THE LIMNOLOGY OF TWO DISSIMILAR SUBARCTIC STREAMS AND IMPLICATIONS OF RESOURCE DEVELOPMENT

by

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Report No. IWR-33 March, 1973

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INTRODUCTION

Because of the relatively undeveloped condition of arctic and subarctic Alaska, an opportunity is presented to draw up water quality management plans before extensive perturbation. These plans cannot, unfortunately, be based upon those drawn up for more temperate regions where much is known about natural stream conditions, for in these Alaskan areas, little is known about the natural physical, chemical, and biological cycles of streams or about their ability to handle the stresses that will be exerted on them should development take place.

The Chena River, in subarctic, interior Alaska, near the city of Fairbanks, has been studied to evaluate the impact of pending construction and operation of flood control structures (Frey, Mueller and Berry, 1970). This river however has already been developed, especially along its lower reaches where the city of Fairbanks is situated.

The watersheds of the two streams chosen for this study roughly parallel each other, although the Chatanika River watershed is about twice as long as that of Goldstream Creek. In addition to the dissimilarity in size, these two streams also differ in regard to terrain, at least along the respective stretches that were studied. The Goldstream Creek study area runs through a bog and extensive muskeg. The Chatanika River, however, was for the most part sampled in the area of mountainous terrain.

The intent of this study was to obtain comprehensive physical and chemical data, to survey the resident invertebrates, and to evaluate the assimilative capabilities of both streams.

As an integral part of the main study, four research assistants developed thesis research topics. Lawrence Peterson studied the seasonal, diurnal and downstream variations in selected physical and chemical parameters along both streams (Peterson, 1973). Two students, Dennis Ward and James Clay, studied aspects of the benthic macroinvertebrates of Goldstream Creek. Ward's objective was "to determine whether temperature, velocity, dissolved oxygen, or pH operate singly, synergistically, or additionally, to control or limit distribution of Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddis flies), in Goldstream Creek" (Ward, 1972).

Clay's objective was to determine the effect of stream discharge, temperature, and light intensity on the drift of Ephemeroptera (mayflies) and Diptera (true flies) in Goldstream Creek (Clay, 1973).

Timothy Hudson conducted a study of the potential assimilative capacity of the streams by investigating their oxygen cycles (Hudson, 1973).

One thesis, by Dennis Ward, is complete and selections from it are appended to this report. The remaining three theses are expected to be completed during 1973.

Description of Study Area

The interior Alaskan location of the two streams (Fig. 1) subjects them to wide variations in climatological parameters. Considering the climate of Fairbanks, Alaska (the closest location with a first order weather station), one can see that the growing season for these streams is relatively short. The ice-free season begins approximately in early May and ends in October. Although this area experiences an extensive

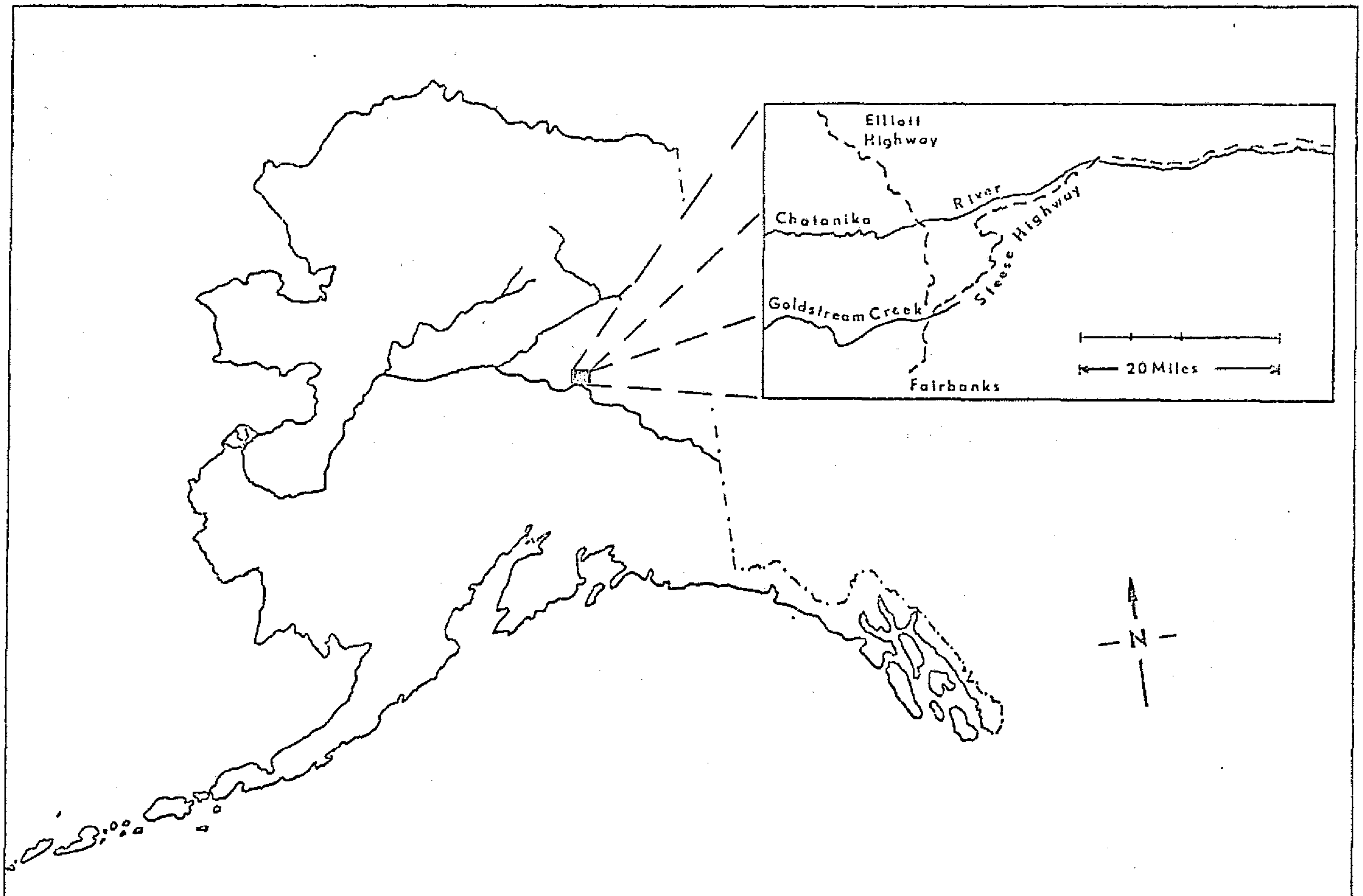


Figure 1. Location of study area

period (averaging 115 days) when the air temperature remains below zero and plummets as low as -66 F, the ice cover affords the streams protection from this extreme cold. However, the air temperature has been known to reach 99 F in the summer and the temperature of the water may become quite high, especially in the shallows. Precipitation is an annual average of 12 inches with snowfall averaging 66.6 inches (Johnson and Hartman, 1969). Snowmelt and summer rains provide, on the average, the main discharges of these streams.

Incident solar radiation varies widely throughout the year with day lengths as long as about twenty-one hours at the summer solstice and as short as three hours forty minutes at the winter solstice, when the sun never rises more than a few degrees above the horizon.

The Chatanika River

The study area along the Chatanika River began at the headwaters (the confluence of Faith and McManus Creeks at an elevation of 1,400 feet) and continued about 60 river miles down to the Elliot Bridge, at an elevation of 550 feet; the last point on the river accessible by road (Fig. 2). From here, the river flows an additional straight-line distance of approximately forty miles to where it enters Minto Flats and swings northwestward to join the Tolovana River. The sampling sites along the river are listed in Table 1.

The stream bottom throughout the study area consisted mainly of sand and shifting gravel interspersed with large boulders. Numerous deep pools are also found in this section of the river.

Development on the Chatanika River. The Chatanika River has felt the influence of man. Cleary Creek, which flows into the Chatanika River near the Chatanika Lodge at Mile 28 on the Steese Highway, was dredged for gold in the first half of this century. Some mining is still being done on the upper reaches of this creek but not to the extent that it affects the Chatanika River. The other major intrusion by man on the Chatanika River was the building of Davidson Dam and Davidson Ditch, which supplied water to miners in the vicinity of Chatanika. The dam was constructed at Mile 68 on the Steese Highway to divert water into Davidson Ditch, which was built on the ridges paralleling the river on its northwest side. After mining activity in the area subsided, a powerhouse was built at Mile 32 on the Steese Highway to utilize the hydraulic head for the generation of electricity. This powerhouse and Davidson Ditch have not been used since the flood of August, 1967, when the powerhouse was damaged to the extent that it was not economically feasible to repair it.

Goldstream Creek

Goldstream Creek (formed by the confluence of Pedro and Gilmore Creeks at an elevation of 880 feet) is a rather small stream which flows from mountainous terrain through extensive bog areas to Minto Flats where it then flows into the Chatanika River. The study area on Goldstream Creek extended from Fox to the Dome sample site, which is located near the Dome spur of the Alaska Railroad, in the upper one-fifth of the Goldstream drainage basin (Fig. 3). The upper portion of the study area is characterized by a sand and gravel bottom, shallow water, and relatively little vegetation in and over the stream. A transition zone occurs just below

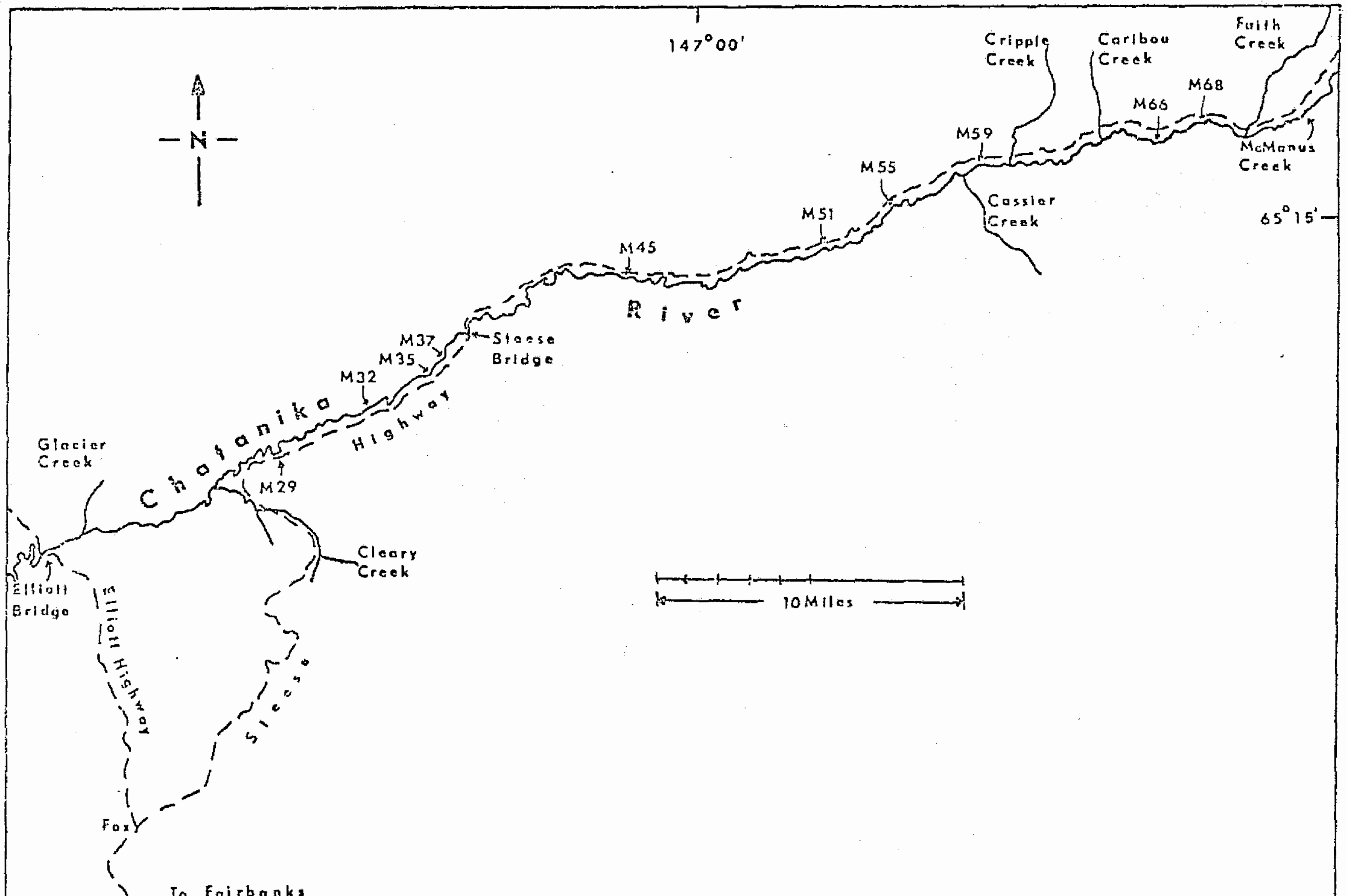


Figure 2. Chatanika River study area

TABLE I. SAMPLING SITES ON THE CHATANIKA RIVER

Code	Site	Location
FCR	Faith Creek	Mile 69.2 Steese Highway. Sampled 10-100 yards above confluence with McManus Creek.
MCR	McManus Creek	Mile 69.2 Steese Highway. Sampled 10 yards above confluence with Faith Creek.
M68	M 68.7	Mile 68.7 Steese Highway. Sampled 100 yards upstream from Davidson Dam.
M66	M 66	Mile 66 Steese Highway. Sampled near the bank opposite Horse Creek.
CA	Caribou Creek	Sampled 100 yards downstream from Caribou Creek near the bench mark (Approximately Mile 64 on the Steese Highway).
CB	BM 1225	Sampled 100 yards upstream from Cripple Creek near the bench mark (at an elevation of 1,225 feet). This is approximately Mile 60.5 on the Steese Highway.
CC	M 59.4	Sampled at Mile 59.4 on the Steese Highway.
CD	Cassier Creek	Sampled 100 yards downstream from Cassier Creek.
M55	M 55.8	Sampled at Mile 55.8 on the Steese Highway.
CE	M 51.4	Sampled at Mile 51.4 on the Steese Highway.
M45	M 45.4	Sampled at Mile 45.4 on the Steese Highway.
SBR	Steese Bridge	Mile 39 on the Steese Highway. Sampled the river at Chatanika Campground.
CF	M 37.5	Sampled at Mile 37.5 on the Steese Highway.
CG	M 35	Sampled at Mile 35 on the Steese Highway.
CH	M 31.8	Sampled 200 yards upstream from the old Chatanika powerhouse, Mile 31.8 on the Steese Highway.
M29	M 29	Sampled at Mile 29 on the Steese Highway.
CI	Cleary Creek	Sampled 100 yards downstream from Cleary Creek.
CJ	Glacier Creek	Sampled 200 yards downstream from Glacier Creek.
EBR	Elliott Bridge	Sampled at Mile 14 on the Elliott Highway.
CK	Lower Chatanika	Sampled about 2 miles upstream from Minto Flats.

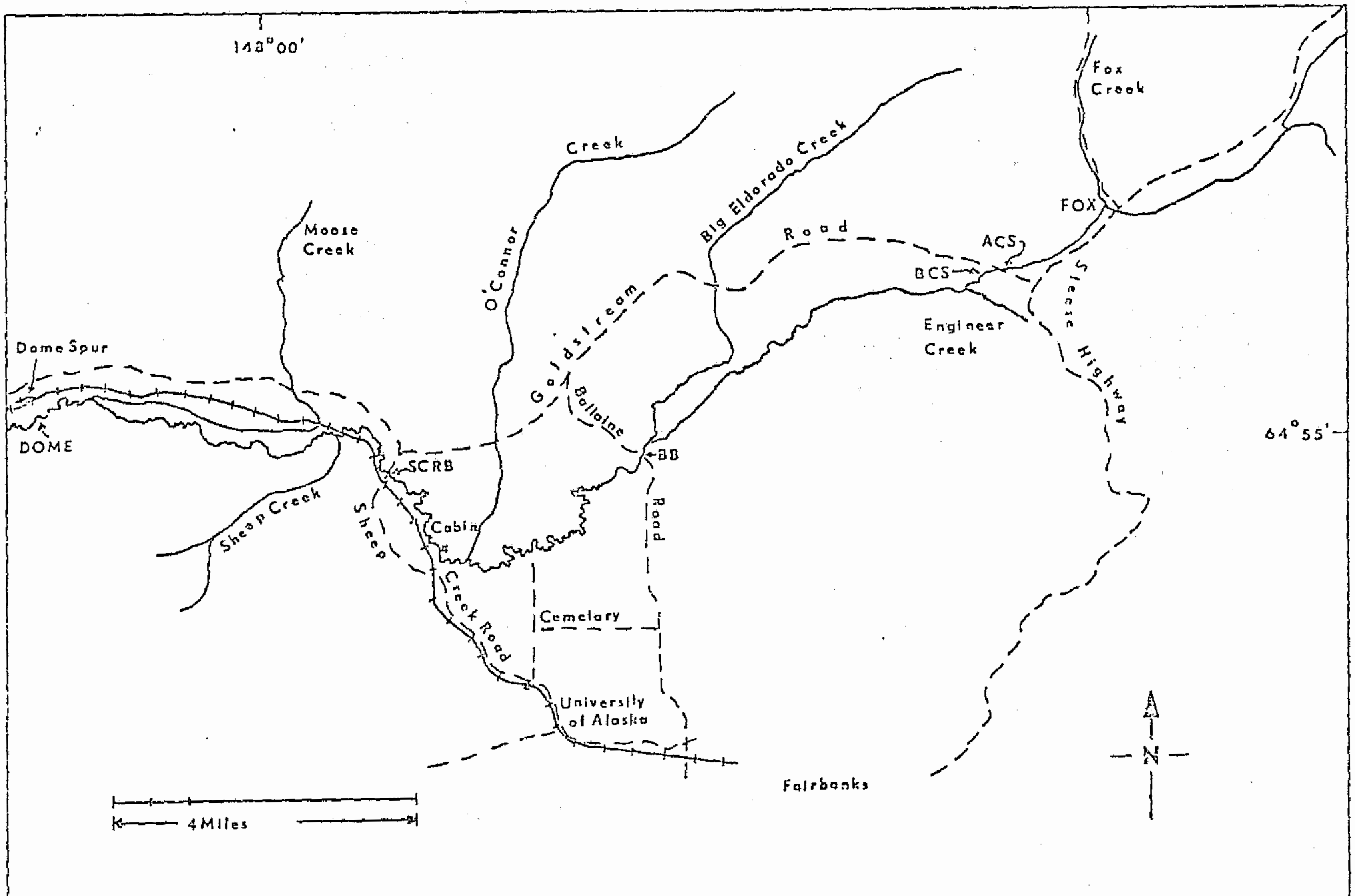


Figure 3. Goldstream Creek study area

the Ballaine Bridge site where Goldstream Creek becomes a meandering stream with relatively deep water, a mud and silt bottom, and extensive overgrowth and tall trees along the banks. The locations of the sampling sites on Goldstream Creek are listed in Table 2.

Development on Goldstream Creek. Gold was discovered on Pedro Creek in 1902. Between 1902 and 1959 the creek area near the community of Fox was extensively dredged and mined. The present channel of Goldstream Creek between the confluence of Pedro and Gilmore Creeks and Fox was constructed in 1957 by an independent miner to provide water to work his claim. The original channel of the creek is about 300 yards west of the present channel. The characteristics of Goldstream Creek changed during the intensive mining activity and the creek is still recovering.

TABLE 2. SAMPLING SITES ON GOLDSTREAM CREEK

Code	Site	Location
FOX	Fox	Sampled where the Steese Highway crosses Goldstream Creek.
GA	Fox Creek	Sampled Fox Creek 50 yards downstream from Fox Spring (0.5 Mile Elliott Highway).
ACS	Above construction site	Sampled 100 feet upstream from new bridge on Goldstream Road.
BCS	Below construction site	Sampled 100 yards downstream from new bridge on Goldstream Road.
GC	Goldstream above Engineer Creek	Sampled 10 feet upstream from Engineer Creek.
GD	Engineer Creek	Sampled Engineer Creek 15 feet upstream from mouth.
GE	Goldstream below Engineer Creek	Sampled 30 feet downstream from Engineer Creek.
GF	Goldstream above Big Eldorado Creek	Sampled about 2 miles upstream from Big Eldor-Creek.
GG	Big Eldorado Creek	Sampled Big Eldorado Creek immediately above the confluence with Goldstream Creek.
BB	Ballaine Bridge	Sampled where Ballaine Road crosses the creek.
CH	Cemetery Road	Sampled at the end of the road which goes due north from Northern Lights Memorial Cemetery.
GI	Goldstream above O'Conner Creek	Sampled immediately above O'Conner Creek.
GJ	O'Conner Creek (Goldstream)	Sampled O'Conner Creek upstream from its confluence with Goldstream Creek.
GK	O'Conner Creek (Road)	Sampled O'Conner Creek where Goldstream Road crosses the creek.
GL	Cabin	Sampled at a cabin which is 0.35 miles from Happy on Sheep Creek Road.
GM	0.4 Mile below Cabin	Sampled 0.4 mile (straight line distance) downstream from cabin where the creek comes within 100 feet of the Alaska Railroad tracks.
GN	0.4 Mile Above SCRB	Sampled 0.4 mile (straight line distance) upstream from the Sheep Creek Road bridge over Goldstream Creek. The sample site was near a small creek flowing into Goldstream Creek from the southwest.
SCRB	Sheep Creek Road	Sampled in an area ranging from 50 yards downstream from the bridge on Sheep Creek road to 100 yards upstream.
GO	Below SCRB	Sampled 200 yards downstream from the bridge.
GP	Sheep Creek	Sampled Sheep Creek 100 feet upstream from confluence with Goldstream Creek.

TABLE 2. SAMPLING SITES ON GOLDSTREAM CREEK, Continued

Code	Site	Location
GQ	Goldstream - Old Bridge	Sampled 0.1 mile below Sheep Creek at an old wooden bridge.
GR	Moose Creek	Sampled Moose Creek below the Alaska Railroad trestle.
DOME	Dome	Sampled near the Dome Spur of the Alaska Railroad.

METHODS

Physical and Chemical

Twenty-one physical and chemical parameters plus air temperature were measured at the nine primary sites on the Chatanika River and the five primary sites on Goldstream Creek from August, 1970, until October, 1971. The Steese Bridge and Elliott Bridge sites on the Chatanika River and the Fox, Ballaine Bridge, and Sheep Creek Road Bridge sites on Goldstream Creek were the only sites sampled throughout the winter.

The analytical methods used to determine the chemical and physical parameters were of two types: expedient field methods and standard laboratory techniques following the APHA handbook (1969), *Standard Methods for the Examination of Water and Wastewater*. Of the twenty-one parameters, alkalinity, carbon dioxide, conductivity, dissolved oxygen, pH, and water temperature were usually determined in the field. Analysis of the remaining parameters was done at the laboratories of the Institute of Water Resources and the Institute of Marine Sciences at the University of Alaska.

Biological

The Surber square foot bottom sampler with a nylon net was used in collecting all benthos samples. Each square foot sample was collected at a depth greater than two inches below the water-substrate interface. If large rocks or debris were encountered, each piece was examined, scraped clean, and subsequently discarded. After collection, each sample was transferred to a 20.3 cm x 35.6 cm polyethylene bag containing stream water. Any organisms adhering to the net were removed with forceps and placed in the sample container. Each sample was then fixed with 10 mls of formalin. The bags were securely tied and transported to the laboratory where the individual organisms were identified and enumerated.

Drift measurements were made using the Wilco drift sampler which consisted of a nylon mesh net (29 threads/cm) mounted on a 30 cm x 45 cm metal frame. This assembly was placed in the stream in such a manner that the net's longest dimension was perpendicular to the stream bed.

The drift nets were placed in the stream for a period of five minutes, at which time they were removed and water was splashed around the outside of the net to consolidate the organisms in the bottom of the net assembly. The contents of each net were then transferred to a polyethylene bag which contained a 10% formalin solution. Upon return to the laboratory, the organisms were separated from the debris, using the sugar flotation method described by Anderson (1959), sorted into taxonomic groups, and counted.

Current velocities were made using a pigmy Gurley Meter. To cross-section a stream, measurements with a Gurley Meter were taken every foot on the horizontal axis and every 2/10' (6.10 cm) on the vertical axis. Depth measurements were taken to the nearest 1/10' (3.05 cm). Stream cross-sectioning was done once during every 24-hour sampling period during the thesis study of drift.

However, velocity was measured using a floating rod method during the thesis study of benthos. Velocity was then recorded as the average of three successive measurements of the stream current, the results being reported in feet per second (fps) using a series of weighted dowel rods 1/2" (1.27 cm) in diameter (Meyer, 1928).

Water temperature readings were taken using a standard centigrade thermometer.

Continuous light intensity readings were taken during the thesis study on drift using an Esterline-Angus Model AW DE milliammeter calibrated with a Luna-Pro light meter to which was attached an International Rectifier silicon solar cell, model S5M. The solar cell was attached to the recorder by two 100' lengths of 22-gauge plastic covered wire. The solar cell was mounted on a 7.62 cm x 12.70 cm piece of Plexiglas, and the whole assembly was then placed on the stream bottom at a depth of approximately 15 cm.

During the first 24-hour sampling period, only one solar cell was attached to the recorder. For the remaining three sampling periods, two solar cells in series were used to attain greater sensitivity in light intensity measurements.

Assimilation Study

Both streams were studied for one calendar year to determine the effects that temperature, photosynthesis, respiration, and reaeration have on the dissolved oxygen content of the streams.

In an attempt to delineate the oxygen content in the two streams over the year, dissolved oxygen, Biochemical Oxygen Demand (BOD), and reaeration were measured.

Dissolved oxygen was measured by the alkaline-iodide-azide modification of the standard Winkler test. Biochemical Oxygen Demand was measured according to *Standard Methods for the Examination of Water and Wastewater*, and replicates were run at an incubation temperature of 4 C. This modification of the standard method was made because the highest temperature annually reached on the average in these streams is less than 20 C, the standard incubation temperature.

Reaeration was measured with Plexiglas chambers similar to those used in an Oklahoma study (Stay, Duffer, DePrater and Keeley, 1967). The chamber bottoms were placed at the four bridge sites (two on each stream) and filled with stream bottom material (stones and/or sand). After an equilibration period of four to six weeks, the top of the chamber was attached and the oxygen content of the water therein measured every four hours for twenty-four hours while the oxygen in the stream was measured every two hours. This experiment was repeated on another date at each site with a black chamber top attached.

Dissolved oxygen in a stream is the net result of diffusion affected by temperature and pressure, additions by reaeration and photosynthesis, and depletion by respiration. The "light box" provides a measure of oxygen produced by photosynthesis minus that utilized in respiration. The "dark box" provides a measure of the oxygen that is used up by the respiration of aquatic organisms. Thus the amount of oxygen that enters a stream in a single day by reaeration can be calculated from the data collected in this experiment over 24 hours.

RESULTS

Physical and Chemical Study

The values for the chemical and physical parameters measured approximately monthly along the Chatanika River study area are presented in Fig. 4; those obtained along the Goldstream Creek study area are shown in Fig. 5.

A diurnal study of selected parameters was conducted at the Elliott Bridge station on the Chatanika River. The results of this study are shown in Fig. 6. Two diurnal studies were conducted simultaneously at the two bridge stations along Goldstream Creek, and these data are presented in Figs. 7 and 8.

In an attempt to evaluate the downstream variation in selected parameters, both streams were sampled at all primary stations and some secondary stations in as short a period of time as possible. This rapid sampling was done twice along the Chatanika River and five times along the Goldstream Creek. These data are presented in Figs. 9 through 15.

Examination of Figs. 4 and 5 reveals the patterns one would expect for these streams, considering the geology, climate, and flow patterns for this area. For instance, under the heavy ice cover of winter, dissolved oxygen decreases, alkalinity increases, and free carbon dioxide increases. Figs. 4 and 5 additionally emphasize the differences between the two streams. Note, for instance, the differences in suspended solids and turbidity which can be explained both by the differences in the composition of surrounding watersheds and the different response in flow to somewhat the same amount of precipitation. The effects of the boggy area surrounding Goldstream Creek can be seen in phenomena such as the increase in minerals, especially iron, during the period when the boggy land is frozen.

The diurnal studies of certain parameters (Figs. 6, 7, and 8) again show what one would expect for these streams, remembering that in late June there are nearly twenty-one hours of daylight.

The downstream studies of selected parameters illustrated in Figs. 9 through 15 also show expected downstream trends, such as the characteristic rise in temperature and the slight decrease in dissolved oxygen.

Biota of the Two Streams

Algae from the four reaeration boxes that were left in the streams were identified. It should be noted that these are the algae of colonization and recolonization in these streams, as the stones when placed in these boxes were for the most part free of living algae. These identifications are presented in Table 3.

Stones from riffles in Goldstream Creek were returned to the laboratory and permanent mounts of the epiphytic diatoms were made and the diatoms identified. These data are presented in Table 4.

The invertebrates that were collected in the benthic and drift sampling programs and in the reaeration chamber bottoms have been identified as completely as possible and this information is presented in Table 5.

Because of the few samples taken, little can be said about the algae and, more specifically, the diatoms of the Creek and River.

The invertebrates collected (Table 5) show the dissimilarities be-

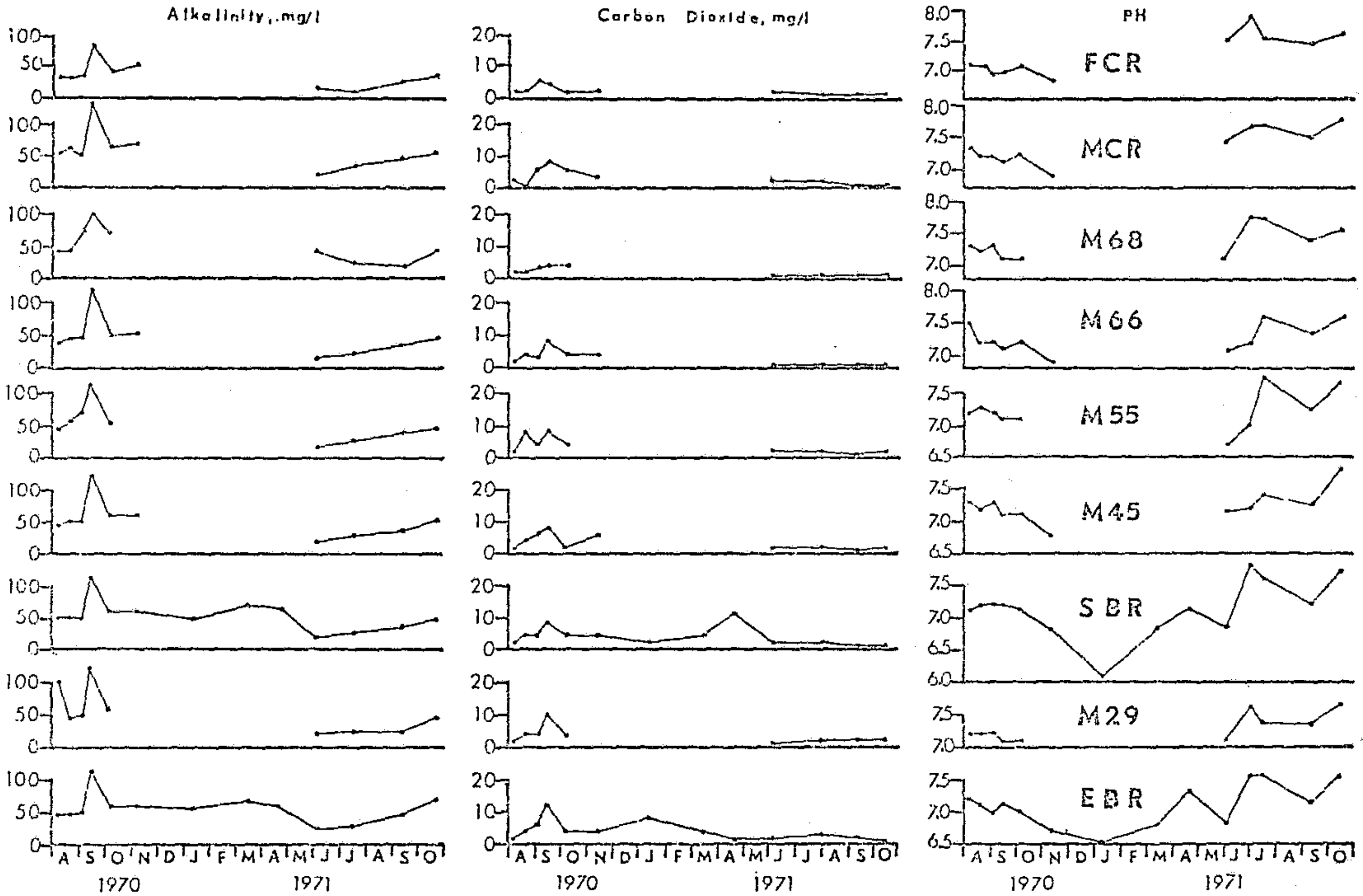


Figure 4. Chemical and physical variations from nine Chatanika River stations, 1970 - 1971

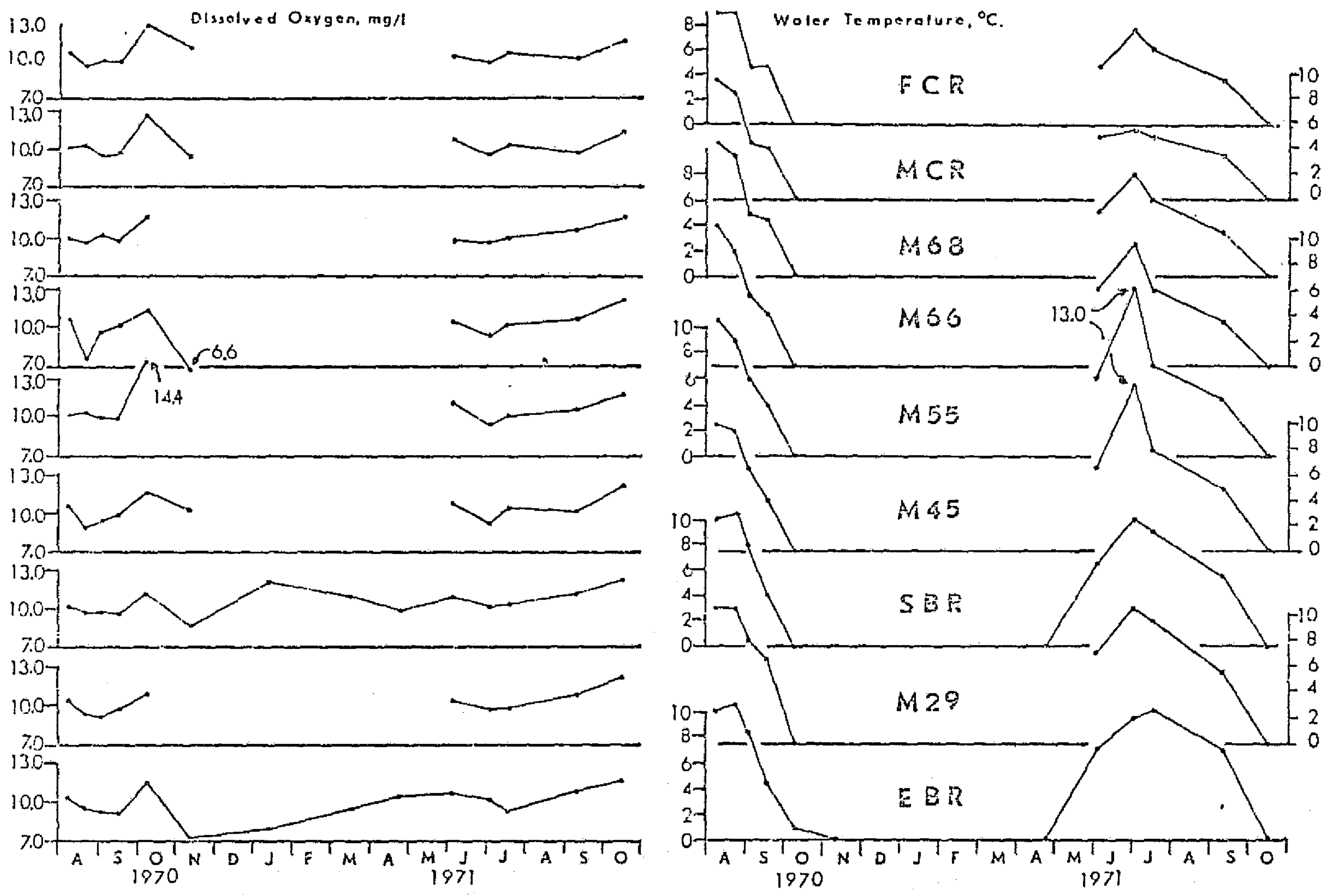
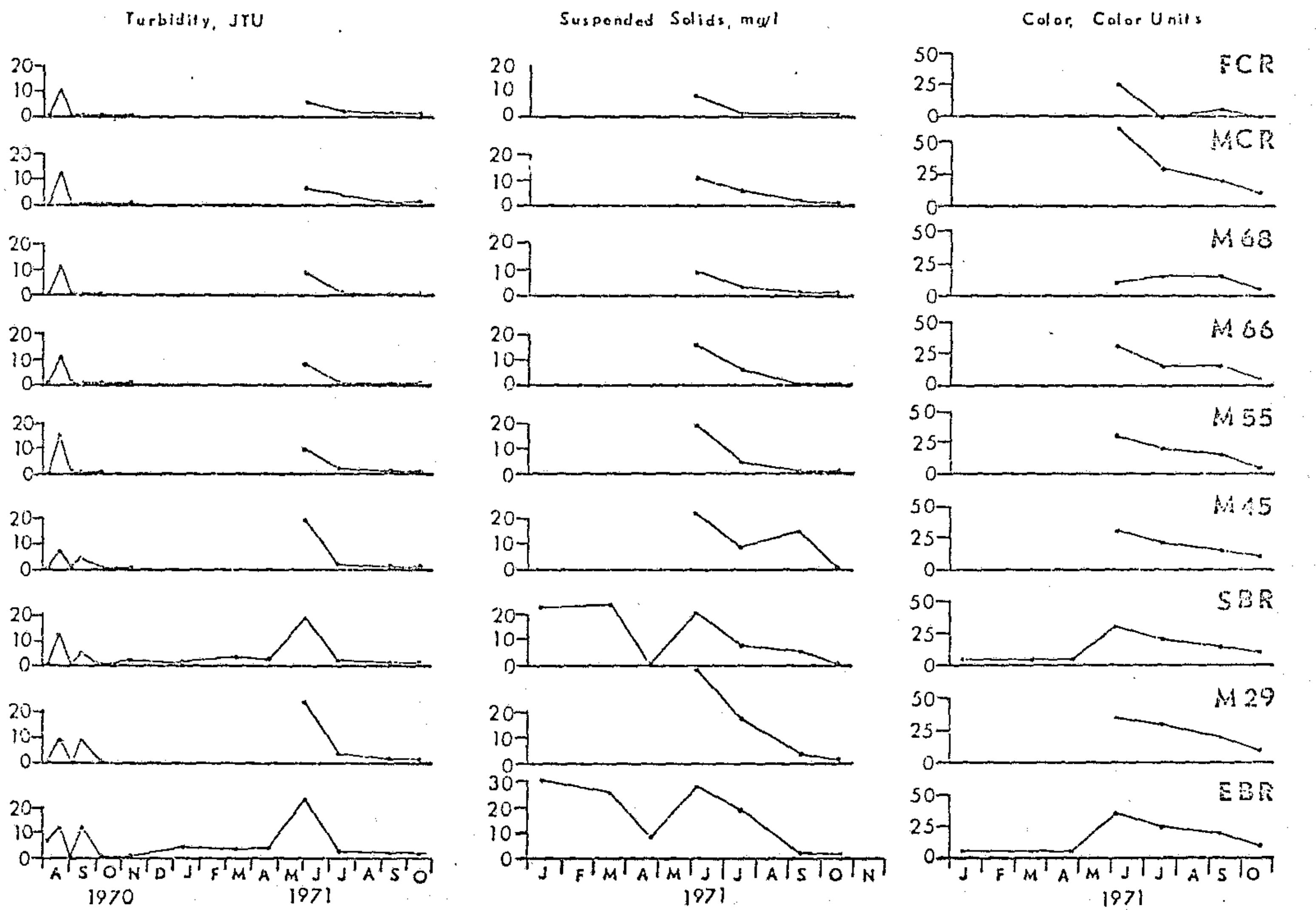


Figure 4. Continued



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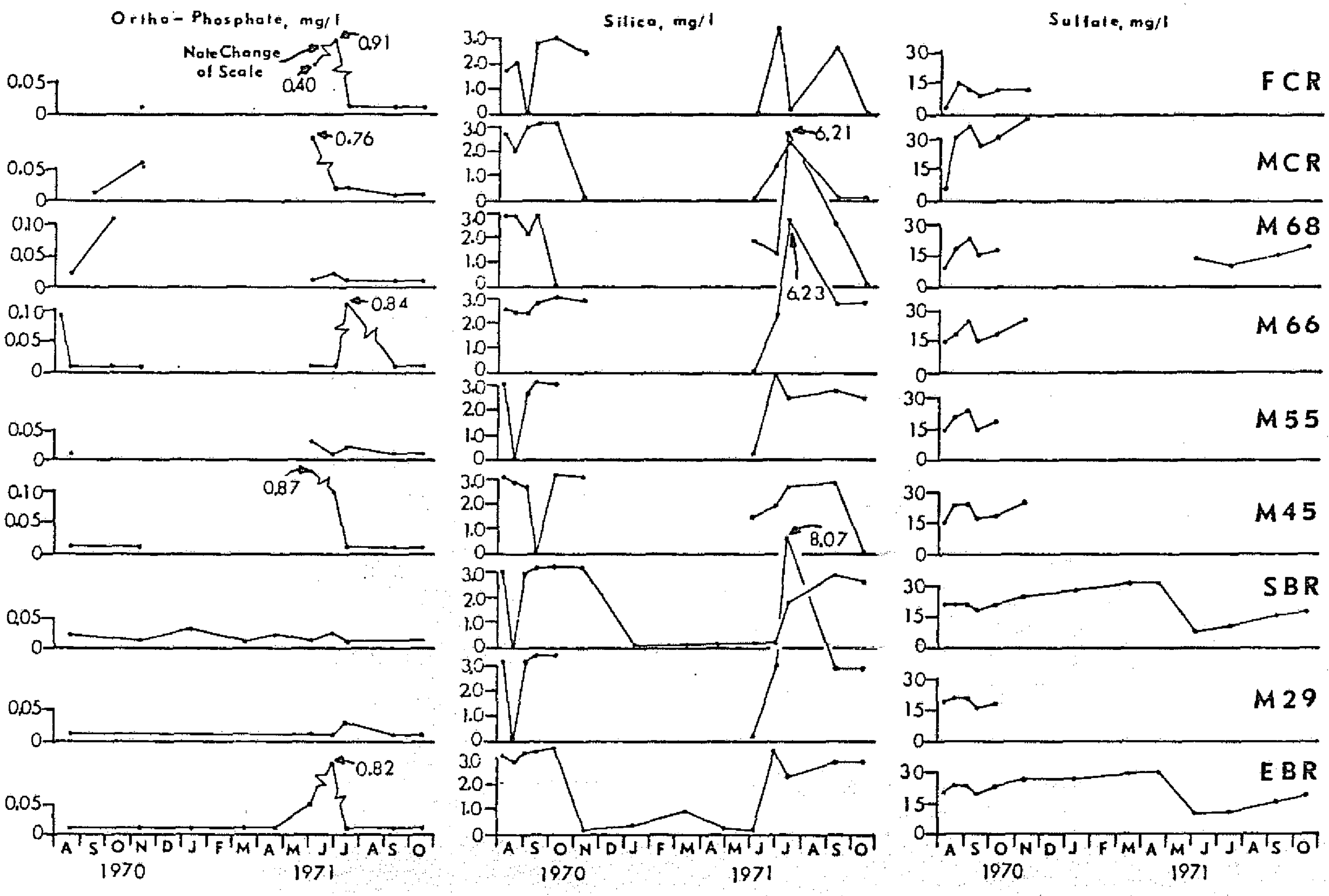

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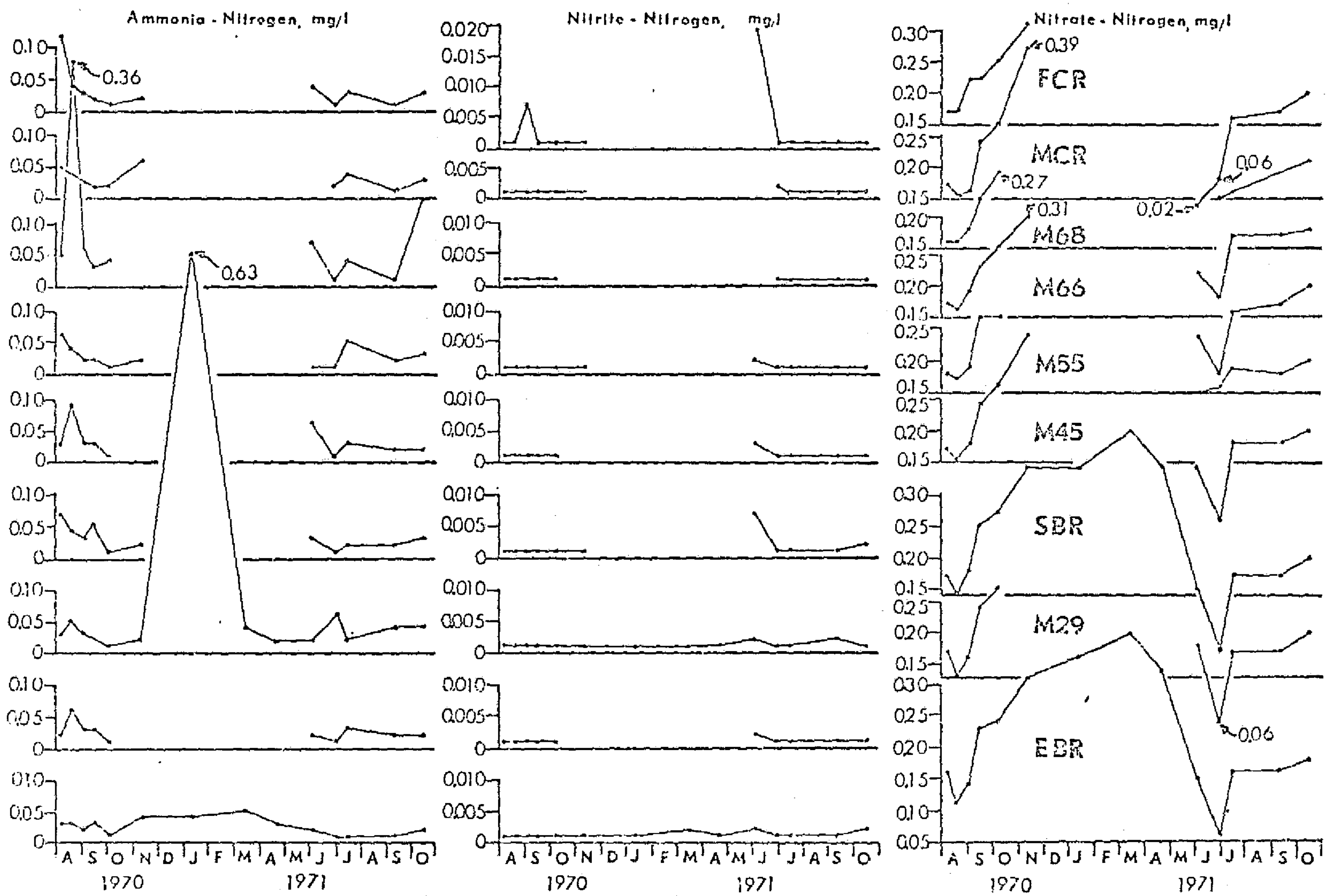

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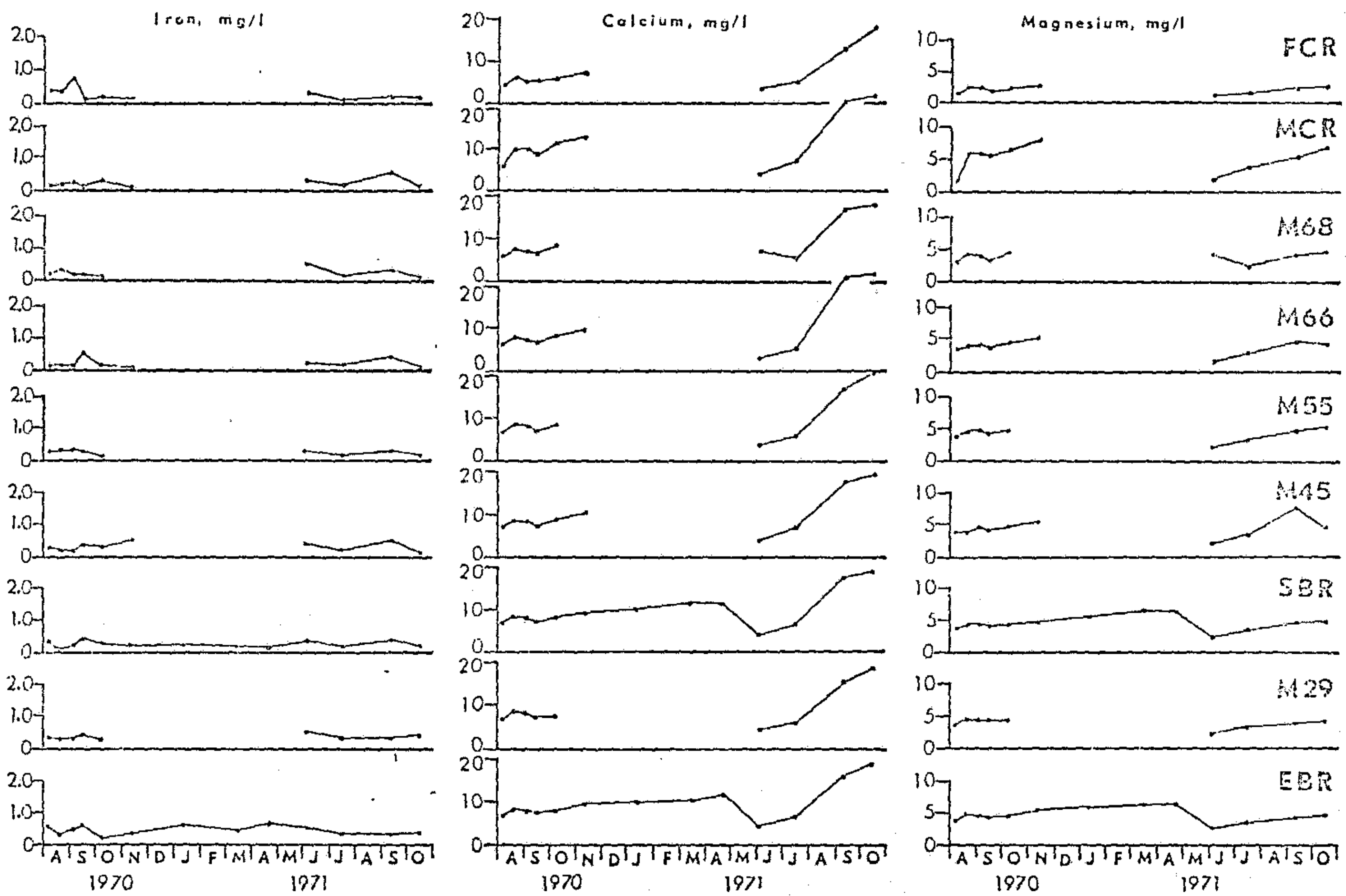

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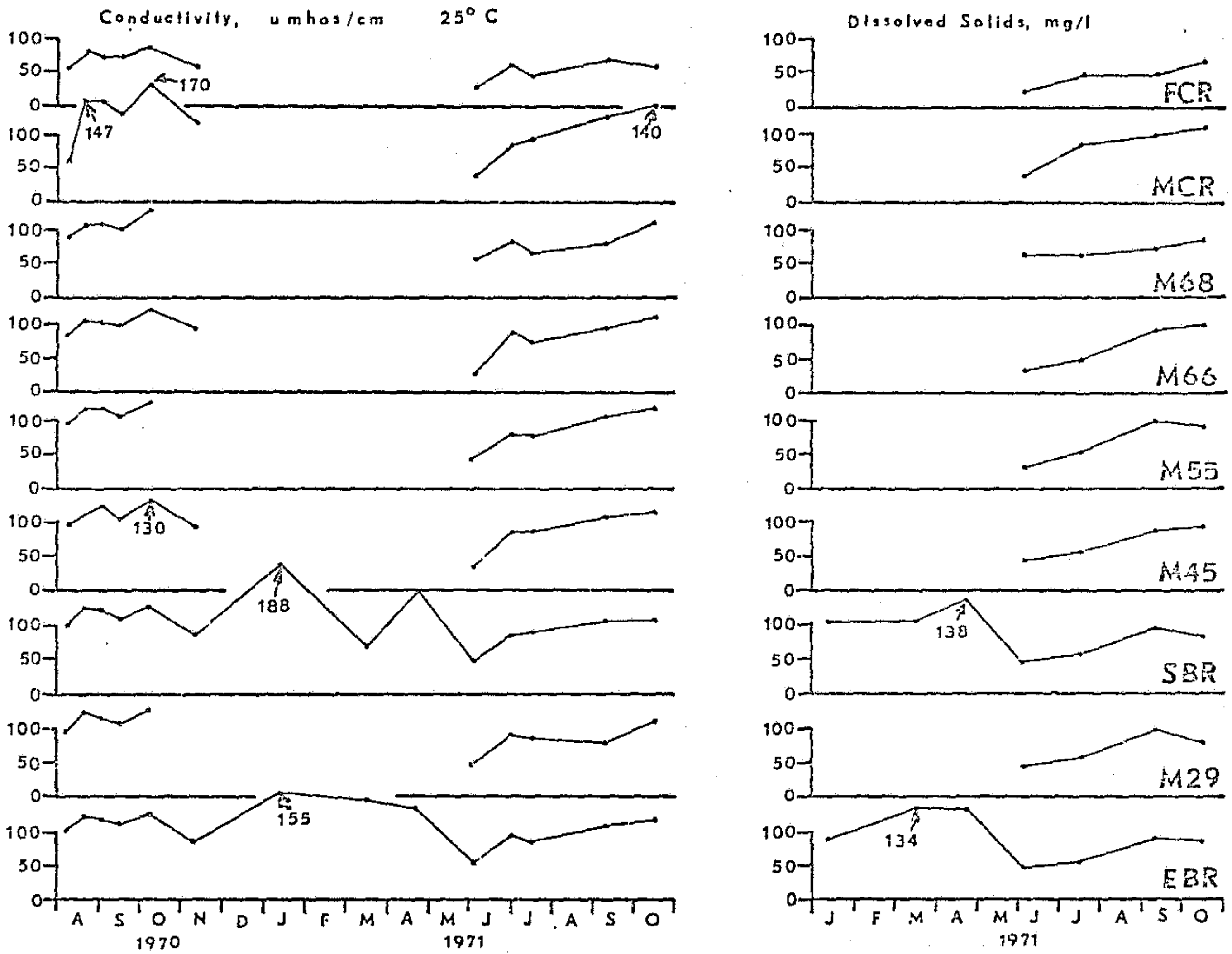

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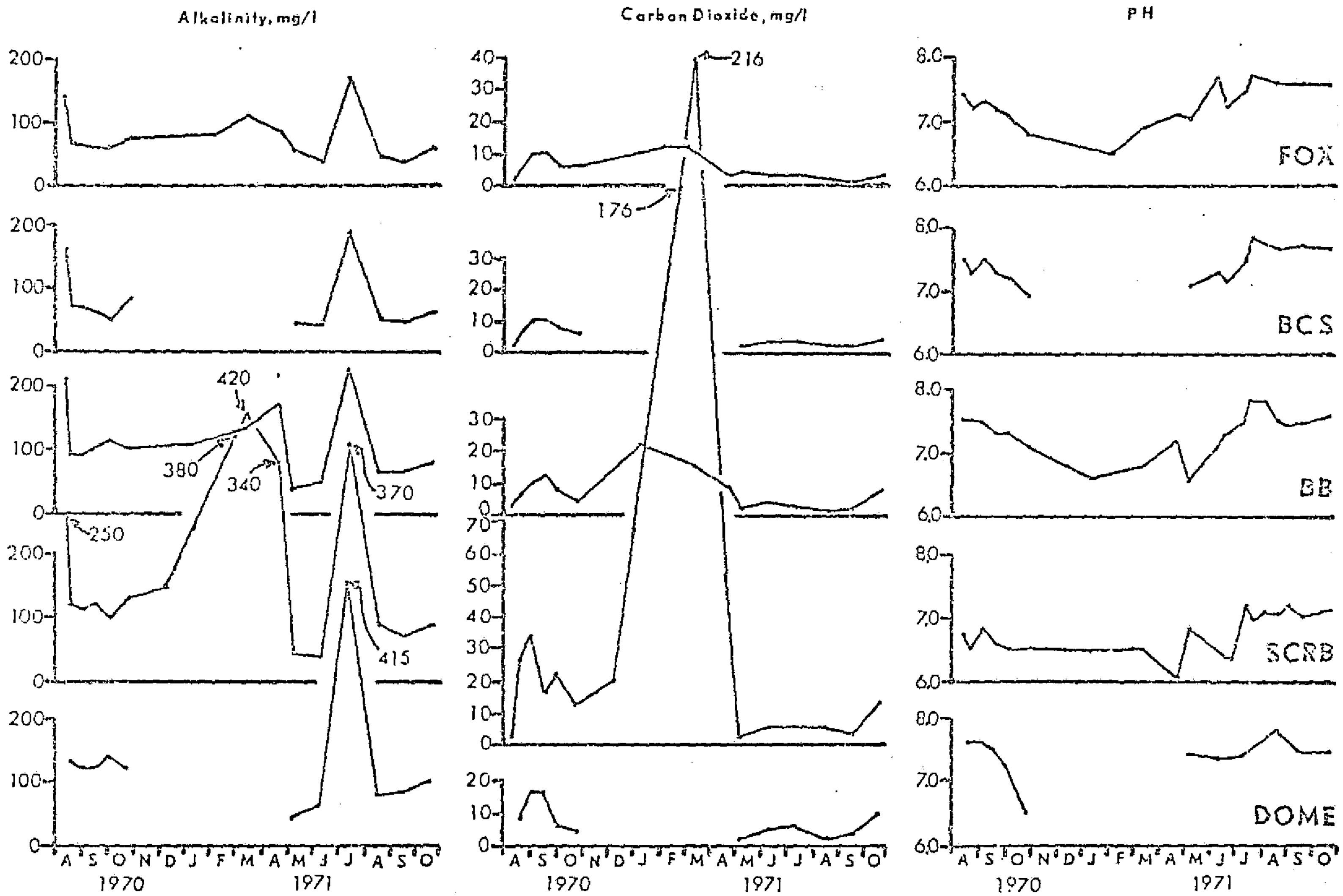
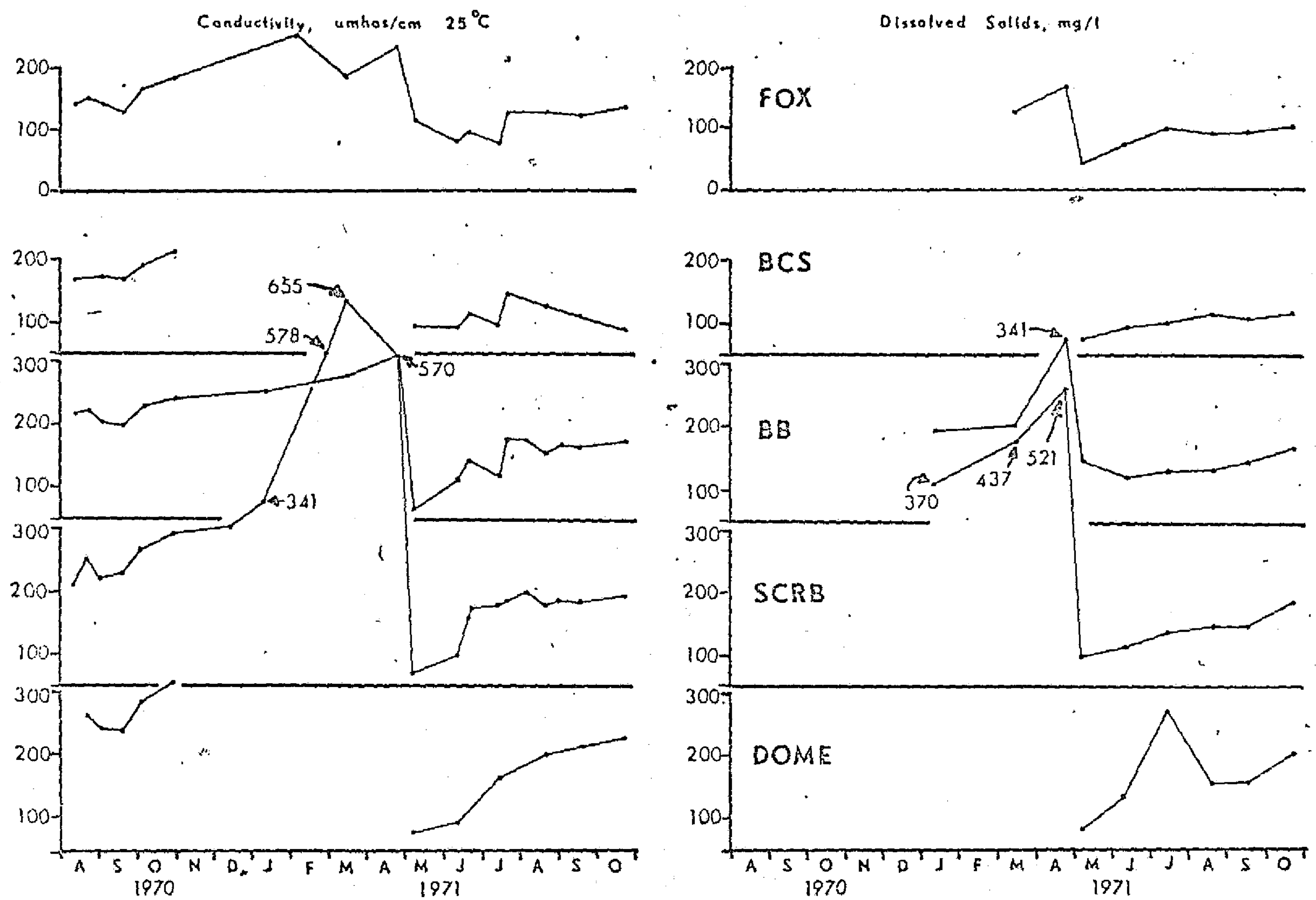


Figure 5. Chemical and physical variations from five Goldstream Creek stations, 1970 - 1971



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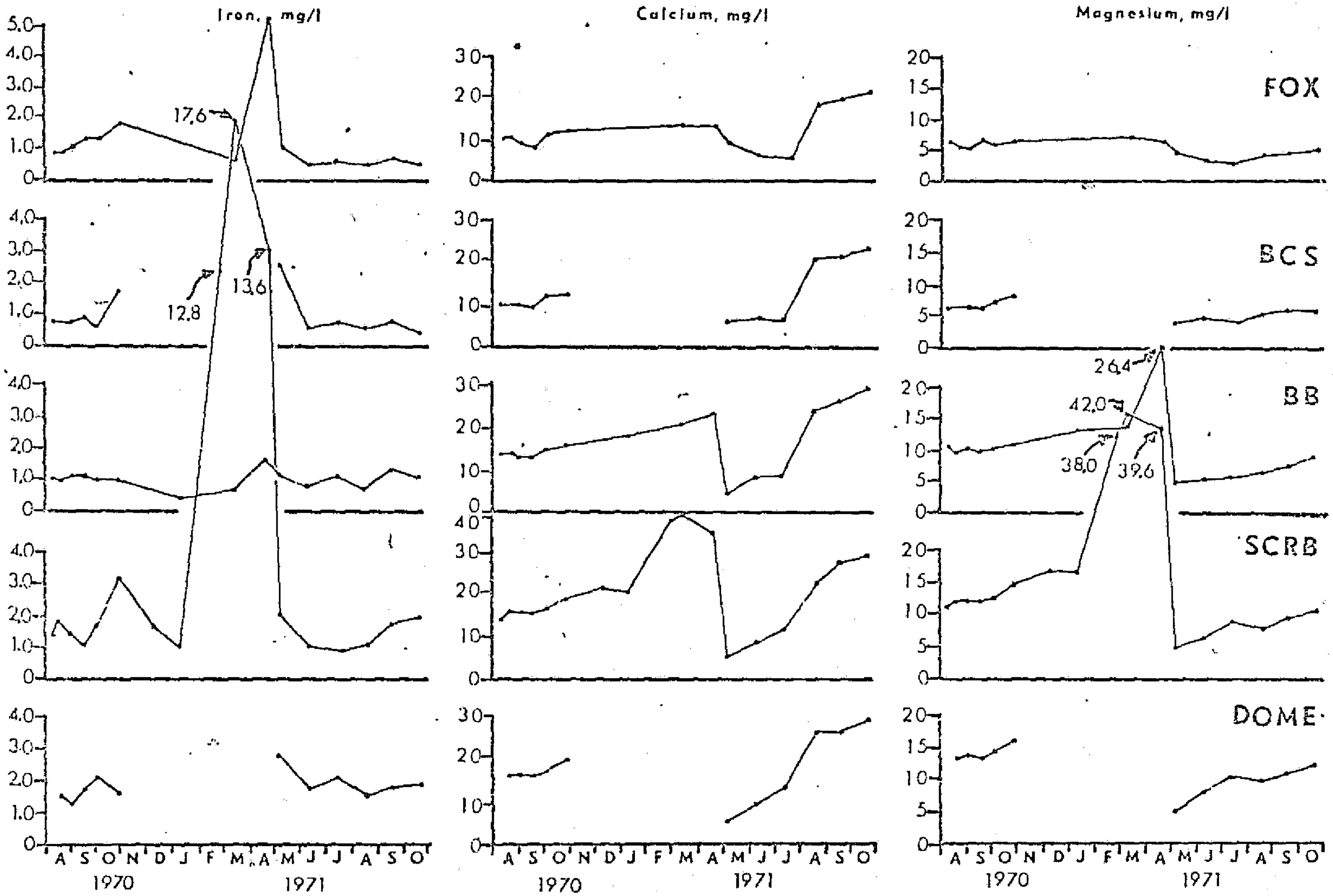

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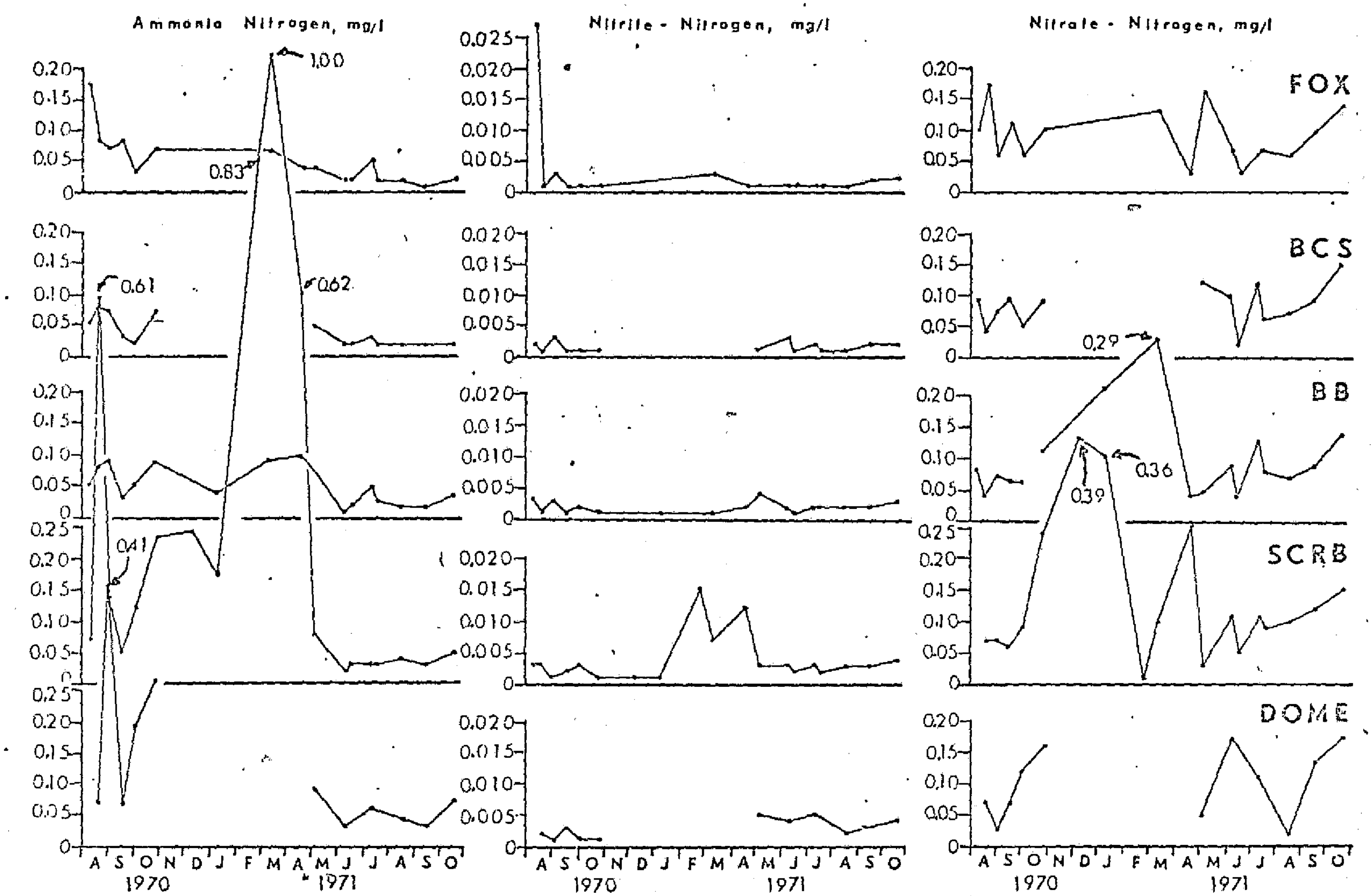

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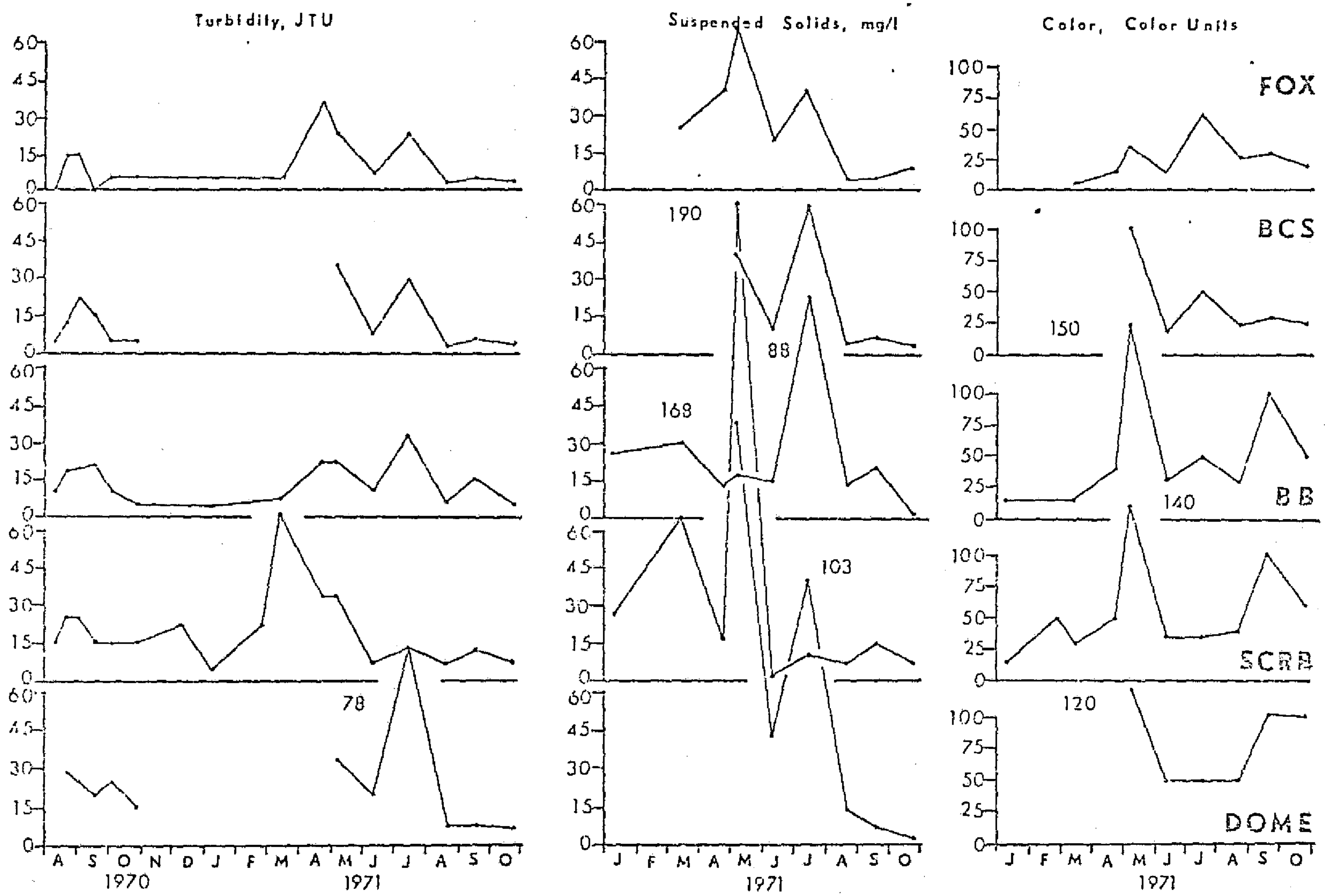

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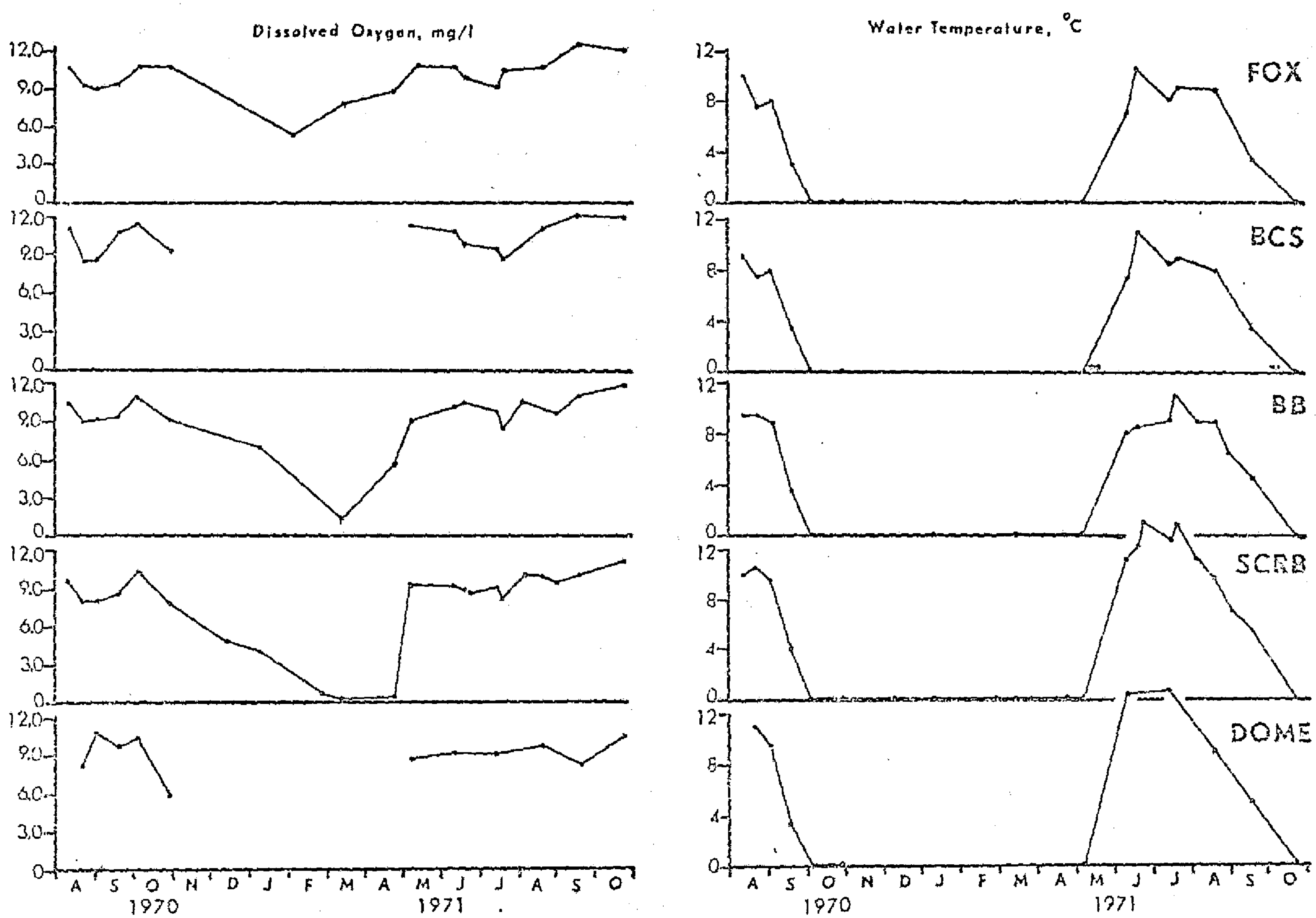

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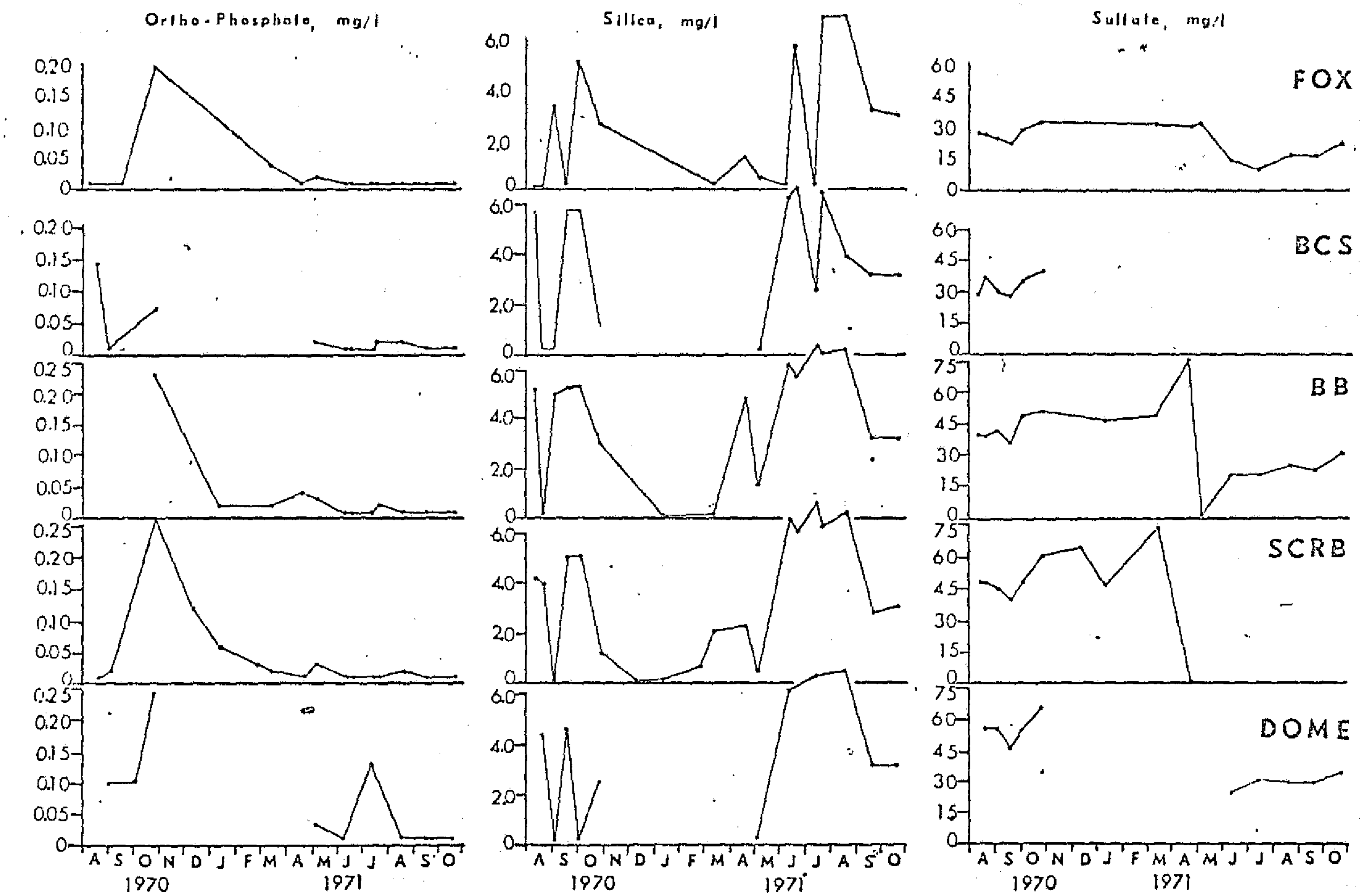

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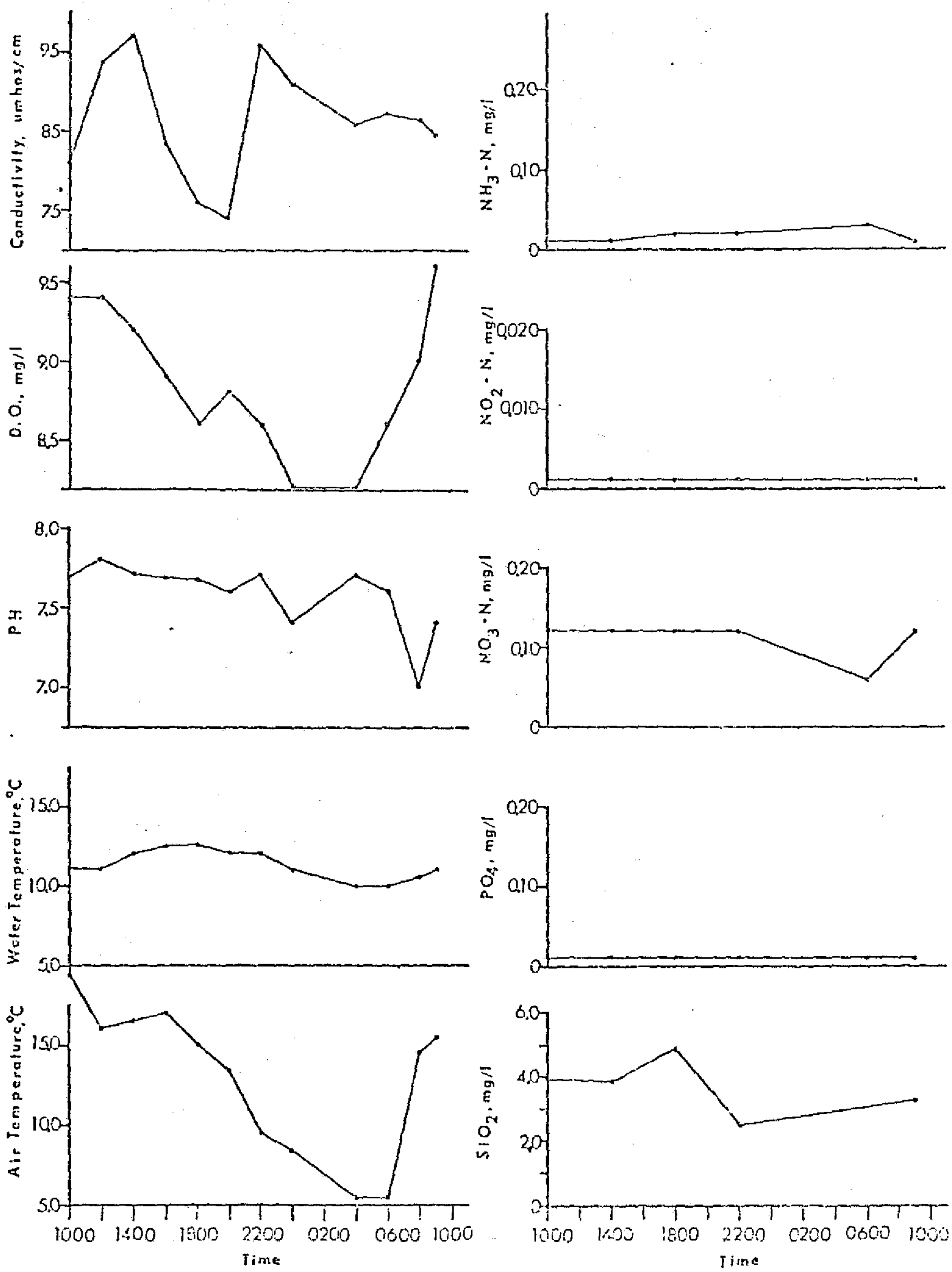


Figure 6. Diurnal chemical and physical variations from Chatanika River, Elliott Bridge station, July 22, 23, 1971

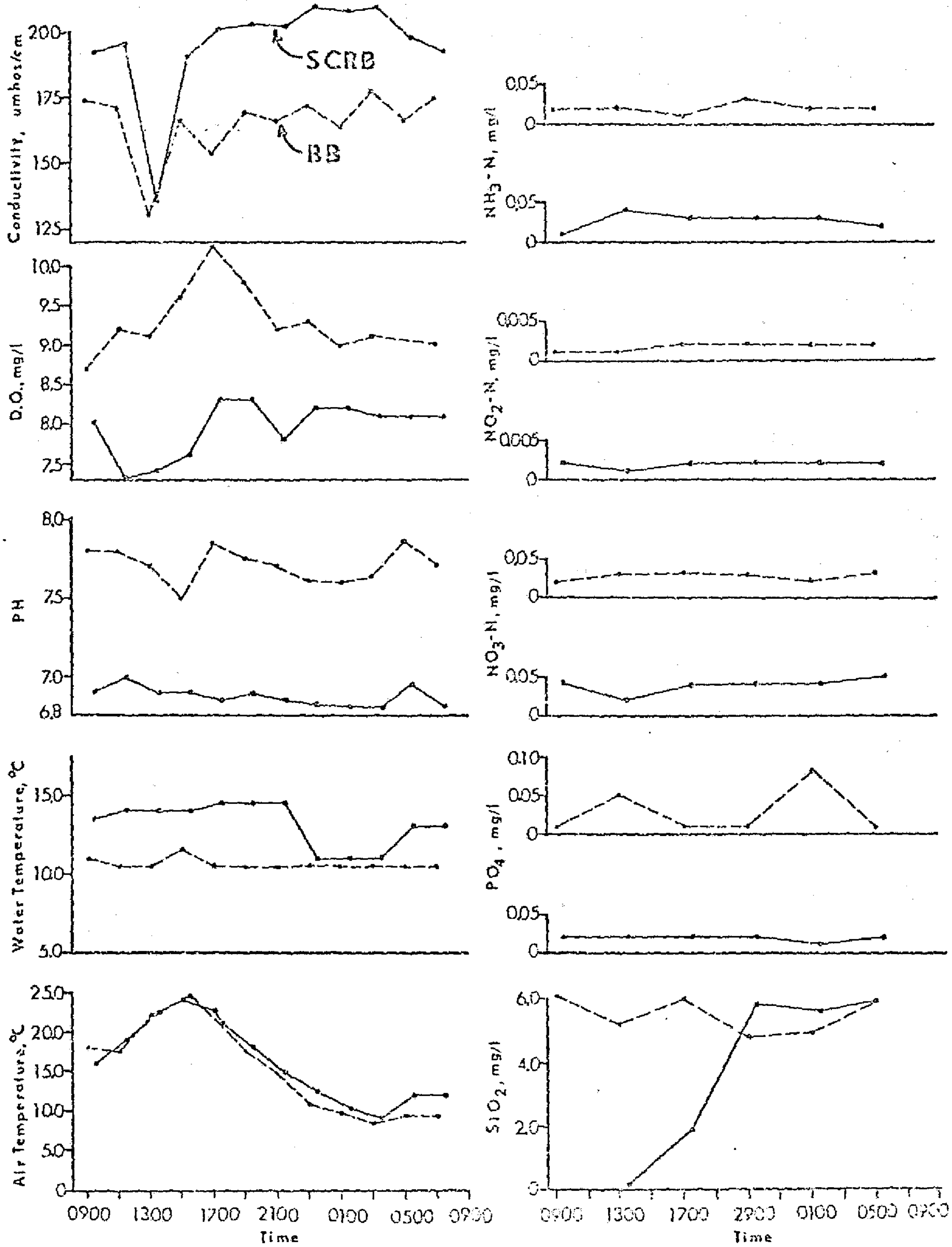


Figure 7. Diurnal chemical and physical variations from Goldstream Creek, June 28, 29, 1971

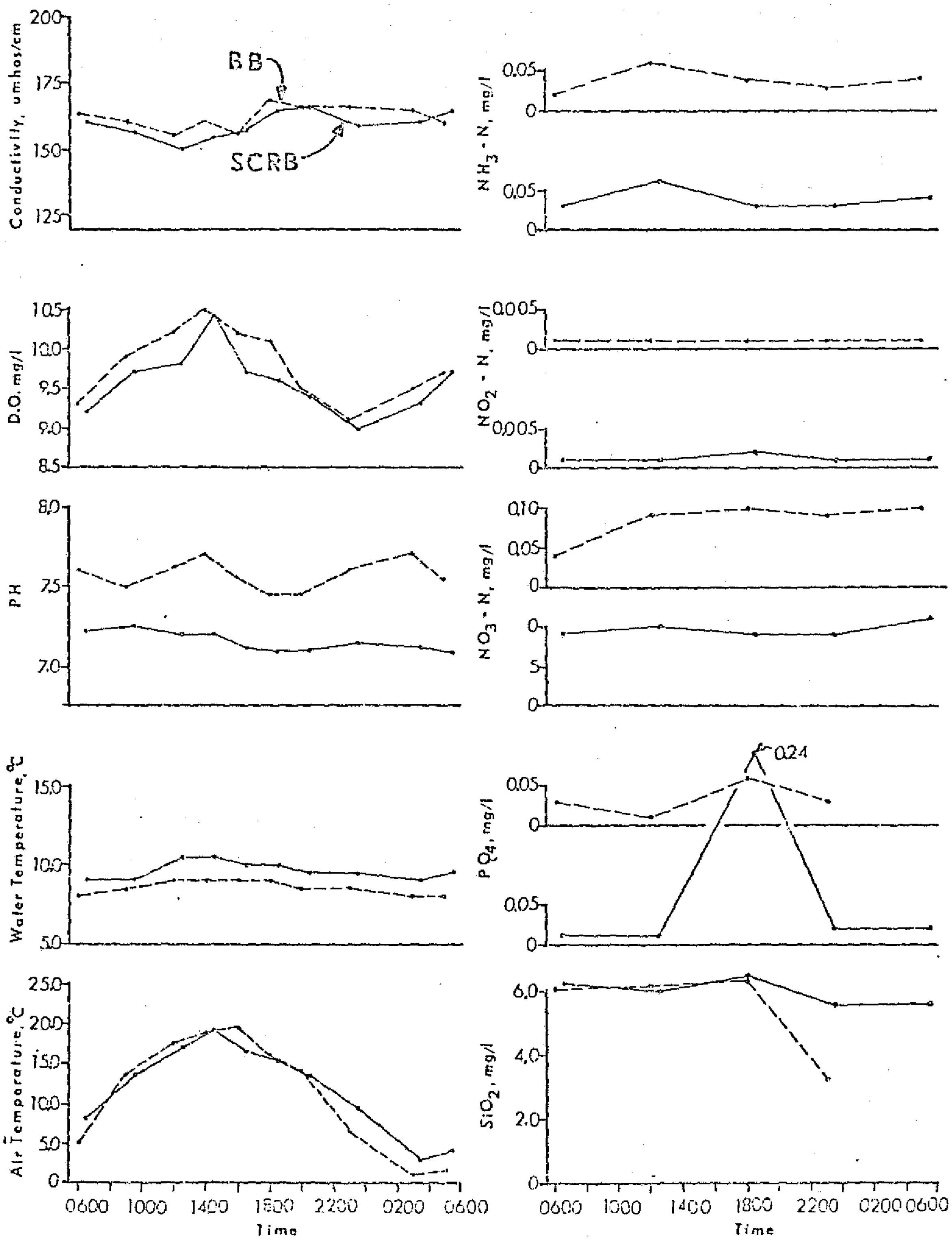


Figure 8. Diurnal chemical and physical variations from Goldstream Creek, August 13, 14, 1971

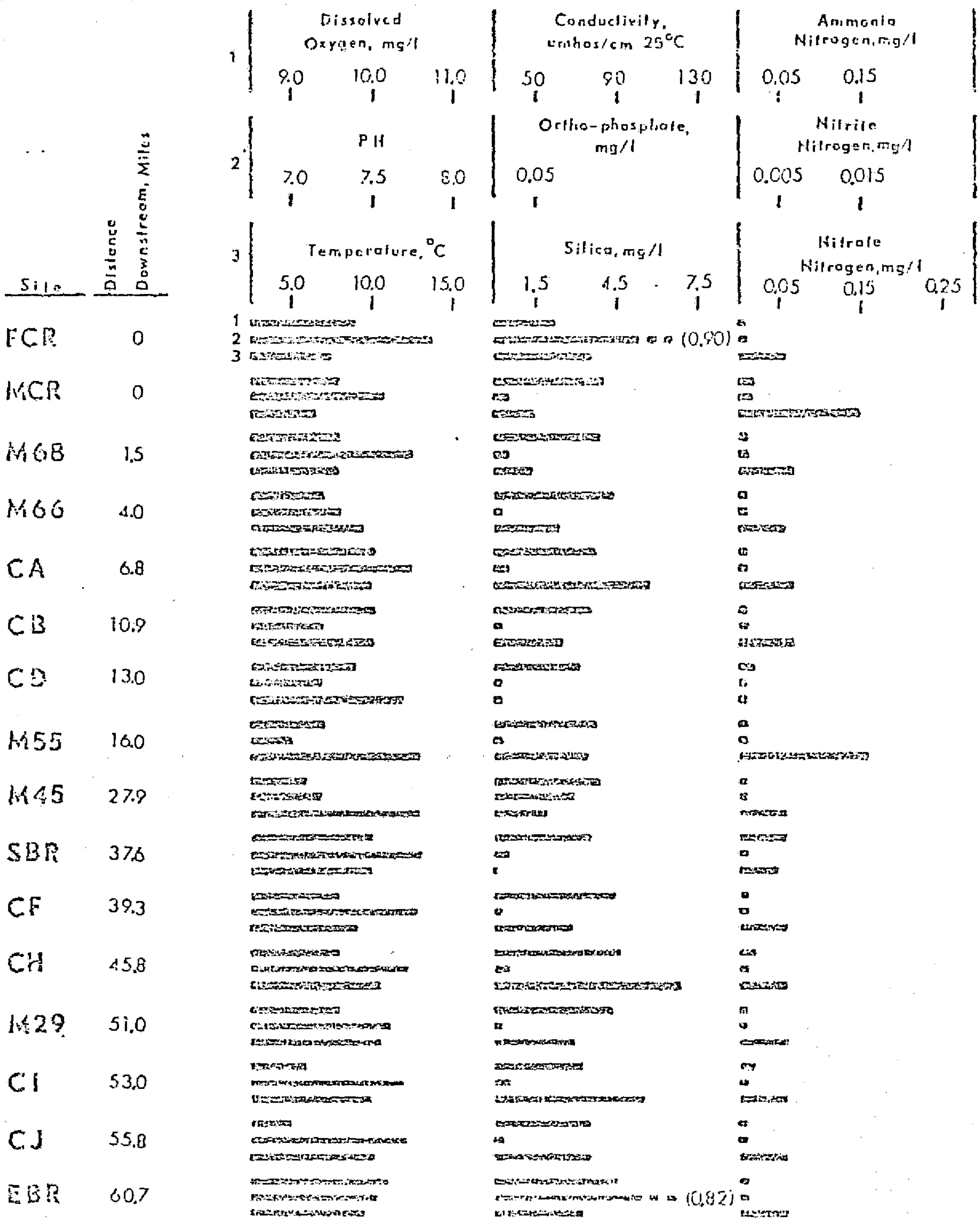


Figure 9. Chemical and physical variations from sixteen Chatanika River stations, July 1, 2, 1971

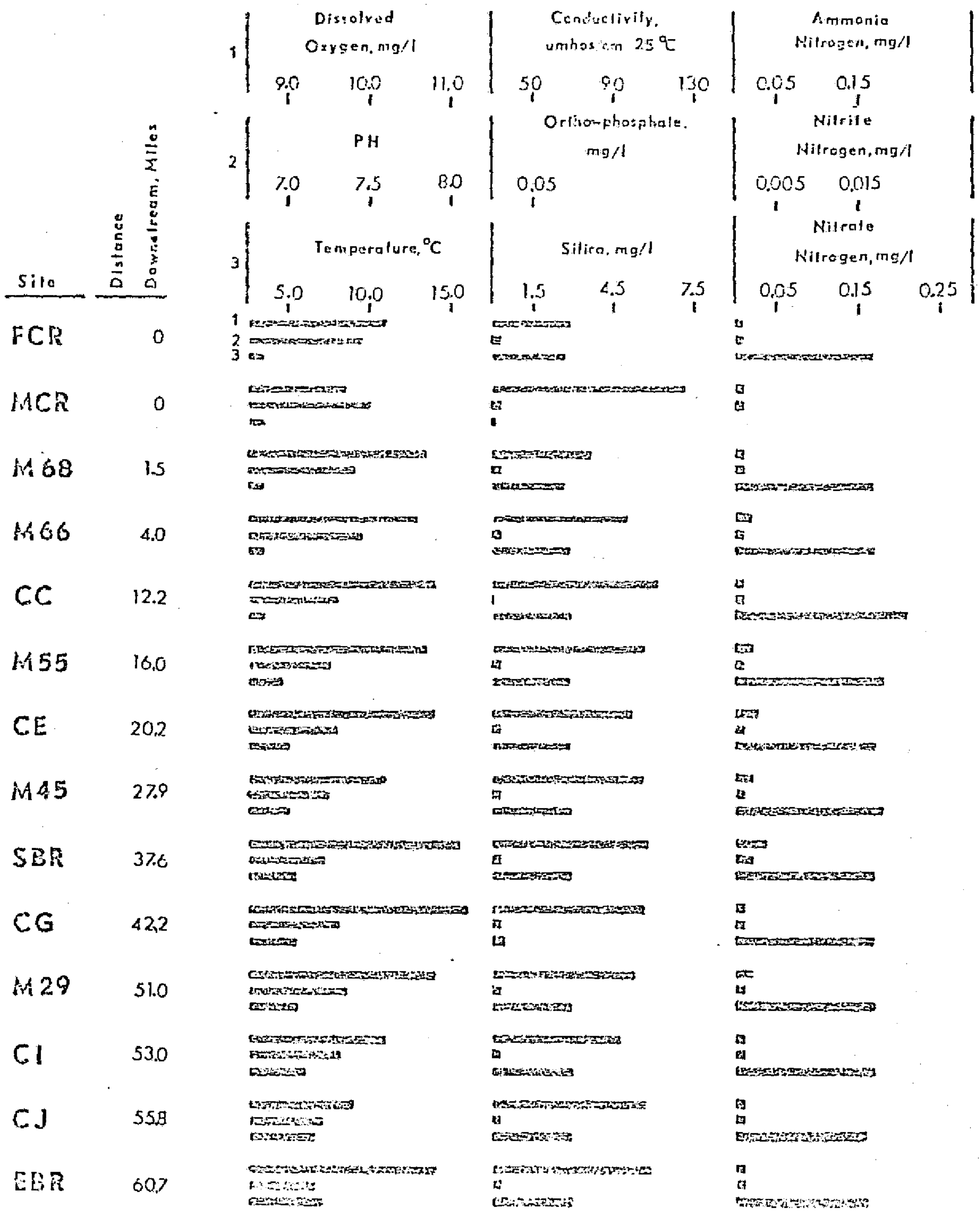
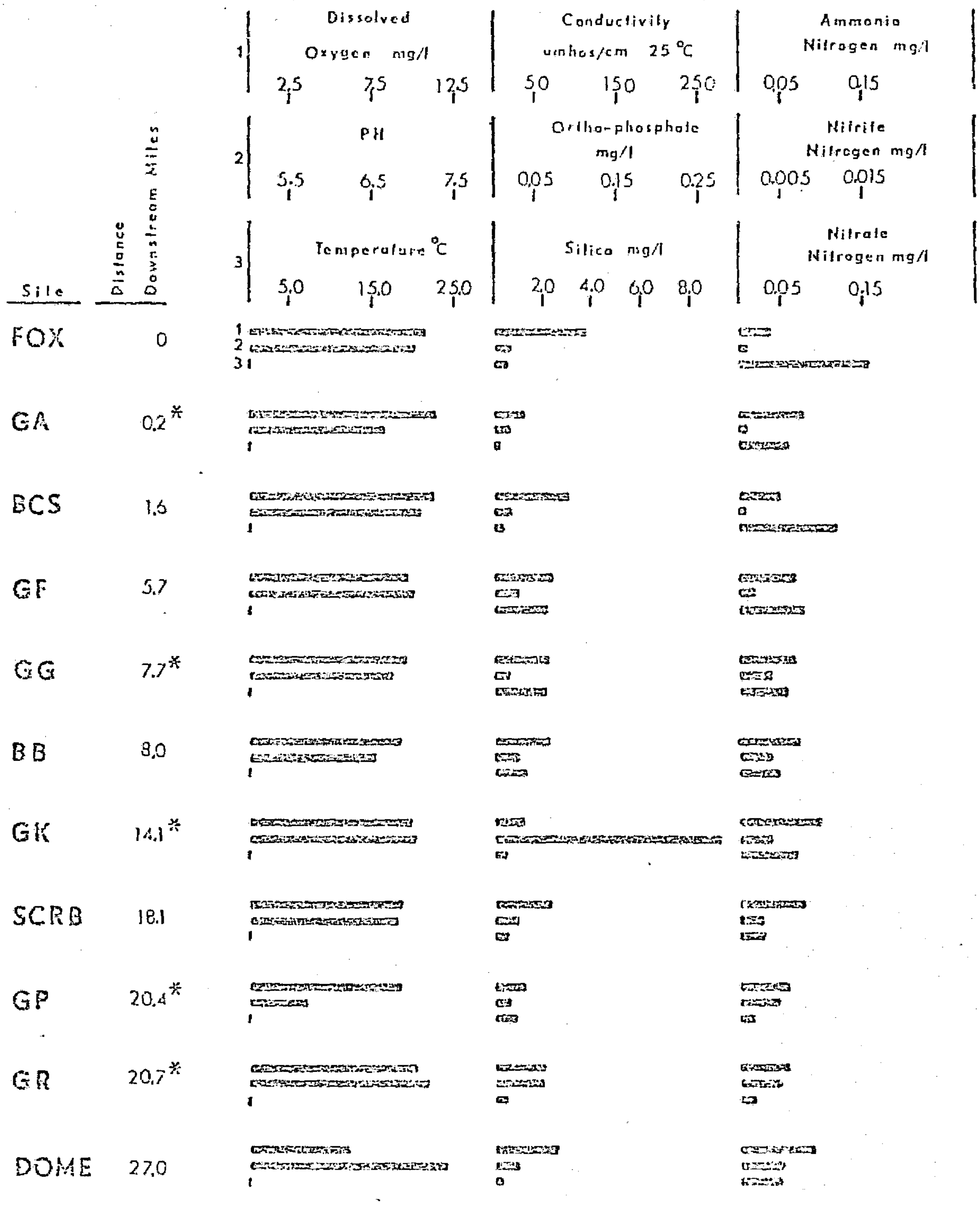
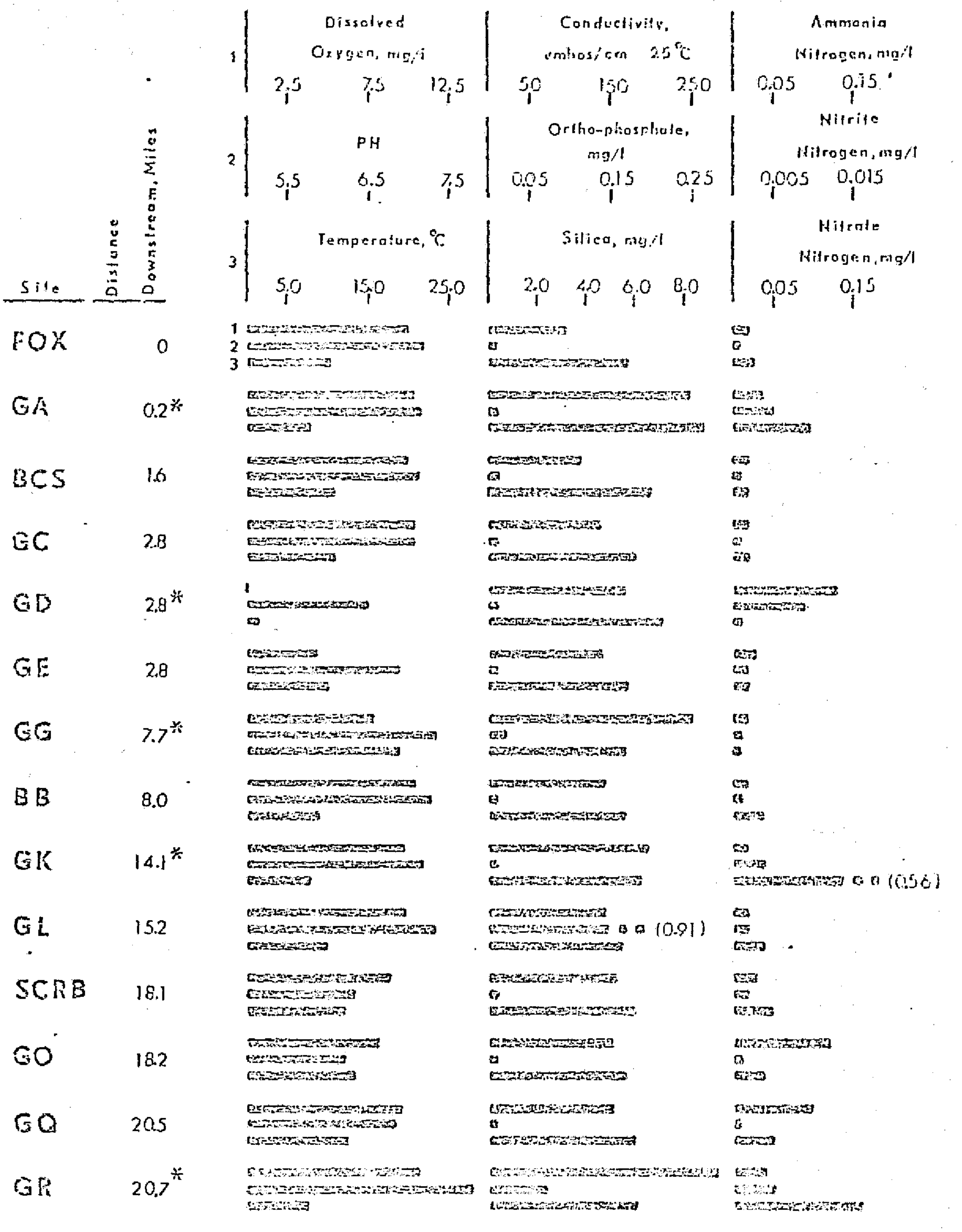


Figure 10. Chemical and physical variations from fourteen Chatanika River stations, September 10, 1971



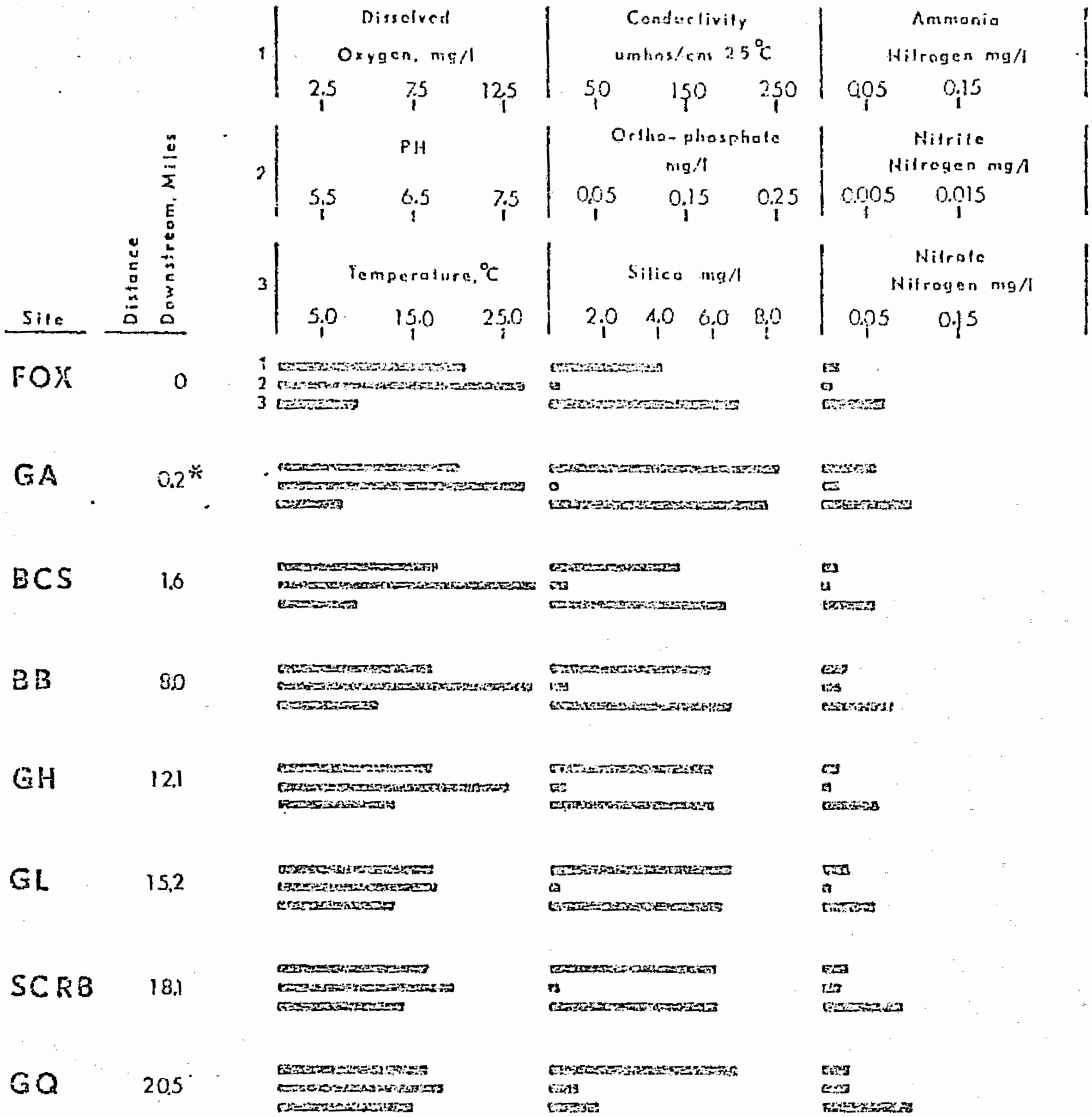
* Sample taken in tributary of Goldstream Creek

Figure 11. Chemical and physical variations from eleven Goldstream Creek stations, May 6,7,1971



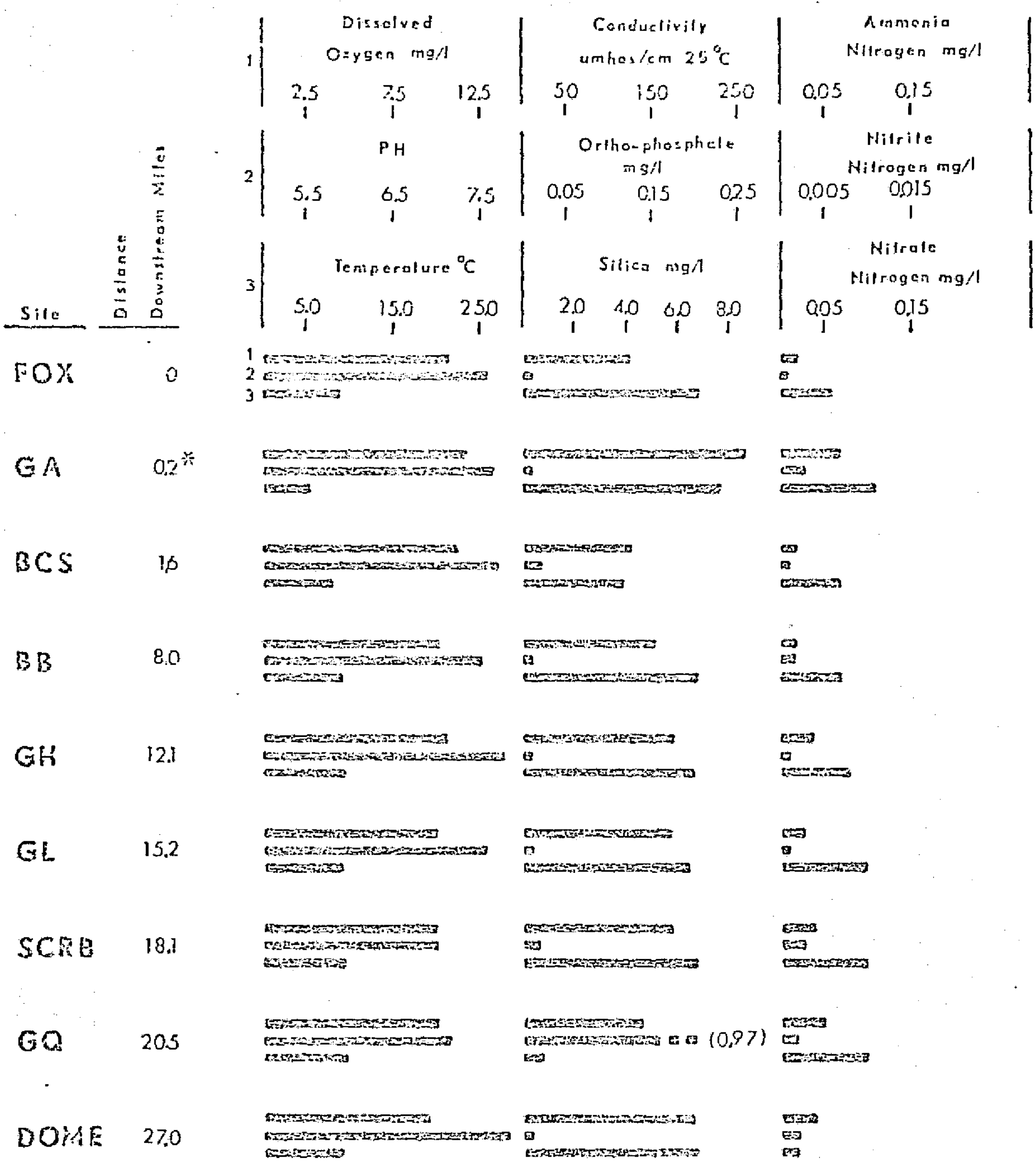
* Sample taken in tributary of Goldstream Creek

Figure 12. Chemical and physical variations from fourteen Goldstream Creek stations, June 18, 1971



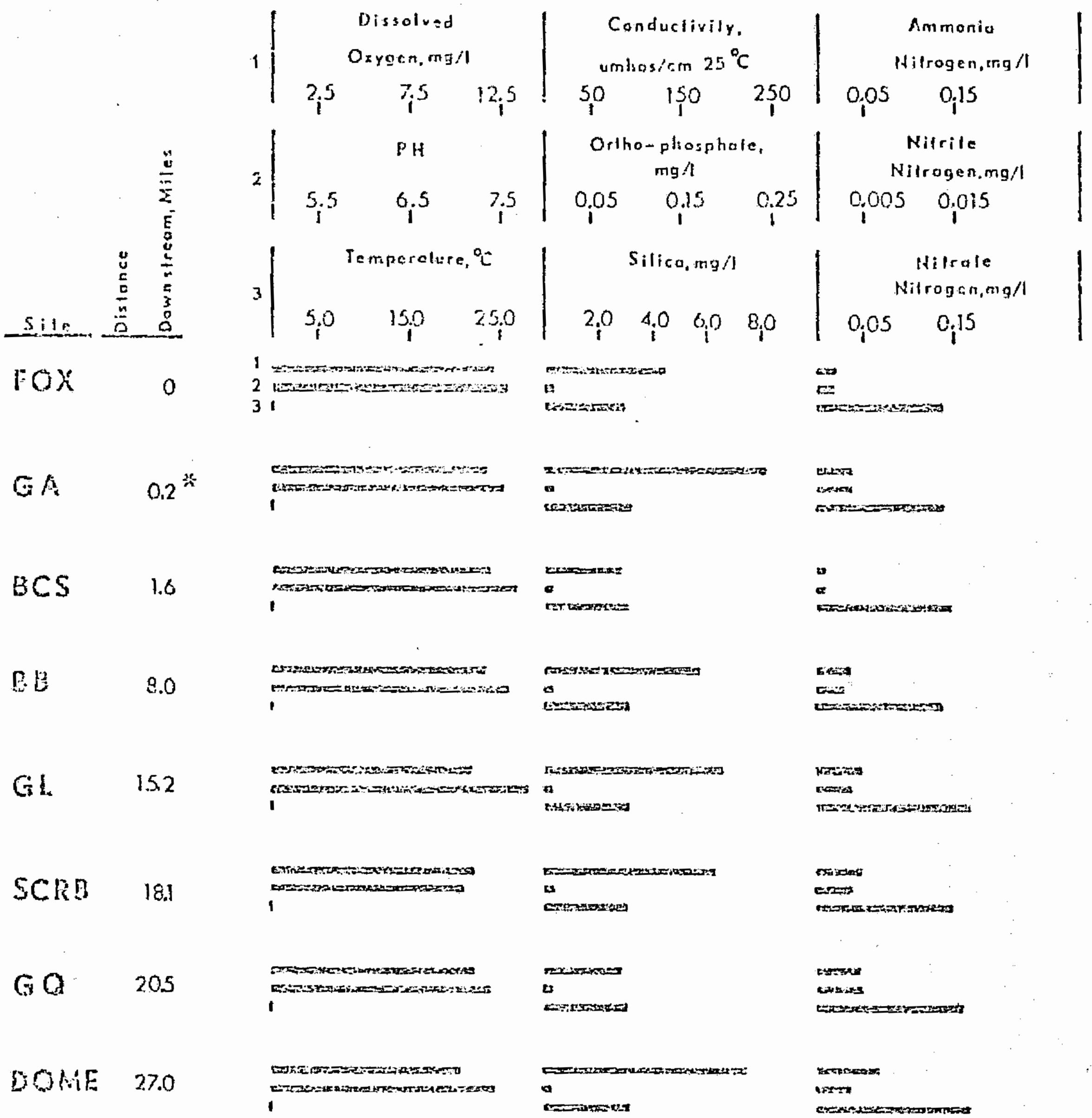
* Sample taken in tributary of Goldstream Creek

Figure 13. Chemical and physical variations from eight Goldstream Creek stations, July 19, 1971



*Sample taken in tributary of Goldstream Creek

Figure 14. Chemical and physical variations from nine Goldstream Creek stations, August 19, 1971



* Sample taken in tributary of Goldstream Creek

Figure 15. Chemical and physical variations from eight Goldstream Creek stations, October 22, 1971

TABLE 3. THE ALGAE OF COLONIZATION AND RECOLONIZATION IN THE CHATANIKA RIVER AND GOLDSTREAM CREEK

Elliott Bridge Station	Steese Bridge Station
Mougeotia sp. *Gomphonema* sp. *Tabellaria* sp. pennate diatoms	*Ulothrix* sp. (with epiphytic diatoms) *Rhizoclonium* sp. *Gomphonema* sp. *Tabellaria* sp. pennate diatoms
Ballaine Bridge	**Sheep Creek Bridge**
substrate mainly sand: unsuitable for filamentous algae	*Chlamydomonas* sp. (some in palmella stage) *Chladophoras* sp. (balls)

TABLE 4. DIATOMS IDENTIFIED AS EPIPHYTIC

ON STONES IN GOLDSTREAM CREEK

Fox Station	Below Construction Site Station	Sheep Creek Bridge
Brebissonia sp.	*Biddulphia* sp. (?)	*Caloneis* sp.
Caloneis sp.	*Ceratoneis* sp.	*Ceratoneis* sp.
Ceratoneis sp.	*Coscinodiscus* sp. or *Cyclotella* sp. (girdle view)	*Cymbella* sp.
Cymbella sp.	*Cymbella* sp.	*Eutonia* sp.
Diatoma sp.	*Meridion* sp.	*Fragilaria* sp.
Eunotia sp.	*Navicula* sp.	*Gomphonema* sp.
Fragilaria sp.	*Synedra* sp.	*Tabellaria* sp.
Gomphonema sp.	*Tabellaria* sp.	
Meridion sp.		
Navicula sp.		
Tabellaria sp.		

TABLE 5. FAUNA COLLECTED BY BENTHIC AND DRIFT SAMPLING

(JUNE, 1970 - OCTOBER, 1971)

	Chatanika River	Goldstream Creek
Chordata		
Osteichthyes - bony fishes		
Perciformes		
Cottidae - sculpins	x	x
Nematoda	x	x
Annelida		
Oligochaeta	x	x
Arthropoda		
Arachnida		
Araneaė - spiders	x	x
Acarina		
Trombidiformes - water mites	x	x
Crustacea		
Copepoda		x
Insecta		
Collembola - springtails	x	x
Ephemeroptera - mayflies		
Arthroplea sp.	x	
Baetis sp.	x	x
Ceniygma sp.	x	
Ephemerella sp.	x	x
Iron sp.	x	
Pseudocloeon sp.	x	x
Rhithrogena sp.	x	
Heptaginidae		
unidentified	x	
Plecoptera - stoneflies		
Alloperla sp.	x	
Chloroperla sp.	x	
Eucapnopsis sp.	x	
Isogenus sp.	x	
Isoperla sp.	x	x
Nemoura sp.	x	x
Paracapnia sp.	x	
Peltoperla sp.	x	
Perlinella sp.	x	
Thysanoptera - thrips (non-aquatic)		x
Coleoptera - beetles		
Haplidae		
Haplius sp.		x
Dytiscidae		
Agabus sp.		x
Oreodytes sp.		x

TABLE 5. FAUNA COLLECTED BY BENTHIC AND DRIFT SAMPLING (JUNE, 1970 - OCTOBER, 1971), Continued

	Chatanika River	Goldstream Creek
Coleoptera - beetles, cont.		
Hydroscaphidae		
Hydroscapha sp.	x	
Staphylinidae		
Emplenota sp.	x	
Emplenota arenaria		x
Trichoptera - caddis flies		
Beraeidae		
unidentified		x
Brachycentridae		
Brachycentrus sp.	x	x
Leptoceridae		
Leptocella sp.	x	
Setodes sp.		x
Triaenodes sp.	x	
Limnephilidae		
unidentified	x	x
Phryganeidae		
Phrygania sp.	x	
Ptilostomis sp.	x	
Rhyacophilidae		
Rhyacophila sp.	x	
Lepidoptera - butterflies and moths		
Pyralididae		
unidentified*	x	x
Diptera - true flies		
Tipulidae - crane flies		
Antocha sp.	x	
Dicranota sp.		x
Dolichopeza sp.	x	
Elliptera sp.	x	
Helius sp.		x
Holorusia sp.	x	
Longurio sp.	x	
Paradelphomyia sp.		x
Pentaneura sp.		x
Phalacrocerca sp.	x	
Trisgoma sp.	x	
Culicidae - mosquitoes		
Anopheles sp.	x	
Dixidae		
Paradixa sp.	x	

* Currently in transit to the Canadian National Museum for identification.

TABLE 5. FAUNA COLLECTED BY BENTHIC AND DRIFT SAMPLING (JUNE, 1970 - OCTOBER, 1971), Continued

	Chatanika River	Goldstream Creek
Diptera - true flies, cont.		
Simulidae - blackflies		
unidentified	x	
Chironomidae** - "nonbiting midges"		
Calopsectra sp.	x	x
Cardiocladius sp.		x
Chironomus sp.		x
Corynoneura sp.		x
Diplocladius sp.		x
Procladius sp.		x
Prodiamesa sp.		x
Stictochironomus sp.		x
Tanypus sp.	x	x
Trichotanypus sp.	x	x
Ceratopogonidae - "biting midges"		
Culicoides sp.		x
Dasyhela sp.	x	x
Sphaeromias sp.		x
Stilobezzia sp.		x
Rhagionidae - snipe flies		
Atherix sp.	x	x
unidentified		x
Tabanidae - horseflies and deerflies		
Chrysops sp.	x	
Dolichopodidae - "long-legged flies"		
Dolichopus sp.		x
Empididae - "dance flies"		
Hemerodromia sp.		x
unidentified	x	x
Sciomyzidae - "marsh flies"		
Sciomyza sp.	x	
Sepedon sp.		x
Muscidae		
Lispocephala sp.	x	
unidentified		x
Hymenoptera - wasps		
Caraphractus sp. (?)		x

** Many individuals of the Chironomidae are not positively identified, therefore this list may be incomplete.

tween the streams quite well. The mayflies (Ephemeroptera) and stoneflies (Plecoptera) of the Chatanika River are more diverse than those of the Goldstream Creek, for instance. This is because the larger Chatanika River provides more niches, especially those related to higher velocity of water.

The two-winged flies (Diptera) also emphasize this difference. The Simulidae (black flies), for instance, were not found in Goldstream Creek at the sampling sites whereas they were found in the Chatanika River where high velocity water flows over rock rubble and provides the correct environment. Many types of Chironomidae (midges) and Ceratopogonidae (biting midges) are found in Goldstream Creek because the requirements for their establishment are better fulfilled in the slower Goldstream Creek.

The Hymenoptera (wasps) may have been misidentified, as this genus has only been collected in the eastern United States (Usinger, 1963). The Lepidoptera (moths) collected could not be further identified; the larval case was lacking as these caterpillers were captured in the drift.

Benthos Thesis Study

The thesis study on the benthos was restricted to the consideration of the Ephemeroptera (mayflies) and Trichoptera (caddis flies). The totals collected for each order at each station are presented in Table 6. Attempts were made to treat these data to determine whether temperature, velocity, dissolved oxygen, and pH had any effects on the distribution of these orders in location and in time in Goldstream Creek.

Because of the strong time dependence imposed on the data by the metamorphic development of the mayflies, no effects could be separated out.

This time dependency is clearly illustrated in Fig. 16 which consists of plots of temperature variation and mayfly nymph number variation for each station. It can be seen that the end of the period of high population of nymphs and the beginning of emergence occurred near the same date. (August 24, 1971) at each station. A time dependency this strong can obscure any other relationship in the data.

The Trichoptera are less dependent on the time of year as a stimulus to pupation and emergence. This is at least true for the order as a whole, in contrast to the mayflies which, as their common name implies, emerge at a specific time of year.

In this study the Trichoptera at the Sheep Creek Bridge station, where the greatest number were collected, were found to have an inverse relationship between their distribution and stream velocity (Fig. 17).

Drift Thesis Study

During the summer of 1971, the drift of invertebrates was measured at Fox on Goldstream Creek during four 24-hour sampling periods. Measurements of stream discharge, water temperature, and light intensity were also made during these sampling periods. In this study, a strong time-dependence was found in the data which obscured any other relationships that might exist with stream discharge, water temperature, or light intensity. Because of their dominance in numbers, the Ephemeroptera and the Diptera were the only orders considered in the study. Figs. 18, 19, 20, and 21 illustrate the time-of-day dependency of the drift. The peak drift occurred at night, except for the first sampling period in which

TABLE 6. TOTAL NUMBER OF MAYFLIES AND CADDIS FLIES COLLECTED AT GOLDSTREAM STATIONS (BENTHOS THESIS STUDY)

Date	FOX		BCS		BB		SCRB	
	May-flies	Caddis flies	May-flies	Caddis flies	May-flies	Caddis flies	May-flies	Caddis flies
6-14-71*	0	0	0	0	0	0	0	1
6-24-71	0	0	0	0	9	11	2	0
7-19-71	151	0	124	1	194	3	29	11
8-4-71	123	0	360	3	184	11	131	59
8-18-71	33	0	134	2	38	2	15	66
9-6-71	15	3	64	3	25	4	32	82
10-16-71	8	6	2	2	3	0	1	1
Totals	330	9	684	11	453	31	210	220

* 6-14, 6-24, and 7-19 are representative of samples of 3 square feet. All totals after 7-19-71 represent samples of 5 square feet.

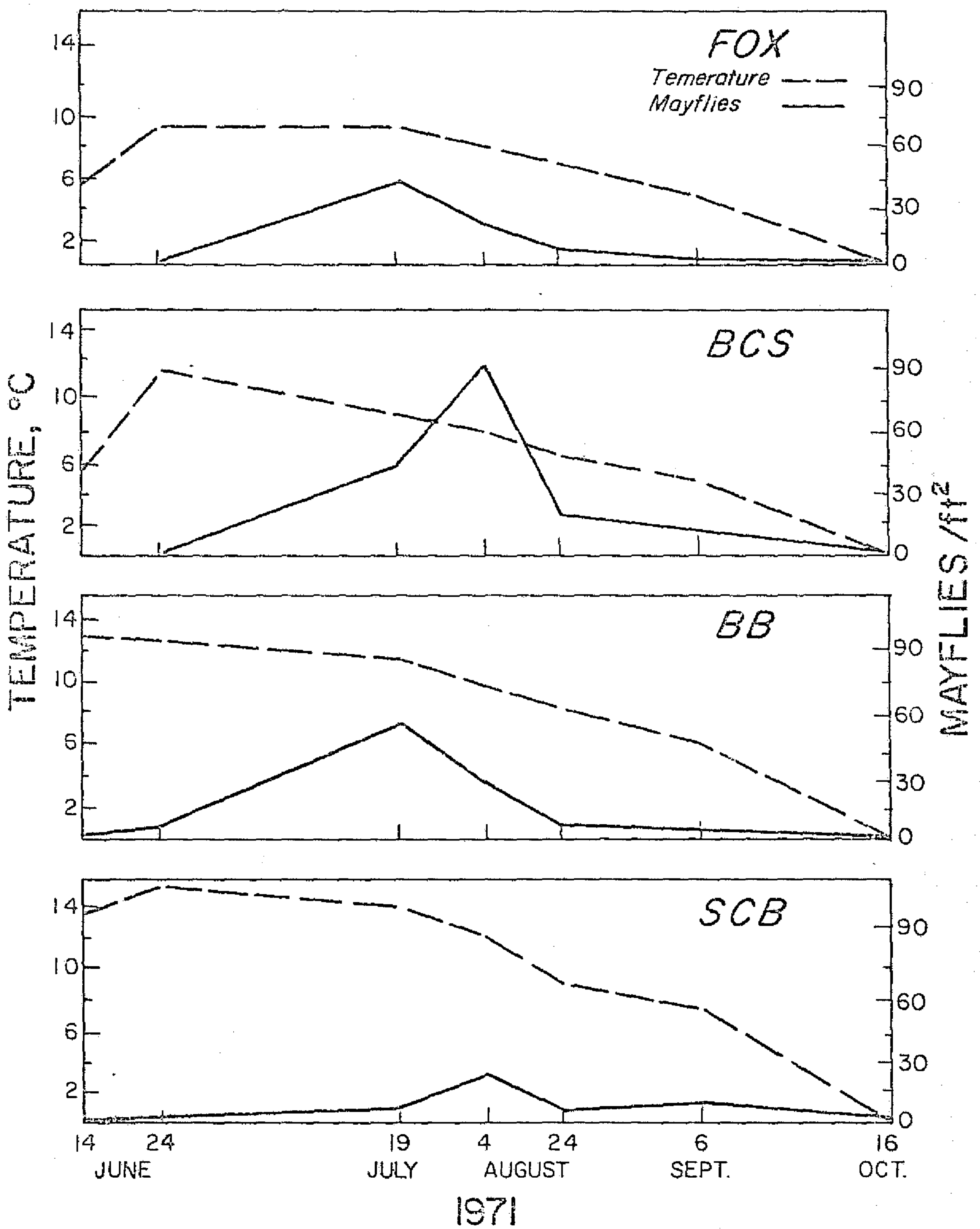


Fig. 16. Summer temperature variation and mayfly distribution in Goldstream Creek, 1971.

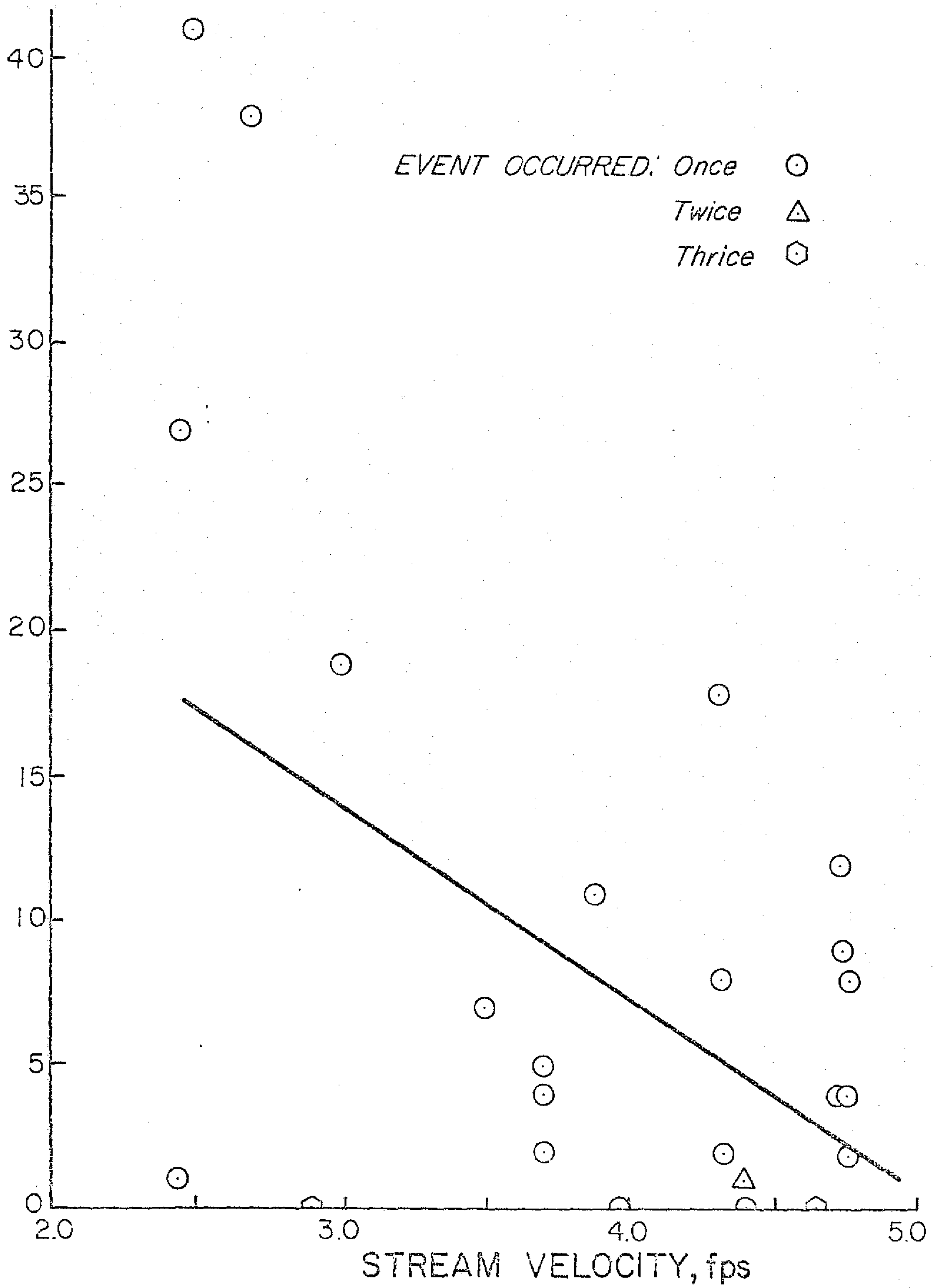


Fig. 17. The relationship between stream velocity and the number of Trichoptera (caddis flies) collected; Sheep Creek Bridge Station, Goldstream Creek.

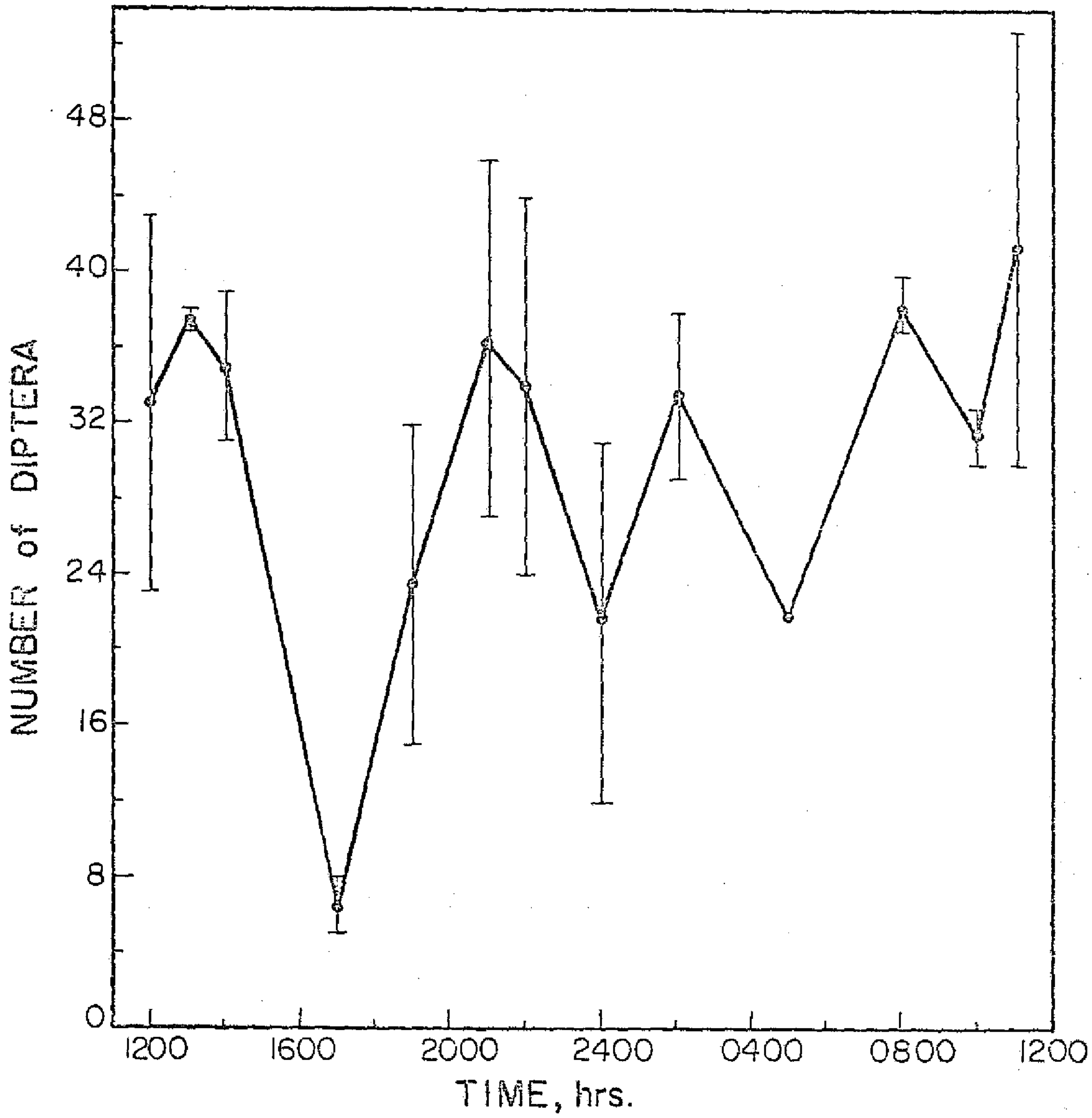


Fig. 18. Numbers of Diptera taken in five-minute drift samples; Coldstream Creek, June 14-15, 1971. Vertical lines represent the range in number of organisms for two replicate samples.

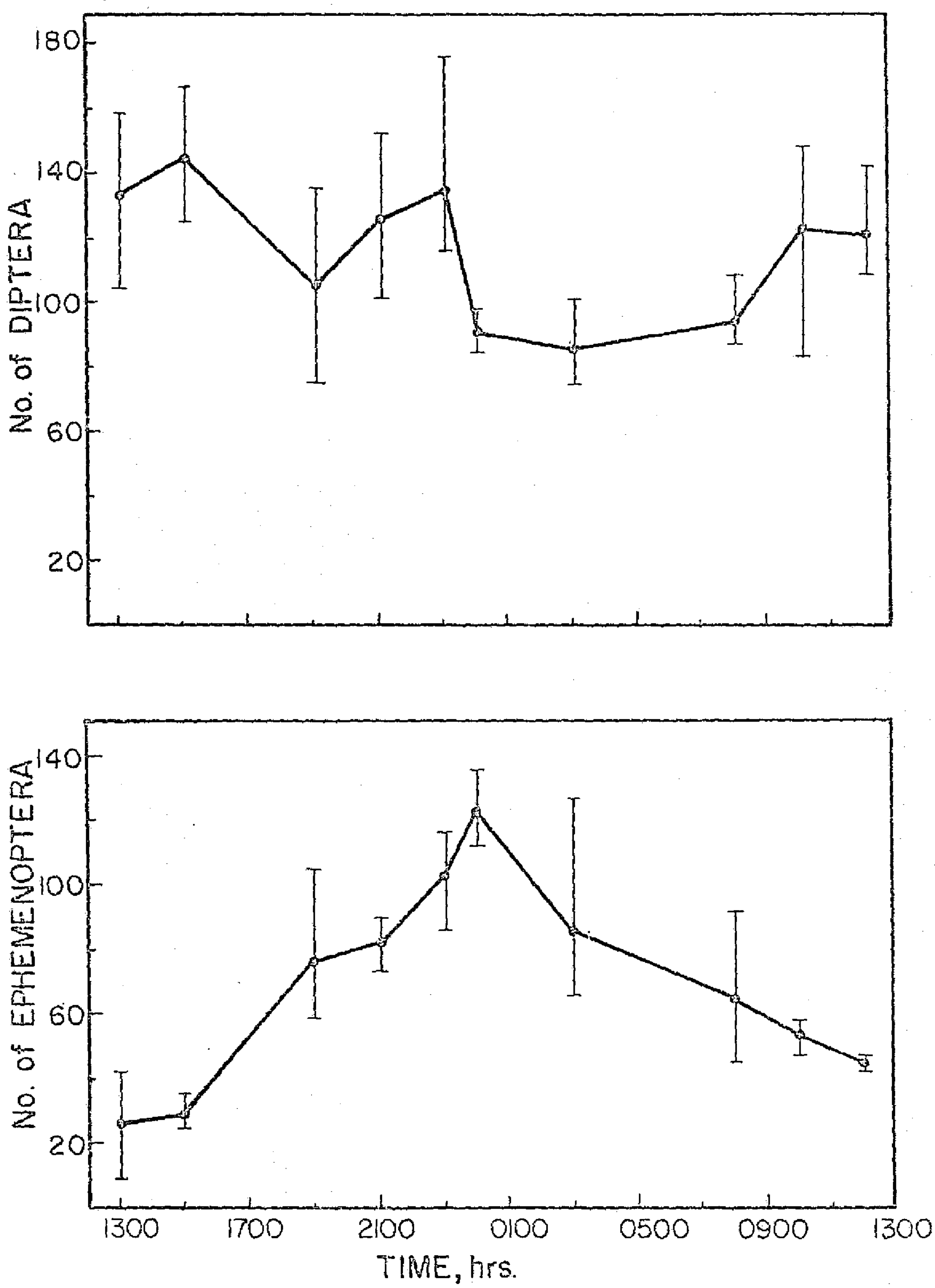


Fig. 19. Numbers of Diptera and Ephemeroptera taken in five-minute drift samples; Goldstream Creek, July 6-7, 1971. Vertical lines represent the range in number of organisms for four replicate samples.

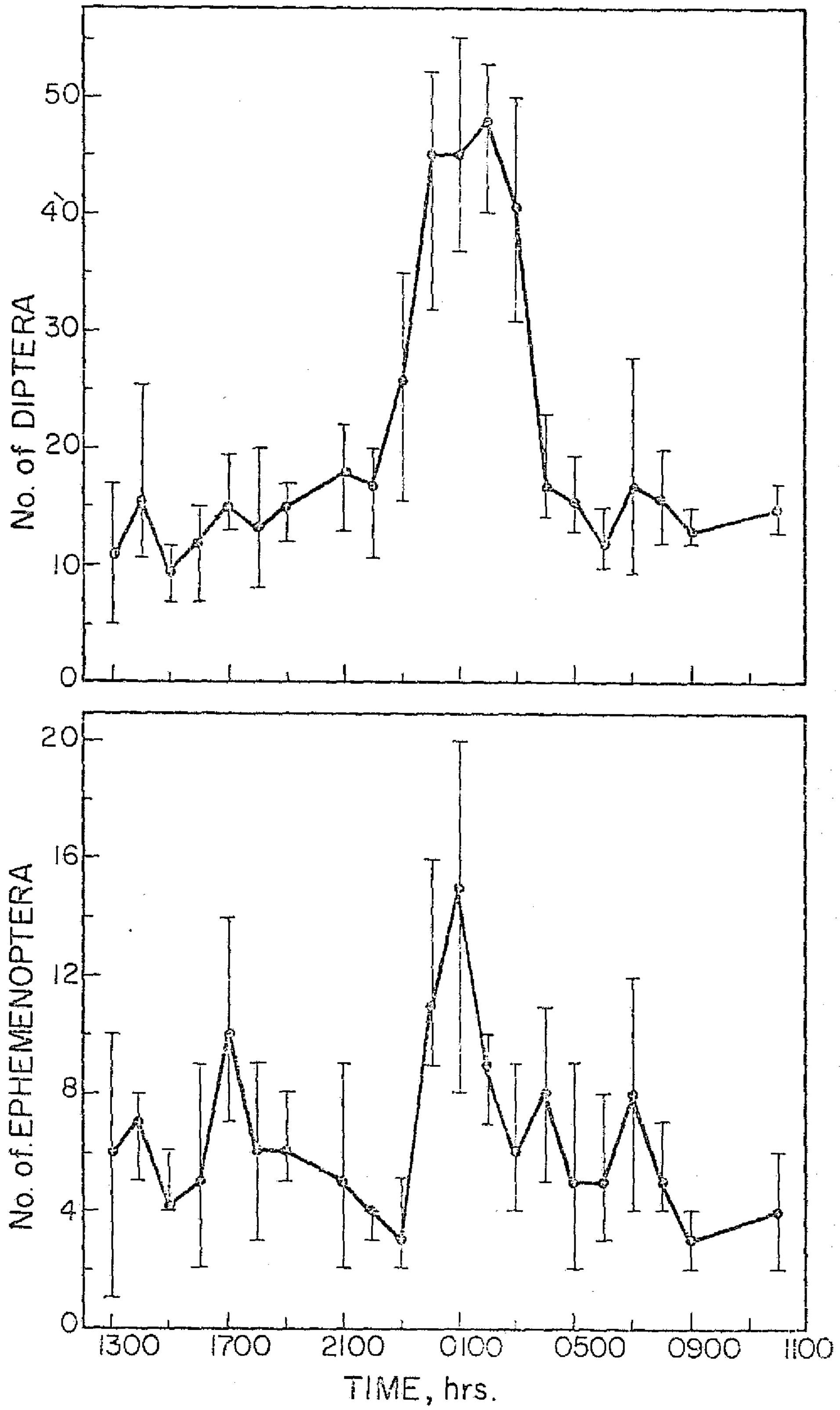


Fig. 20. Numbers of Diptera and Ephemeroptera taken in five-minute drift samples; Goldstream Creek, July 29-30, 1971. Vertical lines represent the range in numbers of organisms for four replicate samples.

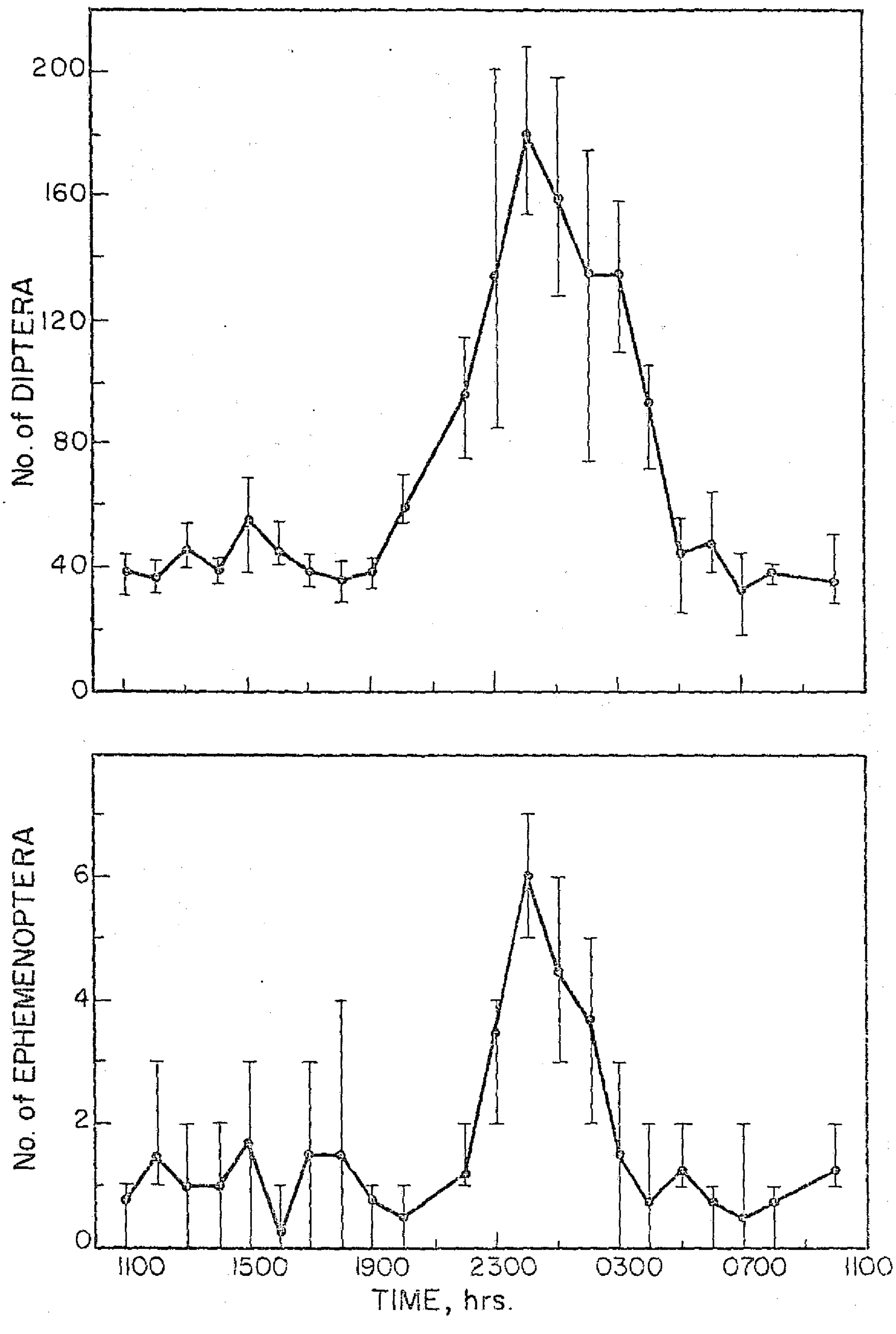


Fig. 21. Numbers of Diptera and Ephemeroptera taken in five-minute drift samples; Goldstream Creek, August 18-19, 1971. Vertical lines represent the range in numbers of organisms for four replicate samples.

so few organisms were collected that there was no apparent pattern to the drift.

Assimilation Thesis Study

Dissolved oxygen sampling was run approximately once a month at the four bridge stations of this study. These data are tabulated in Tables 7 and 8.

Biochemical Oxygen Demand was determined throughout the winter of 1970 through 1971. These data are tabulated in Table 9, which presents the standard 20 C, 5-day test results, and in Table 10, which presents 5-day results for an incubation temperature of 4 C.

The dissolved oxygen measurements show the oxygen regime as it is known under winter ice in this area. The larger streams remain fairly well oxygenated, perhaps because ice formation takes place during the period of moderate flow and then is followed by a drop in water level, which leaves an air space between the ice and the water. The smaller streams seem to have the lowest dissolved oxygen as break-up approaches. The effects on the biota of this low dissolved oxygen, along with the low temperatures, may not be harmful. Even the arctic grayling, *Thymallus arcticus*, has been found in the Chena River where oxygen was essentially measuring zero concentration (Roguski, 1972).

The five-day BODs measured on these streams provide values that approach those of temperate zone streams in winter. As was expected, those BODs incubated at 4 C yielded lower values.

The reaeration portion of this thesis study was not a success because of several factors: the chambers leaked water, thus not effectively isolating the chambers from the stream; the choice of the Winkler test for measuring the dissolved oxygen in the chamber made frequent sampling with proper replication impossible; and the failure to run the light and dark chambers simultaneously introduced errors that could not be overcome.

TABLE 7. NATURAL DISSOLVED OXYGEN LEVELS: CHATANIKA RIVER

Date	Time	D.O. (mg/1)
Elliott Bridge Site:		
Oct. 30, 1970	1600	10.3
Nov. 6, 1970	1600	11.5
Nov. 11, 1970	1500	7.2
Nov. 20, 1970	1500	9.9
Jan. 12, 1971	1300	9.5
March 16, 1971	0900	9.6
July 22, 1971	1300	9.3
July 28, 1971	1500	9.7
Steese Bridge Site:		
Oct. 30, 1970	1700	10.9
Nov. 6, 1970	1700	11.6
Nov. 11, 1970	1600	8.6
Nov. 20, 1970	1600	10.6
Jan. 12, 1971	1400	10.9
Mar. 16, 1971	1400	11.0
Aug. 5, 1971	1400	10.9
Aug. 16, 1971	1500	11.4

TABLE 8. NATURAL DISSOLVED OXYGEN LEVELS: GOLDSTREAM CREEK

Date	Time	D.O. (mg/l)
Ballaine Road Site:		
Nov. 2, 1970	1600	10.2
Nov. 13, 1970	1600	8.4
Nov. 18, 1970	1500	10.5
Jan. 9, 1971	1100	7.1
Mar. 13, 1971	1300	1.7
Apr. 14, 1971	1800	0.3
June 28, 1971	1300	9.1
Aug. 13, 1971	1400	10.5
Sept. 1, 1971	1300	11.1
Sept. 7, 1971	1400	11.1
Sheep Creek Site		
Nov. 2, 1970	1600	8.6
Nov. 13, 1970	1700	8.3
Nov. 18, 1970	1600	7.5
Dec. 7, 1970	1500	5.9
Dec. 9, 1970	1500	6.1
Jan. 9, 1971	1300	4.2
Feb. 21, 1971	0700	1.2
Feb. 23, 1971	1500	1.2
Feb. 27, 1971	1200	1.5
Mar. 13, 1971	1500	0.2
Apr. 14, 1971	1800	0.1
June 28, 1971	1700	8.3
Aug. 13, 1971	1400	10.4
Sept. 9, 1971	1400	11.1
Sept. 14, 1971	1500	11.8

TABLE 9. RESULTS OF FIVE-DAY BIOCHEMICAL OXYGEN DEMAND TESTS;

INCUBATION TEMPERATURE = 20 C

CHATANIKA RIVER:

Date	Steese Bridge	Elliott Bridge
10/30/70	1.3 mg/l	2.1 mg/l
11/06/70	0.3 mg/l	0.3 mg/l
11/11/70	0.2 mg/l	0.3 mg/l
11/20/70	0.4 mg/l	0.6 mg/l
01/12/71	0.1 mg/l	0.4 mg/l
03/16/71	0.5 mg/l	1.0 mg/l

GOLDSTREAM CREEK:

Date	Ballaine Bridge	Sheep Creek Bridge
10/26/70	2.1 mg/l	1.7 mg/l
11/02/70	0.5 mg/l	0.5 mg/l
11/13/70	1.0 mg/l	0.5 mg/l
11/18/70	0.9 mg/l	0.5 mg/l
12/07/70	--------	8.4 mg/l
12/09/70	--------	1.1 mg/l
01/09/71	0.7 mg/l	1.0 mg/l
02/21/71	--------	0.6 mg/l
02/27/71	--------	1.1 mg/l
03/13/71	0.6 mg/l	0.8 mg/l
04/13/71	1.1 mg/l	0.8 mg/l

TABLE 10. RESULTS OF FIVE-DAY BIOCHEMICAL OXYGEN DEMAND TESTS;

INCUBATION TEMPERATURE = 4 C

CHATANIKA RIVER:

Date	Steese Bridge	Elliott Bridge
10/30/70	0.1 mg/l	0.2 mg/l
11/06/70	0.0 mg/l	0.1 mg/l
11/11/70	0.0 mg/l	0.0 mg/l
11/20/70	0.0 mg/l	0.0 mg/l
01/12/71	0.0 mg/l	0.0 mg/l
03/16/71	1.2 mg/l	0.2 mg/l

GOLDSTREAM CREEK:

Date	Ballaine Bridge	Sheep Creek Bridge
11/02/70	0.1 mg/l	0.2 mg/l
11/13/70	0.3 mg/l	0.3 mg/l
11/18/70	0.3 mg/l	0.3 mg/l
12/07/70	--------	0.8 mg/l
12/09/70	--------	0.4 mg/l
01/09/71	0.1 mg/l	0.3 mg/l
02/21/71	--------	0.2 mg/l
02/27/71	--------	0.2 mg/l
03/13/71	0.7 mg/l	0.6 mg/l
04/13/71	0.2 mg/l	0.6 mg/l

SUMMARY

The objectives of this project were:

1. To establish a baseline record of the current flora and fauna before changes due to the development by man can occur;
2. To compile a qualitative and quantitative standard against which future populations can be compared;
3. To assess the sources and the amounts of nutrients being contributed to the streams; and
4. To investigate the effect the present addition of nutrients is having on the community productivity.

The first objective was fulfilled with the exception of incomplete recording of the flora of the streams. The terrestrial flora was not sampled, and the aquatic vascular plants which were assumed to be absent were also not sampled. The algal work was not intensive enough to provide a record, especially in regard to the complete neglect of planktonic algae.

The second objective was for the most part fulfilled with the exceptions noted above. An attempt was made at population quantification for the invertebrates by calculating species diversity for those samples retained at the Institute. These data are contained in Appendices A and B. The invertebrates were separated to species by a technician without exact taxonomic identification. Some error undoubtedly enters concerning the Chironomidae, for instance. Species identification is very difficult, if not impossible, to determine from external characteristics and without expertise. Thus, there may actually be more chironomids than have been counted, which could change the species diversity index markedly.

Objective three was very thoroughly fulfilled over the fifteen months of the chemical study.

Objective four was not fulfilled as community productivity was not measured.

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APPENDICES

APPENDIX A

SPECIES DIVERSITY OF BENTHOS AND DRIFT SAMPLES FROM THE CHATANIKA RIVER

Site	Sample Type	Date	Species Diversity
1. FCR	Riffle	9-04-70	1.37
	Riffle	9-04-70	0.99
	Pool	9-04-70	0.00
	Riffle	10-07-70	0.81
	Pool	10-07-70	0.00
	Riffle	7-01-71	1.52
	Drift, 11:00 p.m.	7-01-71	2.39
	--	7-15-71	0.00
	Riffle	10-17-71	1.00
2. MCR	Riffle	9-04-70	1.58
	Riffle	9-04-70	1.37
	Pool	9-04-70	1.37
	Riffle	10-07-70	2.06
	Pool	10-07-70	2.37
	Riffle	7-01-71	0.82
	Drift	7-01-71	1.52
	Pool	7-01-71	0.00
	--	7-15-71	0.99
	Riffle	10-17-71	0.72
3. M68	Riffle	9-04-70	0.96
	Riffle	9-04-70	1.79
	Pool	9-04-70	1.84
	Pool	9-04-70	1.00
	Riffle	10-07-70	1.51
	Pool	10-07-70	1.53
	Riffle	7-01-71	0.92
	Pool	7-01-71	0.00
	Drift	7-01-71	1.92
	Riffle	9-10-71	0.00
	Drift	9-10-71	1.37
4. M66	Horse Cr.	7-15-70	0.00
	Riffle	9-04-70	1.58
	Riffle	9-04-70	0.76
	Pool	9-04-70	1.00
	Pool	9-04-70	0.00
	IP	9-04-70	0.70
	Riffle	10-07-70	1.32

APPENDIX A

SPECIES DIVERSITY OF BENTHOS AND DRIFT SAMPLES FROM THE CHATANIKA RIVER, Continued:

Site	Sample Type	Date	Species Diversity
	under 10" ice	11-11-70	1.32
	Riffle	7-02-71	1.77
	Pool	7-02-71	1.37
	Drift, 100 hrs.	7-02-71	1.49
5. M55	Riffle	9-04-70	0.92
	Riffle	9-04-70	1.84
	Pool	9-04-70	1.89
	Pool	9-04-70	0.95
	Riffle	10-07-70	0.92
	Pool	10-07-70	1.50
	Riffle	7-01-71	0.91
	Pool	7-02-71	0.00
	Drift, 1630 hrs.	7-02-71	1.61
	Riffle	9-10-71	1.00
	Drift	9-10-71	0.00
6. M45	Riffle 7 C	7-15-70	1.92
	Riffle	9-04-70	1.67
	Riffle	9-04-70	2.92
	Pool	9-04-70	1.30
	Pool	9-04-70	1.87
	Riffle	10-07-70	1.50
	Pool	10-07-70	0.81
	Riffle	7-02-71	2.42
	Drift, 1110 hrs.	7-02-71	2.22
	Pool	7-02-71	2.88
7. SBR	Riffle	7-15-70	2.24
	Pool 7 C	7-15-70	2.10
	Riffle	10-07-70	1.84
	Pool	10-07-70	2.24
	under 4" ice	11-11-70	1.00
	Riffle	7-01-71	1.93
	Pool	7-01-71	1.10
	Drift	7-01-71	0.81
	Drift	9-10-71	0.00
8. CG	Riffle	9-04-70	1.37
	Riffle	9-04-70	0.83
	Pool	9-04-70	2.00

APPENDIX A

SPECIES DIVERSITY OF BENTHOS AND DRIFT SAMPLES FROM THE CHATANIKA RIVER, Continued:

Site	Sample Type	Date	Species Diversity
	Pool	9-04-70	0.70
9. M29	--	7-15-70	0.51
	Pool 8 C	7-15-70	1.46
	Pool	9-04-70	0.72
	Pool	9-04-70	0.00
	Riffle	9-04-70	0.00
	Riffle	9-04-70	0.92
	Riffle	10-07-70	1.79
	Pool	10-07-70	2.24
	Riffle	9-10-71	1.50
	Drift 1720 hrs.	--------	0.92
	Bottom	--------	1.97
10. EBR	Riffle	9-04-70	1.58
	Riffle	9-04-70	0.70
	Pool	9-04-70	1.00
	Pool	9-04-70	0.00
	--	10-07-70	0.81
	Pool	10-07-70	1.00
	under 12" ice	11-11-70	1.28
	Riffle	9-10-71	1.45
	Drift	9-10-71	0.00
	Drift 12" H_2O, 1100 hrs.	--------	1.50
	Bottom	--------	2.12
11. CK	Riffle	7-09-71	2.48
	Drift 12", 5 min.	7-09-71	1.60

APPENDIX B

SPECIES DIVERSITY OF BENTHOS AND DRIFT SAMPLES FROM GOLDSTREAM CREEK

Site	Sample Type	Date	Species Diversity
1. FOX	--	8-10-70	0.80
	Riffle	9-09-70	1.37
	Pool	9-09-70	0.60
	--	10-28-70	1.00
	Riffle	10-29-70	1.01
	Pool	10-29-70	1.78
	Riffle under ice	10-29-70	0.87
	Benthos thesis samples	6-24-71	0.59
	"	7-19-71	1.48
	"	8-04-71, no. 1	0.47
	"	8-04-71, no. 2	0.47
	"	8-04-71, no. 3	1.05
	"	8-04-71, no. 4	0.32
	"	8-04-71, no. 5	0.40
	"	8-18-71, no. 1	1.73
	"	8-18-71, no. 2	1.32
	"	8-18-71, no. 3	1.15
	"	8-18-71, no. 4	1.19
	"	8-18-71, no. 5	1.24
	"	10-14-71	1.58
	"	10-16-71, no. 1	2.55
	"	10-16-71, no. 2	1.25
	"	10-16-71, no. 3	2.23
	Drift thesis samples	6-14-71, 12 N	1.66
	"	6-14-71, 1 PM	1.12
	"	6-14-71, 2 PM	2.06
	"	6-14-71, 5 PM	0.00
	"	6-14-71, 7 PM	0.97
	"	6-14-71, 9 PM	1.65
	"	6-14-71, 10 PM	1.52
	"	6-14-71, 12 M	1.67
	"	6-15-71, 2 AM	1.77
	"	6-15-71, 5 AM	1.50
	"	6-15-71, 8 AM	1.35
	"	6-15-71, 10 AM	1.71
	"	6-15-71, 11 AM	1.44
	"	7-06-71, 1 PM	1.58
	"	7-06-71, 3 PM	1.35
	"	7-06-71, 6 PM	1.38

APPENDIX B

SPECIES DIVERSITY OF BENTHOS AND DRIFT SAMPLES FROM THE GOLDSTREAM CREEK, Continued:

Site	Sample Type	Date	Species Diversity
	Drift thesis samples	7-06-71, 9 PM	1.62
	"	7-06-71, 11 PM	1.62
	"	7-06-71, 12 M	1.44
	"	7-07-71, 3 AM	1.42
	"	7-07-71, 8 AM	1.67
	"	7-07-71, 10 AM	1.50
	"	7-07-71, 12 N	1.75
	"	7-29-71, 1 PM	1.30
	"	7-29-71, 2 PM	1.98
	"	7-29-71, 3 PM	1.60
	"	7-29-71, 4 PM	1.68
	"	7-29-71, 5 PM	1.80
	"	7-29-71, 6 PM	1.70
	"	7-29-71, 7 PM	1.55
	"	7-29-71, 9 PM	1.58
	"	7-29-71, 10 PM	1.49
	"	7-29-71, 11 PM	1.20
	"	7-29-71, 12 M	1.32
	"	7-30-71, 1 AM	1.17
	"	7-30-71, 2 AM	1.28
	"	7-30-71, 3 AM	1.25
	"	7-30-71, 4 AM	1.39
	"	7-30-71, 5 AM	1.28
	"	7-30-71, 6 AM	1.35
	"	7-30-71, 7 AM	1.59
	"	7-30-71, 8 AM	1.79
	"	7-30-71, 9 AM	1.91
	"	7-30-71, 12 N	1.36
	"	8-18-71, 11 AM	1.17
	"	8-18-71, 12 N	1.25
	"	8-18-71, 1 PM	1.38
	"	8-18-71, 2 PM	1.26
	"	8-18-71, 3 PM	1.13
	"	8-18-71, 4 PM	1.07
	"	8-18-71, 5 PM	1.30
	"	8-18-71, 6 PM	1.30
	"	8-18-71, 7 PM	1.24
	"	8-18-71, 8 PM	1.50
	"	8-18-71, 10 PM	1.35
	"	8-18-71, 11 PM	1.39
	"	8-18-71, 12 M	1.54

APPENDIX B

SPECIES DIVERSITY OF BENTHOS AND DRIFT SAMPLES FROM THE GOLDSTREAM CREEK, Continued:

Site	Sample Type	Date	Species Diversity
	Drift thesis samples	8-19-71, 1 AM	1.40
	"	8-19-71, 2 AM	1.36
	"	8-19-71, 3 AM	0.63
	"	8-19-71, 4 AM	1.29
	"	8-19-71, 5 AM	1.27
	"	8-19-71, 6 AM	1.20
	"	8-19-71, 7 AM	1.44
	"	8-19-71, 8 AM	1.15
	"	8-19-71, 10 AM	1.29
2. ACS	2G	8-10-70	1.92
	Pool	9-09-70	2.24
	--	7-15-71	1.79
3. BCS	Dunbar 4G	8-10-70	0.95
	Riffle	9-09-70	0.00
	Pool	9-09-70	0.00
	Riffle	10-29-70	1.91
	Pool	10-29-70	1.31
		6-24-71	0.16
		7-15-71	1.04
		7-19-71	0.00
	Benthos thesis samples	8-04-71, no. 1	0.65
	"	8-04-71, no. 2	0.51
	"	8-04-71, no. 3	0.54
	"	8-04-71, no. 4	0.32
	"	8-04-71, no. 5	0.30
	"	8-04-71, no. 6	0.27
	"	8-18-71, no. 1	0.81
	"	8-18-71, no. 2	0.57
	"	8-18-71, no. 3	0.53
	"	8-18-71, no. 4	0.00
	"	8-18-71, no. 5	0.72
	"	10-16-71	1.92
4. BB	No label	--------	2.00
	No label	--------	1.70
	Riffle	9-09-70	1.21
	Riffle	10-29-70	0.25
	Pool	10-29-70	0.00
	Diw	--------	0.00

APPENDIX B

SPECIES DIVERSITY OF BENTHOS AND DRIFT SAMPLES FROM THE GOLDSTREAM CREEK, Continued:

Site	Sample Type	Date	Species Diversity
	--	7-19-71	1.28
	Benthos thesis samples	8-04-71, no. 1	0.58
	"	8-04-71, no. 2	0.41
	"	8-04-71, no. 3	0.51
	"	8-04-71, no. 4	1.00
	"	8-18-71, no. 1	1.19
	"	8-18-71, no. 2	0.59
	"	8-18-71, no. 3	0.00
	"	8-18-71, no. 4	0.99
	"	8-18-71, no. 5	0.00
	"	10-16-71, no. 1	0.88
	"	10-16-71, no. 2	2.32
	"	10-16-71, no. 3	1.00
5. GI	--	6-22-71	0.92
6. GJ	--	6-22-71	0.98
7. SCRB	--	8-10-70	1.22
	--	9-04-70	2.31
	Riffle	9-09-70	0.93
	Pool	9-09-70	0.39
	Riffle	10-29-70	1.14
	Riffle	10-29-70	0.00
	--	6-24-71	1.68
	--	7-19-71	1.20
	Benthos thesis samples	8-04-71, no. 1	2.18
	"	8-04-71, no. 2	1.50
	"	8-04-71, no. 3	1.93
	"	8-04-71, no. 4	1.51
	"	8-04-71, no. 5	1.98
	"	8-18-71, no. 1	1.52
	"	8-18-71, no. 2	1.10
	"	8-18-71, no. 3	1.38
	"	8-18-71, no. 4	0.87
	"	8-18-71, no. 5	0.64
	"	10-16-71, no. 1	0.00
	"	10-16-71, no. 2	0.92
	"	10-16-71, no. 3	1.00
8. DOME	--	9-09-70	0.00

APPENDIX C

THE SIGNIFICANCE OF SELECTED PHYSICAL AND CHEMICAL VARIABLES IN BENTHIC MACROINVERTEBRATE DISTRIBUTION IN A SMALL SUBARCTIC STREAM

A

THESIS

Presented to the Faculty of the

University of Alaska in Partial Fulfillment

of the Requirements

for the Degree of

MASTER OF SCIENCE

By

Dennis Leon Ward, B.S.

College, Alaska

April, 1972

APPENDIX C

ABSTRACT

The objective of this study was to determine whether temperature, velocity, dissolved oxygen, or pH operate singly, synergistically, or additionally, to control or limit distribution of Ephemeroptera, Plicoptera, and Trichoptera, in Goldstream Creek. It has been demonstrated that temperature ranges from 9.0 - 12.5 C promoted the greatest mayfly nymphal development between June 14, 1971 and October 16, 1971 in Goldstream Creek. Mayflies were dependent on velocity for distribution during both high and low density periods. Caddis flies were velocity dependent during both high and low density periods. Natural biological gradation can be demonstrated in Goldstream Creek.

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