figure 3-31 Mean daily surface and intragravel water temperature collected at Slough 19 (RM 140.0), during the 1983 open water season.

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Surface and intragravel water temperatures were recorded in Upland Slough 19 from May 1 to October 31 (Appendix Table 3-A-36). A data gap caused by instrument failure occurs from May 17 to June 5. From May 1 to May 17 mean daily surface water temperature was warmer than intragravel water temperatures (Figures 3-30 and 3-31). During this period surface water temperature ranged from 1.6°C to 8.5°C while intragravel temperature ranged from 2.3°C to 4.2°C. During June, surface and intragravel water temperatures were similar, and mean monthly temperature calculated for both surface and intragravel water was 5.2°C. In July mean daily surface water temperatures increased and intragravel temperatures decreased. Surface water remained warmer until September 26 when the trend reversed. Between June 5 and October 31 surface water temperature ranged between 1.9°C and 10.0°C and intragravel temperatures ranged from 3.6°C and 7.3°C.

3.3.7 Side Slough 21 (RM 141.8)

Temperature monitoring stations in Side Slough 21 were located at Lower Side Slough 21 (RM 141.8) and Upper Side Slough 21 (RM 142.0). See Appendix Figure 3-A-21 for site locations.

3.3.7.1 Lower Side Slough 21 (RM 141.8)

Surface and intragravel water temperatures were recorded in Lower Side Slough 21 from May 28 to October 31 (Appendix Table 3-A-37). Surface water was warmer than intragravel water until September when the trend reversed (Figures 3-30 and 3-32). During the sampling period surface

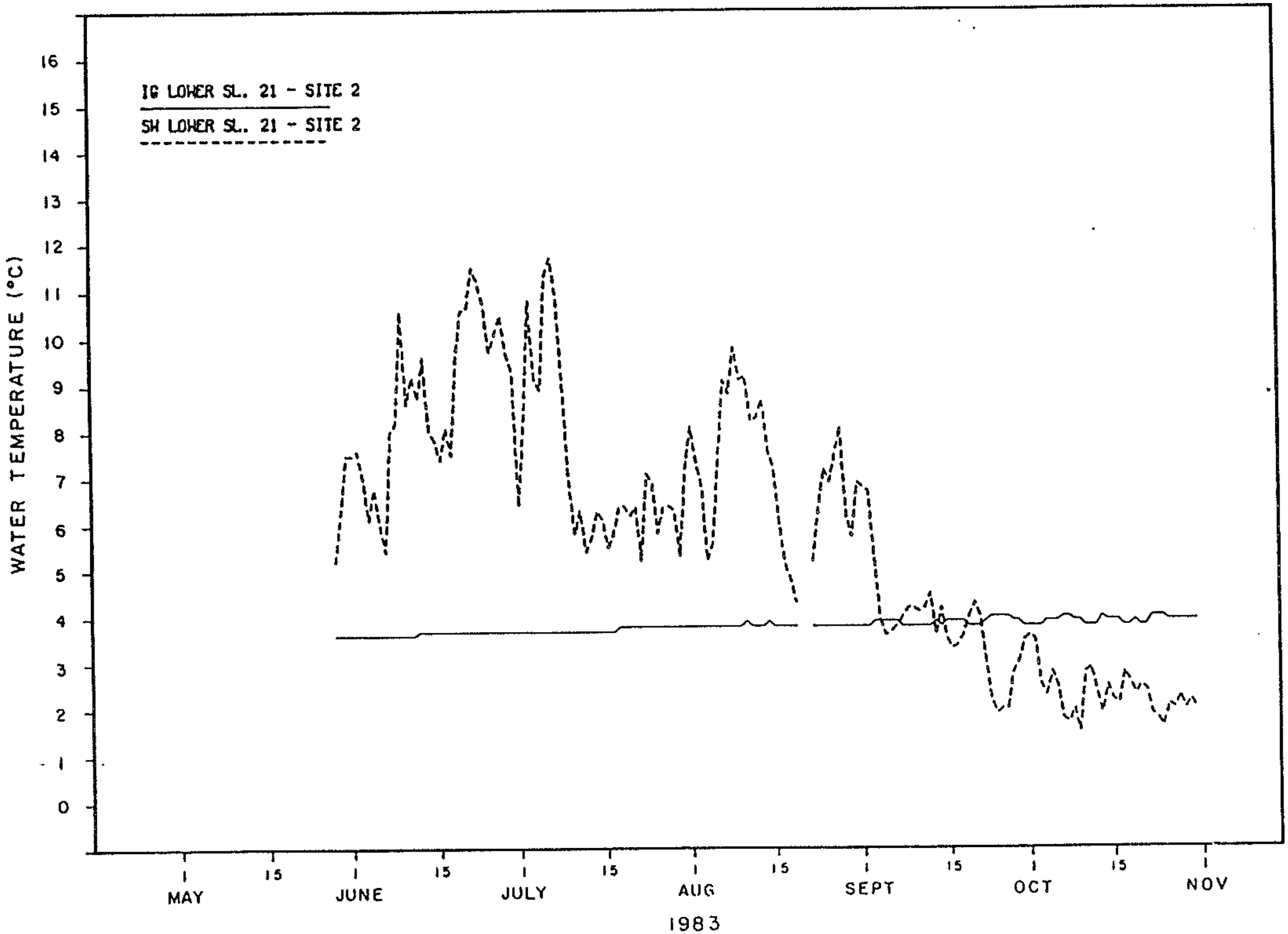

Figure 3-32 Mean daily surface and intragravel water temperature collected at Slough 21 - Site 2 (RM 141.8) during the 1983 open water season.

3.3.7 Side Slough 21 (RM 141.8)

Temperature monitoring stations in Side Slough 21 were located at Lower Side Slough 21 (RM 141.8) and Upper Side Slough 21 (RM 142.0). See Appendix Figure 3-A-21 for site locations.

3.3.7.1 Lower Side Slough 21 (RM 141.8)

Surface and intragravel water temperatures were recorded in Lower Side Slough 21 from May 28 to October 31 (Appendix Table 3-A-37). Surface water was warmer than intragravel water until September when the trend reversed (Figures 3-30 and 3-32). During the sampling period surface water temperatures varied between 0.2°C (in October) and 17.5°C (in June). Mean daily surface water temperatures recorded in July were lower than those recorded in June or August. Intragravel temperatures were stable throughout the open water season ranging from 3.5°C to 4.2°C.

3.3.7.2 Upper Side Slough 21 (RM 142.0)

Surface and intragravel water temperatures recorded in the upper portion of Side Slough 21 from May 1 to October 31, are presented in Appendix Table 3-A-38. A plot of this data is presented in Figure 3-33. Surface and intragravel water temperature corresponded closely to each other. Surface water temperatures ranged from 0.0°C to 14.9°C, while intragravel temperatures ranged from 0.4°C to 13.1°C. Surface water remained warmer than intragravel from May to late-September when the trend

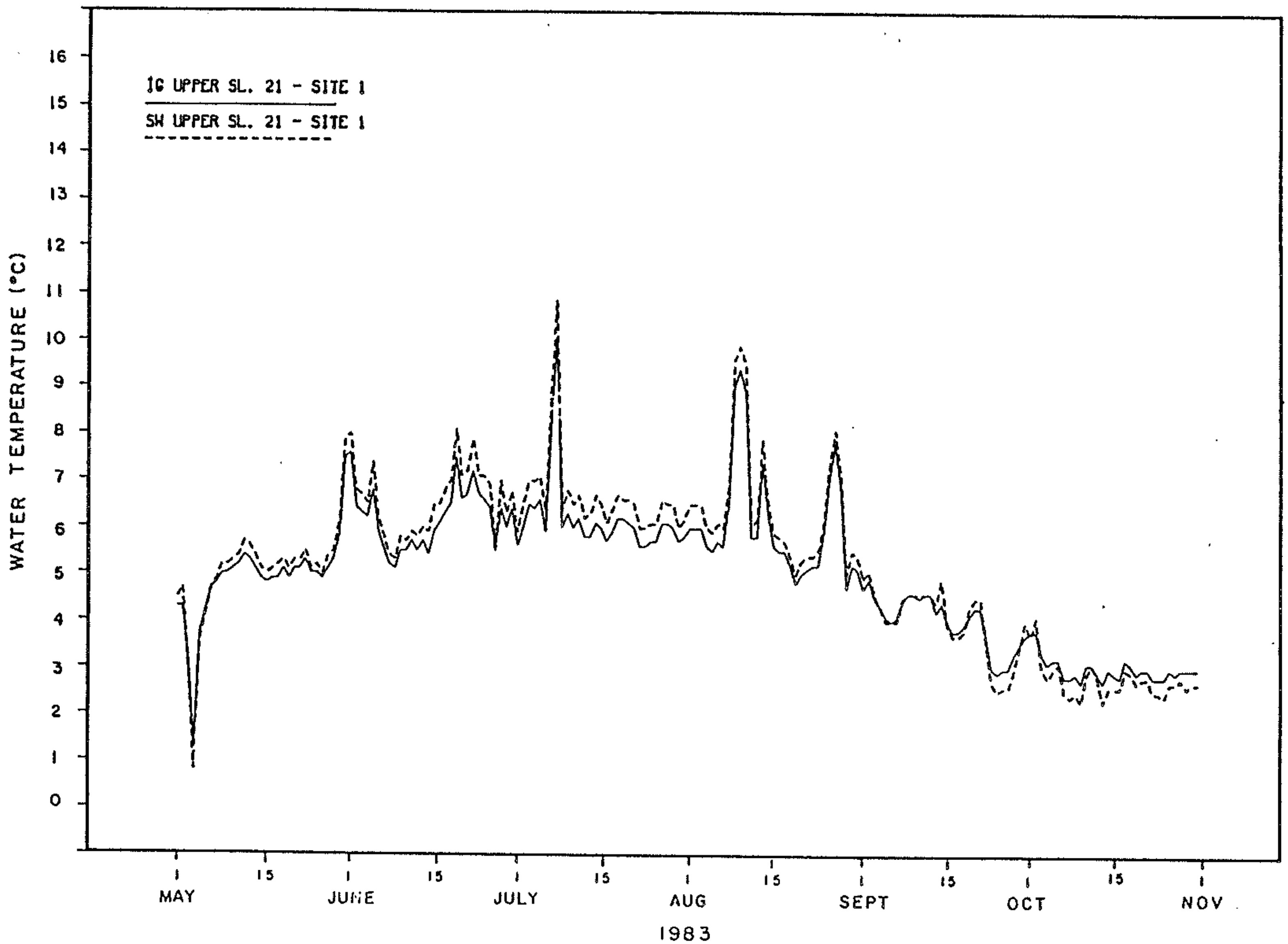

Figure 3-33 Mean daily surface and intragravel water temperature collected at Upper Slough 21 - Site 1, (RM 142.0), during the 1983 open water season.

reversed. A dramatic decrease in both surface and intragravel water temperatures occurred on May 3.

3.3.7.3 Lower Side Slough 21 (RM 141.8) versus Upper Side Slough 21 (RM 142.0)

To determine variations in water temperatures occurring in Side Slough 21, surface and intragravel water temperatures recorded at the lower and upper portion of the slough were compared (Figure 3-34). Overall, surface water temperatures recorded at the lower station, and both surface and intragravel temperature recorded at the upper station were more dynamic than the intragravel water temperatures measured in the lower portion of the slough. During June and early July the range of surface water temperatures recorded in the lower slough was greater than the range of surface water temperatures observed for surface water in the upper portion of the slough. Throughout the remainder of the sampling period surface water temperatures recorded at the two monitoring stations were similar. Intragravel water temperature recorded in the upper slough followed the same general trend as the surface water temperatures recorded at this station whereas intragravel water temperatures in the lower portion of the slough showed very little variation throughout the open water season.

3.4 Tributary Habitats

Surface water temperature data was collected on a continuous basis from thirteen tributaries located from the Yentna River upstream to the

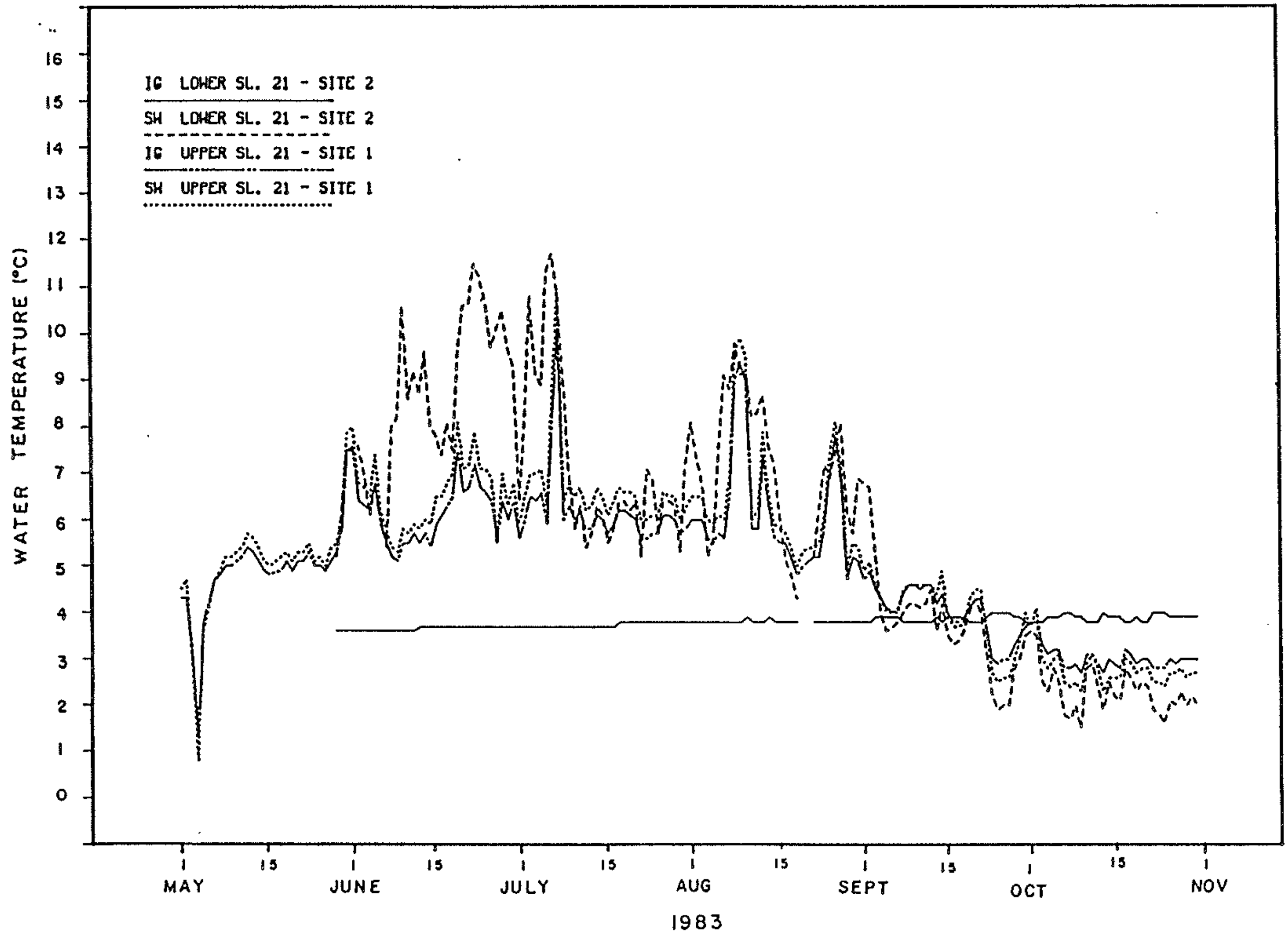

Figure 3-34 Mean daily surface and intragravel water temperature collected at Lower Slough 21 - Site 2 (RM 141.8), and Upper Slough 21 - Site 1 (RM 142.0) during the 1983 open water season.

Oshetna River (Table 3-7). Site maps for each of these temperature stations are presented in Appendix Figures 3-A-5, 3-A-9, 3-A-10, 3-A-15, 3-A-18, 3-A-19, 3-A-22, 3-A-24 to 3-A-29. Daily and monthly minimum, mean, and maximum surface water temperatures for each tributary are presented in Appendix Tables 3-A-39 to 3-A-53. Water year weekly temperatures are presented in Appendix Tables 3-A-91 to 3-A-105. The 1981-1983 period of record for these temperature stations is presented in Appendix Table 3-A-1.

3.4.1 Tributaries Below Talkeetna

The Yentna River was the only tributary located downstream of Talkeetna in which temperature was monitored during the 1983 open water season.

3.4.1.1 Yentna River (RM 28.0, TRM 4.0)

From June 15 to October 7 surface water temperatures recorded in the Yentna River ranged from 0.0°C (in September) to 12.8°C (in June). Warmest temperatures generally were recorded in June and July (Figures 3-35 and 3-36). During this time period daily fluctuations of 2°C per day were recorded. Temperatures declined in August and diurnal fluctuations were reduced to approximately 0.5°C per day. (See Appendix Table 3-A-39).

Table 3-7. Locations of temperature monitoring stations in tributaries of the Susitna River during the 1983 open water season.

Site	River Mile	TRM[1]	River Reach	Temperature Data Type
Yentna River	28.0	4.0	Estuary to Talkeetna	surface water
Chulitna River	98.6		Talkeetna to Devil Canyon	surface water
(Site 1)		0.6	Talkeetna to Devil Canyon	surface water
(Site 2)		2.4	Talkeetna to Devil Canyon	surface water
(Site 3)		4.4	Talkeetna to Devil Canyon	surface water
Talkeetna River	97.2	1.5	Talkeetna to Devil Canyon	surface water
Fourth of July Creek	131.1	0.0	Talkeetna to Devil Canyon	surface water
Fourth of July Creek Plume	131.1	--	Talkeetna to Devil Canyon	surface/ intragravel water
Gold Creek	136.7	0.2	Talkeetna to Devil Canyon	surface water
Indian River	138.6	1.0	Talkeetna to Devil Canyon	surface water
Portage Creek	148.8	0.2	Talkeetna to Devil Canyon	surface water
Tsusena Creek	181.8	0.1	Above Devil Canyon	surface water
Deadman Creek	186.7	0.1	Above Devil Canyon	surface water
Watana Creek	194.1	0.1	Above Devil Canyon	surface water
Kosina Creek	206.8	0.1	Above Devil Canyon	surface water
Goose Creek	231.8	0.1	Above Devil Canyon	surface water
Oshetna River	233.4	0.1	Above Devil Canyon	surface water

1 tributary river mile

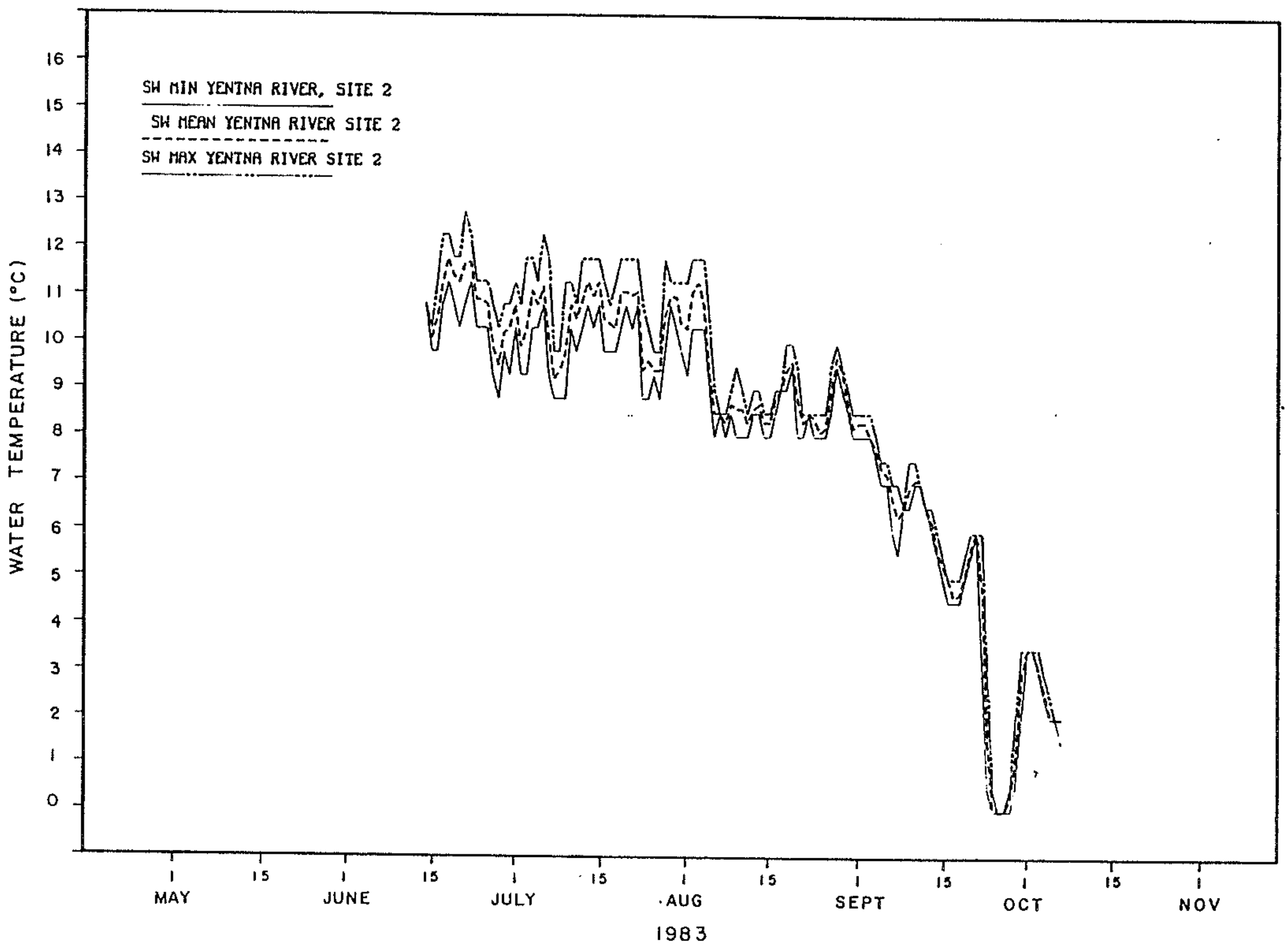

Figure 3-35 Minimum, mean, and maximum daily surface water temperature collected at Yentna River - Site 2 (RM 28.0) during the 1983 open water season.

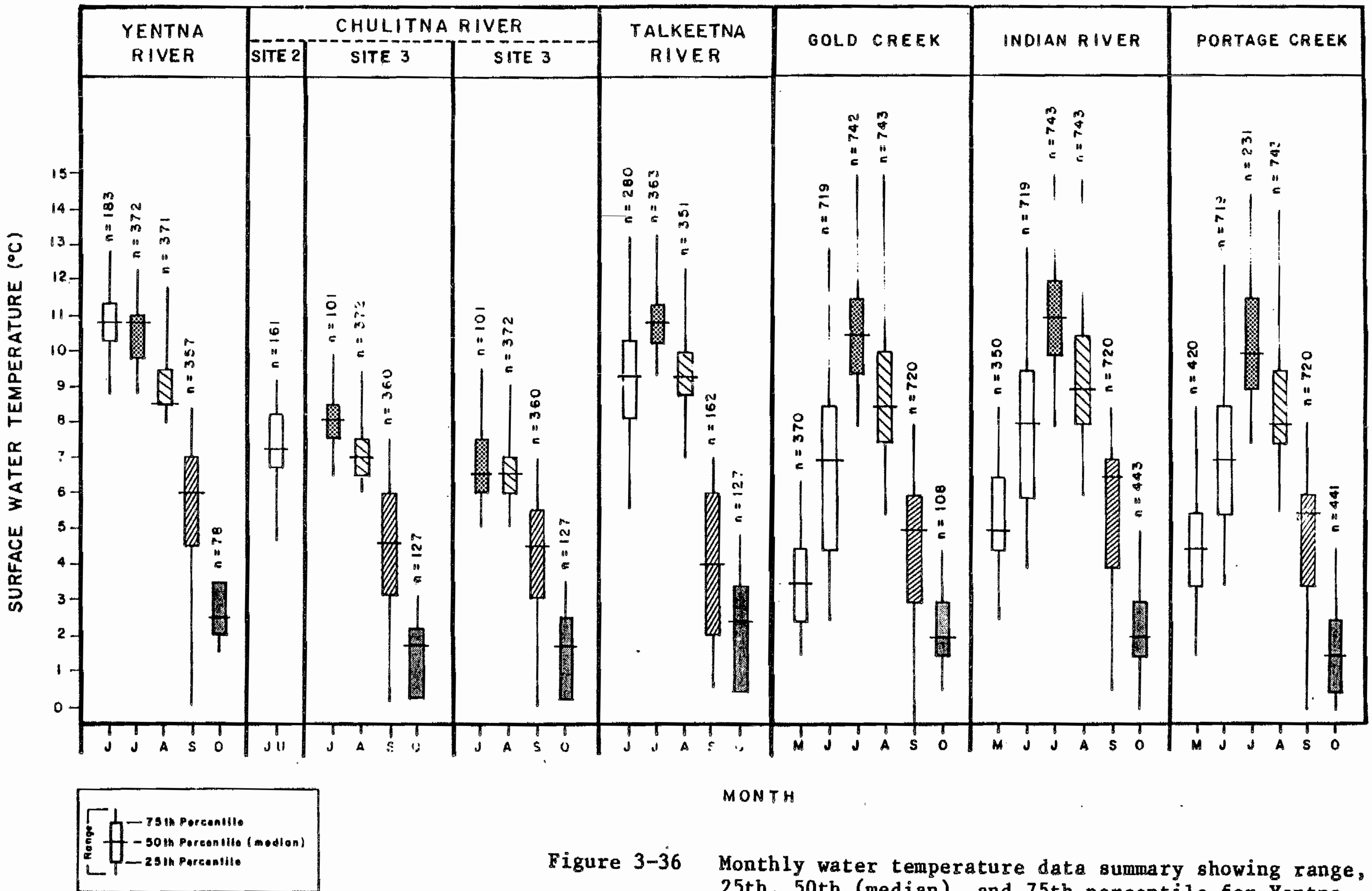

Figure 3-36 Monthly water temperature data summary showing range, 25th, 50th (median), and 75th percentile for Yentna River (RM 28.0), Chulitna River (RM 98.6), and Talkeetna River (RM 97.2), Gold Creek (RM 138.6), and Portage Creek (RM 148.8).

3.4.2 Tributaries Between Talkeetna and Devil Canyon

Six tributaries were monitored for temperature in the Talkeetna to Devil Canyon reach of the Susitna River during the 1983 open water field season (Table 3-7).

3.4.2.1 Talkeetna River (RM 97.2, TRM 1.5)

Surface water temperatures were monitored in the Talkeetna River from May 29 to October 11. A plot of the mean daily temperatures is presented in Figure 3-37. Temperatures in the Talkeetna River ranged from 0.4° (in October) to 13.3°C (in June and July) (Figure 3-36), diurnal fluctuations as great as 3°C per day observed. Gaps in the data for June and September were the result of instrument failure.

3.4.2.2 Chulitna River (RM 98.6, TRM 0.6, 2.4, 4.4)

A temperature recorder was installed in the Chulitna River on May 29 at Site 2 (TRM 0.6). This recorder was lost during a peak flow event resulting in a data gap from June 14 to July 23. Temperature monitoring stations were installed at two locations on July 23, Site 3 (TRM 2.4) and Site 4 (TRM 4.4). From the temperature record available (Appendix Tables 3-A-40 to 3-A-42) plots of the mean daily temperature recorded at each station were developed (Figure 3-38), and of the minimum, mean, and maximum temperatures recorded at Sites 2 and 3 were developed (Figure 3-39). A review of Figure 3-38 indicates that surface water temperatures at Site 3 were warmer then the temperatures recorded at Site 4

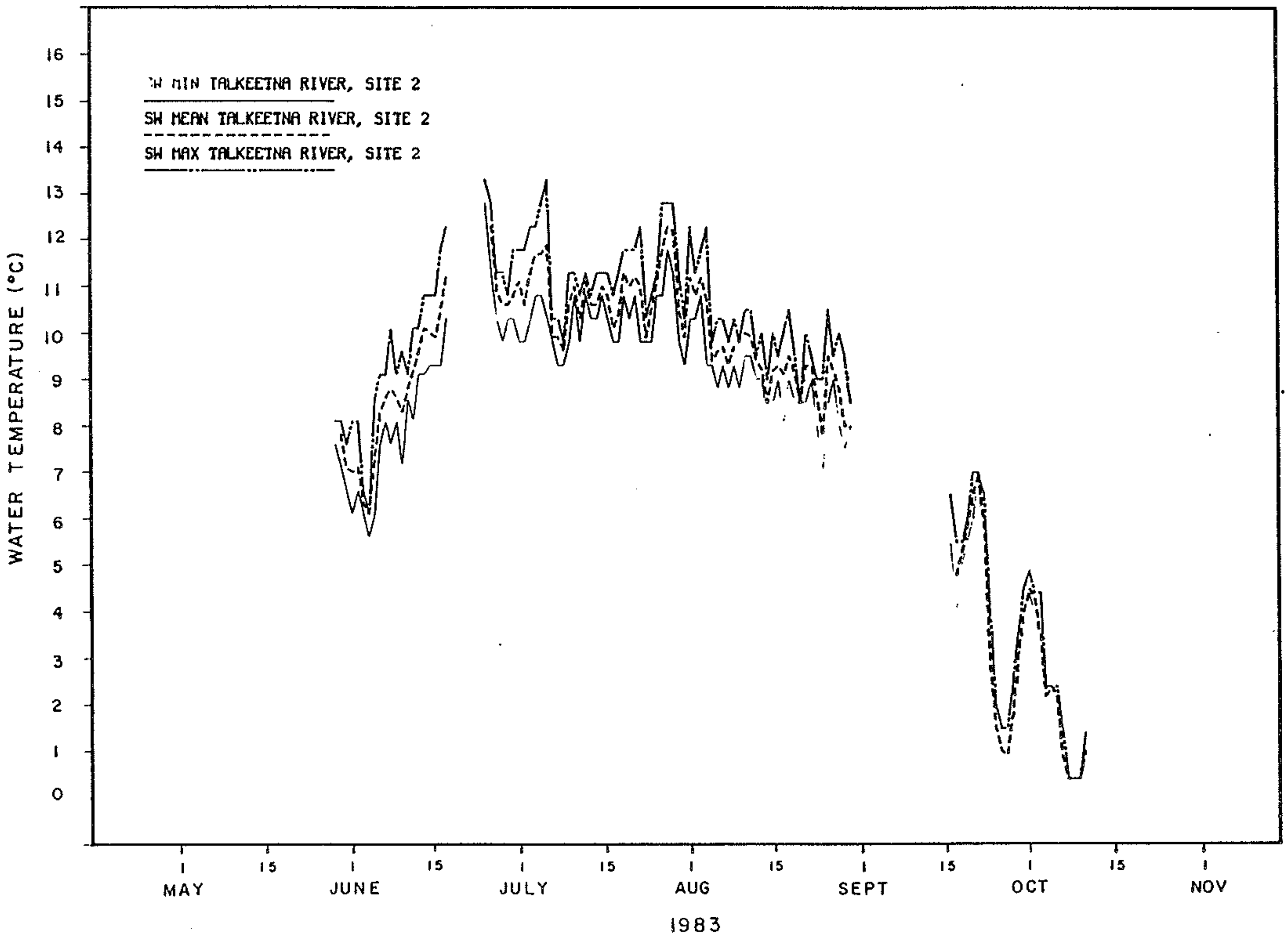

Figure 3-37 Minimum, mean maximum daily surface water temperature collected at Talkeetna River - Site 2 (RM 97.2) during the 1983 open water season.

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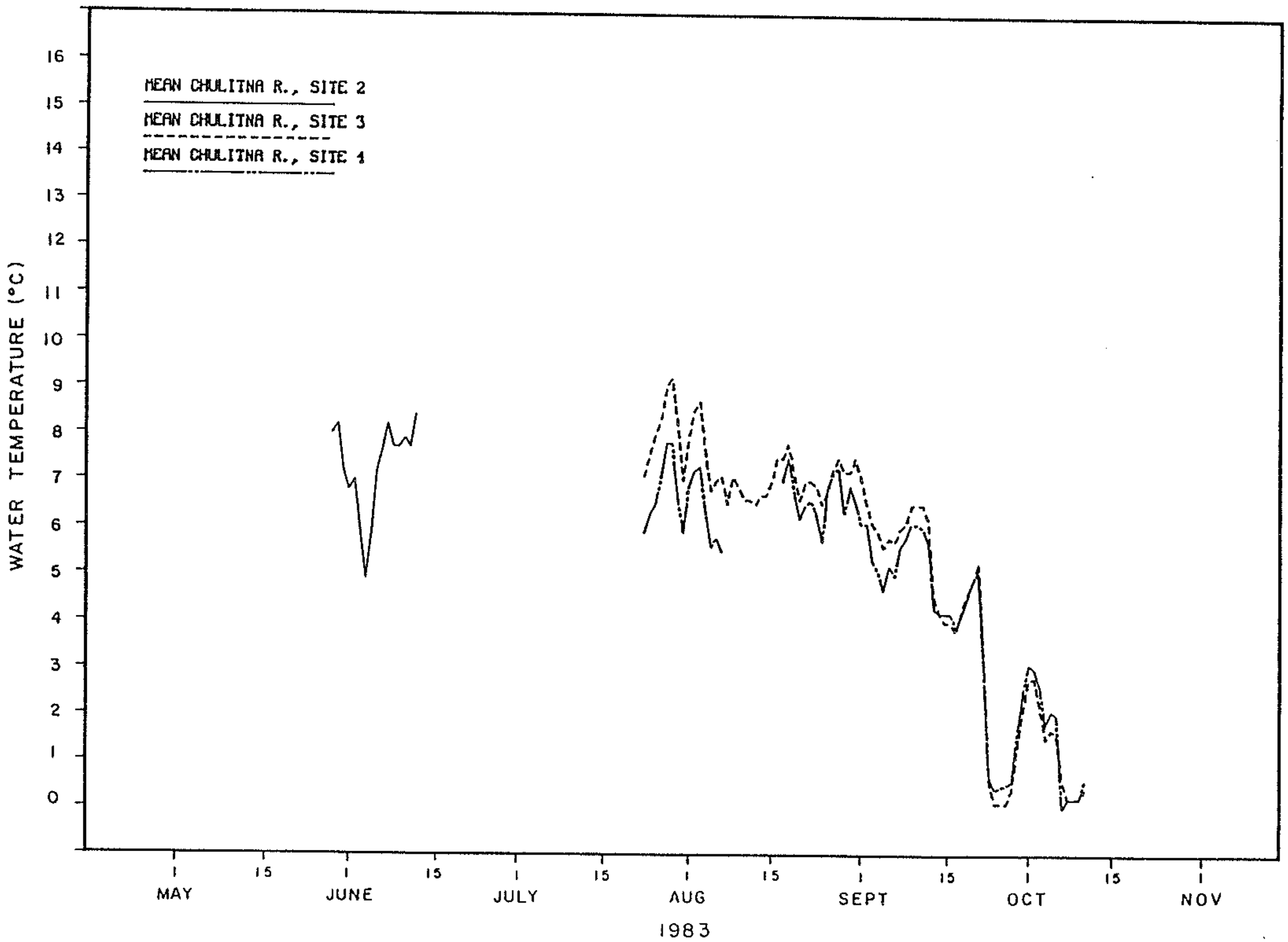

Figure 3-38 Mean daily surface water temperature collected at the Chulitna River Sites 2, 3, and 4 (RM 98.6) during the 1983 open water season.

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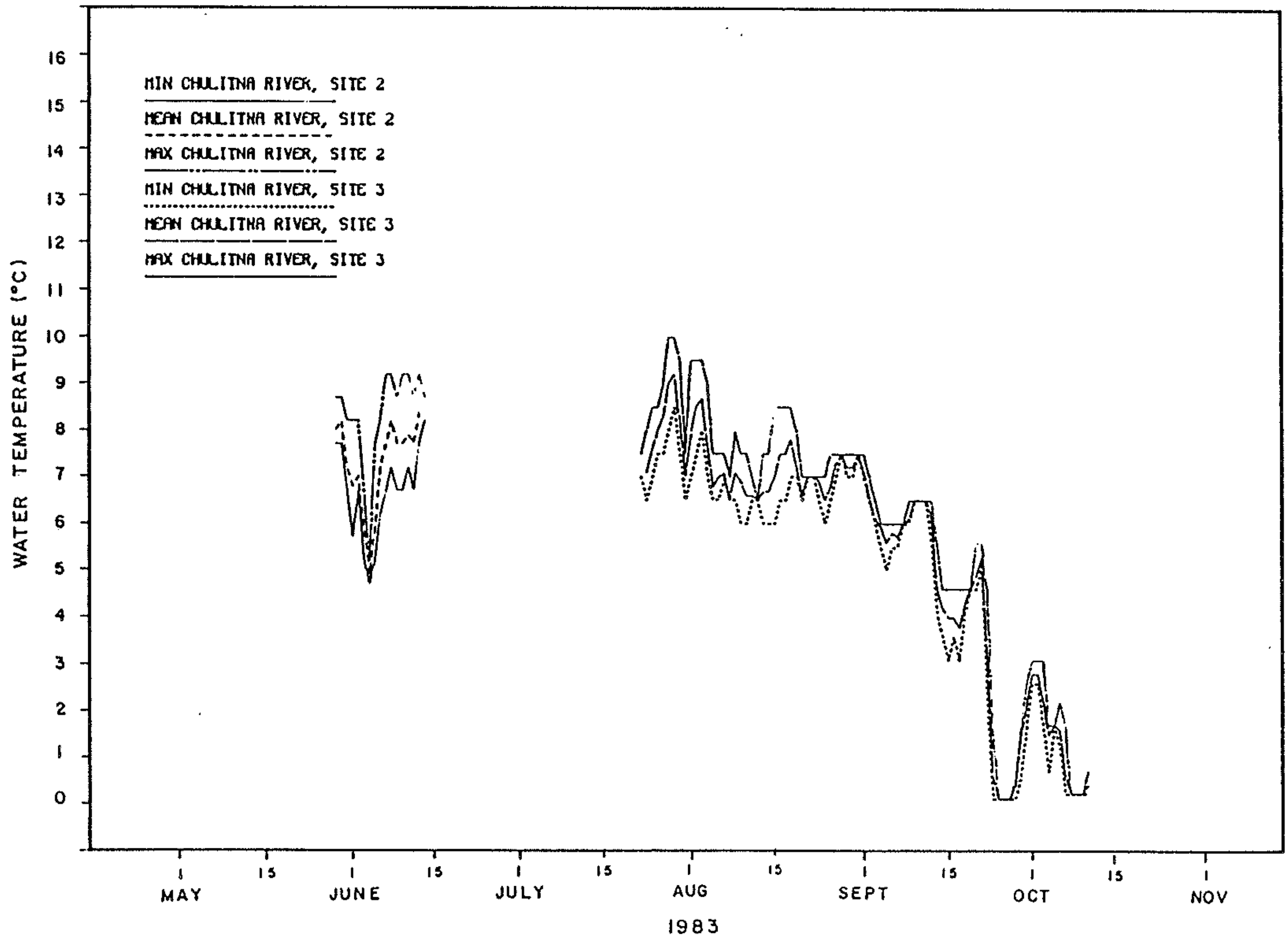

Figure 3-39 Minimum, mean, maximum daily surface water temperature collected at Chulitna River - Sites 2, and 3 (RM 98.6) during the 1983 open water season.

from mid-July to mid-September. During the remainder of the period of record, from late September through mid-October, temperatures recorded at Sites 2 and 3 were similar. Temperatures at Site 2 ranged from 6.7°C to 9.2°C. Temperatures at Site 3 ranged from 0.0°C (in September) to 10.0°C (in July) while temperatures at Site 3 ranged from 0.0°C (in September) to 9.5°C (in July).

3.4.2.3 Fourth of July Creek (RM 131.1, TRM 0.0)

In support of the ADF&G incubation study an intragravel temperature monitoring station was installed in Fourth of July Creek and downstream of the tributary mouth within the clear water plume on September 1. Intragravel temperatures recorded in the Creek from September 1 to October 31 ranged from -0.3°C to 8.9°C. Intragravel temperatures recorded in the clearwater plume ranged from -0.2°C to 7.9°C (Appendix Table 3-A-44, Figure 3-40).

3.4.2.4 Gold Creek (RM 136.7, TRM 0.2)

Surface water temperature data was collected at Gold Creek from May 6 to October 5 (Appendix Table 3-A-45). Temperatures ranged from -0.5°to 15.0°C. Generally temperatures increased through July and began to decline in August (Figures 3-36 and 3-41).

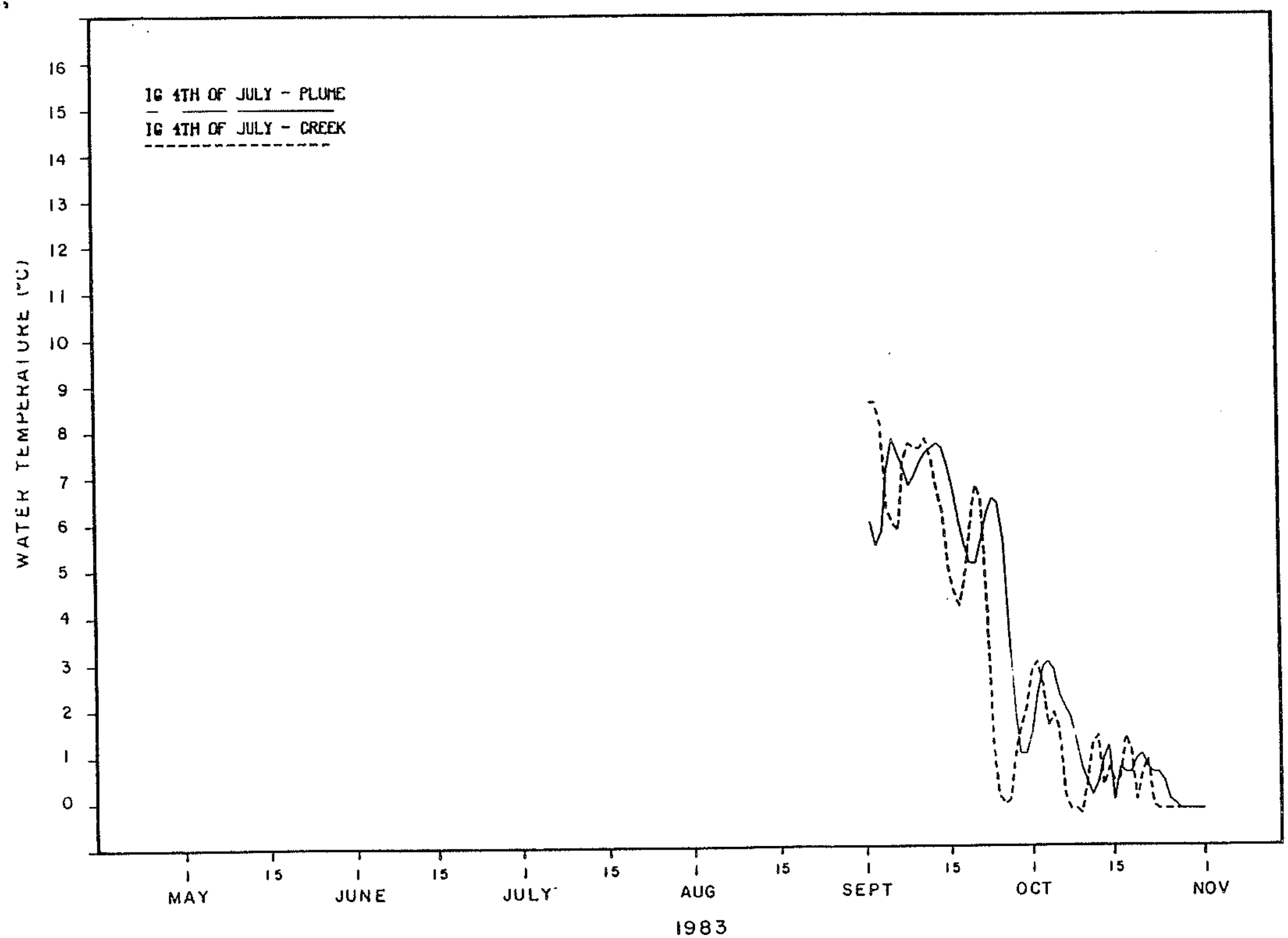

Figure 3-40 Mean daily intragravel temperature collected at Fourth of July Creek and Plume (RM 131.1) during the 1983 open water season.

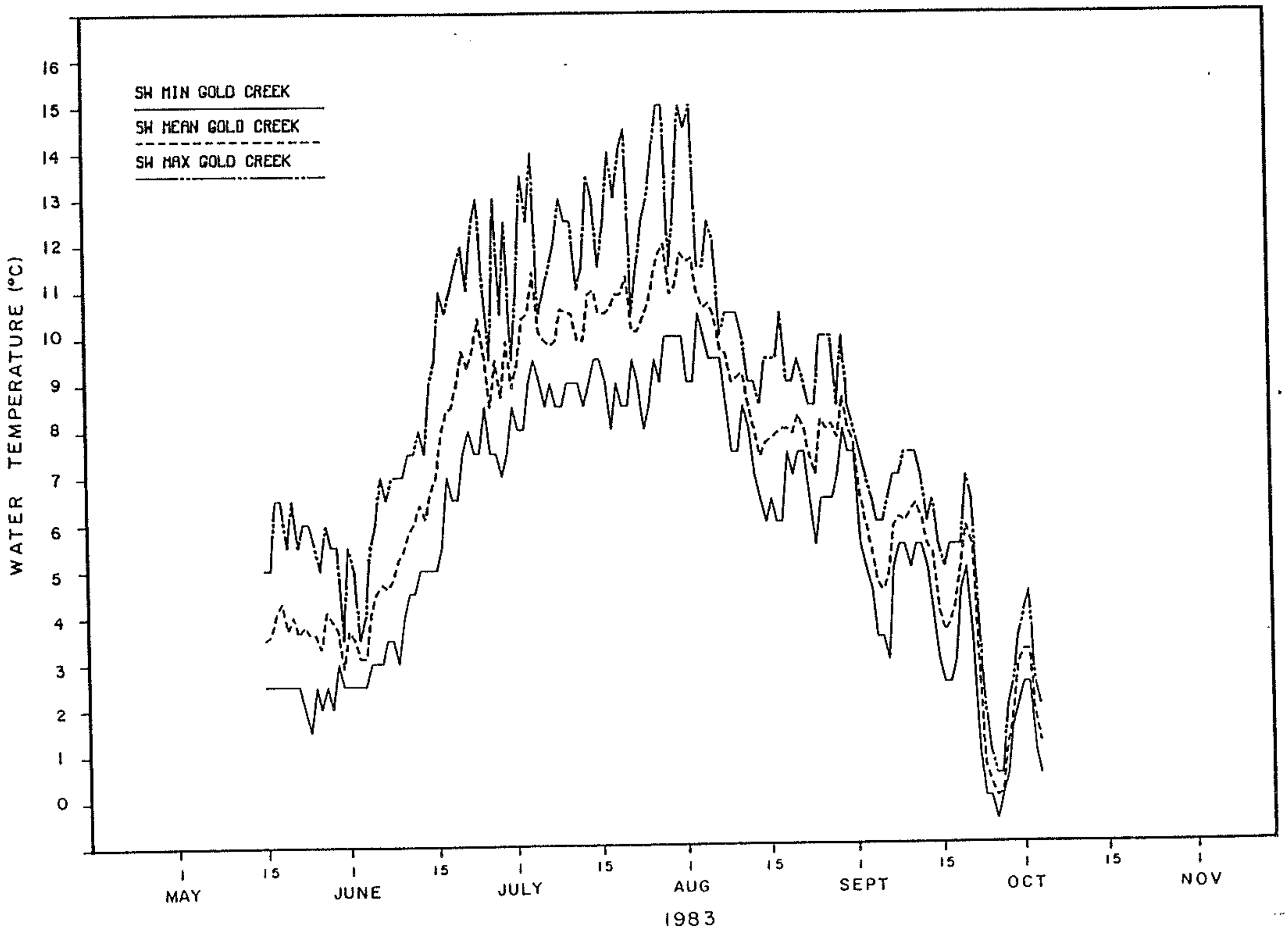

Figure 3-41 Minimum, mean, maximum daily surface water temperature collected at Gold Creek (RM 136.7) during the 1983 open water season.

5.8

3.4.2.5 Indian River (RM 138.6, TRM 1.0)

Surface water temperature data was recorded in Indian River from May 17 to October 19 (Appendix Table 3-A-46). Temperatures ranged from 0.0°C in October to 15.0°C in July and August. Generally, water temperatures increased from May through late July or early August when cooling occurred (Figures 3-36 and 3-42). A brief increase in water temperature occurred in late September to early August.

3.4.2.6 Portage Creek (RM 148.8, TRM 0.2)

Surface water temperature was collected at Portage Creek from June 16 to October 19 (Appendix Table 3-A-47). A data gap occurring from July 7 to July 28 was the result of a malfunctioning recorder. Temperatures ranged from 0.0°C (in September and October) to 14.5°C (in July). Generally, temperatures increased from May to August with an overall decline occurring in August and September (Figures 3-36 and 3-43). A brief increase in water temperature occurred in late September to early October.

3.4.2.7 Comparison of Gold Creek, Indian River, and Portage Creek

A review of the mean daily surface water temperatures for Gold Creek, Indian River, and Portage Creek (Figure 3-44) shows the surface water temperatures recorded at Gold Creek, Indian River and Portage Creek to be relatively similar with mean daily temperatures generally warmer at

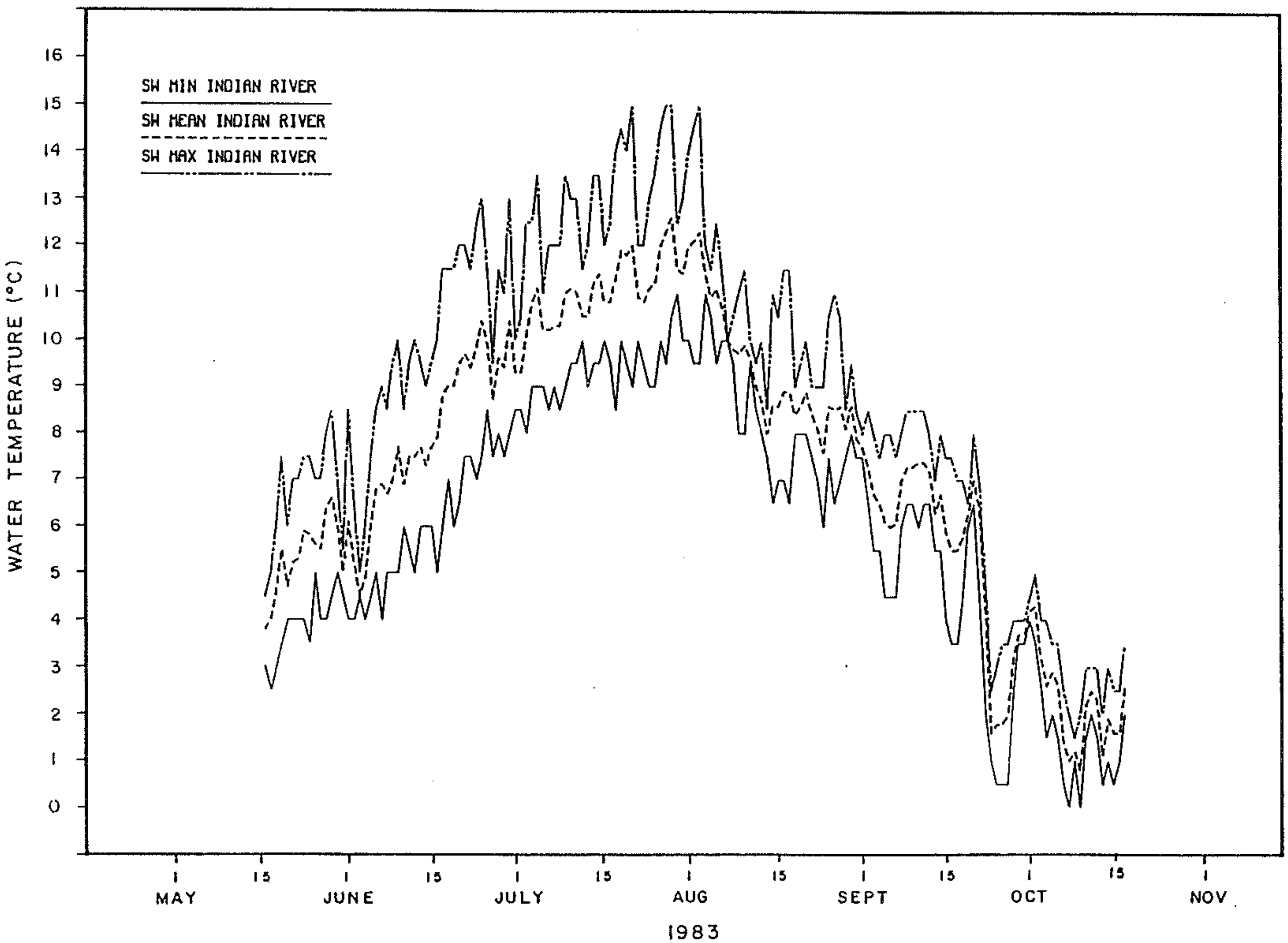

Figure 3-42 Minimum, mean, maximum daily surface water temperature collected at Indian River (RM 138.6) during the 1983 open water season.

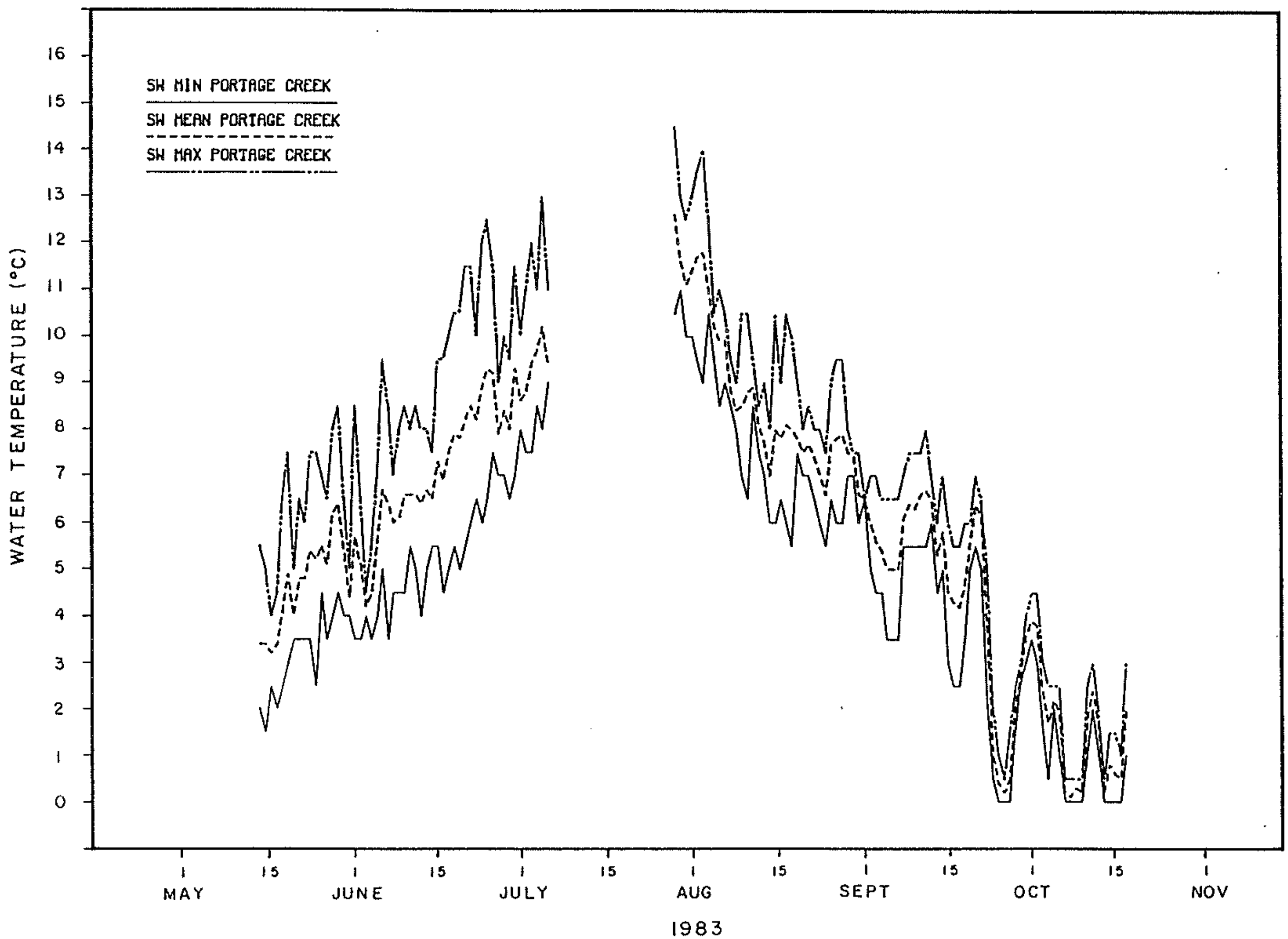

Figure 3-43 Minimum, mean, maximum daily surface water temperature collected at Portage Creek (RM 148.8) during the 1983 open water season.

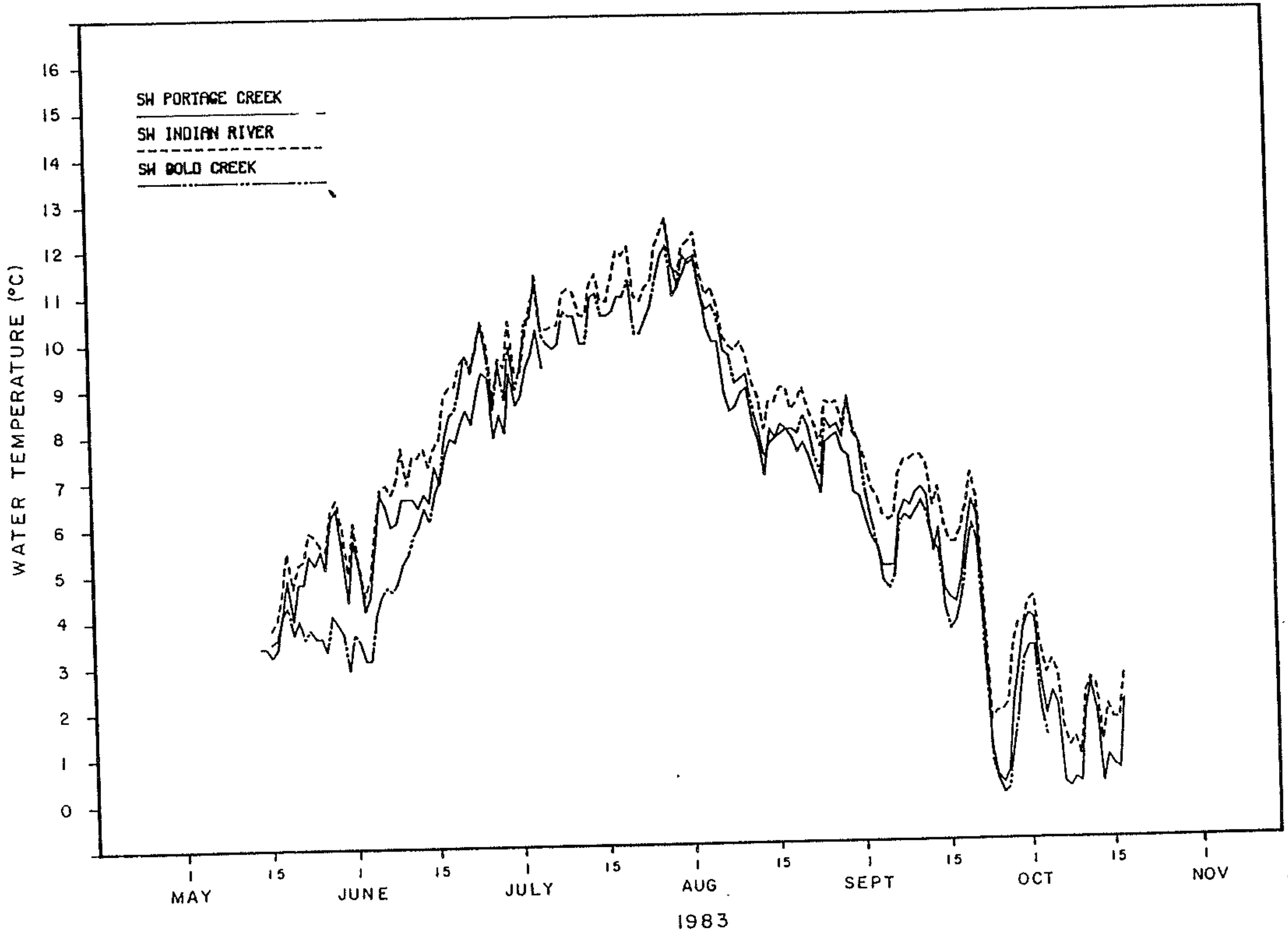

Figure 3-44 Mean daily surface water temperatures collected at Gold Creek (RM 136.7), Indian River (RM 138.6), and Portage Creek (RM 148.8) during the 1983 open water season.

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Indian River and coldest at Gold Creek. Diurnal fluctuations of up to 5°C per day were observed at all three locations (Figures 3-41 to 3-44).

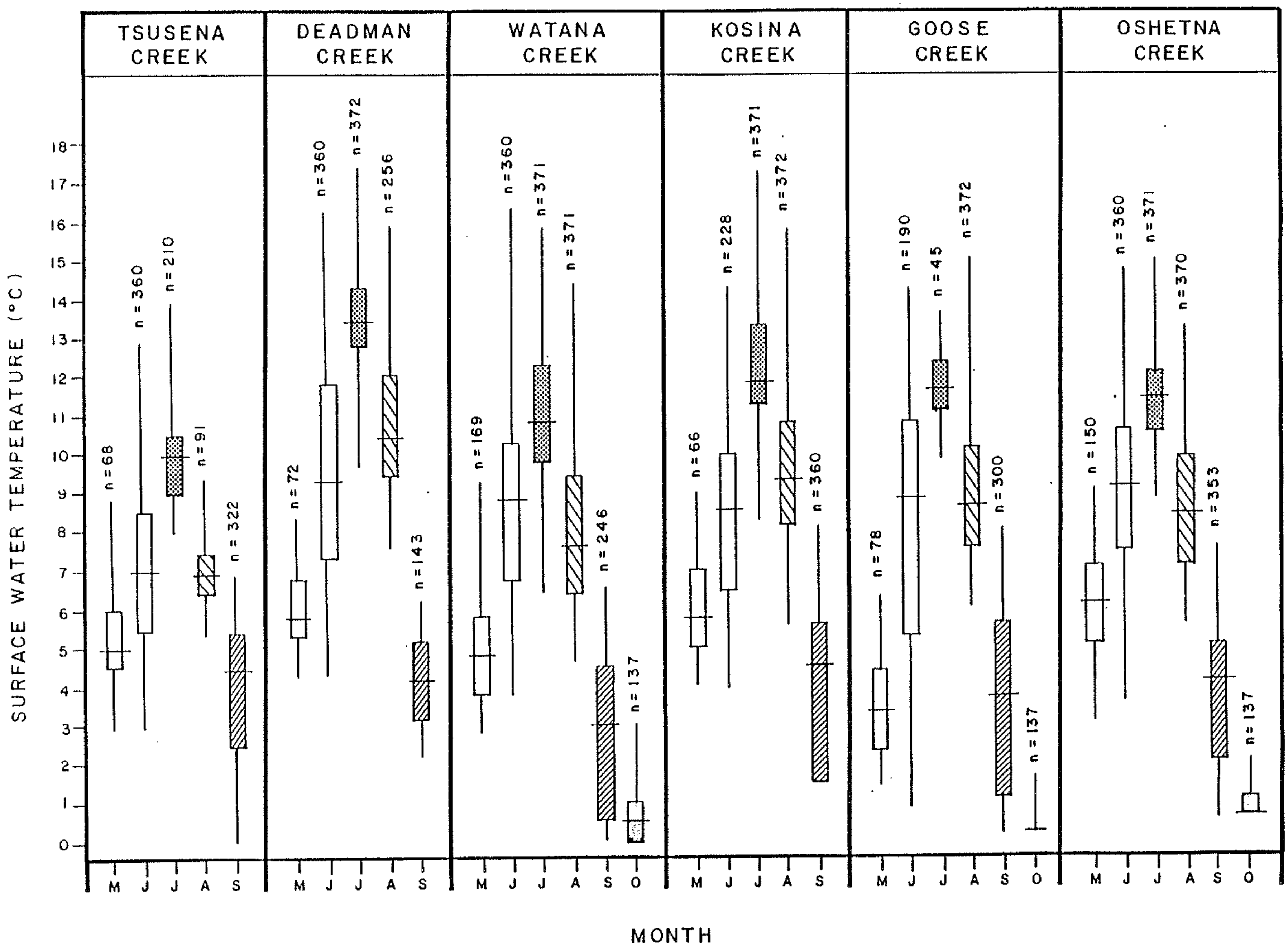
3.4.3 Tributaries above Devil Canyon

Surface water temperature was continuously monitored in six clear water tributaries located upstream of Devil Canyon from Tsusena Creek (RM 181.8) to the Oshetna River (RM 233.4). These tributaries included Tsusena Creek (RM 181.8), Deadman Creek (RM 186.7), Watana Creek (RM 194.1), Kosina Creek (RM 206.8), Goose Creek, (RM 231.8), and the Oshetna River (RM 233.4).

A review of the plots of minimum, mean, and maximum temperatures obtained for each of these tributaries (Figures 3-45 to 3-51) shows that the water temperature was generally warmest during June and July with a general decline occurring in August. Lowest water temperatures were recorded in September and October. Water temperatures often fluctuated 5-6°C per day. Generally, temperatures were warmest in Deadman Creek and coldest in Tsusena Creek.

3.4.3.1 Tsusena Creek (RM 181.8, TRM 0.1)

Surface water temperatures were collected in Tsusena Creek from May 26 to September 27. A gap in the data which occurred from July 18 to August 24 was due to instrument failure. Surface water temperatures ranged from 0.0°C in September to 14.0°C in July (Appendix Table 3-A-48, Figure 3-46).



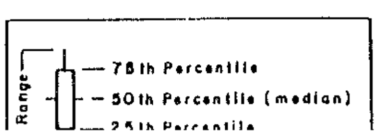


Figure 3-45 Monthly water temperature data summary showing range, 25th, 50th (median), and 75th percentile for Tsusena Creek (RM 181.8), Deadman Creek (RM 186.7), Watana Creek (RM 194.1), Kosina Creek (RM 206.8), Goose

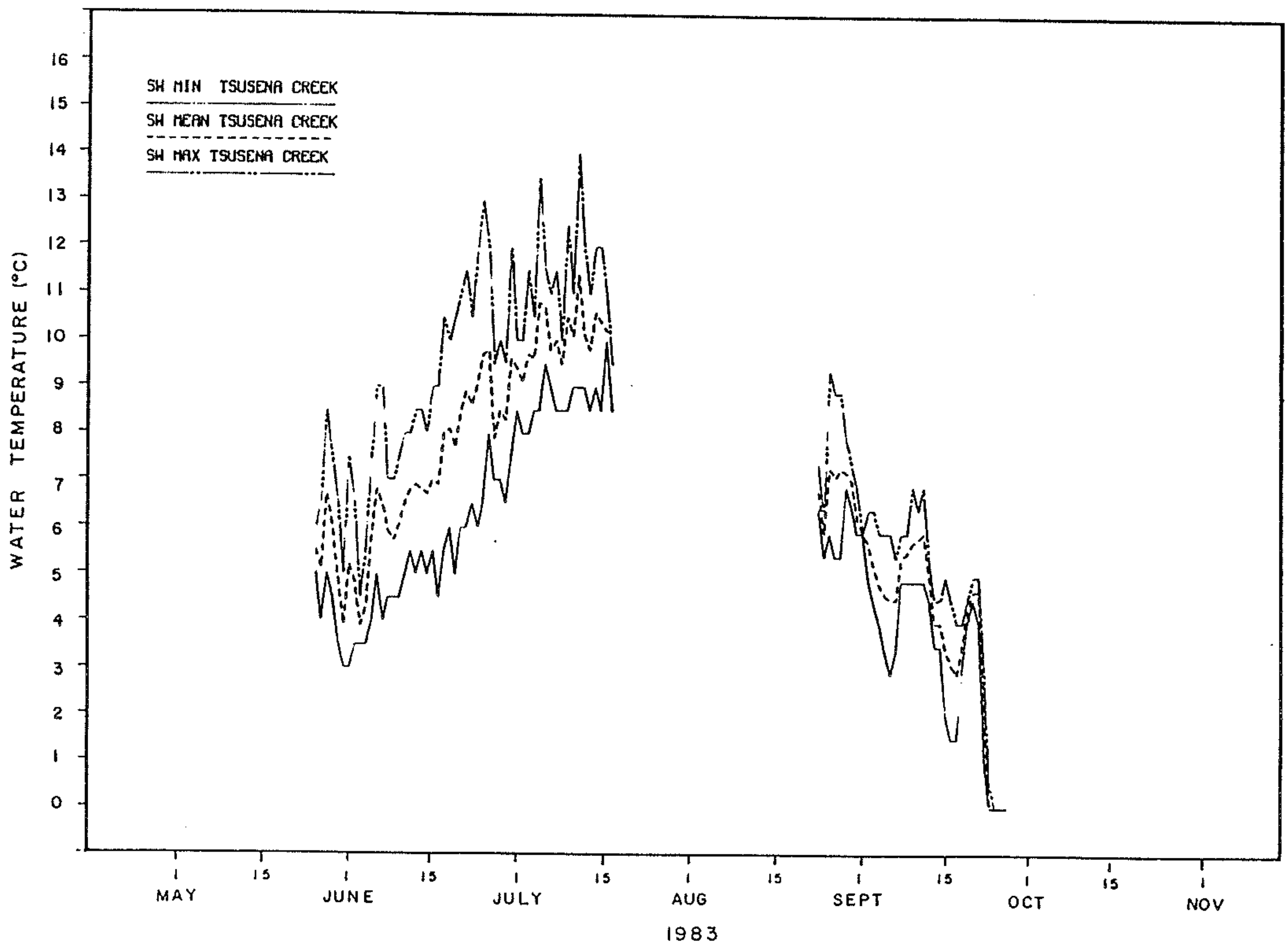


Figure 3-46 Minimum, mean, maximum daily surface water temperature collected at Tsusena Creek (RM 181.8) during the 1983 open water season.

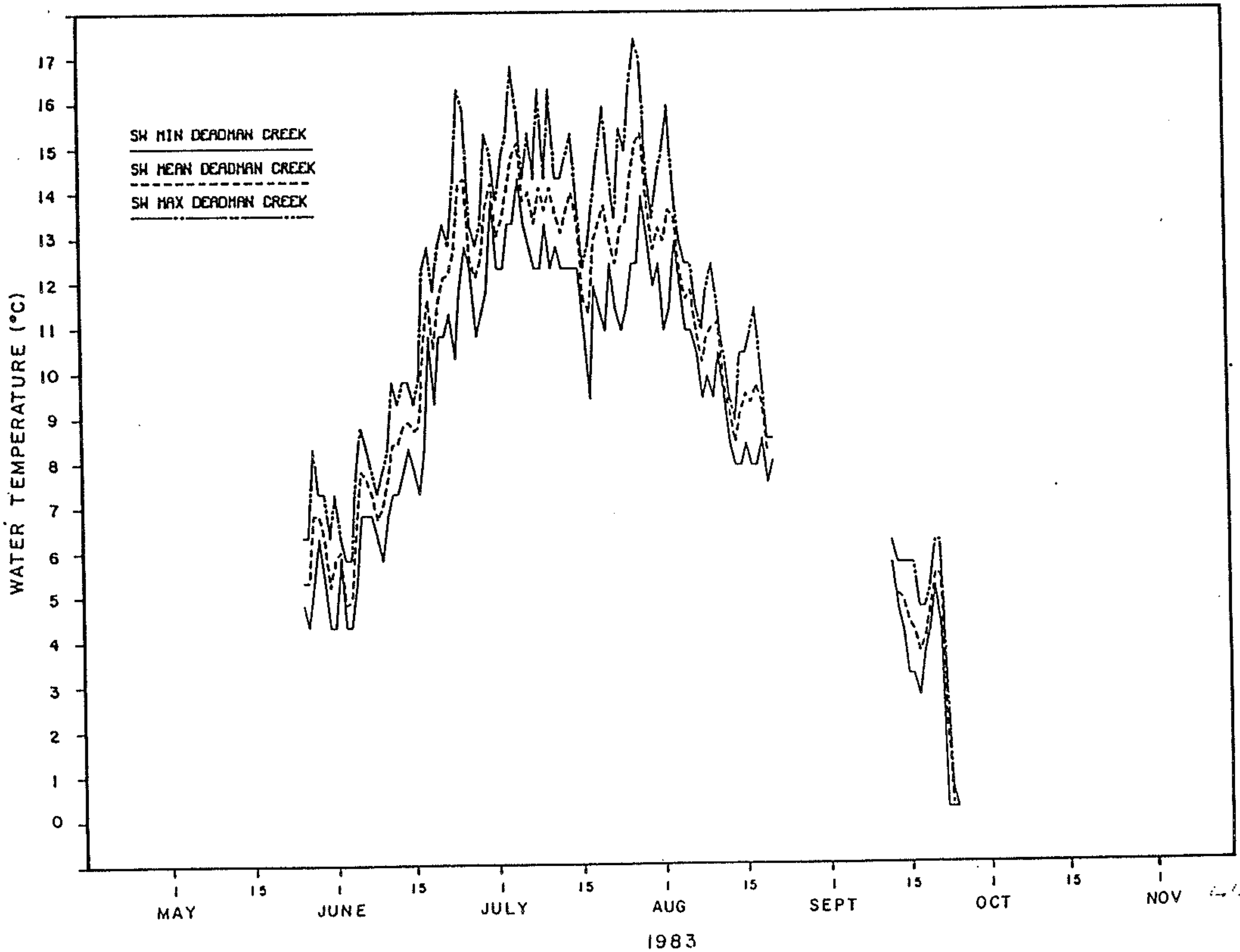


Figure 3-47 Minimum, mean, maximum daily surface water temperature collected at Deadman Creek (RM 186.7) during the 1983 open water season.

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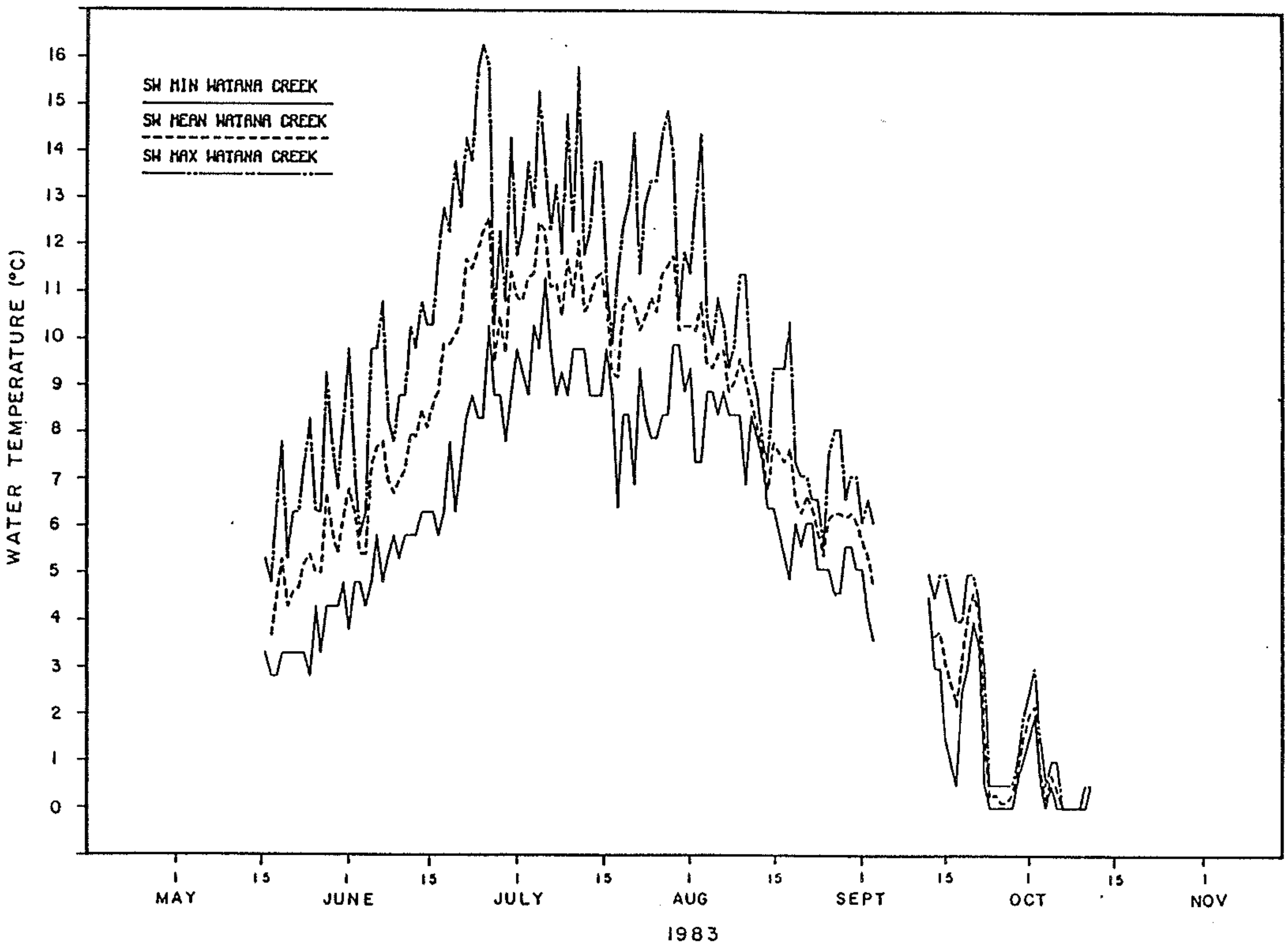

Figure 3-48 Minimum, mean, maximum daily surface water temperature collected at Watana Creek (RM 194.1) during the 1983 open water season.

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9.5

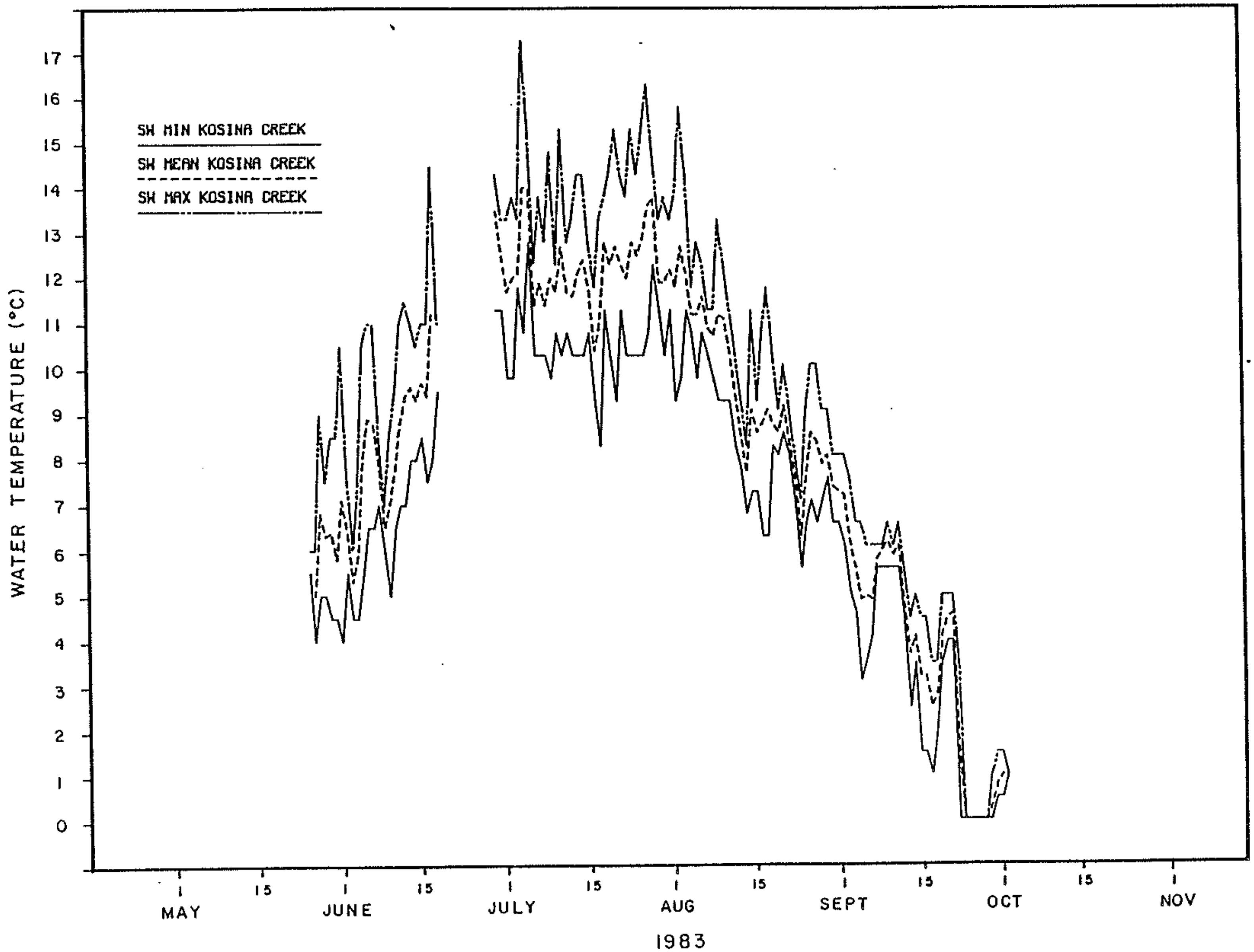

Figure 3-49 Minimum, mean, maximum daily surface water temperature collected at Kosina Creek (RM 206.8) during the 1983 open water season.

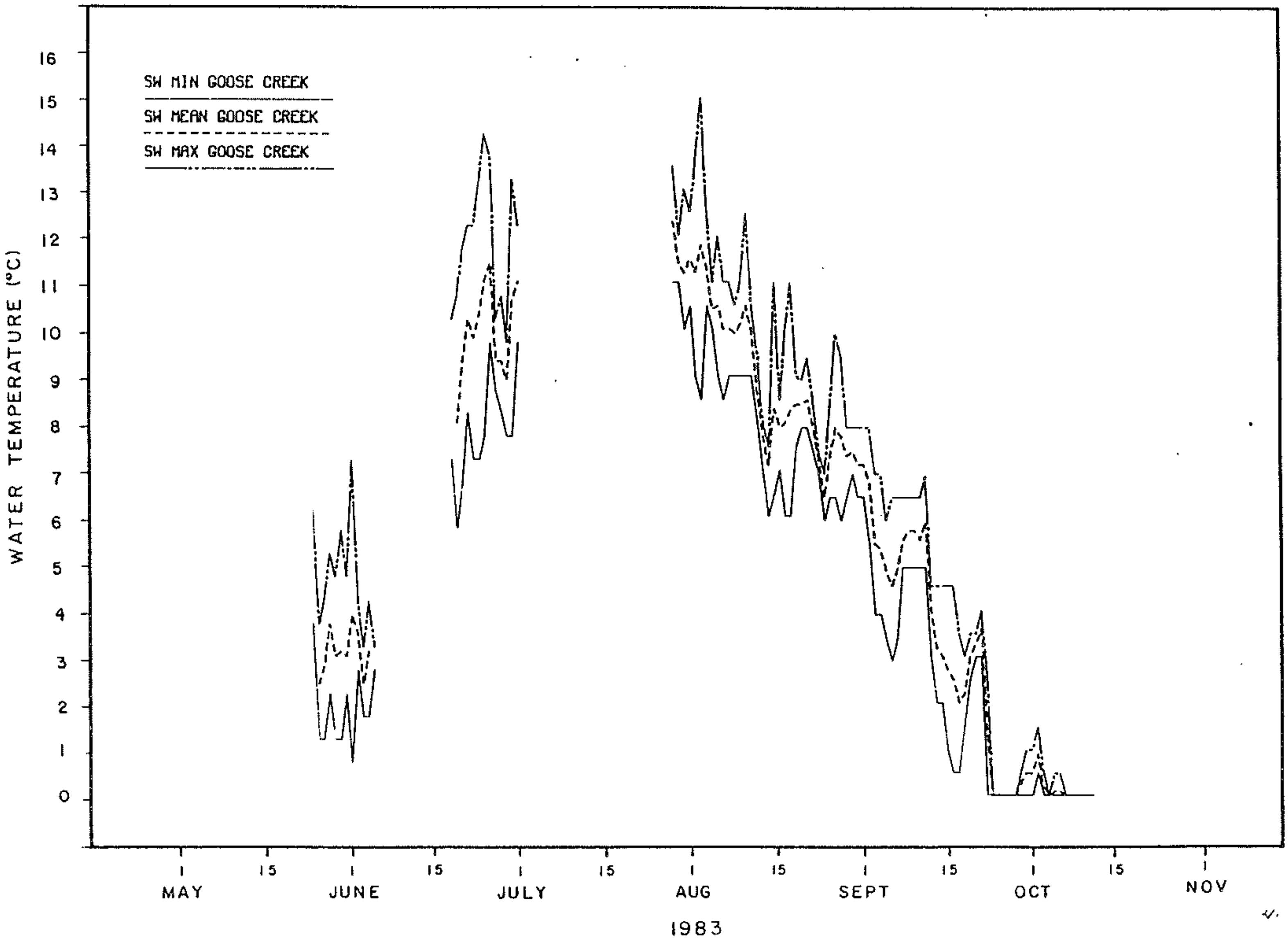

Figure 3-50 Minimum, mean, maximum daily surface water temperature collected at Goose Creek (RM 231.3) during the 1983 open water season.

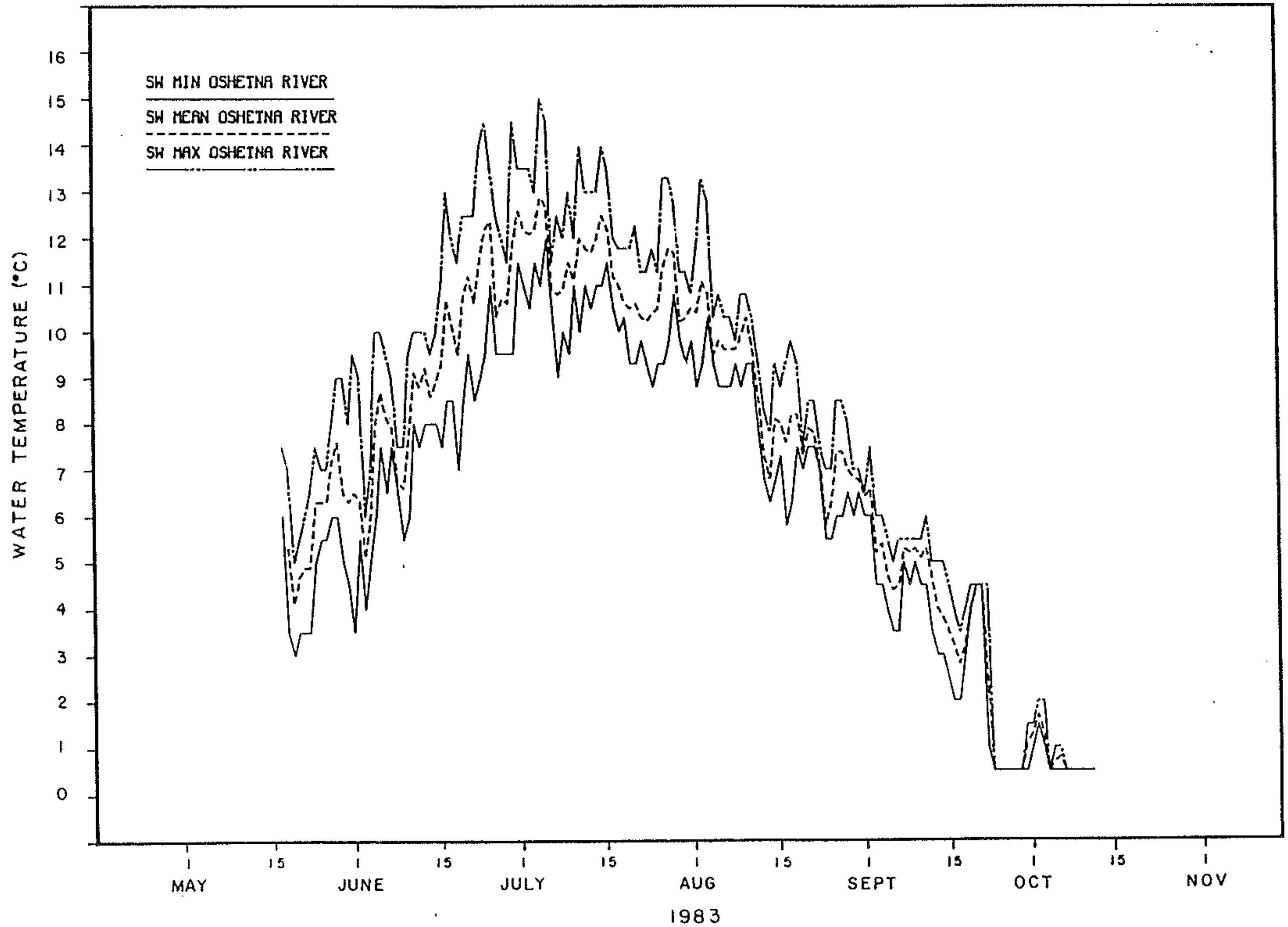

Figure 3-51 Minimum, mean, maximum daily surface water temperature collected at Oshetna River (RM 233.4) during the 1983 open water season.

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3.4.3.2 Deadman Creek (RM 186.7, TRM 0.1)

Surface water temperatures were collected in Deadman Creek from May 26 to September 25. The data gap occurring August 22 to September 13 resulted from instrument failure. Surface water temperatures ranged from 0.2°C in September to 17.4°C in August (Appendix Table 3-A-49, Figure 3-47).

3.4.3.3 Watana Creek (RM 194.1, TRM 0.1)

Surface water temperatures were recorded in Watana Creek from May 17 to October 12. A gap in the data occurred from September 3 to September 13 and was due to instrument failure. Surface water temperatures ranged from 0.0°C in September and October to 16.3°C in June (Appendix Table 3-A-50, Figure 3-48).

3.4.3.4 Kosina Creek (RM 206.8, TRM 0.1)

Surface water temperatures were recorded in Kosina Creek from May 26 to October 2. A gap in the data occurring from June 19 to June 30 resulted from instrument failure. Surface water temperatures ranged from 0.0°C in September to 17.3°C in July (Appendix Table 3-A-51, Figure 3-49).

3.4.3.5 Goose Creek (RM 231.3, TRM 0.1)

Surface water temperatures were recorded in Goose Creek from May 25 to October 10. Data gaps occurring from June 5 to June 19 and from July 1 to July 28 were the result of instrument failure. Temperatures ranged from 0.1°C in September and October to 15.1°C in August (Appendix Table 3-A-52, Figure 3-50).

3.4.3.6 Oshetna River (RM 233.4, TRM 0.1)

Surface water temperatures were recorded in the Oshetna River from May 19 to October 12. Temperatures ranged from 0.5°C (in September and October) to 15.0°C (in July and August) (Appendix Table 3-A-53, Figure 3-51).

3.5 Interhabitat Relationships

To determine possible temperature relationships comparisons were made between water temperature data recorded in the various habitats. These comparisons are summarized below.

3.5.1 Mainstem habitats versus tributary habitats

To determine temperature influences that tributaries have on the temperature regime of the mainstem Susitna River, water temperatures recorded at tributary monitoring stations were compared to water temperatures recorded at monitoring stations located at the mainstem Susitna River.

3.5.1.1 Comparison of the surface water temperature recorded in the Yentna River and in the mainstem Susitna River

A plot of surface water temperature over time for Yentna River, mainstem Susitna River above the Deshka, and the mainstem Susitna River at Susitna station is presented in Figure 3-52. During the months of June and July, surface water temperatures recorded at the Yentna River were lower than both the Susitna River at Susitna Station and above the Deshka monitoring stations. Temperatures varied as much as 3°C from June and July between the Susitna River stations above the Deshka and the Yentna River. Surface water temperatures between the Susitna River at Susitna station and the Yentna River showed less variation in July compared to the June record. The average surface water temperature for the Yentna River in July was 10.5°C compared to the 3°C at Susitna Station and 12.0°C for the Susitna River above the Deshka. Temperature data was not recorded at Susitna Station after July, therefore further comparisons between mainstem Susitna River temperatures at Susitna Station and Yentna River temperatures were not made. From August through October, surface water temperatures recorded at the Yentna River and in the mainstem above the Deshka River were similar. Average August temperature in the Yentna River was 9.0 compared to 9.2°C for the mainstem Susitna River above the Deshka.

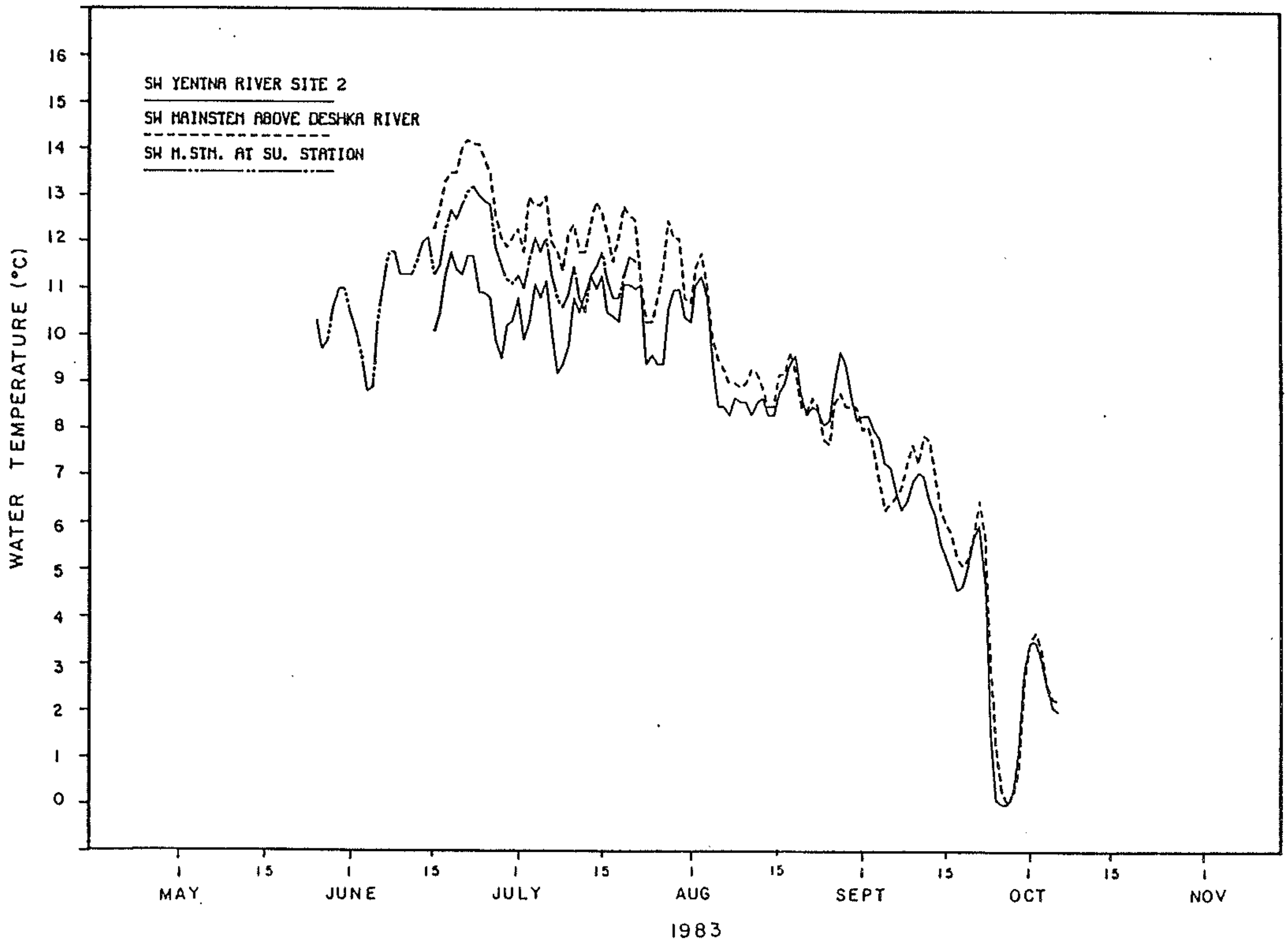

Figure 3-52 Mean daily surface water temperature collected at Yentna River - Site 2 (RM 29.5), Mainstem Susitna River Above Deshka River (RM 41.1), and at Susitna Station (RM 25.8).

/Q/

3.5.1.2 A comparison of the Chulitna and Talkeetna Rivers to mainstem Susitna River surface water temperatures

A plot of surface water temperature over time for the Susitna River temperature monitoring stations located at the Parks Highway Bridge (RM 83.9) and Talkeetna Fishwheel Camp (RM 103.0) are compared to the stations located at the Chulitna River (RM 98.6) and the Talkeetna River (RM 97.2) (Figure 3-53). For the period of record from mid-June to September the Chulitna River was colder than the Talkeetna and Susitna Rivers. The Talkeetna River for the same period was warmer than the Chulitna but remained colder then the mainstem Susitna River stations. The Talkeetna Fishwheel Station located upstream of the Chulitna and Talkeetna Rivers was the warmest during this period with the mainstem Susitna River at the Parks Highway warmer than both tributaries. For example, the mean monthly August temperatures occurring upstream of th Chulitna and Talkeetna Rivers was 10.4°C (Talkeetna Fishwheel Camp) compared to 9.4°C for the Talkeetna River, 6.9°C for the Chulitna River and 10.2°C downstream of these tributaries in the Susitna River at the Parks Highway Bridge. The Parks Highway station and the Talkeetna River had similar temperatures in mid-September and all the stations were similar from late September to mid-October, (end of the period of record).

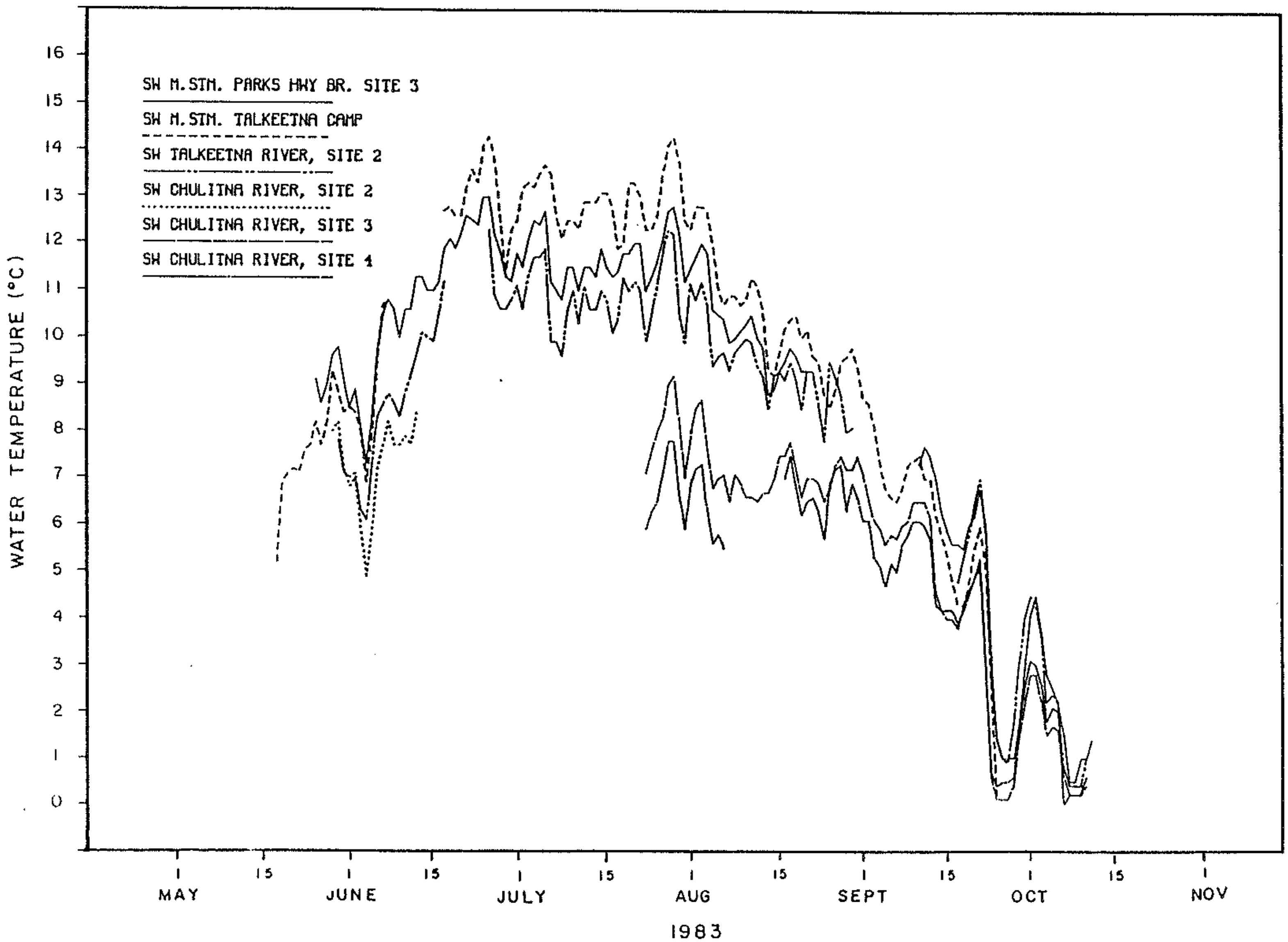

Figure 3-53 Mean daily surface water temperature collected Mainstem Susitna River at Parks Highway Bridge - Site 3 (RM 83.9), Mainstem Susitna River at Talkeetna Fishwheel Camp (RM 103.0), Talkeetna River - Site 2 (RM 97.2), and the Chulitna River - Sites 2, 3, and 4 (RM 98.6) during the 1983 open...

3.5.1.3 Comparison of intragravel water temperatures recorded at Fourth of July Creek to the intragravel water temperatures obtained in the clear water plume of Fourth of July Creek and to the mainstem Susitna River temperatures

Intragravel water temperatures were obtained from both Fourth of July Creek (RM 131.1) and the clear water plume of Fourth of July Creek from September 1 to October 31. These water temperatures are compared to the mainstem intragravel water temperatures obtained at LRX 29 (RM 126.1) and presented in Figure 3-54. A comparison of these three sites was performed primarily to determine if a similarity exists among intragravel water temperatures occurring in the creek to those monitored slightly downstream of the creeks mouth (in the clear water plume) in the adjacent side channel. The comparison to the mainstem intragravel water temperature at LRX 29 (5 miles downstream of Fourth of July Creek) was to evaluate the general intragravel temperature characteristics of these three distinct habitat areas. The time of measurement for the intragravel water temperatures obtained from Fourth of July Creek occurred during the fall months which results in a general decline in intragravel water temperatures. Further comparisons among these three sites is difficult because of the variability occurring in the plume of Fourth of July Creek which is dependent upon flow from the creek, the availability of surface water in the side channel where the plume is located, and the limited record of data including the absence of surface water temperature data from Fourth of July Creek.

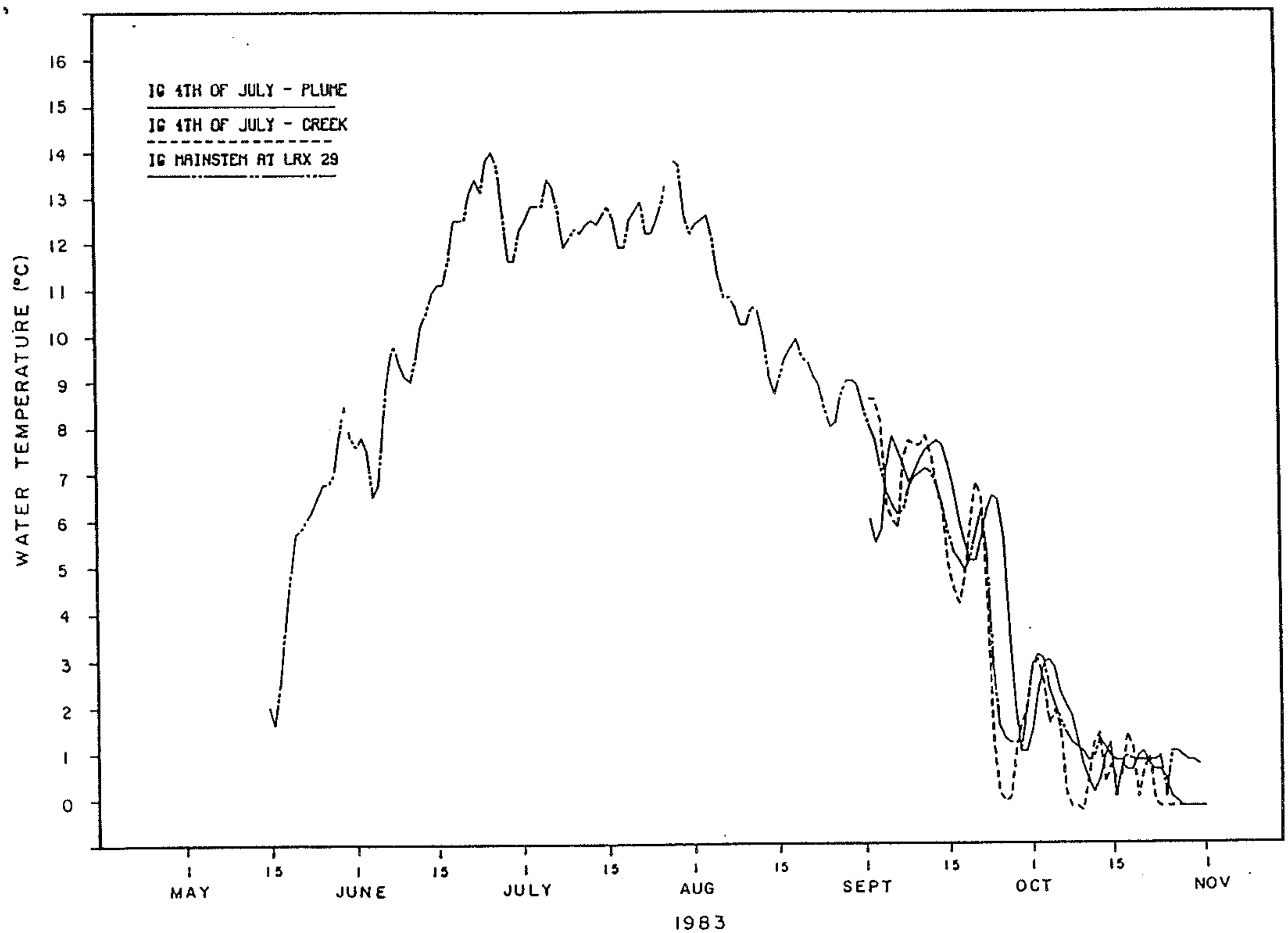

Figure 3-54 Mean daily intragravel water temperature collected at Fourth of July Creek and Plume (RM 131.1), and mean daily surface and intragravel water temperature collected at Mainstem Susitna at LRX 29 (RM 126.1) during the 1983 open water season.

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3.5.1.4 A comparison of Gold Creek surface water temperatures to Mainstem Susitna River surface water temperatures

To compare the surface water temperatures of the Gold Creek tributary (RM 136.7) to those in the mainstem Susitna River stations at the Gold Creek Station (RM 136.6), located downstream of Gold Creek on the same shore), upstream of Gold Creek (RM 136.8) and at Curry Fishwheel Camp (downstream of Gold Creek at river mile 120.7) a plot of these sites are developed (Figure 3-55). A review of this plot shows that for the period of record (mid-May to early October) the Gold Creek tributary is consistently cooler than the mainstem Susitna River. The Gold Creek station in the mainstem downstream of the tributary was also cooler than the remaining Susitna River sites with Curry Camp being the warmest.

3.5.1.5 A comparison of Indian River Surface water temperatures and to mainstem Susitna River surface water temperatures

A comparison of Indian River (RM 138.6) to mainstem Susitna River surface water temperatures at the stations located at Devil Canyon (RM 150) and above Gold Creek (RM 136.8) is presented in Figure 3-56). Between May and July temperatures recorded at the monitoring station at Indian River (RM 138.6, TRM 1.0) were generally lower than mainstem temperatures recorded at Devil Canyon (RM 150.0) and above Gold Creek (RM 136.8) (Figure 3-56). Mean June temperature in Indian River was 7.9 while the mean June temperature calculated for mainstem Susitna River

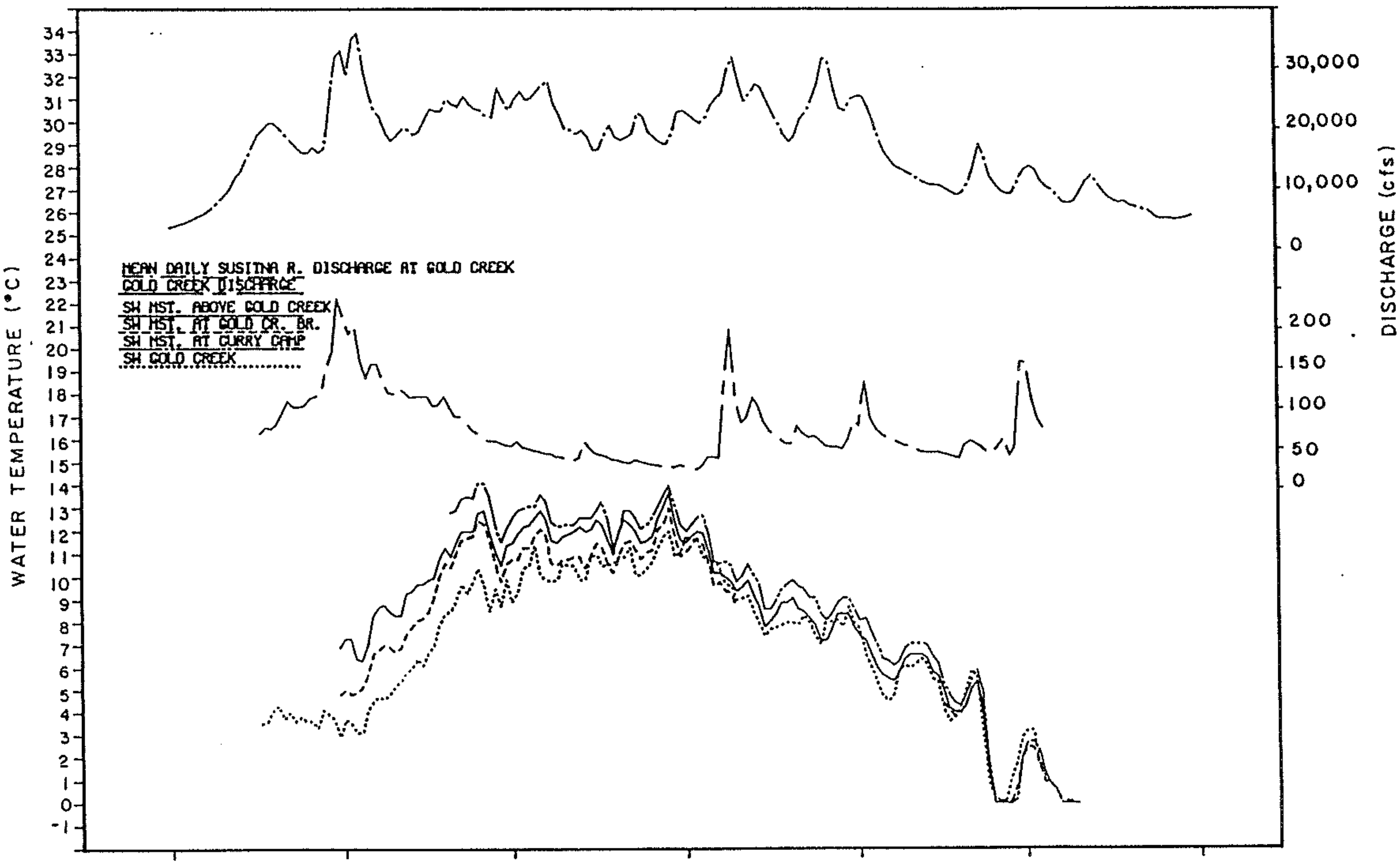

Figure 3-55 Mean daily surface water temperature collected at Mainstem Susitna River above Gold Creek (RM 136.8), at Mainstem Susitna River Gold Creek Bridge (RM 136.6), Mainstem Susitna River at Curry Fishwheel Camp (RM 102.7), at Gold Creek (RM 136.7), and mean daily Susitna River discharge at Gold Creek (USGS gaging station 15292000).

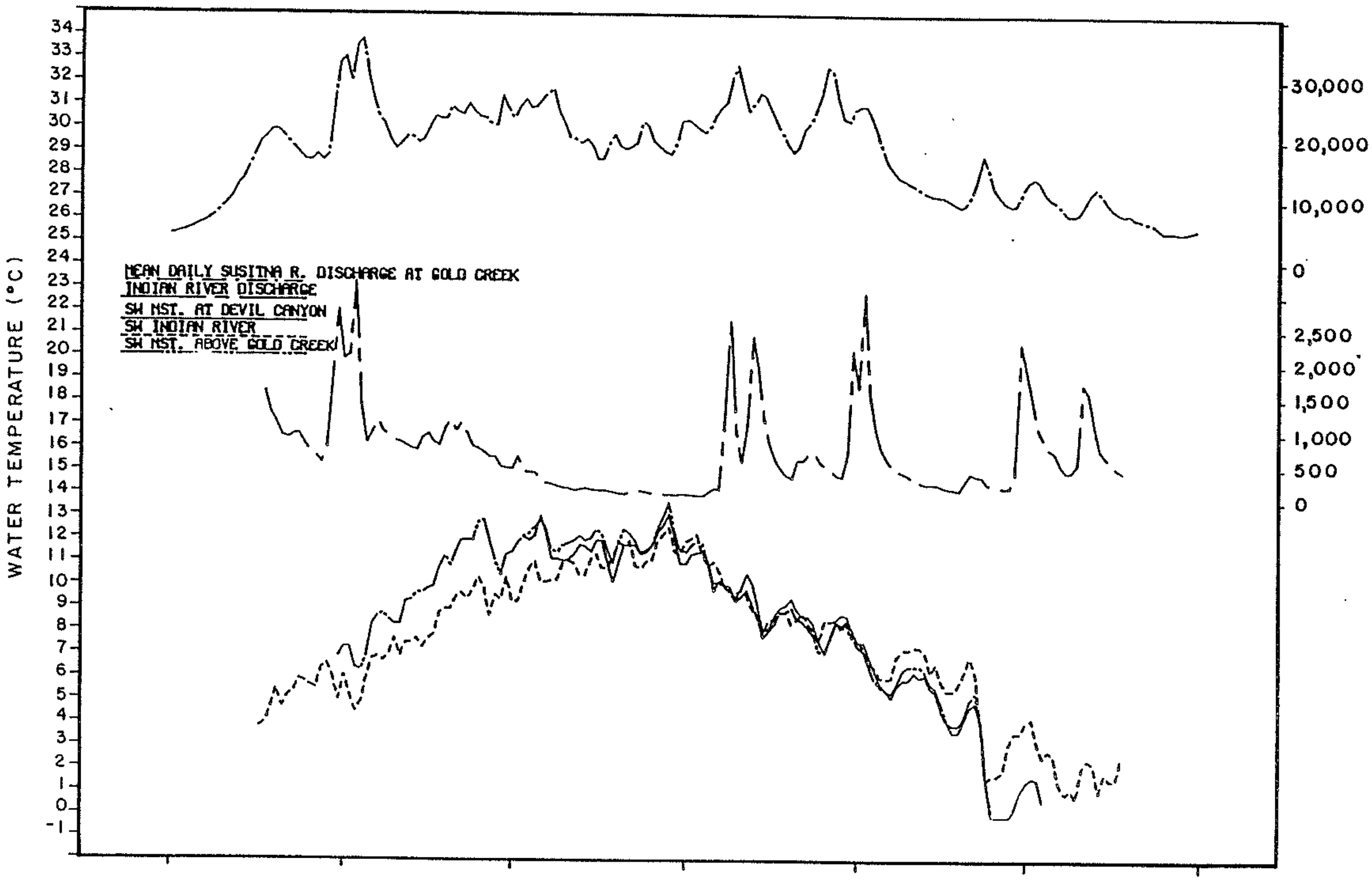

Figure 3-56 Mean daily surface water temperature collected at Mainstem Susitna at Devil Canyon (RM 150.1), Mainstem Susitna River above Gold Creek (RM 136.8) at Indian River (RM 138.6), and mean daily Susitna River discharge at Gold Creek (USGS gaging station 15292000).

above Gold Creek was 9.8°C. No temperature data was evaluated at Devil Canyon in June. In August surface water temperatures at Indian River were comparable to mainstem temperatures. August temperatures averaged 9.4° in Indian River compared to 9.2°C at the monitoring station at Mainstem Susitna River above Gold Creek and 9.4°C in Devil Canyon. In September and October temperatures were warmer in Indian River than these mainstem temperature locations. Mean monthly surface temperatures for September at Indian River and at the mainstem at Devil Canyon were 5.6°C and 4.3°C respectively.

3.5.1.6 A comparison of Portage Creek surface water temperature and mainstem Susitna River surface water temperatures

A comparison of Portage Creek (RM 148.8) surface water temperatures to mainstem Susitna River surface water temperatures at the stations located at Devil Canyon (RM 150.0) and above Gold Creek (RM 136.8) is presented in Figure 3-57. Surface water temperatures recorded at the monitoring station at Portage Creek found to be colder than surface water temperatures recorded at the mainstem monitoring stations from mid May through August (Figure 3-57). Mean August temperatures were 8.5° at Portage Creek compared to 9.2°C at above Gold Creek and 9.4°C at Mainstem Susitna River at Devil Canyon. From September 1 to September 26 temperatures at Mainstem Susitna River at Devil Canyon and Portage Creek correspond closely to each other. Average September temperatures were 4.3°C and 4.6°C respectively. Mean monthly September temperatures in the mainstem above Gold Creek were 5.2°C. In late September and October

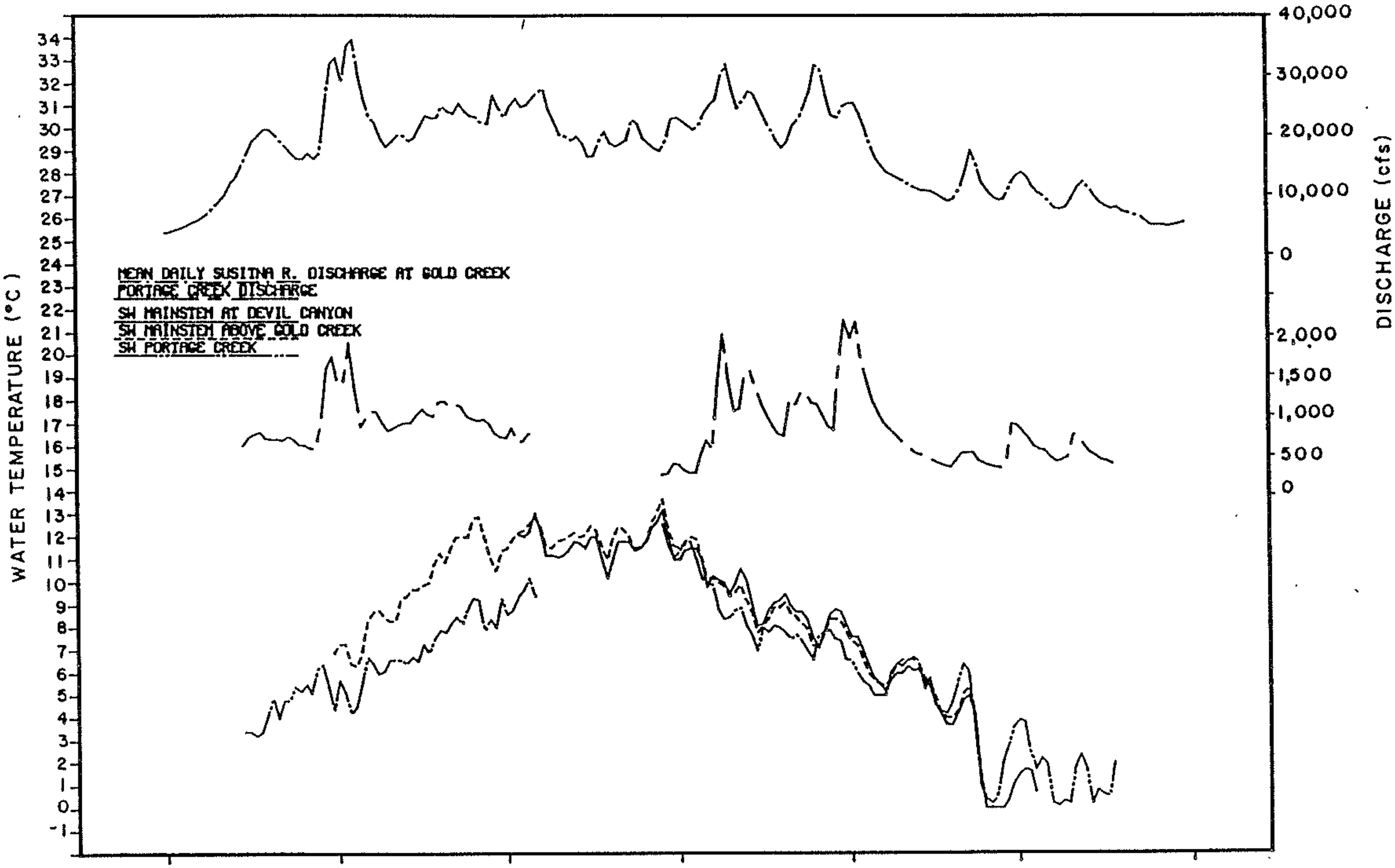

Figure 3-57 Mean daily surface water temperature collected at Mainstem Susitna at Devil Canyon (RM 150.1), Mainstem Susitna River above Gold Creek (RM 136.8) at Portge Creek (RM 148.8), and mean daily Susitna River discharge at Gold Creek (USGS gaging station

surface water temperatures in Portage Creek were warmer than mainstem temperatures.

3.5.1.7 Mainstem Susitna River and Tributaries above Devil Canyon

Mainstem surface water temperatures obtained above Devil Canyon were recorded only at two locations (above Tsusena Creek RM 181.9 and above Oshetna River RM 234.9, 235.7). A comparison of tributary surface water temperatures to mainstem surface water temperatures was not performed due to the distance and location between the mainstem stations and the potential for substantial mixing of the tributary water with mainstem water.

3.5.2 Mainstem Susitna River and Side Channels

Surface and intragravel water temperatures recorded at monitoring stations at side channel 10, Upper Side Channel 11, and Side Channel 21 are compared to mainstem Susitna River temperatures.

3.5.2.1 Side Channel 10 (RM 133.9) and Mainstem Susitna River above Gold Creek (RM 136.8)

A comparison of Side Channel 10 surface and intragravel water temperature to mainstem surface water temperature upstream at the above Gold Creek station is presented in Figure 3-58. Generally, the surface water temperature at Side Channel 10 was found to be warmer than the mainstem

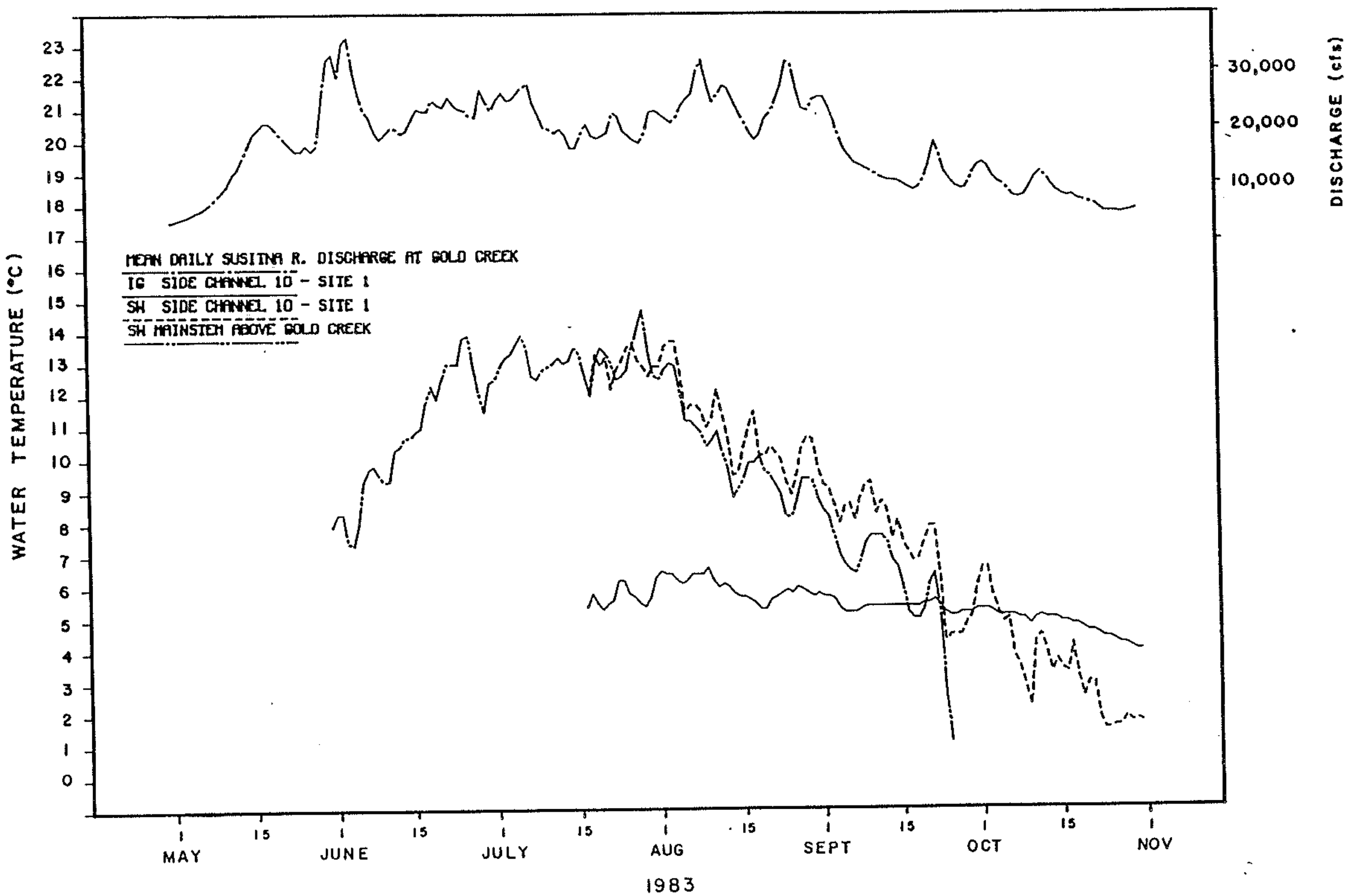

Figure 3-58 Mean daily surface water temperature collected at Mainstem Susitna above Gold Creek (RM 136.8), mean daily surface and intragravel water temperature collected at Side Channel 10 - Site 1 (RM 133.9) and mean daily Susitna River discharge at Gold Creek ([illegible])

water in those periods when the side channel was breached by mainstem discharge. The minimal variation occurring in the intragravel water temperature for Side Channel 10 although colder appeared to correspond to general trends of both the side channel and mainstem surface water temperatures until the cooler periods of mid-September to October. Intragravel water temperatures in October were warmer than both surface water in the side channel and in the mainstem.

3.5.2.2 Upper Side Channel 11 (RM 136.3) and Mainstem Susitna River Above Gold Creek (RM 136.8)

A comparison of Upper Side Channel 11 surface and intragravel water temperatures to mainstem surface water temperatures upstream at the Above Gold Creek station is presented in Figure 3-59. A review of this figure shows that the surface water temperature occurring in this side channel and in the mainstem Susitna River approximately 0.5 miles upstream were very similar during the months of mid-July to September. This side channel has been determined to be breached at mainstem discharges as low as 12,700 cfs (Chapter 1). During the mid-July to September period this side channel was continuously breached (Figure 3-59). In September, the temperature station in Upper Side Channel 11 was moved to a new location in the side channel. Through September and October surface water temperatures monitored in Upper Side Channel 11 showed greater variation to the mainstem surface water temperatures and generally were warmer. This is primarily attributed to the reduced frequency of breaching mainstem discharges occurring in late-September and October for Upper Side Channel 11. Intragravel water temperatures

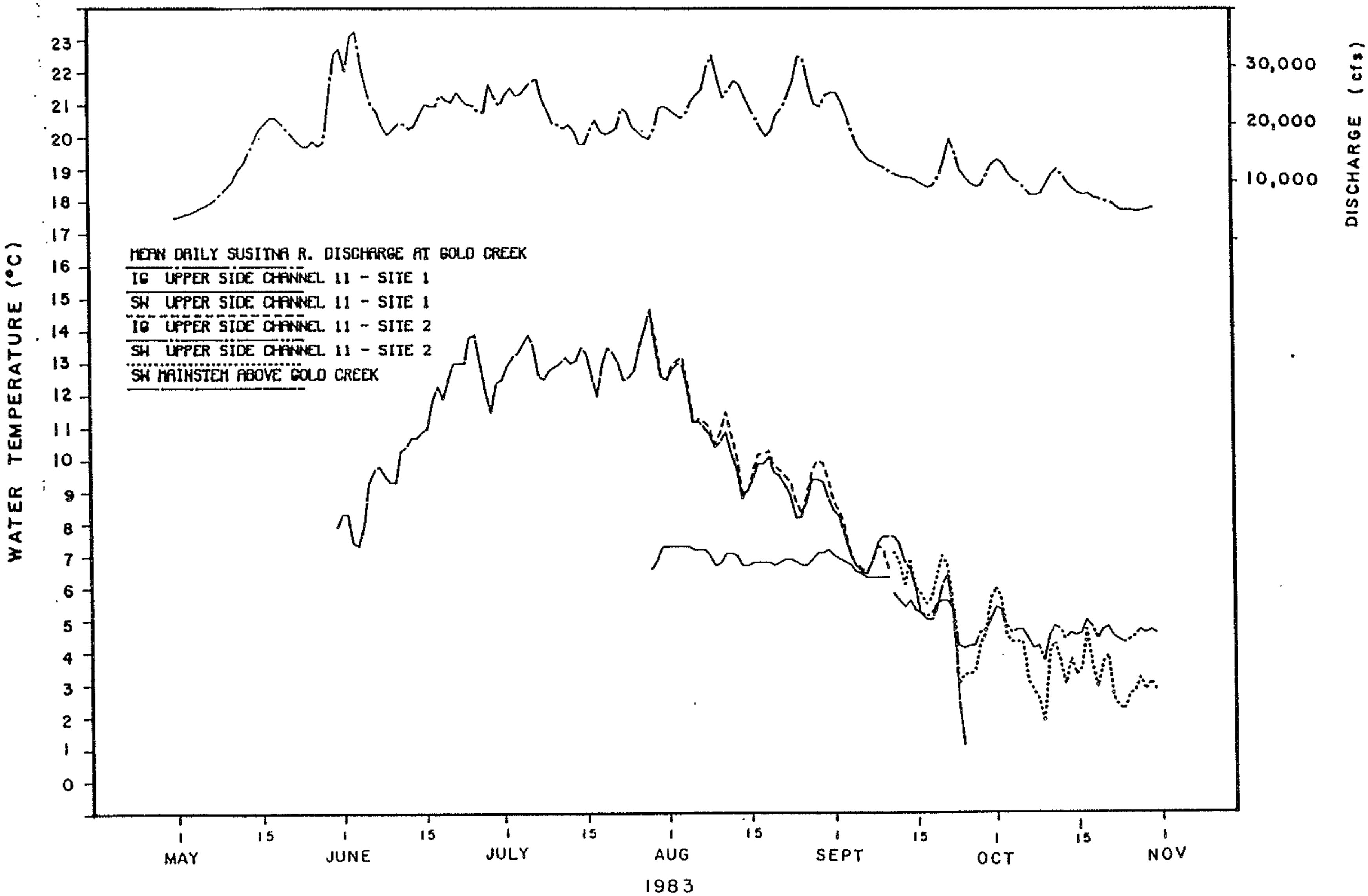

Figure 3-59 Mean daily surface Water Temperature collected at Mainstem Susitna River above Gold Creek (RM 136.8), Mean daily intragravel and surface Water Temperature collected at Upper Side Channel 11 - Sites 1 and 2 (RM 136.3), and mean daily Susitna River discharge at Gold Creek (USGS Gaging Station 15292000).

showed little variation in temperature from the late-July to September period. As surface water temperature cooled in the side channel and in side channel and in the mainstem intragravel water in the side channel was found to be warmer in October. The intragravel and surface water temperature occurring in Upper Side Channel 11 in October shows a corresponding trends different to that occurring in the mainstem (Figure 3-59).

3.5.2.3 Side Channel 21 (RM 141.0) and Mainstem Susitna River at LRX 57 (RM 142.3)

A comparison of Side Channel 21 surface and intragravel water temperatures to mainstem surface and intragravel water temperatures at LRX 57 is presented in Figure 3-60 from the limited period of record for both the mainstem temperature station and the side channel stations shows that the intragravel water at LRX 57 was substantially warmer than the surface water in the mainstem and the side channel. Intragravel water in the side channel was cooler than both the mainstem and side channel surface water temperatures.

3.5.3 Mainstem Susitna River and Sloughs

Temperatures recorded at Lower Slough 8A, Upper Slough 8A, Slough 9, Slough 19, Lower Slough 21 and Upper Slough 21 were compared to Mainstem Susitna River temperatures.

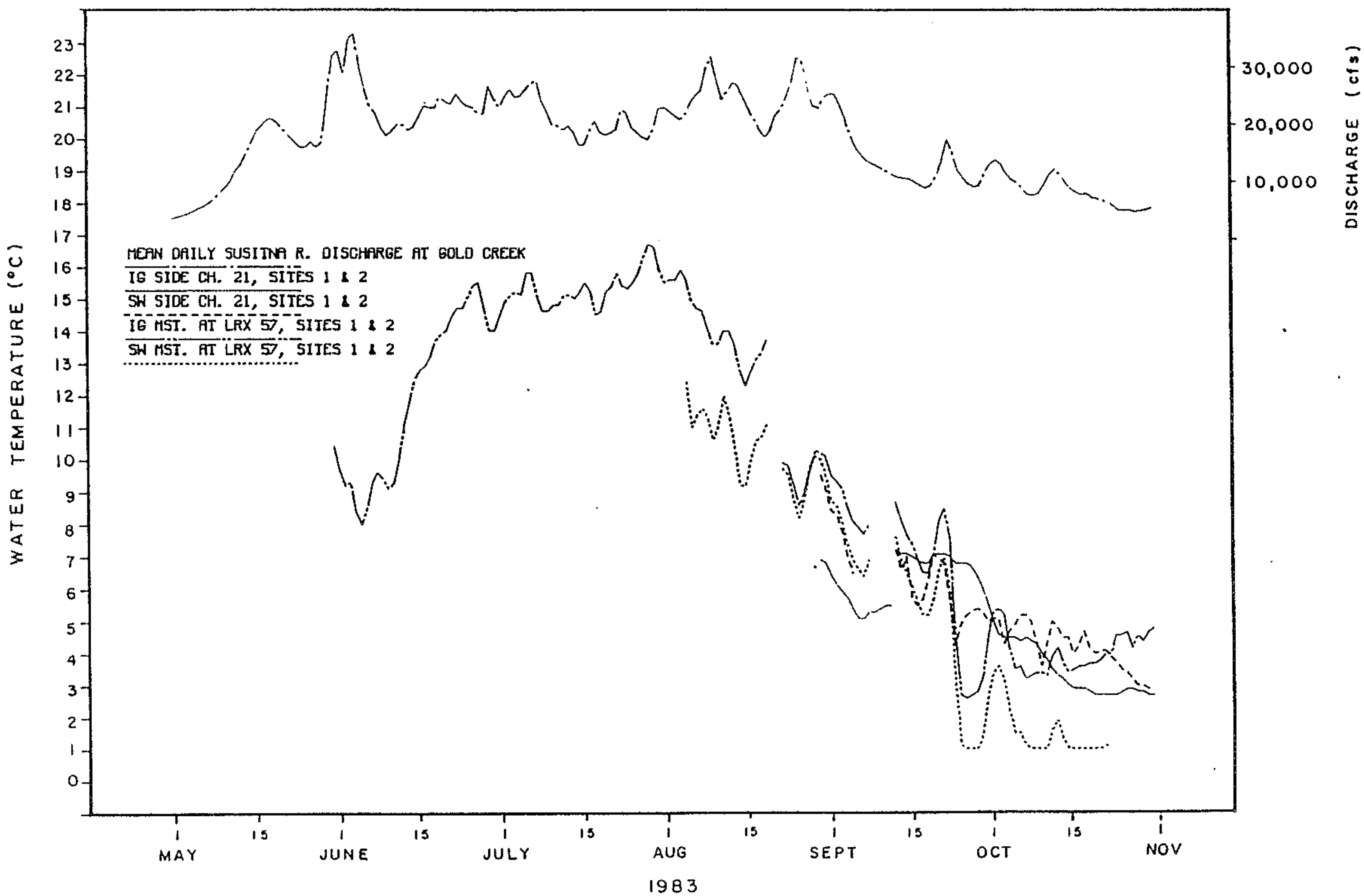

Figure 3-60 Mean daily intragravel and surface Water Temperature collected at Side Channel 21 - Site 1 and 2 (RM 141.0), at Mainstem Susitna River LRX 57 - Site 2 (RM 142.3), and mean daily Susitna River discharge at Gold Creek (USGS Gaging Station

3.5.3.1 Lower Side Slough 8A (RM 125.6) and Mainstem Susitna River at LRX 29 (RM 126.1)

A comparison of Lower Side Slough 8A surface and intragravel water temperatures to mainstem surface and intragravel water temperatures at LRX 29 is presented in Figure 3-61. Surface and intragravel water temperatures in the mainstem station were found to be similar to the surface water temperatures occurring in the lower portion of this side slough. Intragravel water temperature monitored in the lower portion of the side slough (site 2) showed very little variation during the months of May to mid-August. The slough temperature station was moved in August. The intragravel water temperatures obtained from the new slough temperature station corresponded closely to the slough surface water and the mainstem surface and intragravel water temperatures throughout most of September. From late September through October for the slough and mainstem intragravel water temperatures was warmer than surface water temperatures obtained in the mainstem and the slough. Intragravel water temperature obtained in the slough was the warmest whereas surface water temperature was coldest among these two temperature stations during the fall period of late September through October.

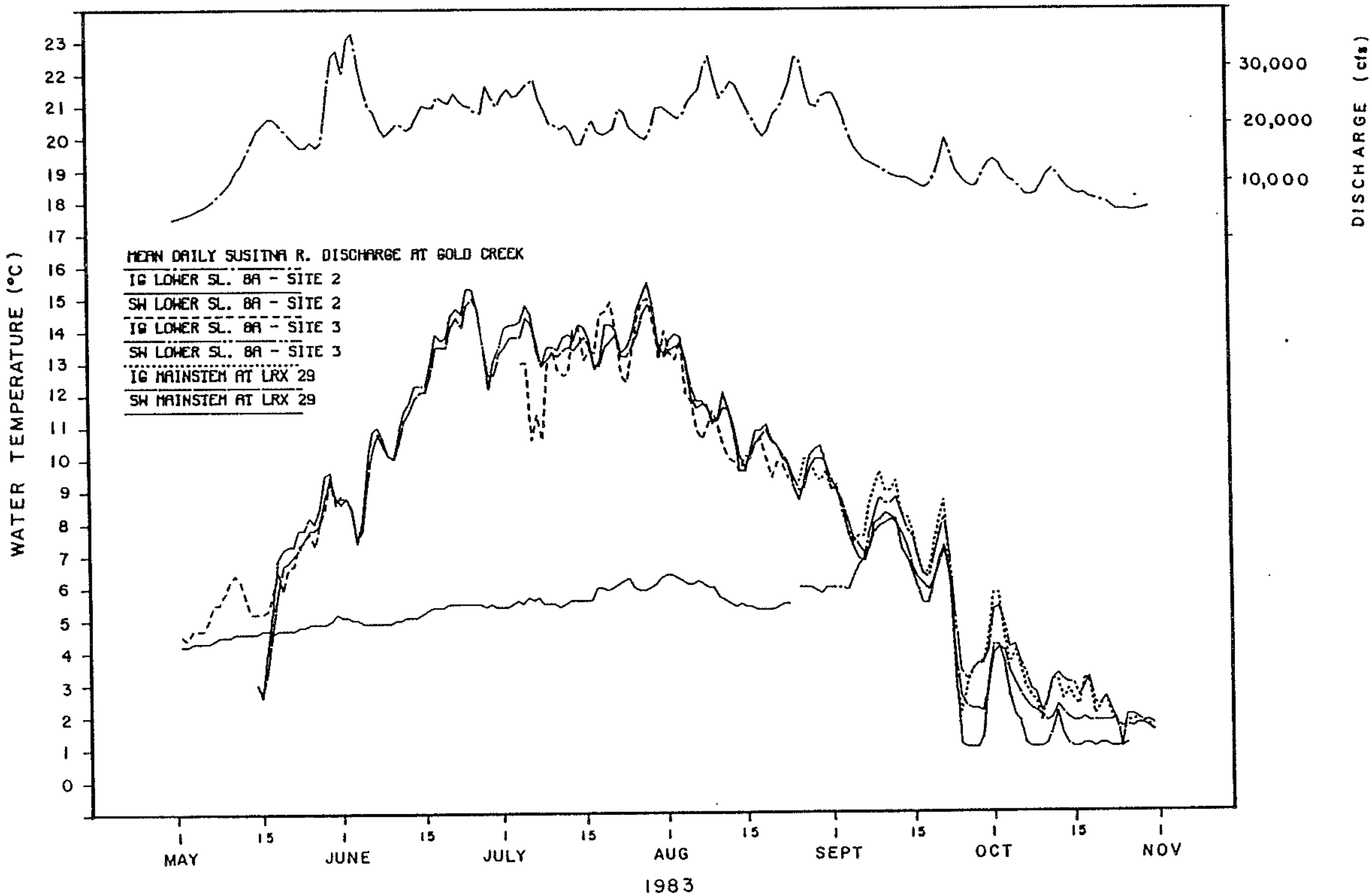

Figure 3-61 Mean daily intragravel and surface water temperatures collected at Lower Slough 8A - Sites 2 and 3 (RM 125.6), at Mainstem Susitna River at LRX 29 (RM 126.1), and mean daily Susitna River discharge at Gold Creek (USGS Gaging Station 1529[illegible]0).

3.5.3.2 Upper Side Slough 8A (RM 126.6) and Mainstem Susitna River at LRX 29 (RM 126.1)

A comparison of Upper Side Slough 8A surface and intragravel water temperatures to mainstem surface and intragravel water temperatures at LRX 29 is presented in Figure 3-62. Both the surface and intragravel water temperatures obtained from the upper portion of Side Slough 8A were found to be substantially lower than the mainstem surface and intragravel water temperatures obtained at LRX 29. Maximum surface water temperature obtained at this slough station was 12.8°C compared to 15.8°C for the mainstem. Slough intragravel temperature ranged as high as 6.0°C compared to 14.4°C for mainstem intragravel. The upper portion of Side Slough 8A was estimated to breach at mainstem discharge levels of 33,000 cfs. The relatively high mainstem discharge necessary to breach the upper portion of Side Slough 8A resulted in this temperature station rarely receiving the direct influence of mainstem surface water caused by a breaching event.

3.5.3.3 Slough 9 (RM 128.6) and Mainstem Susitna River at LRX 29 (RM 126.1)

A comparison of Side Slough 9 surface and intragravel water temperatures to mainstem surface and intragravel water temperatures at LRX 29 is presented in Figure 3-63. Although LRX 29 is approximately 2.5 mile downstream of Side Slough 9, the extensive period of record (May through October) for this mainstem station made LRX 29 the preferred mainstem

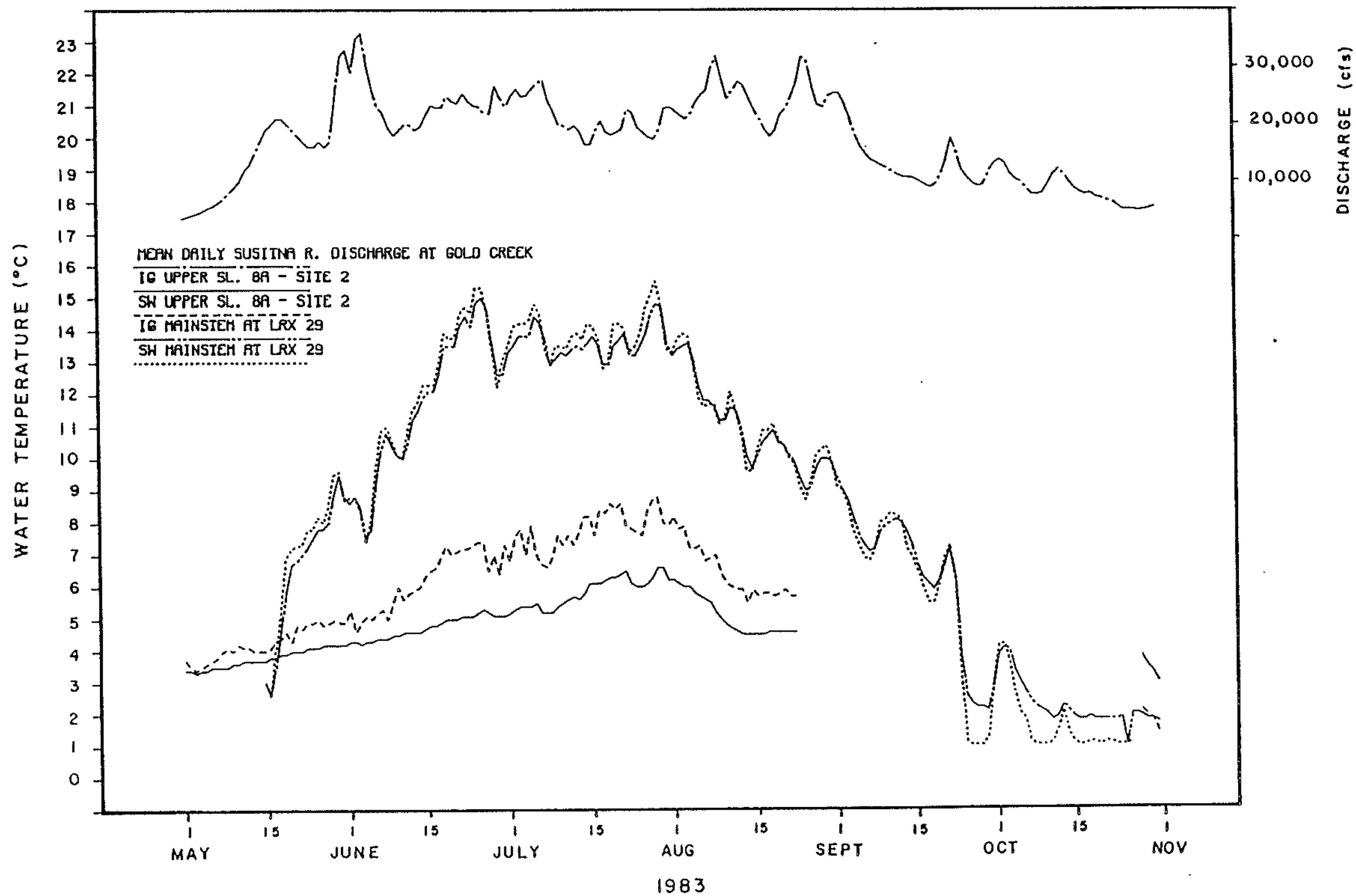

Figure 3-62 Mean daily intragravel and surface water temperatures collected at Lower Slough 8A - Site 2 (RM 126.6), Mainstem Susitna River at LRX 29 (RM 126.1), and mean daily Susitna River discharge at Gold Creek (USGS Gaging Station 1[illegible]000[illegible]

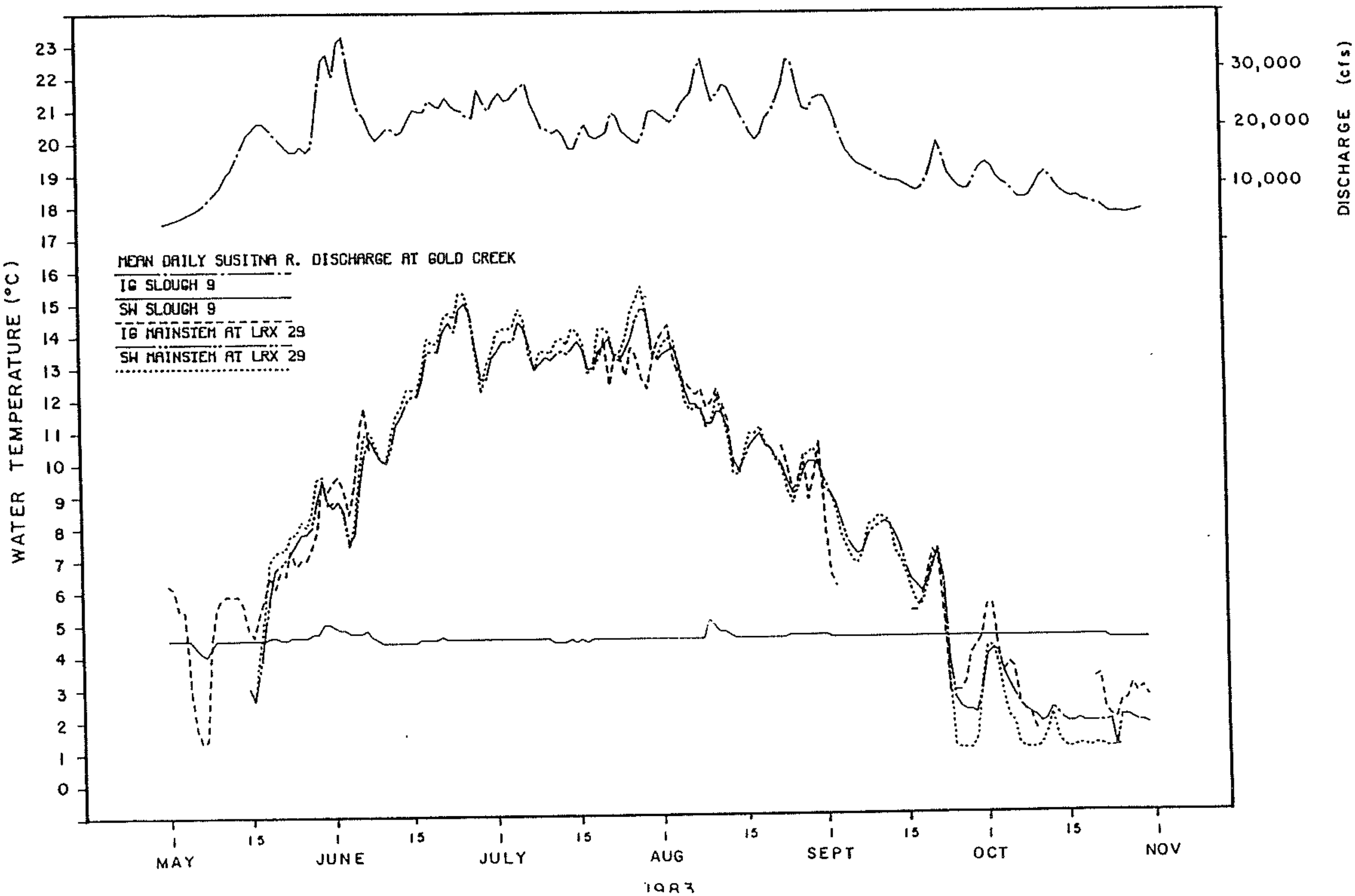

Figure 3-63 Mean daily intragravel and surface water temperatures collected at Mainstem Susitna River at Slough 9 (RM 128.6), LRX 29 (RM 126.1), and mean daily Susitna River discharge at Gold Creek (USGS Gaging Station 15292000). ....

site for comparison to Side Slough 9. Surface water temperatures in Side Slough 9 corresponds closely to the temperatures monitored in the mainstem at LRX 29 from mid-May through the latter part of August. This slough was determined to be substantially breached by mainstem discharge exceeding 19,000 cfs. The mainstem discharge of 19,000 cfs occurred frequently during the mid-May to mid-August period which affected surface water slough temperatures. Intragravel water temperatures in Side Slough 9 showed very little variation in temperature throughout the the period of May through October. The intragravel water temperatures in the slough did not appear to correspond directly to Slough 9 surface water or mainstem surface water at the downstream stations at LRX 29. During the period of September through October more variation occurred between slough surface water temperatures to mainstem surface water. This was a period when mainstem breaching occurred less frequently. Intragravel water temperatures in the slough was found to be warmer than both surface and intragravel in the LRX 29 mainstem station and slough surface water during the late September through October period.

3.5.3.4 Slough 11 (RM 135.7) and Mainstem Susitna River at LRX 29 (RM 126.1)

A comparison of Side Slough 11 surface and intragravel water temperatures to mainstem surface and intragravel water temperatures at LRX 29 is presented in Figure 3-64. LRX 29 is approximately 9.5 miles downstream of Side Slough 11 but was chosen as the representative mainstem surface water temperature site because of its extensive period of record (May through October). From a review of this plot surface water temper-

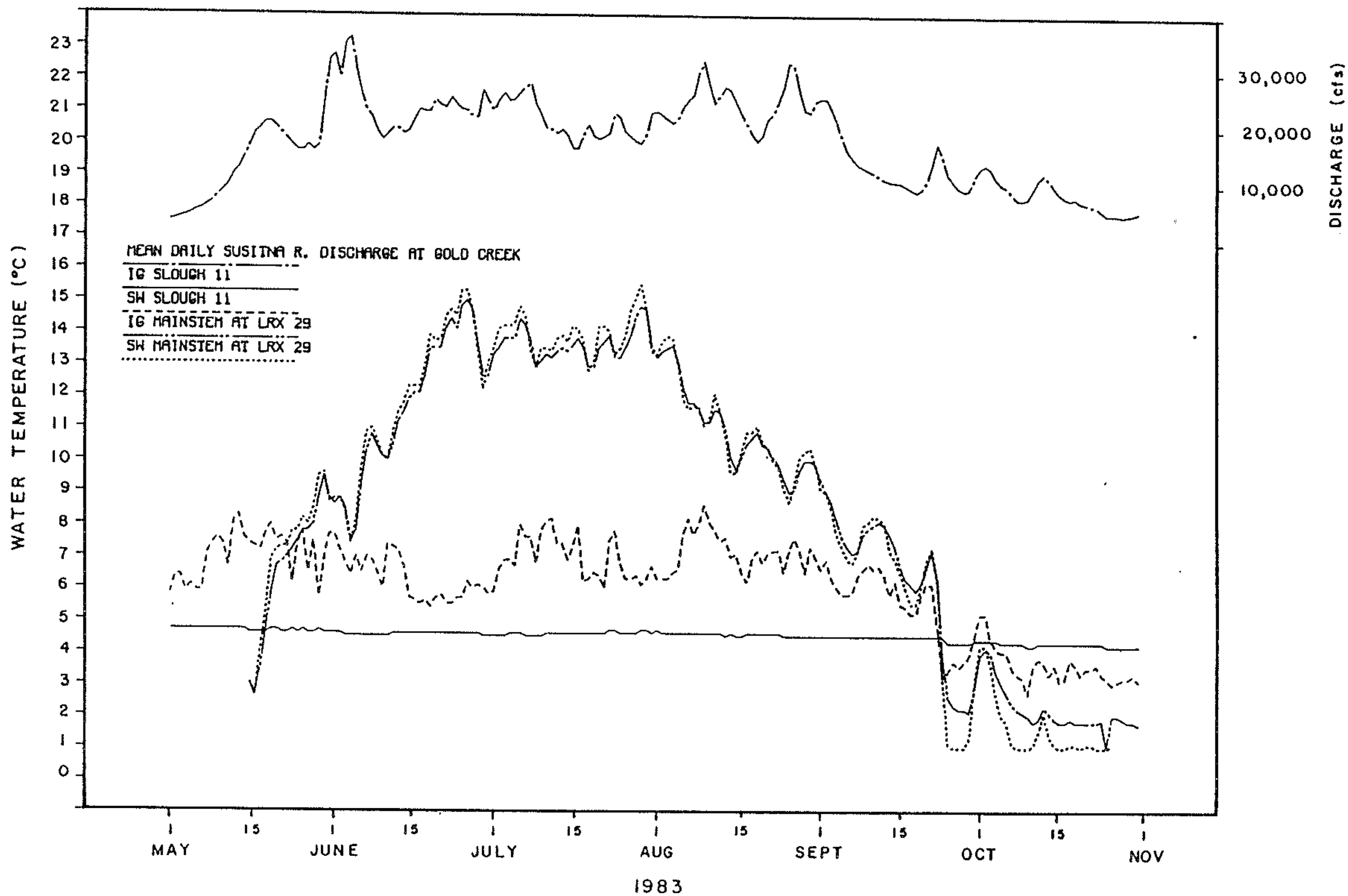

Figure 3-64 Mean daily intragravel and surface water temperatures collected at Slough 11 (RM 135.3), Mainstem Susitna River at LRX 29 (RM 126.1),

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atures in Side Slough 11 did not resemble mainstem surface water temperature except during the spring and fall months of the year. Side Slough 11 was never breached in 1983 therefore temperatures at this slough station were not a result of mainstem water entering from the head of the slough.

3.5.3.5 Upland Slough 19 (RM 140.0) and Mainstem Susitna River at LRX 57 (RM 142.3)

A comparison of Upland Slough 19 surface and intragravel water temperatures to mainstem surface and intragravel water temperature at LRX 57 is presented in Figure 3-65. Upland Slough 19 was the only upland slough monitored for temperature in 1983. Upland sloughs are only connected to the mainstem at their mouths therefore mainstem surface water enters into the upland sloughs via the sloughs mouth. From a review of the plot of Upland Slough 19 and mainstem water temperatures at LRX 29 shows that a substantial difference of temperature occurs between these two habitats. Although water temperature in the mainstem were similar to surface water temperature in the slough during a brief period in late September this is primarily a function of air temperatures. Surface and intragravel water temperatures were cooler for the slough during the late May to late September period compared to mainstem temperatures and warmer in the spring and fall months.

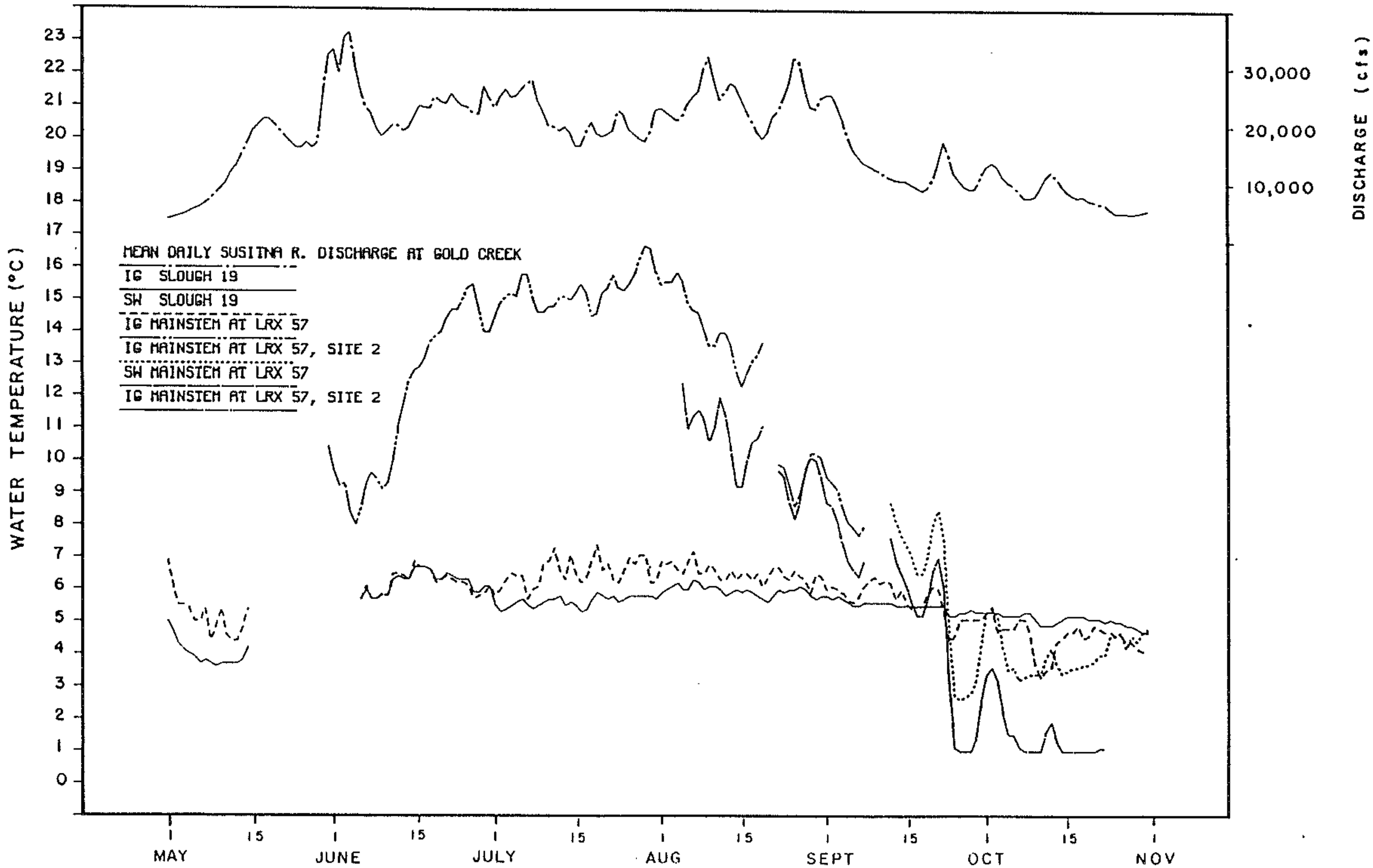

Figure 3-65 Mean daily intragravel and surface water temperatures collected at Slough 19 (RM 140.0), Mainstem Susitna River at LRX 57 (RM 142.3), and mean daily Susitna River discharge at Gold Creek (USGS Gaging Station 15292000).

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3.5.3.6 Side Slough 21 (RM 141.8) and Mainstem Susitna River at LRX 57 (RM 142.3)

A comparison of Side Slough 21 surface and intragravel water temperatures to mainstem surface and intragravel water temperatures is presented in Figures 3-66 and 3-67. Surface and intragravel water temperatures were obtained from two locations in Side Slough 21, lower and upper portions of the slough. A review of Figure 3-66 shows that generally both surface and intragravel water temperatures were cooler in the slough compared to mainstem surface and intragravel water temperatures until October. Intragravel water temperatures in the slough was warmest during October. An unusual event occurs at LRX 57 throughout most of the open water. Intragravel water temperature is warmer than surface water at LRX 57. The surface and intragravel water temperature monitored in the upper portion of Side Slough 21 were also found to be cooler than the surface and intragravel water temperatures occurring at LRX 57, until late September. From late September through October the slough surface and intragravel water temperatures compared with the mainstem intragravel water temperatures whereas the mainstem surface water was much cooler.

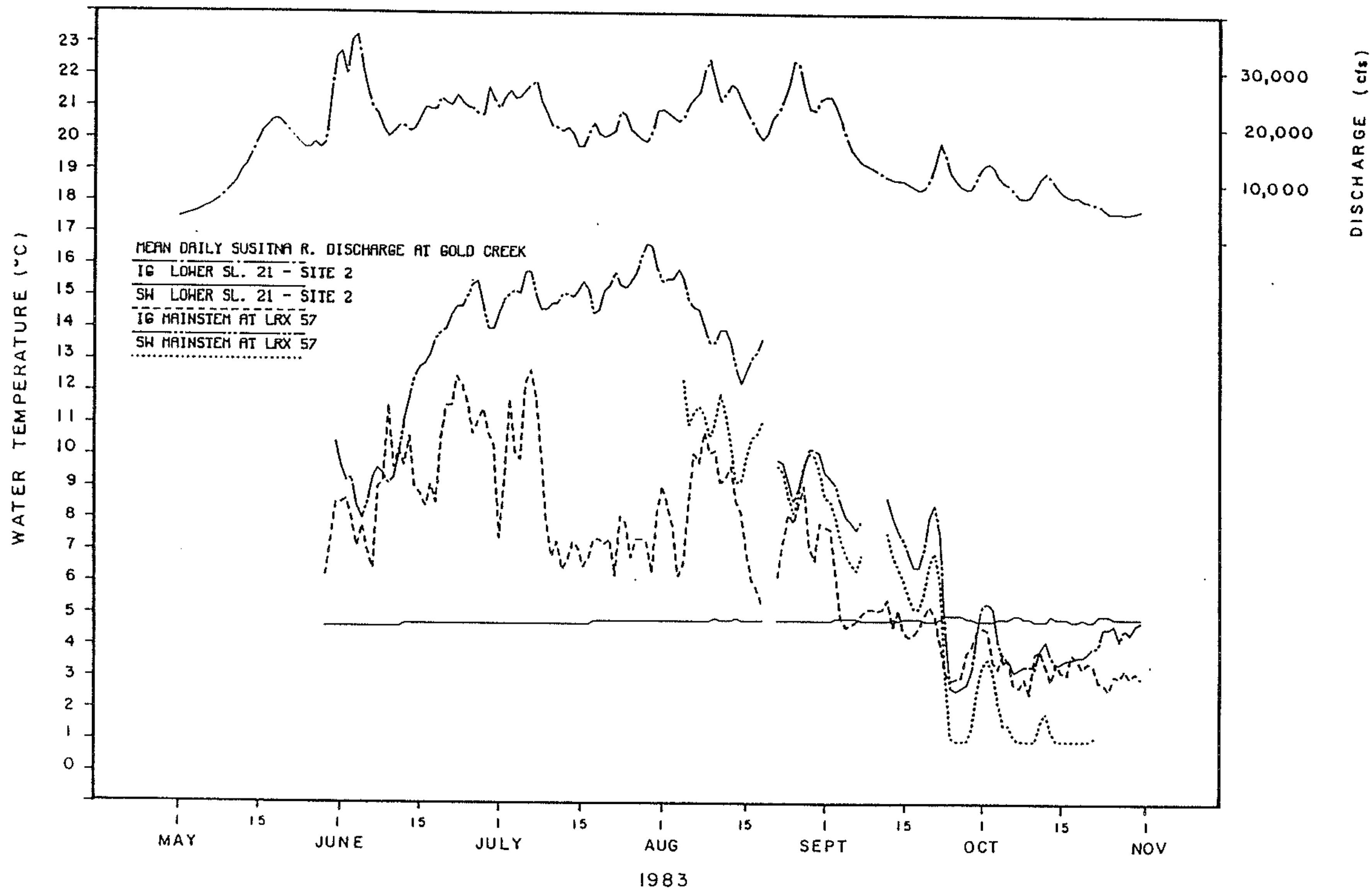

Figure 3-66 Mean daily intragravel and surface water temperatures collected at Lower Slough 21 - Site 2 (RM 141.8), Mainstem Susitna River at LRX 57 (RM 142.3), and mean daily Susitna River discharge at Gold Creek (USGS Gaging Station 15292000).

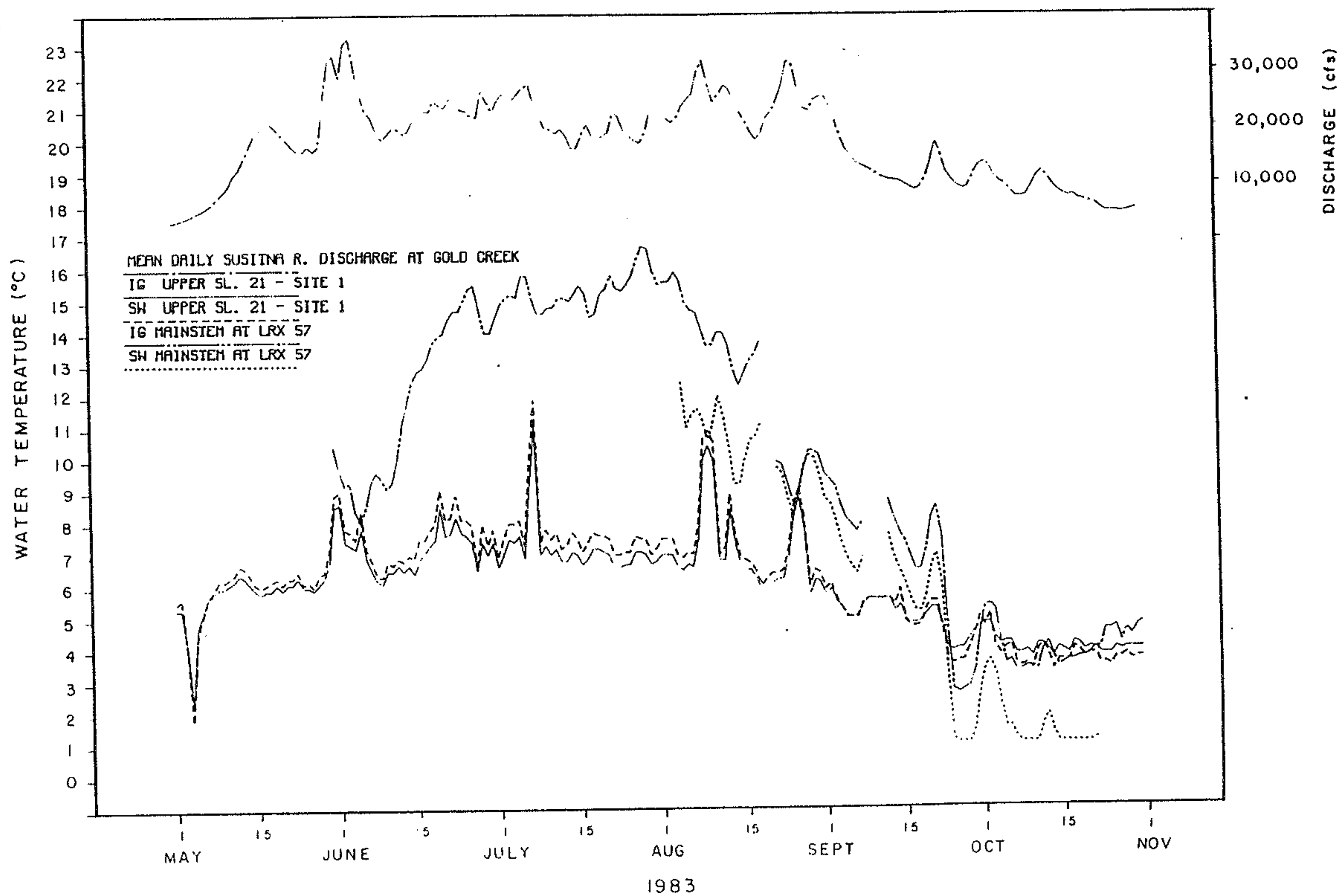

Figure 3-67 Mean daily intragravel and surface water temperatures collected at Upper Slough 21 - Site 1 (RM 142.0), Mainstem Susitna River at LRX 57 (RM 142.3), and mean daily Susitna River dischar at Gold Creek (USGS Gaging Station 15292000).

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3.5.4 Susitna River Side Channels and Sloughs

3.5.4.1 Upper Side Channel 11 (RM 136.3) and Side Slough 11

A comparison of Upper Side Slough 11 surface and intragravel water temperatures to those obtained in Side Slough 11 presented in Figure 3-68. A review of Figure 3-68 shows that Side Channel 11 had a much greater range of surface water temperature compared to the slough. This is primarily due to the frequency of breaching occurring at Side Channel 11 and the absence of breaching at Side Slough 11. Intragravel water temperatures recorded at the Side Channel temperature station were found to be within the same range of temperature for surface water in the slough for much of the July to late-September period. Intragravel water temperature on October was warmer than surface water for both habitats with the mainstem intragravel water temperature slightly warmer than slough intragravel.

3.5.4.2 Side Channel 21 (RM 141.0) and Side Slough 21 (RM 141.8)

A comparison of surface and intragravel water temperatures for Side Channel 21 to those temperatures for Side Slough 21 is presented in Figures 3-69 and 3-70. Two temperature stations were located in Side Slough 21. From the limited data base for the Side Channel 21 intragravel temperatures, it shows that the side channel intragravel water

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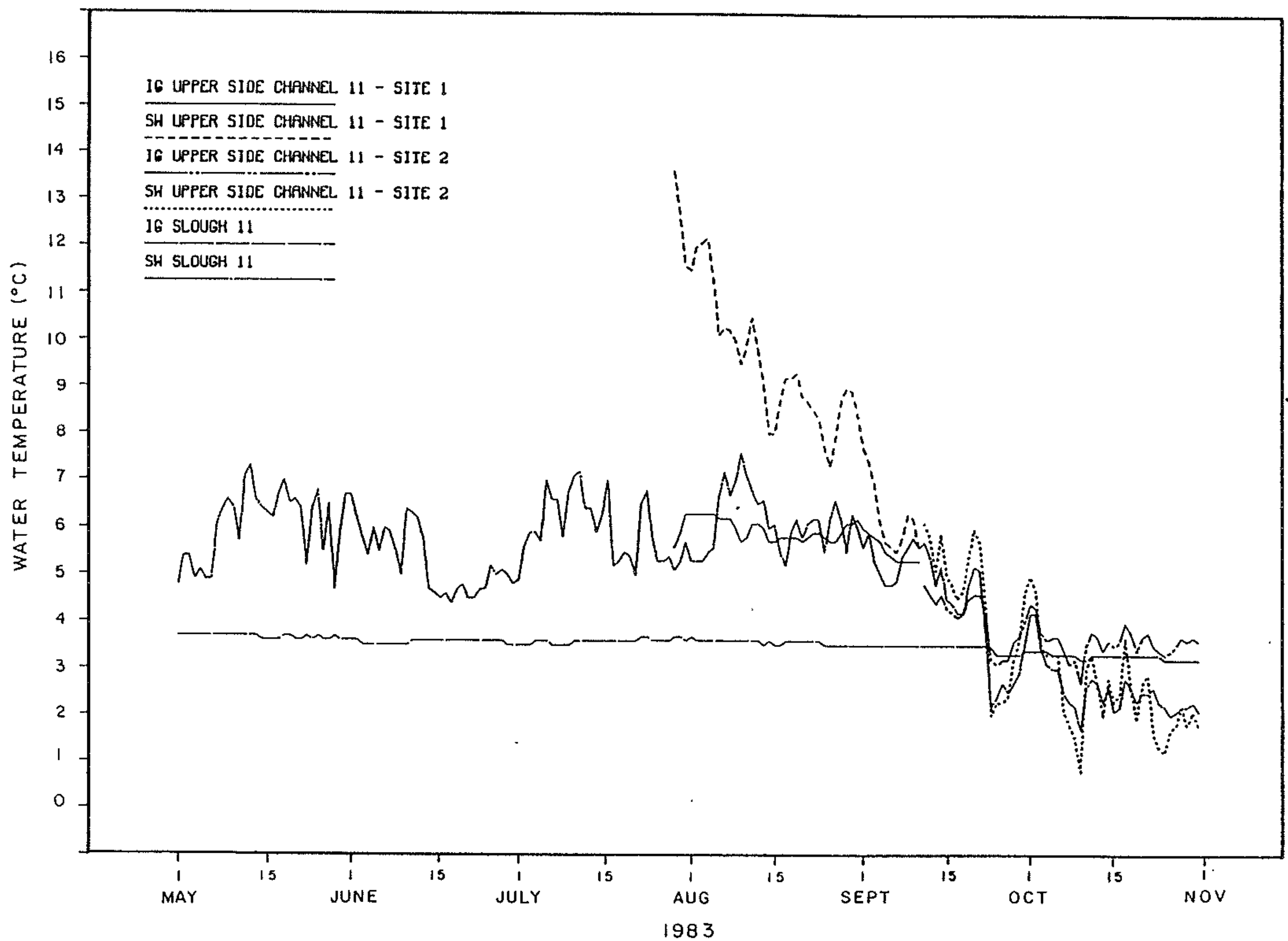

Figure 3-68 Mean daily intragravel and surface water temperatures collected at Upper Side Channel 11 - Sites 1 and 2 (RM 136.3), and at Slough 11 (RM 135.3) during the 1983 open water season.

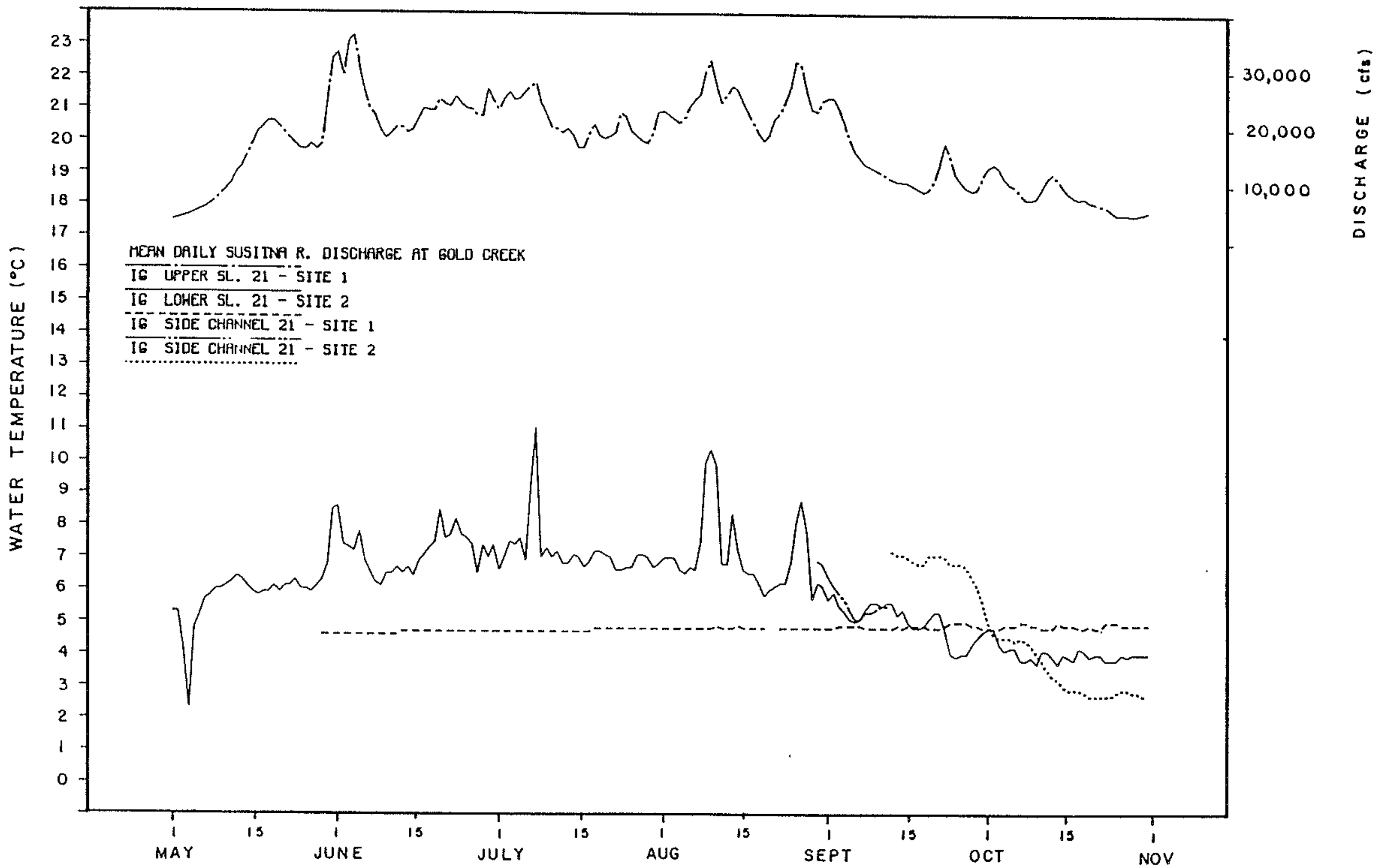

Figure 3-69 Mean daily intragravel and surface water temperatures collected at Upper Slough 21 (RM 142.0), Lower Slough 21 - Site 2 (RM141.8), Side Channel 21 - Sites 1 and 2 (RM 141.0), and mean daily Susitna River discharge at Gold Creek (USGS Gaging Station 15292000).

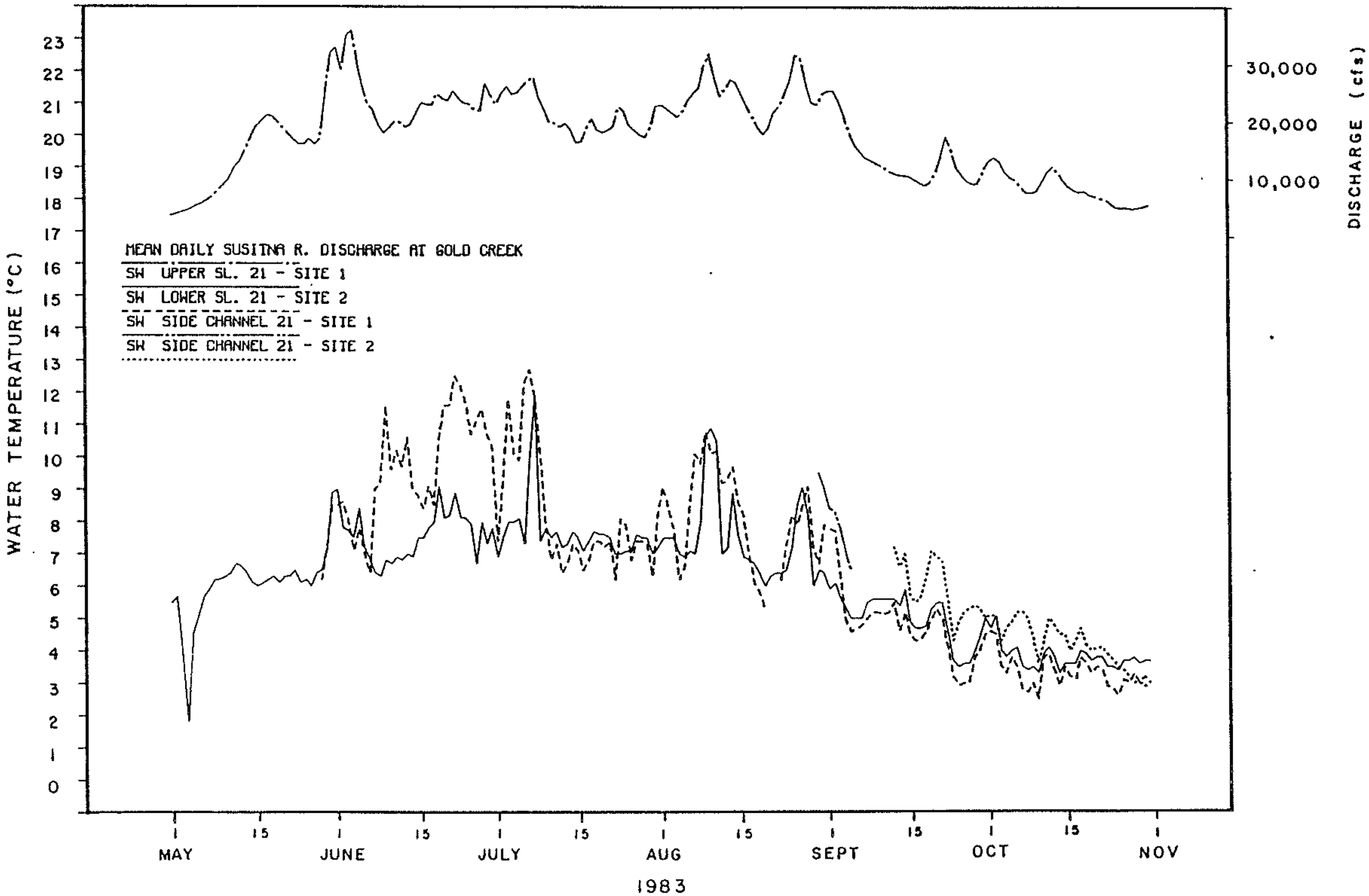

Figure 3-70 Mean daily intragravel temperatures collected at Upper Slough 21 (RM 142.0), Lower Slough 21 - Site 2 (RM141.8), Side Channel 21 - Sites 1 and 2 (RM 141.0), and mean daily Susitna River discharge at Gold Creek (USGS Gaging Station 15292000).

temperatures are cooler than intragravel temperatures occurring in the slough during October..

the surface water data for Side Channel 21 is limited to late August and early September through October. A review of Figure 3-70 shows that surface water temperatures occurring on the slough. The month of September was a period when Side Channel 21 was still receiving mainstem discharge through overflow Channel A5 (Chapter 1). Side Slough 21 was not breached in September in October.

4.0 DISCUSSION

4.1 Mainstem Habitat

Surface water temperature was monitored in the mainstem Susitna River from river mile 4.5 continuing upstream to river mile 236.0 during the 1983 open water season. The temperature stations in the lower Susitna River (estuary to Parks Highway Bridge) were established primarily to support the ADF&G eulachon study and to provide the most downstream temperature data (Parks Highway Bridge Station) for the temperature model studies. Surface water temperatures were monitored in both the middle reach (Parks Highway to Devil Canyon) and the upper reach (above Devil Canyon) mainstem Susitna River to provide temperature data to support the ADF&G fishery studies and provide the data necessary for temperature model studies of the Susitna River and proposed impoundment.

Intragravel water temperature data was collected from three locations (LRX 9, LRX 29, and LRX 57) in the mainstem Susitna River in 1983. These temperature stations were established to provide baseline intragravel temperature data to evaluate on a general level intragravel temperature regimes occurring in the middle river of the mainstem Susitna River.

4.1.1 Lower Reach - Estuary (RM 0.0) to Parks Highway Bridge (RM 83.9)

A limited surface water temperature data base was obtained from many of the temperature stations located in the lower reach in 1983 due to the short duration of the eulachon study (Appendix Table 3-A-1). From the temperature data available, surface water temperatures were found to be relatively homogenous in the lower reach of the Susitna River throughout the month of May, primarily a result of winter conditions. Temperatures were generally increasing throughout May and June with the months of July and August being periods where the greatest variation in temperature occurred among the temperature stations. The greatest fluctuations in water temperature also occurred in July and August. With the occurrence of cooler air temperatures in mid-August, surface water temperatures responded and showing a general decline through August to the end of the sampling period, usually late October. Throughout the open water period (May to November) surface water temperatures were found to exhibit the same general trends among the seven temperature stations extending from the Parks Highway Bridge downstream to the river mile 4.5. Surface water temperatures among the seven stations ranged from 0.0°C (in October) to a high of 14.0°C (in July) during the 1983 open water field season.

The Yentna River, one of the largest tributaries to the Susitna River, is located at river mile 28 and provides a substantial discharge to the Susitna River.

The temperature data available from two Susitna River temperature stations (Figure 3-2), Flathorn Station located downstream of the Yentna River and the Above the Yentna Station, shows the Yentna River provides surface water temperature to the Susitna River that increase Susitna River temperatures. This Yentna River influence is most noticeable during the summer months whereas in May the Yentna River temperature was similar to Susitna River temperatures.

The Delta Island Complex which extends from river mile 43 to river mile 51, divides the Susitna River into two main channels and a series of small channels and islands. The expanse of this complex of channels and islands could potentially influence the surface water temperature of the Susitna River. The temperature data obtained from temperature stations located above the Deshka River (downstream of the Delta Islands) and at the Parks Highway Bridge (upstream of the Delta Islands) showed that during the months of June to mid-July surface water temperature was warmer downstream of the Delta Islands. This trend was reversed in late July following a decrease in water temperatures.

Through October temperatures were very close between the two stations. The temperature differences between these two stations may result from the greater influence of air temperature on surface water through the Delta Islands. To adequately evaluate the influence of the Delta Island Complex on surface water temperatures of the Susitna River, further study is necessary.

4.1.2 Middle Reach - Parks Highway Bridge (RM 83.9) to Devil Canyon (RM 150.0)

Surface Water Temperature

Surface water temperatures evaluated from Devil Canyon at river mile 150.0 downstream to the Parks Highway Bridge, located at river mile 83.9, were found to be relatively similar from Devil Canyon to Talkeetna Fishwheel Camp (RM 103.0) although surface water temperatures generally increased downstream of Devil Canyon to Talkeetna Fishwheel Camp (RM 103.0). Surface water temperatures generally were colder at the Parks Highway Bridge due to the influence of the Talkeetna and Chulitna Rivers. The greatest variation in surface water temperatures among the ten temperature stations in this reach of the river occurred during the months of June and July. In the months of May and June, temperatures generally increased and were the warmest, with a general decline occurring in August and continuing through October. Surface water temperatures ranged from 0.0°C to 15.5°C from Devil Canyon to the Talkeetna Fishwheel from May through October and 0.5°C to 13.5°C at the Parks Highway Bridge. The temperature station located at river mile 135.8 monitored surface water temperature in association with a dissolved gas probe. Temperatures at this site were found to be unusually warmer which may be attributed to the temperature recorder. The temperature recorder installed in the mainstem Susitna River at Gold Creek (RM 136.6) was located to monitor the surface water temperature of the clear water plume resulting from the tributary flow of Gold Creek. This temperature data and the data collected from the temperature station above Gold Creek (RM 136.9) was obtained to evaluate previous temperature data obtained by the USGS at their Gold Creek Station (USGS 15292000). The USGS station in previous years was located in an area potentially affected by the Gold Creek tributary. The Gold Creek streamflow was found to influence the surface water temperature at the Gold Creek Bridge Station resulting in colder water temperatures than recorded in the mainstem upstream of Gold Creek.

Intragravel Water Temperature

Intragravel water temperatures evaluated from three locations in the mainstem Susitna River from Talkeetna to Devil Canyon were found to exhibit similar temperature patterns, however, actual temperatures varied among the three stations. The greatest variation in temperatures occurred during June and July with the warmest intragravel water temperatures occurring at LRX 57 (RM 142.3), the most upstream site, and the coolest at LRX 9 (RM 103.3), the most downstream site. During the months of May, and from late August to late September, intragravel water temperatures were similar. Through October intragravel water temperatures at LRX 57 were substantially warmer than at the remaining two sites.

At LRX 57, when intragravel water temperatures were compared to corresponding surface water temperatures, it was found that intragravel water was consistently warmer than surface water. This phenomenon was noted during the field season and the field biologists evaluated both the temperature probes and instrument for error. The sampling gear was found to be operating correctly. Usually surface water temperatures are warmer than intragravel during the periods of warm air temperature with the reverse occurring during the winter months. Intragravel water temperatures were found to range from 0.2°C to 14.6°C for the LRX 9 and LRX 29 stations compared to 1.6°C to 16.0°C at LRX 57.

4.1.3 Upper Reach - Devil Canyon (RM 150.0) to Above the Oshetna River (RM 234.9)

Surface water temperature was monitored at two locations upstream of Devil Canyon during the 1983 open water season. Generally, surface water temperatures were colder at the upstream temperature station (Above the Oshetna), located at river mile 235.0, compared to the lower station (Above Tsusena Creek), located at river mile 181.9. The increase in water temperature is primarily the result of inflow from several clear water tributaries. Temperatures recorded at Devil Canyon (RM 150.0) were found to be very similar to those recorded at the Above Tsusena Creek station throughout the open water season of 1983.

4.2 Side Channel and Side Slough Habitats

Surface and intragravel water temperatures were obtained at side channel and side slough habitats located in the reach of river from Talkeetna to Devil Canyon. A major characteristic of these two habitat types is that mainstem water enters these habitats at their head portions at various mainstem discharge levels. Prior to being breached at their heads by mainstem discharge, flow in these habitats is primarily generated by surface water runoff in the form of small tributaries, and groundwater flow. Surface water temperatures in side channels and side sloughs is influenced, prior to a breaching event, by solar radiation and groundwater. The surface water temperatures in these habitats subsequent to a breaching event resemble those of the mainstem if the breaching is sufficient to provide a substantial volume of mainstem water into the site.

A breaching event in early May at Side Slough 21 due to breakup of the mainstem river dramatically reduced both surface and intragravel water temperatures in the slough. The surface water temperatures in side channel and side sloughs were usually cooler than mainstem surface water temperatures prior to the site being breached. The frequency of overtopping events corresponded to the similarity of surface water temperatures between side channels and side sloughs to mainstem surface water temperatures. Side channel habitat overtopped more often than side sloughs resulting in a temperature regime similar to that of the mainstem. Intragravel water temperatures were found to remain cooler than surface water during the warmer months of the year, May through September. Usually by mid-October intragravel water is warmer than surface water. Intragravel water temperatures show less variation in temperature compared to surface water with side channel habitat having a greater range in intragravel temperature than side sloughs.

Side Slough 11 intragravel temperatures varied less than 1°C compared to a range of 5.4°C for Side Channel 21 from June through October. Intragravel water temperatures were found to vary from within a side channel or side slough study site. This difference in intragravel water temperatures within a side channel or side slough habitat could result from several factors, the most obvious being localized groundwater upwelling.

4.3 Upland Slough Habitat

Surface and intragravel water temperature was obtained from only one upland slough in 1983. Surface and intragravel water temperature obtained in Upland Slough 19 were found to remain cooler and have a less range of temperature than mainstem surface water temperatures from June until October. During October, both surface and intragravel water temperatures were warmer than the mainstem Susitna River. As in all upland sloughs, mainstem water only enters from the mouth of the slough. With an absence of breaching events and low volume of flow, Upland Slough 19 maintained a relative narrow range of temperature with surface and intragravel temperatures occasionally having very similar temperatures.

4.4 Tributary Habitats

Surface water temperatures recorded in the mainstem Susitna River directly reflect the influence of the lower surface water temperatures contributed by the Yentna, Talkeetna, and Chulitna River. Although the temperature influence is not of the same magnitude, tributaries contributing smaller volumes of water also affect mainstem surface water temperatures. Usually, the clear water plume of the smaller tributaries is a good indicator of the relative contribution of the smaller tributaries on mainstem water temperatures. These clear water plumes vary depending upon tributary and mainstem discharge. Although the Portage Creek and the Chulitna, Talkeetna, and Indian Rivers provide cooler flow into the mainstem during the warmer periods of the year (June and July), these tributaries are warmer than the mainstem during the month of October.

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