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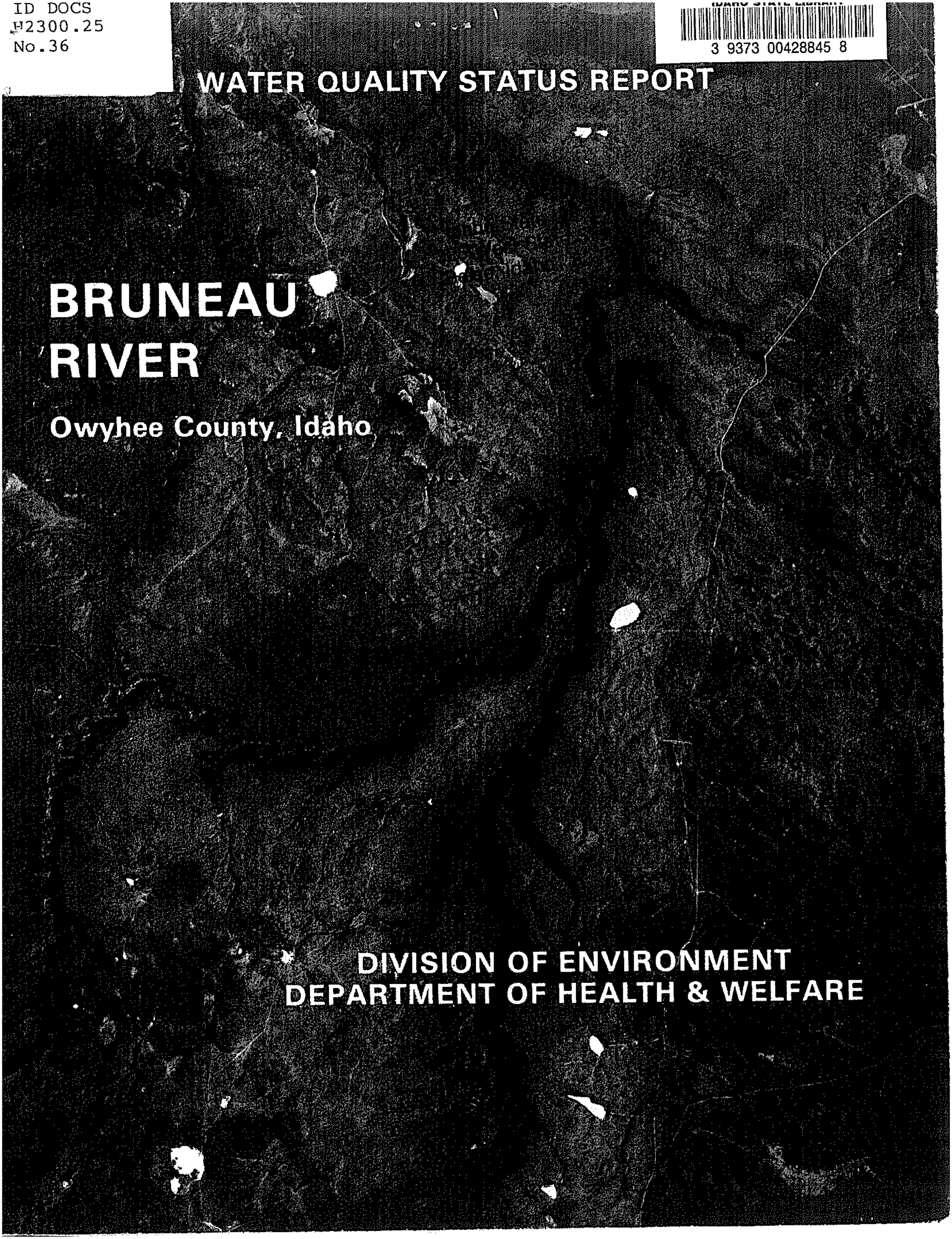
WATER QUALITY STATUS REPORT

BRUNEAU RIVER

Owyhee County, Idaho



DIVISION OF ENVIRONMENT
DEPARTMENT OF HEALTH & WELFARE

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WATER QUALITY STATUS REPORT

BRUNEAU RIVER

OWYHEE COUNTY, IDAHO

1975

Report by:

William H. Clark

1979

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Survey Conducted by:

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IDAHO DEPARTMENT OF HEALTH & WELFARE
DIVISION OF ENVIRONMENT
Boise, Idaho

Water Quality Series No. 36

COVER PHOTOGRAPH

High altitude photograph of the Bruneau River System, Owyhee County, Idaho. The East Fork Bruneau River enters from the top right of the photo. The West Fork Bruneau River enters from the lower left of the photo. The Jarbidge River enters from the bottom (South) of the photo. The photograph is from color infrared at a scale of 1:125,000.

Photograph is courtesy of NASA and the Idaho Department of Water Resources.

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ABSTRACT

A water quality survey of the Bruneau River System was conducted by IDHW, Division of Environment during 1975 (May 14-15, September 3-4, and October 14-15). The survey was conducted to help determine if the Bruneau River in Idaho qualifies for inclusion in the National Wild and Scenic Rivers System, to determine the water quality status, and to attempt to assess nonpoint source problems.

Nine sample stations on the Bruneau Rivers and Jarbidge Rivers were examined for physical, chemical, and biological parameters.

The May sample represents the peak of the hydrograph (runoff period) for the survey. Visually the runoff period increased turbidity and the discharge of the system. Both loadings and concentrations of solids, BOD_5, nitrogen, phosphorus, iron, and bacteria were increased and at their maximum during this time.

The Hot Springs generally increase water temperature, fluoride, and fecal coliform bacteria and depress dissolved oxygen and macroinvertebrate species diversity (although only slightly).

Since no point sources are known along the river, the major influences on water quality must be attributed to natural sources and to a lesser extent to nonpoint sources especially in the lower Bruneau Valley.

Fluoride, iron and bacterial concentrations at times exceed the maximum limits provided by the State of Idaho for drinking water. Zinc concentrations may be toxic for some aquatic life. For public health requirements, it is recommended that all surface waters be treated before human consumption.

PURPOSE OF STUDY

The primary purpose of this survey was to provide water quality data to assist in determining the suitability of the Bruneau River System for the National Wild and Scenic River System.

Other purposes of the study are to determine the status of the water quality for segment classification, to offer an indication of nonpoint source problems and to provide background water quality data for this river system.

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INTRODUCTION

The Bruneau River System under study is located in the south central and south eastern portion of Owyhee County in southwestern Idaho (See Figure 1). It has an approximate drainage area of 3,310 square miles (8573 Km^2) (Ross & Savage 1967).

The major tributaries of the Bruneau River included in the study are: The East and West Forks of the Bruneau River, the East and West Forks of the Jarbidge River, Sheep Creek and Mary's Creek. Unsampled minor and intermittent tributaries entering the river system include: Black Leg Creek, Bull Creek, Cat Creek, Columbet Creek, Cottonwood Creek, Cougar Creek, Dorsey Creek, Hot Creek, Louse Creek, Loveridge Creek, Miller Water Canyon, Poison Creek and Pole Creek. Big Jacks Creek and Little Jacks Creek enter the Bruneau River downstream from the Highway 51 bridge west of Bruneau (Below Station 1).

LAND USE

The U. S. Department of Interior's Bureau of Outdoor Recreation (BOR) (now the Heritage Conservation and Recreation Service) is considering 230 river miles (370 Km) for inclusion in the National Wild and Scenic Rivers System in cooperation with various State and Federal agencies. According to the Bureau of Outdoor Recreation (1975) the 73,600 acres (297,859 ha) along the length of the river has an ownership, as follows:

	River Miles	Acres	Percent
Federal	184	58,880	80
State	12	3,840	5
Private	34	10,880	15
Totals	230	73,600	100
	(370 Km)	(297,859 ha)	

The U. S. Department of Interior, Bureau of Land Management (BLM), administers most of the federal lands in Owyhee County. All of the federal land back above the Bruneau, Jarbidge and Sheep Creek canyons is grazed by livestock (cattle, sheep and some horses).

Under permit from the BLM, some winter grazing occurs within the Bruneau Canyon upstream from Indian Hot Springs (near Station 2) and in Sheep Creek Canyon.

A large area along the eastern part of the main Bruneau Canyon composes the Saylor Creek Air Force bombing practice range.

All State lands are school sections and most of them are under grazing lease.

Owyhee County has a 1980 population of 8,239 (IDHW 1980).

Private land ownership is higher along the river bottoms than in the uplands because the more desirable homestead lands border the streams. The land along the lower 16 miles (25.7 km) of the Bruneau River (downstream from the mouth of the canyon) is in private ownership. This land is mostly irrigated for pasture, row crops and hay. Recently, large pivot sprinkler systems have been installed.

Annual assessment work is done on about 40 mine claims in the area; none are patented. Limited mining of jasper occurs near Indian Hot Springs (located just below the confluence of the Jarbidge River and Sheep Creek, Figure 1) and is the only currently active operation. Gold mining claims are filed along the Jarbidge River; a mercury claim (inactive) is on Sheep Creek; and limestone and gold claims have been filed on Hot Creek (located just upstream of Station 2 in Figure 1).

The main forms of recreation in the area are hunting and fishing. The river area is also used by boaters and hikers. Some commercially-operated recreational facilities are located at Murphy Hot Springs (Figure 1).

GEOLOGY AND SOILS

The lower portion of the Bruneau River system flows through the Malheur-Boise-King Hill section, while the very upper portion near Nevada lies in the Owyhee uplands section, geomorphic province (Ross & Savage 1967). A portion of the water for the Bruneau River originates in the Jarbidge Mountains in northern Nevada at an elevation near 11,000 feet (3,353 m). It flows through the Owyhee Uplands section, which has surface elevations of 4,000 (1,219 m) to 5,000 (1,524 m). Most of the lavas of the Owyhee Uplands are older than those of the Snake River plains to the north. Some of the lava is basalt, but most of the rocks are rhyolites and welded tuffs. Structurally, the Owyhee Uplands section is an uplifted area with doming and block-faulting common. Because this section is at higher elevations and because erosion has been active over a larger time, this area is very deeply dissected which forms the present day Bruneau Canyon. The Malheur-Boise-King Hill section is lower in elevation, nearing 2,500 feet (762 m) at the mouth of the Bruneau River. This area consists mainly of lacustrine and fluviatile sediments that are extensively interbedded with basalt flows. These lava flows can be seen in the rims and walls of the Bruneau and tributary canyons (Ross & Savage 1967).

According to the USDA (1973), the general soils of the area are as follows:

The upper reaches of Mary's Creek and Sheep Creek flow through shallow 25-51 cm (10-20") and moderately deep 51-102 cm (20-40"), well-drained, neutral to slightly acid, stony loam and silt loam soils that are moderately steep (12-30%) and weathered from sedimentary and acid igneous rocks. The precipitation of the area is variable and receives 25-76 cm (10-30") of annual precipitation.

The head waters of the Jarbidge River and the East Fork of the Bruneau River are in moderately deep, well-drained, slightly acid to mildly alkaline, silt loam soils that are nearly level (0-2%) to moderately steep (12-30%), and formed in wind-laid silts and materials weathered from basic and igneous rocks. This area receives 28-41 cm (11-16") of average annual precipitation.

The central portion of Mary's Creek and, to a lesser extent, Sheep Creek, pass through shallow 25-51 cm (10-20") to deep more than 102 cm (40"), well-drained, neutral to mildly alkaline, stony and gravelly loam soils that are sloping (2-12%) to steep and formed in materials weathered from basalt and rhyolite. This area receives 20-41 cm (8-16") of average annual precipitation.

The majority of the Bruneau River System flows through soils that are deep, moderately deep and shallow, well-drained, neutral to moderately alkaline, silt loam soils that are undulating and formed in wind-laid silts. The mean annual temperature of this area is 8.3° C (47° F) and it receives about 20-30.5 cm (8-12") of average annual precipitation.

Leaving the mouth of the Canyon, the lower portion of the Bruneau River flows through agricultural soils which are deep and moderately deep, well-drained, mildly and moderately alkaline, silt loam to sandy loam soils that may be gravelly, and are nearly level to sloping and have formed in mixed alluvium and lake sediments. This area receives 10-30.5 cm (7-12") of annual precipitation.

VEGETATION

According to Kuchler (1964), the natural vegetation of the Bruneau River System is as follows:

In Nevada the Jarbidge River forms in the Great Basin Pine Forest. The headwaters of Mary's Creek begin in a wheat grass (*Agropyron spicatum*) and blue grass (*Poa secunda*) community which is a dense, low to medium tall grassland.

The majority of the river system flows through the sagebrush steppe vegetation type. This is an area of dense to open grassland with dense to open shrub synusia. The dominant vegetation is bluebunch wheatgrass (*Agropyron spicatum*) and big sagebrush (*Artemisia tridentata*).

Lupinus sericeus, Orysopsis hymenoides, Plox spp., Poa nevadensis, Poa secundia, Purshia tridentata, and Sitanion spp. also are common components of the vegetation.

A small portion of the eastern rim of the West Fork of the Bruneau River Canyon and a portion of the western rim of the main Bruneau Canyon plus the flat area from the mouth of the canyon to the mouth of the river are in a saltbrush (Atriplex) greasewood (Sacrobatus) vegetation type. This area is characterized by open stands of low shrubs and dwarf shrubs. The dominants are shadscale (Atriplex confertifolia) and greasewood (Sarcobatus vermiculatus). Other components of this community are: Allenrolfea occidentalis, Artimisia spinescens, Ariplex spp., Distichlis spicatum, Eurotia lanata, Grayia spinosa, Kochia americana, Lycium cooperi, Menodora spinescens, and Suaeda torreyana.

The U. S. Bureau of Outdoor Recreation (BOR) (1976) shows the vegetation of the Bruneau Canyon itself as composed of brush, grass, cottonwood trees and Juniper trees (Figures 20-23 of the present report illustrates this canyon vegetation).

Some endangered or threatened plants may occur in the study area (Henderson et al. 1977).

Parsons (1968) describes the environment of Owyhee County including information and a map of a portion of the area now under study for Wild and Scenic River inclusion.

PAST STUDIES IN AREA

The U. S. Geological Survey (USGS) has maintained a flow station at Hot Spring (Station 2) from July, 1909, to March, 1915, and from October, 1943, to present. Water quality data has been recorded since October, 1965.

The USGS also has a flow measurement station at Rowland, Nevada, which is located on the West Fork of the Bruneau River only a few miles south of the Idaho-Nevada border. Station 6 is just north of this gage. Records are available from June 1913, to September 1918, with annual maximums for water years 1962-1966 available, and complete records for October 1966, to present.

The following miscellaneous sites have been recorded by USGS (1974a and 1974b):

Station	Type	Period of Record
West Fork Jarbidge River (Station 5)	Flow & Field Measurements*	1961 - 1966 1973
Buck Creek (mouth) (Station 5)	Flow & Field Measurements	1961 - 1962 1973
East Fork Jarbidge River (Station 4)	Flow & Field Measurements	1928-1933, 1953-1971** 1973

* Temperature and specific conductance
** Peak flows

Stoner (1978) presents some water quality data for Big Jacks Creek for June 15, 1972.

Riggs and Warenberg (1976) presented recorded and estimated flows for many streams in Owyhee County including the Bruneau River and some of its tributaries.

The Bureau of Outdoor Recreation (BOR) began a study of the Bruneau River system in 1972 to determine if portions of it satisfied the criteria for inclusion in the National Wild and Scenic Rivers System.

In the Draft Environmental Statement prepared by BOR (1975), they conclude:

> "The waters presently are of high enough quality to support native aquatic life and permit swimming. The confined nature of the canyons, however, make waste disposal difficult."
>
> "As long as the amount and type of recreational use are carefully regulated and adequate sanitary facilities are provided at campgrounds, the overall impact should be minimal. The Bureau of Land Management will include provision for such safegards if the proposal is adopted."

The Bureau of Land Management, Boise District Office, is currently studying this river as part of the Owyhee Resource Area.

Hydrologic investigations have been conducted on the Reynolds Creek Experimental Watershed in Owyhee County since 1961 by the Agricultural Research Service - U. S. Department of Agriculture (for example see Stephenson and Street 1978).

The geothermal properties of the Bruneau Area have long been known (Russell 1902 and Waring 1965).

The lower Bruneau River has recently been designated a known geothermal resource area (KGRA) and is currently under study by the U. S. Department of Energy (Spencer *et al*. 1979). Some ground water quality data is presented in this report.

The Bureau of Land Management has identified a portion of the West Fork Bruneau River and the East Fork Jarbidge River both near the Nevada-Idaho border for intensive inventory (Wilderness Review).

MATERIALS AND METHODS

Nine sample sites were chosen to give a representative picture of the river system. Stations 1, 3, 7, and 8 were sampled from bridges, the remaining from streamside (Figure 1). The sample stations are as follows:

Station #	Description & Location
1	Bruneau River near Bruneau T6S, R5E, S25; Latitude 42^{o} 53'N, Longitude 115^{o} 48'W; Elevation 763 m (2500')
2	Bruneau River at Hot Springs T7S, R6E, S27; Latitude 42^{o} 46'N, Longitude 115^{o} 43'W; Elevation 793 m (2600')
3	Bruneau River, East Fork, at Clover Crossing T11S, R9E, S23; Latitude 42^{o} 27'N, Longitude 115^{o} 22'W; Elevation 1342 m (4400')
4	Jarbidge River, East Fork, below Murphy's Hot Springs T16S, R9E, S14; Latitude 42^{o} 02'N, Longitude 115^{o} 23'W; Elevation 1525 m (5000')
5	Jarbidge River, West Fork, above confluence with East Fork Jarbidge River; T16S, R9E, S10; Latitude 42^{o} 03'N, Longitude 115^{o} 24'W; Elevation 1525 m (5000')
6	Bruneau River, West Fork T16S, R7W, S8; Latitude 42^{o} 03'N, Longitude 115^{o} 34'W; Elevation 1403 m (4600')
7	Mary's Creek (SE of Grasmere) T13S, R5E, S11; Latitude 42^{o} 19'N, Longitude 115^{o} 48'W; Elevation 1525 m (5000')
8	Sheep Creek (SE of Grasmere) T14S, R6E, S15; Latitude 42^{o} 12'N, Longitude 115^{o} 44'W; Elevation 1525 m (5000')
9	Bruneau River, East Fork, at Winter Camp T10S, R8E, S15; Latitude 42^{o} 33'N, Longitude 115^{o} 31'W; Elevation 1171 m (3840')

Field parameters were determined with the use of portable meters. Dissolved oxygen and temperature were measured with a Yellow Springs Instrument Company Model 54A meter. The pH was determined with a Photovolt 126A pH meter. The meters were calibrated at the beginning of each survey and checked for accuracy at the end of the survey.

Photographs were taken with a 35mm SLR camera.

Flow was measured in September and October, 1975. The water level was too high for hand measurements in May. A relatively stable, confined section of the stream was chosen for flow measurement. The stream was then divided into segments and velocity measurements were made using a standard wade rod and pygmy current meter. Flow measurements at Stations 3 and 4 were made in confined concrete channels.

Observations were recorded of weather conditions and general water characteristics.

Samples collected for chemical and bacteriological analysis were obtained with the use of an extendable "dipper" sampler.

Chemical samples were collected in two Nalgene one liter polyethylene bottles. Both were preserved at 4° C on ice. A third liter sample was collected in a disposable polyethylene cubitainer, preserved with 2 ml of H_2SO_4, and cooled to 4° C for nutrient analysis.

Trace (heavy) metal sampling was conducted on the October survey. Samples were collected in 250 ml glass bottles containing 2 ml of HNO_3 and placed on ice.

Coliform bacteria were sampled by collecting 125 ml of water into a sterile glass bottle. Samples were preserved on ice, at 4° C.

In May, the water was too high for benthic sampling. Benthos were sampled during the September and October surveys. When possible, the bottom sampling was done in depths of one foot or less. Three discrete samples were taken at each station with one square foot (0.093 m^2) Surber Sampler. The samples were sorted from the rocks in the field and preserved in alcohol. Water mites (Acari) were hand collected in the field with a pipette to prevent loss. The substrate type, water depth and water velocity were determined and recorded for each station.

Macroinvertebrates were sorted from the debris at the laboratory. The specimens were identified by the author unless otherwise noted. Voucher specimens are deposited with the Division of Environment, Boise, Idaho.

Invertebrates were identified using the following references: Brown (1972); Edmondson (1959); Jensen (1966); Lehmkuhl (1979); Logan (1967); Merritt and Cummins (1978); Usinger (1963); and Wiggins (1977). Species diversity was calculated using the machine formula of Lloyd, Zar, and Karr (1968) as presented by Weber (1973).

RESULTS AND DISCUSSION

Waste Sources

Point Sources

No known point sources occur along the Bruneau River System at this time.

Nonpoint Sources

The majority of the Bruneau River system apparently received minimum impact from nonpoint sources.

Mining and road construction activities are low. Past mining activities on the Jarbidge may be important. For most of the river system, livestock grazing is the only significant potential form of nonpoint source pollution. The recreation facility at Murphy Hot Springs may be a probable source during certain times of the year, but was not found to be significant during this survey.

Buck Creek was a source of nonpoint pollution during the May, 1975, survey (See Figure 3). The input into Buck Creek was believed to be a livestock confinement facility at the Diamond "A" Ranch in Nevada. Sheep Creek, Mary's Creek, upper West Fork of Diamond River and the East Fork of Bruneau River all appear to have natural or nonpoint source influence at times.

Potential nonpoint source impacts are found in the lower few miles of the Bruneau River from near the mouth of the canyon to the mouth of the river. The major inputs may occur during the late spring, summer and early fall from agricultural return flow waters. There is probably some impact from livestock overwintering in the area.

Platts (1978) in summarizing our state of knowledge concerning livestock interactions with the aquatic environment notes that rangelands have been altered for so long that we don't have adequate documentation of "natural" conditions that existed before man's alterations. Platts states that livestock grazing can affect the streamside environment, channel morphology, the structure of the soil portion of the streambank, and the water column. The water column can be altered by "increasing water temperature, nutrients, suspended sediment, and bacterial counts, and by altering the timing and volume of waterflow".

Johnson *et al*. (1978) have shown that cattle grazing significantly increased bacterial contamination of a stream in Colorado.

Physical Parameters

Temperature

Water temperatures are listed in Table 1 and shown in Figure 4. Figures 2 and 3 give temperature for Stations 1 and 2 respectively for a period from 1972 to 1976 and 1972 to 1975 (Station 2 was discontinued as a routine sample station). These figures show relatively long-term temperature trends for the lower river stations. The station at Hot Springs (Station 2) has higher winter temperatures than similar streams in S.W. Idaho (unpublished data, IDHW) and apparently has a direct effect on the elevated temperatures of Station 1 (near mouth). Station 2 had minimum temperatures of around 5° C and Station 1 had minimum temperatures of about $2\text{-}3^{\circ}$ C. This contrasts to temperatures of 0 and even -0.5°C for comparable rivers in the winter.

Figure 3 shows summer temperatures exceeding the maximum criteria of 19° C for salmonid fish. This may inhibit development of a fishery in this reach.

Temperatures measured during the survey (Table 1 and Figure 4) show a range of 7.5 - 17.6° C for the survey. Not much variation was observed on a given survey date and this range was due primarily to the time lapse between stations.

Dissolved Oxygen

Dissolved oxygen (% saturation) at Stations 1 and 2 for the period 1972-1976 and 1972-1975 respectively are shown in Figures 2 and 3 in relation to the 90% (of saturation) State Standard. Some violations of this standard are apparent. These may be mostly due to the slow moving character and high pool to riffle ratio of this reach.

The dissolved oxygen concentrations were never less than the 6 mg/l State Standard (Figure 5, Table 1). The data varies some from station to station with the time lapse between stations playing an important part. The slightly elevated temperatures at Stations 1 and 2 may account for the slightly lower concentrations at these stations. The highest concentrations at Station 8 (Mary's Creek) during September and October, 1975, were the result of dense macrophyte and submerged algal communities present at that station.

The percent saturation values of dissolved oxygen dropped below the 90% Standard 5 times (20% of samples). The highest values were found at Station 8 as discussed above (Figure 5, Table 1).

pH

The pH for the survey is shown in Figure 4 and listed in Table 1. The pH values found only violated the 6.5 - 9 Standard Units (SU) State Standard two times (8% of samples). These were both in October and were values slightly above 9 SU. The pH of a water represents the interrelated result of a number of chemical equilibria. Some of the pH values were relatively high and may be partly explained by photosynthesis. Aquatic plants take up dissolved carbon dioxide during the daylight hours and can yield high pH values.

Flow (Discharge)

The flow data consists of two types: discharge for the Bruneau River at Hot Springs (Station 2) from USGS (1975); and discharge measurements taken by IDHW during the September and October, 1975, surveys. The high flows found during the runoff period encountered in the May survey precluded measurements then.

Figure 6 shows the general nature of the discharge of the Bruneau River at Hot Springs (Station 2). The high flow period ranges from March through June depending on the particular year in question with peak flow (hydrograph peak) usually in May. Yearly low flow occurs from August through October.

Figure 7 shows the discharge at the sample stations during the September and October surveys. During this season the tributary streams are of relatively low discharge and all combine to yield a more significant flow at Stations 1 and 2.

Riggs and Harenberg (1976) listed some measured and estimated flows for the Bruneau River and many of its tributaries for the months of July 1975, and September 1972.

Chemical Parameters

The results of the chemical analyses are listed in Tables 2 and 3.

Chemical Oxygen Demand

Chemical oxygen demand (COD) is used to determine the oxygen equivalent of the organic matter in a sample that is susceptible to oxidation.

COD values (Table 2) were highest at the mouth (Station 1) and Clover Crossing (Station 3) possibly corresponding to human activities in these areas. These values are not particularly high and are similar to those found on the Owyhee River (Clark 1978).

Biochemical Oxygen Demand

Biochemical oxygen demand (5-day) (BOD_5) is used to determine the oxygen equivalent of the organic matter in water than can be oxidized by biological systems. The BOD_5 levels (Table 2) for the survey were mostly values less than one, with a single sample having a maximum of 2.2 mg/l. This would be expected in this type of stream receiving no industrial or municipal pollution.

Alkalinity

Alkalinity is not a polluting substance, but is a measure of the buffering capacity of water. The alkalinity values are shown in Table 2. Alkalinity is associated with pH and hardness. The Environmental Studies Board (1973) notes that alkalinities above 30-35 mg/l are required to have a non-corrosive type of water. The Bruneau River values are just above this minimum. Figures 10 and 11 show long-term trends in alkalinity for Stations 1 and 2 respectively and show the annual variation found.

Solids

The analyses for solids is a measure of the dissolved ionic and suspended material in the stream.

Total solids (residue remaining after evaporation at ca. 105° C) were highest on the lower and main river stations as would be expected (Table 2 and Figure 9). The total solids value for the May "runoff period" (mean 572 mg/l) were significantly higher than the "low flow" period (mean 145 mg/l) due to sediment washed into the river. This is shown in the suspended solids (nonfiltrable residue) data (Table 2).

Specific Conductance

Specific or electric conductance is an indication of the ion concentration of water.

Specific conductance values were highest on the main stream Bruneau River Stations (Table 2 and Figure 8). The tributaries were relatively lower in value with the forks of the Jarbidge River yeilding the least. These values are less than many waters (Hem 1970) but are similar to those found on the Owyhee River (Clark 1978).

Specific conductance varied with season at main river stations (Table 2). Station 1 (mouth) showed the largest variation, increasing from 12 µmhos/cm in May to 34 in September.

Turbitity

Turbidity is another measure of the amount of suspended material being carried in a stream. Turbidity values (Table 2 and Figure 9) were also significantly higher during the May "runoff period". During the May survey, the West Fork of the Bruneau River had the highest turbidity value for the study (140 J.T.U.). Buck Creek seems to have been a major influence on the Jarbidge River system in May and October (See Table 2 and Figure 3).

Nutrients

Nutrients are a major concern when examining the water quality of a stream. An inadequate supply of nutrients may yield an "unproductive" stream. Yet an excess amount of nutrients may yield a "polluted" stream containing an overabundance of plant and animal growth. The most readily available forms of nutrients available for algal utilization are total inorganic nitrogen (TIN = $NH_3 + NO_2 + NO_3$) and orthophosphate (0 - PO_4).

The level of total inorganic nitrogen (TIN) considered to be critical for algal bloom potential is approximately 0.3 mg/l (Tangerone and Bogue 1975). During the May 1975, survey all stations exceeded this level. This may apparently be attributed to "natural runoff" since no samples exceeded the 0.3 mg/l level during the "low/flow" period (Table 3 and Figure 14). The highest nitrate values were found in May for Station 5 (West Fork Jarbidge River). This is attributed to Buck Creek (Figure 14).

Figures 12 and 13 show the trends for nitrate from 1970-1976 for Station 1 and for 1972-1976 for Station 2 respectively. They are compared to the algal bloom potential level which is for TIN. These trends show a great variability with a slight lowering in nitrate for the period of record.

The concentration of dissolved orthophosphate often considered to be critical for algal bloom potential in lakes is approximately 0.01 mg/l (Sawyer 1947). There has been some debate concerning this value and Reckhow (1979) suggests a value of 0.02-0.025 mg/l as more realistic for free flowing streams. This limit was exceeded on most stations during the survey (Table 3 and Figure 14). The Jarbidge River stations usually had the lowest phosphate values for the survey except for Station 5 (West Fork) during May (Figure 14). This increase is attributed to the influence of Buck Creek.

The trends for phosphate at Stations 1 and 2 are shown in Figures 1 and 13 respectively compared with the algal bloom potential level. The phosphate concentrations have also been variable and while have apparently been lowered at Station 2 (Hot Springs) they appear to be elevated at Station 1 (mouth), suggesting agricultural influence in the lower few miles of the river.

Fluoride

Fluoride levels were examined because the lower area has some geothermal potential and a history of high fluoride levels. As can be seen in Figure 8 and Table 3, the levels are low except at Stations 1 and 2.

The maximum levels of fluoride established for drinking water systems (IDHW, 1977) are temperature dependent. According to these standards, the September samples at Stations 1 and 2 exceed the drinking water standards.

Trace Metals

Trace (heavy) metals are important because of their toxic effects on living organisms. Mercury (Hg), Lead (Pb), Copper (Cu), and Zinc (Zn) were examined during the October, 1975, survey. The results are shown in Table 4 and Figure 15. All of these metals were detected at Station 1 (mouth) possibly indicating downstream increases and perhaps a human relationship.

Mercury was only found in a detectable amount at Station 1.

The only additional station containing lead was 4 (East Fork Jarbidge River) possibly reflecting the mining history in the area.

Copper was found on both Jarbidge tributaries again reflecting past activities. It also occurred at Station 2 (Hot Springs).

Zinc was the most common trace metal being found at all stations. It was found in its highest concentrations at Stations 4 and 1 for the above reasons. As Zinc could be toxic or limiting to some of the aquatic life, Zinc is recommended to not exceed 5 mg/l for domestic water supplies (EPA 1977). Recommended levels for freshwater aquatic life depend on pH and hardness. The concentrations found at Station 1 and Station 4 may have an adverse effect on aquatic life.

During runoff, Iron exceeded the criteria suggested by EPA (1977) of 1.0 mg/l for freshwater aquatic life. The iron concentrations for the May survey were high for all stations except for the mouth (Station 1). Station 1 exceeded this criteria on the October survey. These iron values could limit some forms of aquatic life.

Miscellaneous

Additional chemical parameters which were examined to help characterize the Bruneau River system were: Chloride, manganese, sodium, potassium, and sulphate (See Table 3 for results).

Biological Parameters

Bacteriological Water Quality

The bacteriological water quality of the Bruneau River system is shown in Figures 16 and 17 and listed in Tables 5 and 6.

Bacteria of the Fecal Coliform group are considered indicators of fecal contamination from warm-blooded animals. The State Water Quality Standards (IDECS, 1973) state that a violation occurs if a single sample exceeds 500 organisms per 100 ml of sample. No samples taken during this survey exceeded this standard (Figure 16 and Table 5). The data were variable but showed the May "runoff period" as having the highest values. Fecal coliform values are not to exceed a geometric mean of 50/100 ml. This standard was exceeded during the May survey at most stations (Figure 16), associated with the runoff period. The mouth (Station 1) violated this standard on all three surveys.

The State Standard for total coliform bacteria is a geometric mean of 240/100 ml. This standard applies "where associated with a fecal source(s)" (IDECS 1973). Figure 17 and Table 5 show the variation found and show that the highest counts were made during the May survey. Geometric means of this data (Table 6) show only two water quality violations, for Stations 1 (mouth) and 8 (Mary's Creek). These violations may be primarily "natural" since they are caused by the high values of the "runoff period". These values may be due, in part, to nonpoint sources.

Bacterial levels are elevated somewhat at the lower Stations 1 and 2 throughout the year (Table 5, Figures 16 and 17). This is probably a result of increased livestock activity on the lower portion of the river. The other portions of the river showing high bacterial densities (Stations 6, 7, 8) are also in areas utilized by livestock. The elevated bacterial levels in streams in livestock grazing areas has been documented by Meehan and Platts (1978), Platts (1978), and Stephenson and Street (1978) to list a few recent papers. Stephenson and Street (1978) studied streams on the Reynolds Creek Watershed in Owyhee County, Idaho, and stated that "The occurrence of fecal coliforms was directly related to the presence of cattle on summer and winter pastures. Fecal coliform counts in adjacent streams were found to increase soon after cattle were turned in and remained high for several months after cattle were removed."

Varness et al. (1978) studies the influences of camping in areas with no sanitary facilities. They concluded "Indicator densities increased during weekend human-use periods when compared to weekdays. Increases in indicator densities were also noted downstream from heavily used camping areas compared to upstream sites." This research points to possible future problems with increased human use of the river system especially at concentrated camp sites and vehicle access points on the river.

MACROINVERTEBRATES

Macroinvertebrates are important as water quality indicators since they spend all or part of their life cycles in the water and thus reflect long-term conditions. Although accurate for many situations, chemical and physical analysis alone can't give enough biological information to predict long-range effects or to monitor change over time.

The macroinvertebrates collected during the September and October surveys are listed in Table 7. Densities for individual taxa are shown in Table 7. Table 8 is a general summary of the habitats, habits, trophic relationships and a brief statement of possible water quality significance of the invertebrates collected. Table 9 lists the macroinvertebrate diversity (d) and density for each sample date and a mean value for each station.

Winget and Mangum (1979) have developed a biotic condition index resulting in macroinvertebrate tolerance quotients (TQ). These numbers reflect a taxon's tolerance to levels of alkalinity, sulfate, sediment and stream gradient. Tolerance quotients range from 2 to 108. The more tolerant a particular taxon is to environmental stress, the higher the index number. If an organism has a high TQ it does not mean that it is restricted to a polluted habitat. Although all of these parameters were not examined during the present study the tolerance quotients of Winget and Mangum (1979) are presented for the species found.

The diversity index most commonly used (Wilhm 1970) is as follows:

0 - 1	=	Polluted
1 2.5	=	Unstable
2.5 - 3	=	Unpolluted

Using this scheme and Table 9, one can see that basically the upstream stations (#3-9, Figure 1) are in an "unpolluted" or stable condition. The lower stations (1, mouth and 2, Hot Springs) show a slightly lower diversity as would be expected because of increased concentrations of some pullutants and the nature of these lower reaches.

Table 8 summarizes the species of macroinvertebrates collected during the survey in relation to ecological information and requirements as well as some general information as to their possible water quality significance.

Macroinvertebrates (other than insects)

These organisms made up only a minor portion of the benthic fauna of the Bruneau River System (Table 7). The gastropods were found mainly at Station 8 (Mary's Creek). Here the slower waters and abundance of food contribute to their existence. The group appears pollution tolerant and has a TQ of 108 (Winget & Mangum 1979). Only a single pelecypod was collected during the survey although numerous empty shells were noted on the stream bank at Station 3 (East Fork Bruneau River). These normally inhabit more sandy and silty habitats and would not be expected in riffle samples.

Mites are often not found in benthic samples because of their small size. By field sorting the samples, five species were identified. Aquatic mites (Acari) are reported by Winget and Mangum (1979) as pollution tolerant (TQ=108).

As a group the annalida (worms and leeches) are pollution tolerant with a TQ of 108 (Winget & Mangum 1979). Few were collected during this survey reflecting good water quality.

Amphipoda (amphipods) are also pollution tolerant and were only found at Station 8 (Mary's Creek).

Insecta (insects)

The insects dominated the benthic fauna as would be expected. As can be seen from Table 8, the insects inhabit a wide variety of habitats. They also demonstrate a broad range of habits and trophic relationships which gives an indication of their importance in the stream ecosystem. The water quality significance of the insects found likewise is variable and shows a range of individual tolerance quotients from 18 (intolerant of pollution) to 108 (pollution tolerant).

Ephemeroptera (Mayflies)

A variety of mayflies was found during the survey (Tables 7 and 8). The Ephemeroptera have in the past been thought to be indicators of good water quality. There is currently some dispute concerning their indicator value. The answer probably lies in making specific determinations when possible. The mayflies are such a diverse group that the tolerance quotients for those collected during this survey range from 21 to 108. The Heptageniidae are intolerant to pollution contrasting with *Tricorythodes minutus* which is pollution tolerant, reaching large populations in many of Idaho's larger more polluted rivers. The Heptageniidae are mainly found above the lower two Bruneau River Stations (1 and 2) indicating good upstream water quality.

Odonata (Dragonflies and Damselflies)

The Odonata were most common at Station 8 (Mary's Creek) where conditions are more favorable for them. Some were also found at the lower Stations 1 and 2. Pennak (1953) states that these are rare in polluted waters but they occur at our stations with relatively lower water quality and Winget and Mangum (1979) give a TQ of 108 for the group.

Plecoptera (Stonefiles)

Stoneflies are well known inhabitants of streams of high water quality. Plecoptera were found at all of the sample stations indicating the generally good quality of the river system. They were more abundant at the upper stations (See Table 7). The Plecoptera found have tolerance quotients ranging from 18-48 (Winget & Mangum 1979).

Hemiptera (True bugs)

The truly aquatic Hemiptera were represented by *Ambrysus mormon*, the "creeping water bug". This insect is common in the lower Bruneau River which is near its northern distribution in the United States. These bugs are piercers and can (if provoked) inflict painful bites to swimmers. A TQ of 72 was assigned to them by Winget and Mangum (1979). A unique thermophyllic form occurs only at the Indian Bathtub area above Hot Springs (Station 2).

Coleoptera (Beetles)

The aquatic beetles (mainly Elmidae) are believed to be of water quality significance. The Elmidae (riffle beetles) spend their entire life cycles in the water. They are usually found in riffle areas and require high dissolved oxygen levels. Because they can withstand other pollutants Winget and Mangum (1979) assigned them a TQ of 108. The elmids were found mainly at the upper stations (Table 7). Several other beetles were found in small numbers during the survey.

Trichoptera (Caddisflies)

Caddisflies were common at all stations and were the most abundant group of organisms (Table 7). Hydropsyche were dominant at most stations. This genus is a pollution tolerant one found in most of Idaho's waters. The genus has a TQ of 108 (Winget & Mangum 1979). The variety of species found have a TQ range of 18 to 108. The remaining caddisflies are mostly found in unpolluted waters and occurred above Stations 1 and 2.

Diptera (flies)

The true flies were found at all stations. This is another diverse group as indicated by the species present (Table 7). There is a wide range of pollution tolerances in this group also, ranging from 24 to 108 for this survey. The most common tolerant forms present were the midges and black flies. They occurred at nearly all stations.

Lepidoptera (Butterflies and Moths)

The only member of this group present was the aquatic moth, Parargyractis, which was only found at the lower (#1, mouth) station. They do require well oxygenated water. They have a TQ of 72 (Winget & Mangun 1979).

CONCLUSIONS

The runoff period (hydrograph peak) occurred in May. Visually, the runoff period increased turbidity and discharge. Both loadings and concentrations of solids, BOD_5, Nitrogen, Phosphorus, Iron and bacteria were increased and at their maximum during this time.

The Hot Springs generally increase water temperature, fluoride and fecal coliform bacteria and depress dissolved oxygen and macroinvertebrate species diversity (although only slightly).

Since no point sources are known along the river the major impacts on water quality must be attributed to natural sources and to a lesser extent to nonpoint sources especially in the Bruneau Valley.

Fluoride, iron, and bacterial concentrations at times exceed the limits provided by the State of Idaho for drinking water. Zinc concentrations may be toxic for some aquatic life.

In general, water chemistry and benthic macroinvertebrates indicate that the river portion under study for inclusion is of good water quality. The Bruneau River is of good water quality as evidenced by physical, chemical and biological parameters, and suitable from that standpoint to be included in the National Wild and Scenic Rivers System.

RECOMMENDATIONS

1. It is recommended that the Bruneau River System under study be included into the National Wild and Scenic River System since it meets the necessary water quality requirements.

2. It is recommended that the agency or agencies involved in administering the Bruneau Wild and Scenic Rivers in Idaho take all necessary precautions required to preserve and not degrade the water quality of the river.

3. For public health requirements it is recommended that all surface waters be treated before human consumption.

4. Application of best management practices on grazing and irrigated lands should improve water quality.

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TABLE I

PHYSICAL PARAMETERS, BRUNEAU RIVER SURVEY, 1975

	Parameter	Stations #1	#2	#3	#4	#5	#6	#7	#8	#9
May 14, 1975	DO (mg/l)	10	9.6	8.4	8.6	10.4	9.0	9.4	9.6	---
	DO (% Saturation)	102%	100%	94%	82%*	101%	90%	90%	87%	---
	Temp. (°C)	13	13.5	16	10	10.5	12	9.0	8	---
	pH (SU)	8.2	8.3	8.1	8.0	8	8.3	7.9	7.8	---
	Flow (cfs)	3800**	3170	---	---	---	---	---	---	---
September 3, 1975	DO (mg/l)	8.3	8.9	9.8	8.5	8.4	10	8.9	12.5	---
	DO (% Saturation)	88%*	100%	105%	92%	87%*	99%	100%	142%	---
	Temp. (°C)	14.5	17.6	14.5	15	14	16	17	17.5	---
	pH (SU)	8	7.2	8.2	8.2	8.5	8.6	8.1	8.9	---
	Flow (cfs)	120**	115	15	32	22	31	3	2	---
October 16, 1975	DO (mg/l)	9	9.3	11.3	11.4	11	9.9	9.8	11.8	10.5
	DO (% Saturation)	87%	91%	94%	92%	104%	95%	92%	114%	101%
	Temp. (°C)	10	11	4	3	9.5	10	9.1	9.5	10
	pH (SU)	7.6	7.9	8.3	8	9.5	8.6	7.5	7.6	9.1
	Flow (cfs)	240**	163	20	26	30	54	22	10	43

---Station Not Sampled

* Below State Standard of 90% Saturation

** Estimated

TABLE 2

BRUNEAU RIVER SURVEY, LAB ANALYSES, 1975

May 14, 1975

Parameter	STATIONS #1	#2	#3	#4	#5	#6	#7	#8	#9
Turbidity (J.T.U.)	120	100	90	23	64	140	95	90	---
pH (Lab	7	7	7.1	6.6	6.6	7.3	6.8	6.7	---
Total Solids mg/l	713	675	785	113	239	975	595	482	---
Suspended Solids mg/l	---	---	5.4	50	159	772	540	460	---
BOD_5 mg/l	1.0	0.9	0.7	0.9	0.2	1.6	1.2	2.2	---
COD mg/l	---	---	---	---	---	---	---	---	---
Alkalinity H_2CO_3 mg/l	54	50	50	30	38	68	48	44	---
Specific Conductance (umhos/cm)	120	120	110	57	76	125	85	68	--

September 3, 1975

Parameter	#1	#2	#3	#4	#5	#6	#7	#8	#9
Turbidity (J.T.U.)	2.8	1.8	6.0	3.0	1.8	1.2	2.5	2.0	---
pH (Lab)	7.5	7.6	7.9	7.6	8.1	8.5	8.0	8.8	---
Total Solids mg/l	267	172	236	81	89	162	121	132	---
Suspended Solids mg/l	7	4	9	5	6	5	5	15	---
BOD_5 mg/l	0.5	1.2	0.7	0.7	0.8	0.7	0.7	1.2	---
COD mg/l	10.5	7.8	10.5	4.3	6.2	5.5	8.2	9.8	---
Alkalinity H_2CO_3 mg/l	130	90	70	32	40	118	82	96	---
Specific Conductance (umhos/cm)	340	205	140	63	87	240	150	175	---

October 15, 1975

Parameter	#1	#2	#3	#4	#5	#6	#7	#8	#9
Turbidity (J.T.U.)	3.8	1.7	3.8	1.7	25	2.3	2.1	3.6	4.0
pH (Lab)	7.6	7.8	7.5	7.1	7.6	8.1	7.7	7.8	7.8
Total Solids mg/l	217	145	143	68	82	176	135	113	124
Suspended Solids mg/l	14	4	7	1	3	8	3	1	7
BOD_5 mg/l	1.4	1.7	1.0	0.1	0.7	0.5	0.1	0.5	0.6
COD mg/l	13.2	9.2	13.0	6.2	9.2	10.0	9.8	11.4	12.8
Alkalinity H_2CO_3 mg/l	108	84	68	32	40	120	80	80	72
Specific Conductance (umhos/cm)	270	195	150	70	90	240	160	140	140

--- Not Sampled

BRUNEAU RIVER SURVEY, LAB ANALYSES, 1975

Date	Parameter*	STATIONS #1	#2	#3	#4	#5	#6	#7	#8	#9
May 14, 1975	NH_3	1.57	1.47	1.20	0.29	0.78	0.98	0.83	0.98	---
	NO_3	1.56	1.61	0.47	1.74	2.23	1.98	1.02	1.10	---
	NO_3 (N)	0.35	0.36	0.11	0.39	0.50	0.23	0.23	0.25	---
	NO_2	0.04	0.04	0.03	0.01	0.02	0.12	0.08	0.09	---
	PO_4	0.44	0.31	0.30	0.07	0.12	0.70	0.59	0.58	---
	PO_4 (P)	0.14	0.10	0.10	0.02	0.39	0.23	0.19	0.19	---
	Cl	3	3	2	2	2	4	6	6	---
	F	0.33	0.22	0.21	0.24	0.07	0.04	0.01	0.01	---
	Fe	0.01	2.86	2.16	0.66	11.36	3.37	2.21	2.91	---
	Mn	1	1.1	90	20	40	80	0.70	70	---
	Na	8.4	7.9	8.6	4.5	5.3	5.9	4	3.4	---
	K	3.7	3	5.2	1.9	2.7	3.8	3	2.2	---
	SO_4	50	40	32	10	19	12	10	10	---
September 3, 1975	NH_3	0.20	0.15	0.44	0.18	0.18	0.09	0.18	0.22	---
	NO_3	0.11	0.54	0.01	0.01	0.01	0.01	0.01	0.01	---
	NO_3 (N)	0.03	0.12	0.01	0.01	0.01	0.01	0.01	0.01	---
	NO_2	0.003	0.001	0.003	0.002	0.001	0.001	0.002	0.001	---
	PO_4	0.06	0.04	0.08	0.04	0.03	0.02	0.17	0.04	---
	PO_4 (P)	0.02	0.01	0.03	0.01	0.01	0.01	0.06	0.01	---
	Cl	2	3	3	2	2	2	3	2	---
	F	2.84	2.30	0.22	0.20	0.08	0.45	0.12	0.05	---
	Fe	0.01	0.03	0.23	0.06	0.01	0.02	0.10	0.03	---
	Mn	0.01	0.01	0.02	0.01	0.01	0.01	0.01	0.01	---
	Na	42.9	22.8	10.9	6	5.4	11.1	8.9	8.8	---
	K	6.3	3.8	4.3	2.5	3.2	3.7	4.1	3.1	---
	SO_4	30	12.5	11.5	40	11	14.5	10	10	---
October 16, 1975	NH_3	0.12	0.12	0.25	0.05	0.07	0.09	0.21	0.31	0.24
	NO_3	0.28	0.27	0.01	0.36	0.22	0.01	0.16	0.01	0.01
	NO_3 (N)	0.06	0.06	0.01	0.08	0.05	0.01	0.04	0.01	0.01
	NO_2	0.004	0.005	0.005	0.004	0.005	0.002	0.003	0.006	0.005
	PO_4	0.06	0.10	0.18	0.04	0.05	0.06	0.17	0.11	0.12
	PO_4 (P)	0.02	0.03	0.06	0.01	0.02	0.02	0.06	0.04	0.04
	Cl	5.8	3.9	4.8	2	2	20	2.9	2.9	3.9
	F	2	1.35	0.19	0.30	0.17	0.47	0.11	0.11	0.25
	Fe	1.76	0.14	0.23	0.28	0.48	0.21	0.14	0.14	0.19
	Mn	0.04	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	Na	28.7	17.3	9.6	10.5	6.3	4.0	10.1	7.3	6.6
	K	4.2	3.4	4.7	1.9	2.3	2.8	3.0	1.6	4.2
	SO_4	26	12	12.5	10	10	13	10	10	12

* All results reported in mg/l

--- Station not sampled

TABLE 4

BRUNEAU RIVER SURVEY TRACE (HEAVY) METAL CONCENTRATIONS

October 16, 1975

Station	Hg*	Pb*	Cu*	Cd*	Zn*
#1	.013	.02	.031	<.001	1.12
#2	<.005	<.01	.001	<.001	.046
#3	<.005	<.01	<.001	<.001	.006
#4	<.005	.02	.026	<.001	.171
#5	<.005	<.01	.002	<.001	.036
#6	<.005	<.01	<.001	<.001	.008
#7	<.005	<.01	<.001	<.001	.007
#8	<.005	<.01	<.001	<.001	.006
#9	<.005	<.01	<.001	<.001	.017

*mg/l

TABLE 5

FECAL AND TOTAL COLIFORM DENSITIES PER 100 ML
BRUNEAU RIVER SURVEY, 1975

Station	May 15, 1975		September 3, 1975		October 16, 1975	
	Fecal	Total	Fecal	Total	Fecal	Total
1	375	1400	72	150	75	180
2	225	600	32	34	15	99
3	175	1400	66	84	5	60
4	<5	<200	8	70	10	200
5	25	200	<2	14	<5	70
6	>400	5000	4	12	<5	14
7	275	3200	<2	8	5	44
8	>400	6000	2	5	15	70
9	---	---	---	---	30	50

---Station Not Sampled

TABLE 6

GEOMETRIC MEANS FOR

TOTAL COLIFORM BACTERIA/100 ml,

BRUNEAU RIVER SURVEY, 1975

STATION	GEOMETRIC MEAN
1	336*
2	58
3	163
4	141
5	70
6	94
7	104
8	276*
9	50 (Only one sample)

* Water Quality Violation

TABLE 7

Benthic Macroinvertebrates - Bruneau River, September 3-4 and October 14-15, 1975.

ORGANISM	DATE	SAMPLE STATIONS AND SUBSAMPLES (#/0.093 m^2) 1			2			3			4			5			6			7			8			9 (Comp. of 3 samples)
		1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1
MOLLUSCA																										
GASTROPODA																										
Planorbidae																										
Gyraulus sp.	Sept.	0	0	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	3	-
	Oct.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	36	19	6	0
Physidae																										
Physa sp.	Oct.	0	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	1	3	0
Ancylidae																										
Ferrissia sp.	Oct.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
PELECYPODA	Oct.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
ANNELIDA																										
OLIGOCHAETA	Oct.	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	1	2	0	0	0	0
HIRUDINEA																										
Erpobdellidae																										
Erpobdella punctata (Leidy)[1]	Sept.	0	0	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	-
ARTHROPODA																										
CRUSTACEA																										
AMPHIPODA																										
Talitridae																										
Hyalella azteca (Saussure)	Oct.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0
INSECTA																										
EPHEMEROPTERA (N)																										
Baetidae																										
Baetis bicaudatus Dodds	Sept.	0	15	-	12	5	5	0	6	12	6	0	34	1	6	4	8	4	3	5	17	7	10	2	7	-
	Oct.	3	13	13	14	0	3	5	15	1	35	17	20	85	17	0	21	28	19	10	2	6	27	17	40	30
Baetis intermedius Dodds	Sept.	10	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-
	Oct.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Heptageniidae																										
Cinygmula sp.	Sept.	0	0	-	0	0	0	0	0	0	5	1	0	2	2	0	1	0	0	6	9	4	8	0	0	-
	Oct.	0	0	0	0	0	0	10	45	0	15	5	69	105	20	0	12	4	2	3	13	11	0	0	0	18

ORGANISM	DATE	SAMPLE STATIONS AND SUBSAMPLES (#/0.093 m²) 1			2			3			4			5			6			7			8			9 (Comp. of 3 samples)
		1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1
Micrasema sp.	Oct.	0	0	0	0	0	0	0	0	0	0	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Helicopsychidae (L)																										
Helicopsyche sp.	Sept.	0	0	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	2	0	0	0	0	-
	Oct.	0	1	0	5	9	1	2	0	0	0	0	0	0	0	0	0	0	1	52	27	25	6	9	8	29
Leptoceridae (L)																										
Nectopsyche sp.	Oct.	0	0	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17	25	0	0	0	3
Unidentified	Sept.	0	0	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	-
	Oct.	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	1
DIPTERA																										
Tipulidae (L)																										
Hexatoma sp.	Sept.	0	0	-	0	0	0	0	0	0	4	1	2	0	0	1	0	0	0	2	1	1	0	0	0	-
	Oct.	27	17	2	0	0	0	0	0	0	1	6	1	16	3	4	1	0	0	2	0	5	2	0	0	0
Psychodidae (L)																										
Pericoma sp.	Oct.	0	0	0	0	0	0	0	0	0	1	0	0	0	0	3										
Simuliidae (L & P)																										
Simulium sp.	Sept.	3	10	0	0	0	0	1	0	0	0	0	0	0	3	0	0	3	0	258	100	2	4	0	0	-
	Oct.	1	2	4	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	9	0	6	1	0	0
Chironomidae (L & P)																										
Calopsectra sp.	Sept.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	14	0	0	3	1	0	-
	Oct.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	2	0	6	3	19	34	20	0
Unidentified	Sept.	3	13	0	3	4	12	3	0	0	5	108	57	30	22	12	7	10	15	10	0	3	79	14	40	-
	Oct.	2	3	2	12	2	0	8	2	1	70	10	9	52	10	63	30	42	57	4	10	0	10	7	16	35
Rhagionidae (Athericidae) (L)																										
Atherix variegata Walker	Sept.	1	0	-	2	4	7	0	0	0	2	5	13	6	0	9	1	7	5	0	0	0	0	0	0	-
	Oct.	0	0	0	3	1	3	0	0	0	15	20	10	26	0	7	6	19	8	3	1	2	0	0	0	1
Dolichopodidae (L)	Oct.	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Empididae (L)	Sept.	1	0	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-
Muscidae (L & P)																										
Lispe sp.	Oct.	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Unidentified (L)	Oct.	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	0	0	0	0	1	0	0	0	0	0
LEPIDOPTERA (L)																										
Pyralidae																										
Parargyractis sp.	Sept.	7	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-

ORGANISM	DATE	SAMPLE STATIONS AND SUBSAMPLES (#/0.093 m²) 1			2			3			4			5			6			7			8			9 (Comp. of 3 samples)
		1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1
HEMIPTERA																										
Naucoridae (A & N)																										
Ambrysus mormon Montandon	Sept.	44	13	-	1	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-
	Oct.	1	2	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Saltidae (A)	Oct.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
COLEOPTERA																										
Dytiscidae (A)	Sept.	0	0	-	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	-
Psephenidae (L)																										
Psephenus falli Casey	Sept.	0	0	-	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-
	Oct.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Dryopidae (A)																										
Helichus striatus LeConte	Sept.	0	0	-	0	0	0	0	0	0	0	0	0	0	0	0	0	1	5	0	0	0	0	0	0	-
	Oct.	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	2	0	0
Elmidae (A & L)																										
Microcylleopus pusillus (LeCorte)	Sept.	3	1	-	0	1	0	1	5	3	0	0	1	3	0	0	5	4	20	1	0	0	0	0	0	-
	Oct.	2	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	13	7	8	8	0	1	2	0	17
Optioservus divergens (LeCorte)[2]	Sept.	0	0	-	3	4	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	-
Optioservus quadrimaculatus (Horn)	Sept.	0	0	-	0	0	0	0	0	0	2	4	0	8	6	10	0	0	0	0	0	0	0	0	0	-
	Oct.	0	0	0	0	0	0	0	0	0	1	3	4	61	2	14	0	0	0	0	0	0	0	0	0	0
Optioservus seriatus (LeCorte)[2]	Sept.	0	0	-	0	0	0	0	0	2	0	0	0	0	0	0	9	10	13	1	3	0	0	0	0	-
	Oct.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	3	7	0	0	0	1	4	0	41
Zaitzevia parvula (Horn)	Sept.	1	2	-	0	0	0	0	0	6	0	0	0	4	0	0	10	6	13	0	0	0	0	0	0	-
	Oct.	0	4	1	0	0	0	1	0	0	5	2	2	13	1	24	4	13	4	0	0	0	0	0	0	8
Unidentified (L)	Sept.	0	0	-	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-
	Oct.	0	0	0	0	0	0	0	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TRICHOPTERA																										
Hydropsychidae (L)																										
Hydropsyche sp.	Sept.	390	0	0	20	9	40	0	0	13	13	12	12	29	25	0	20	15	18	15	19	10	2	1	2	-
	Oct.	3	0	171	37	75	307	10	4	2	149	40	56	359	29	68	18	25	20	9	0	0	25	22	19	257
Rhyacophilidae (L)	Oct.	0	0	0	0	0	0	0	0	0	0	0	0	7	3	12	0	0	0	0	0	0	0	0	0	0
Glossosomatidae (P & L)	Sept.	15	8	-	8	4	0	0	0	0	0	4	1	4	8	3	10	2	12	3	2	2	0	0	0	-
	Oct.	1	4	4	0	1	3	0	0	0	4	6	0	10	1	8	0	2	0	1	0	3	2	2	2	8
Brachycentridae (L)																										
Amiocentrus sp.	Sept.	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	-
	Oct.	0	0	0	0	0	0	0	0	0	91	34	6	46	40	220	0	0	0	0	0	0	0	0	0	0
Brachycentrus sp.	Sept.	28	4	-	6	2	95	1	2	12	4	2	2	7	7	3	0	2	8	0	0	0	0	0	0	-
	Oct.	1	15	23	7	11	25	2	5	1	8	8	0	21	0	4	1	1	0	0	0	0	0	0	0	11

ORGANISM	DATE	SAMPLE STATIONS AND SUBSAMPLES (#/0.093 m²) 1			2			3			4			5			6			7			8			9 (Comp. of 3 samples)
		1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1
Epeorus sp.	Sept.	0	0	-	0	0	0	0	1	2	0	0	0	0	0	0	1	0	0	1	0	5	0	0	0	-
	Oct.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0
Rhithrogena sp.	Sept.	0	21	-	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-
	Oct.	1	0	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Unidentified	Oct.	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ephemerellidae																										
Ephemerella grandis Eaton	Oct.	0	0	0	0	0	0	0	0	0	7	0	0	0	0	3										
Ephemerella hecuba (Eaton)	Sept.	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	-
Ephemerella hystrix Traver	Sept.	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	-
Ephemerella sp.	Sept.	2	0	-	0	0	5	0	0	0	4	8	0	0	0	0	0	0	0	0	0	0	0	0	0	-
	Oct.	0	0	6	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Leptophlebiidae																										
Paraleptophlebia sp.	Sept.	0	0	-	0	0	0	0	3	2	0	0	0	0	0	0	0	0	0	0	0	1	1	1	4	-
	Oct.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	0	0	0	0
Tricorythidae																										
Tricorythodes minutus Traver	Sept.	9	0	-	7	18	17	0	3	1	0	0	0	0	0	0	0	0	0	0	5	0	0	4	8	-
Polymitarcidae	Oct.	0	3	3	10	6	30	0	0	0	0	0	0	0	0	2	0	3	6	4	21	33	6	1	2	0
Ephoron album (Say)	Sept.	3	0	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-
Unidentified	Oct.	0	0	0	0	0	0	0	0	0	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0
ODONATA (N)																										
Gomphidae																										
Ophiogomphus sp.	Sept.	4	0	-	0	0	0	0	2	0	0	0	0	0	0	0	0	0	2	0	0	4	1	0	4	-
	Oct.	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	1	1	0	1	1	2	3	8	15	6
Coenagrionidae	Sept.	0	0	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	3	2	-
	Oct.	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	4	5	6	7	8	0
PLECOPTERA (N)																										
Pteronarcidae																										
Pteronarcys californica Newport	Sept.	0	0	-	0	0	0	0	0	0	2	0	0	1	0	0	1	1	3	0	0	0	0	0	0	-
Perlidae	Oct.	0	0	0	0	0	0	0	0	0	6	1	2	4	1	1	1	0	0	0	0	0	0	0	0	0
Hesperoperla pacifica (Banks)	Sept.	1	1	-	1	0	1	0	0	0	0	0	0	6	1	0	0	0	0	0	0	0	0	0	0	-
	Oct.	0	0	1	0	0	0	0	0	0	6	7	0	14	1	2	0	0	0	0	0	0	0	0	0	0
Unidentified	Sept.	2	0	-	0	0	0	0	5	0	2	3	3	0	0	0	5	0	1	25	1	3	0	0	0	-
	Oct.	0	0	0	0	0	0	0	0	0	3	0	2	0	0	0	1	1	1	0	0	0	3	0	0	0
Perlodidae	Sept.	0	0	-	0	2	1	6	6	1	0	0	0	0	0	2	4	0	0	0	0	2	2	0	0	-
	Oct.	0	0	0	0	0	1	6	6	1	8	7	3	0	0	10	0	0	0	1	0	0	0	5	4	45

ORGANISM	DATE	SAMPLE STATIONS AND SUBSAMPLES (#/0.093 m²) 1			2			3			4			5			6			7			8			9 (Comp. of 3 samples)
		1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1
ACARI																										
Sperchonidae																										
Sperchon sp.[3]	Sept	0	1	-	0	0	0	0	0	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Oct.	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lebertiidae																										
Legertia sp.[3]	Oct.	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Hygrobatidae																										
Hygrobates sp.[3]	Sept.	0	3	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Oct.	0	0	0	0	3	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Atractides sp.1[3]	Sept.	0	1	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Atractides sp.2[3]	Sept.	0	0	-	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

\- Station not sampled

[1]det. D. J. Klemm
[2]det. H. P. Brown
[3]det. D. R. Cook

A = Adult(s)
P = Pupa(e)
L = Larva(e)
N = Nymph(s)

TABLE 8.. Benthic Macroinvertebrates, Bruneau River Survey, Summary of Ecological Data (Insect Portion Modified after Merritt & Cummins, 1978) and Water Quality Significance.

TAXA	HABITAT	HABIT	TROPHIC RELATIONSHIPS	WATER QUALITY SIGNIFICANCE
MOLLUSCA (Snails and Clams) GASTROPODA (Snails)				Calcium carbonate essential for shell construction TQ 108
Planorbidae _Gyraulus_ sp.	Lotic - erosional and depositional (vascular hydrophytes), Lentic - erosional and depositional (vascular hydrophytes)	Climbers	Scrapers (algae and detritus)	Probably relatively pollution tolerant.
Physidae _Physa_ sp.	Lotic - erosional and depositional (vascular hydrophytes), Lentic - erosional and depositional (vascular hydrophytes)	Climbers	Scrapers (algae and detritus)	Usually requires aquatic vegetation[1] TQ 108
Ancylidae Ferrissia sp.	Lotic - erosional	Climbers	Scrapers (algae and detritus)	Require water at near oxygen saturation[1]
PELECYPODA (Clams)	Lotic and lentic	Burrowers	Collectors (detritus)	Unpolluted habitats[2]; Sensitve to pollution and siltation 2 and 3 TQ 108
ANNELIDA				
OLIGOCHAETA (Worms)	Lotic - erosional and depositional (Sediments, vegetation) Lentic - Sediments, vegetation	Burrowers	Collectors (detritus)	Tollerant to organic pollution; thrive in low dissolved oxygen concentraition [1] TQ 108
HIRUDINEA (Leeches) Erpobdellidae _Erpobdella punctata_ (Leidy)	Lotic - erosional and depositional, Lentic	Swimmers	Parasites, Piercers, Engulfers (Predators) Collectors	Tollerant to pollution [2] TQ 108

TABLE 8. (continued)

TAXA	HABITAT	HABIT	TROPHIC RELATIONSHIPS	WATER QUALITY SIGNIFICANCE
ARTHROPODA CRUSTACEA				TQ 108
AMPHIPODA Taltridae *Hyalella azteca* (Saussure)	Lentic and Lotic	Swimmers (mostly nocturnal)	Scrapers (algae and detritus)	Require an abundance of dissolved oxygen and colder waters 1
INSECTA (Insects) EPHEMEROPTERA (Mayflies)				TQ 108 (above) TQ 72
Baetidae *Baetis bicaudatus* Dodds *Baetis intermedius* Dodds	Lotic - erosional and depositional and Lentic - littoral	Swimmers Climbers Climbers	Collectors-gatherers, (detritus, diatoms), Scrapers	TQ 72
Heptageniidae *Cinygmula* sp.	Lotic - erosional	Clingers	Scrapers, collectors-gatherers	TQ 21
Epeorus sp.	Lotic - erosional	Clingers	Collectors-gatherers, Scrapers	TQ 21
Rhithrogena sp.	Lotic - erosional	Clingers	Collectors-gatherers, (detritus, diatoms), Scrapers	TQ 21
Ephemerellidae *Ephemerella grandis* Eaton *Ephemerella hecuba* (Eaton) *Ephemerella hystrix* Traver *Ephemerella* sp.	Lotic - erosional and depositional (vascular hydrophytes and sediments), Lentic - vascular hydrophytes	Clingers Sprawlers Swimmers	Collectors-gatherers (detritus, diatoms) scrapers, some shredders-herbivores, filamentous algae	TQ 24 TQ 48
Leptophlebiidae *Paraleptophlebia* sp.	Lotic - erosional (Sediments and detritus)	Swimmers, Clingers Sprawlers	Collectors-gatherers (detritus, diatoms), shredders-detritivores	TQ 24
Tricorythidae *Tricorythodes minutus* Traver	Lotic - depositional Lentic - littoral (sediments)	Sprawlers Clingers	Collectors-gatherers	Tend to be pollution tollerant TQ 108
Polymitarcidae Ephoron album (Say)	Lotic - erosional and depositional, Lentic - littoral (sediment)	Burrowers	Collectors-gatherers	TQ 48

TABLE 8. (continued)

TAXA	HABITAT	HABIT	TROPHIC RELATIONSHIPS	WATER QUALITY SIGNIFICANCE
ODONATA (Dragonflies)				
Gomphidae *Ophiogomphus* sp.	Lotic - erosional and depositional (sand) of small cold streams	Burrowers	Engulfers (predators)	TQ 108
Coenagrionidae (Damselflies)	Lentic and Lotic	Climbers	Engulfers (predators)	TQ 108
PLECOPTERA (Stoneflies)				
Pteronarcidae *Pteronarcys californica* Newport	Lotic - erosional and depositional (logs, leaf litter)	Clingers-Sprawlers	Shredders-detritivores, (engulfers, /predators/), (Scrapers)	TQ 18
Perlidae *Hesperoperla pacifica* (Banks)	Lotic and lentic erosional	Clingers	Engulfers (predators)	TQ 18
Perlodidae	Lotic and lentic erosional	Clingers	Engulfers (predators) some scrapers	TQ 48
HEMIPTERA (True Bugs)				
Naucoridae *Ambrysus mormon* Montandon	Lotic and lentic erosional (sediments and vasculary hydrophytes)	Clingers-Swimmers	Piercers - Carnivores	TQ 72
Saltidae	Lentic - vascular hydrophytes (emergent zone)	Climbers (at shore, semiaquatic)	Piercers - carnivores (scavengers	N/A
COLEOPTERA (Beetles)				
Dytiscidae (Predaceous diving beetles)	Lentic - vascular hydrophytes, Some Lotic - depositional	Climbers, Swimmers	Piercers, Carnivores	TQ 72
Psephenidae (Water Pennies) *Psephenus falli* Casey	Larvae are aquatic Lotic and lentic-erosional	Clingers	Scrapers	Tolerant to variety of water quality conditions

TABLE 8. (continued)

TAXA	HABITAT	HABIT	TROPHIC RELATIONSHIPS	WATER QUALITY SIGNIFICANCE
Dryopidae (Dryopid beetles) Helichus striatus LeConte	Adults only are aquatic. Lentic-littoral, Lotic -erosional	Clingers, Climbers	Scrapers, Collectors-gatherers	Probably tollerant since larvae do not live in water.
Elmidae (Riffle beetles) Microcylleopus pusillus (LeConte)	Lotic - erosional and depositional	Clingers, Climbers, Burrowers	Collectors-gatherers Scrapers	Generally indicate excellent water quali Adults and larvae live in water. Requi high dissolved oxygen levels. 4, 5
Optioservus divergens (LeConte) Optioservus quadrimaculatus (Horn) Optioservus seriatus (LeConte)	Lotic - erosional and depositional (sediments and detritus)	Clingers	Scrapers, collectors-gatherers	
Zaitzevia parvula (Horn)	Lotic - erosional (cobbles and gravel)	Clingers	Scrapers, collectors-gatherers	TQ 108
TRICHOPTERA (Caddisflies)				
Hydropsychidae Hydropsyche sp.	Lotic - erosional, some lentic - erosional	Clingers (net spinning retreat makers)	Collectors-filterers Some engulfers (predators)	Tend to be pollution tollerant, often abundant below dams TQ 108
Rhyacophilidae	Lotic - erosional	Clingers (free ranging)	Generally engulfers (predators)	TQ 18
Glossosomatidae	Lotic - erosional	Clingers (Saddle or turtle shell case makers	Scrapers	TQ 32
Brachycentridae Aminocentrus sp.	Lotic - erosional (rocks and vascular hydryphytes)	Clingers, climbers (case a straight, tapered tube of silk)	Collectors-gatherers	TQ 24
Brachycentrus sp.	Lotic - erosional (on logs, branches or vascular hydrophytes)	Clingers (case tapered, smooth, square in cross section)	Collectors-filterers (algae, detritus	TQ 24
Micrasema sp.	Lotic - erosional (on logs, branches or aquatic hydrophytes	Clingers-Sprawlers (case of silk and vegetation)	Shredders-herbivores (chewers), collectors-gatherers	TQ 24

TABLE 8. (continued)

TAXA	HABITAT	HABIT	TROPHIC RELATIONSHIPS	WATER QUALITY SIGNIFICANCE
Helicopsychidae *Helicopsyche* sp.	Lotic and lentic-erosional	Clingers (case snail shell shaped, fine mineral)	Scrapers	Tend to be pollution tollerant TQ 18
Leptoceridae *Nectopsyche* sp.	Lentic - vascular hydrophytes, Lotic - erosional and depositional (vascular hydrophytes).	Climbers - swimmers (Case long, slender, of mineral and vegetation with long	Shredders-herbivores (chewers), Collectprs-gatherers (engulfers /predators/)	TQ 54
DIPTERA (True Flies)				
Tipulidae (Crane Flies) *Hexatoma* sp.	Lotic - erosional and depositional (detritus and moss), Lentic - Littoral (detritus)	Burrowers-sprawlers, Clingers	Engulfers (Predators; Oligochaeta, Diptera)	TQ 36
Psychodidae (Moth or Filter Flies) *Pericoma* sp.	Lotic - depositional (margins), Lentic - littoral (detritus)	Burrowers	Collectors-gatherers	TQ 36
Simuliidae (Black Flies) *Simulium* sp.	Lotic - erosional	Clingers (abdominal hooks; silk threads)	Collectors-filterers	TQ 108
Chironomidae (Midges) *Calopsectra* sp.	Lentic - vascular hydrophytes, Lotic - erosional	Climbers, Clingers (net spinners)	Collectors-filterers and gatherers, a few scrapers)	TQ 108
Unidentified	All types of aquatic habitats	Burrowers	Collectors-gatherers or engulfers (predators) and piercers-predators	TQ 108
Rhagionidae (Athericidae) *Atherix variegata* Walker	Lotic - erosional and depositional	Sprawlers-Burrowers	Piercers-predators	TQ 24
Dolichopodidae	Lentic and Lotic Margins (Semi-aquatic)	Sprawlers-Burrowers	Engulfers (predators)	TQ 108

TABLE 8. (continued)

TAXA	HABITAT	HABIT	TROPHIC RELATIONSHIPS	WATER QUALITY SIGNIFICANCE
Emphididae (Dance Flies)	Lotic - erosional and depositional (detritus), Lentic - littoral	Sprawlers-Burrowers	Engulfers (predators) Some collectors-gatherers	TQ 108
Muscidae Lispe sp.	Lentic - littoral, Lotic - depositional, erosional	Sprawlers	Engulfers (predators)	TQ 108
LEPIDOPTERA (Butterflies & Moths)				
Pyralidae Parargyractis sp. (Aquatic Moths)	Lotic - erosional Lentic - erosional	Clingers (silk retreat makers)	Scrapers	TQ 72
ACARI (Mites) Sperchonidae Sperchon sp. Lebertiidae Lebertia sp. Hygrobatidae Hygrobates sp. Atractides sp.1 Atractides sp.2	Lotic - erosional (vascular hydrophytes) Lentic - littoral (vascular hydrophytes)	Sprawlers, Climbers, Weak Swimmers	Parasites as larvae (aquatic and semi-aquatic insects) Piercers (carnivores) Collectors (detritus)	TQ 108

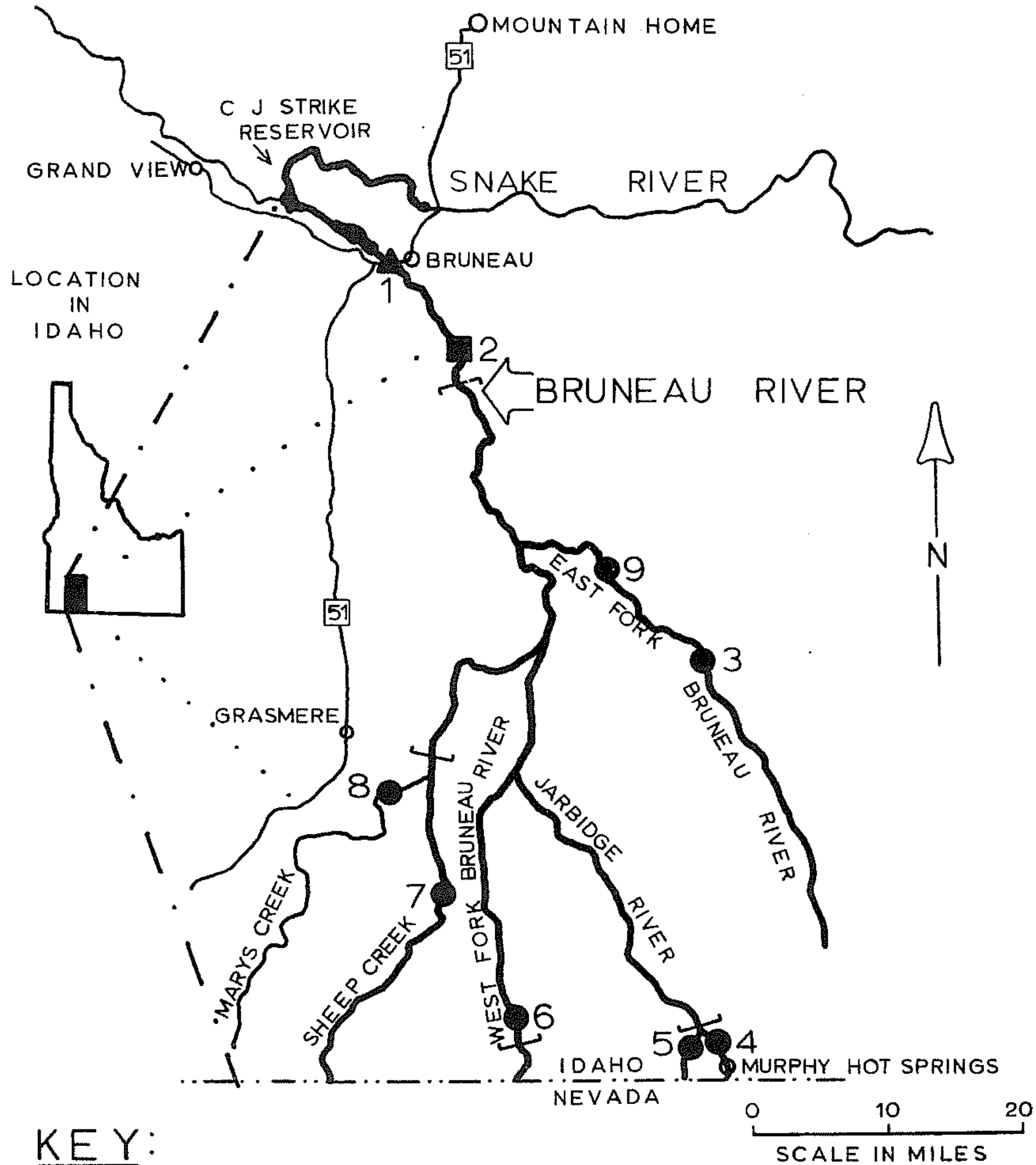
1. Pennak 1953
2. Sawyer 1974
3. Fuller 1974
5. Young 1961
6. Sinclair 1964

TQ = Winget and Mangum 1979

TABLE 9. Macroinvertebrate Diversity ($\bar{d}$) and Density, Bruneau River Survey September 3-4 and October 14-15, 1980

STATION/DATE	Sample 1 n	Sample 1 $\bar{d}$	Sample 2 n	Sample 2 $\bar{d}$	Sample 3 n	Sample 3 $\bar{d}$	Mean n	Mean $\bar{d}$
1. Mouth Bruneau River								
Sept.	543	1.80	106	3.14	---	---	324.5	2.47
Oct.	49	2.48	73	3.10	247	1.80	123	2.46
Mean for Station							223.75	2.46
2. Bruneau River Hot Springs								
Sept.	63	2.80	55	2.94	190	2.30	102.7	2.68
Oct.	91	2.57	109	1.67	390	1.24	196.7	1.83
Mean for Station							149.7	2.25
3. Bruneau River East Fork at Clover Crossing								
Sept.	20	2.33	33	2.99	56	2.94	36.3	2.75
Oct.	46	2.88	77	1.81	6	2.25	43	2.31
Mean for Station							39.7	2.53
4. Mouth East Fork Jarbidge River								
Sept.	50	3.27	148	1.60	178	2.34	125.3	2.40
Oct.	438	2 94	185	3.53	186	2.53	269.7	3.0
Mean for Station							197.5	2.70
5. Mouth West Fork Jarbidge River								
Sept.	105	3.0	80	2.63	44	2.63	76.3	2.75
Oct.	819	2.78	130	2.76	464	2.49	471	2.68
Mean for Station							273.7	2.72
6. Bruneau River, West Fork								
Sept.	82	3.23	68	3.34	112	3.29	67.3	3.29
Oct.	103	2.89	157	3.0	135	2.7	131.7	2.86
Mean for Station							99.5	3.1
7. Sheep Creek								
Sept.	347	1.64	159	1.97	44	3.28	183.3	2.3
Oct.	100	2.55	227	4.0	116	2.92	147.7	3.16
Mean for Station							165.5	2.73
8. Mary's Creek								
Sept.	112	1.80	35	2.6	72	2.6	73	2.33
Oct.	163	3.42	148	3.44	145	3.15	102	3.34
Mean for Station							87.5	2.83
9. Bruneau River East Fork at Winter Camp								
Oct.	(Composite of 3 samples)				520	2.75	173.3	2.75

FIG. 1. BRUNEAU RIVER SYSTEM



KEY:

▲ TREND ANALYSIS STATION

■ OLD NETWORK STATION

● OTHER SAMPLE STATIONS

[ ] NATIONAL WILD-SCENIC RIVER SYSTEM (PROPOSED)

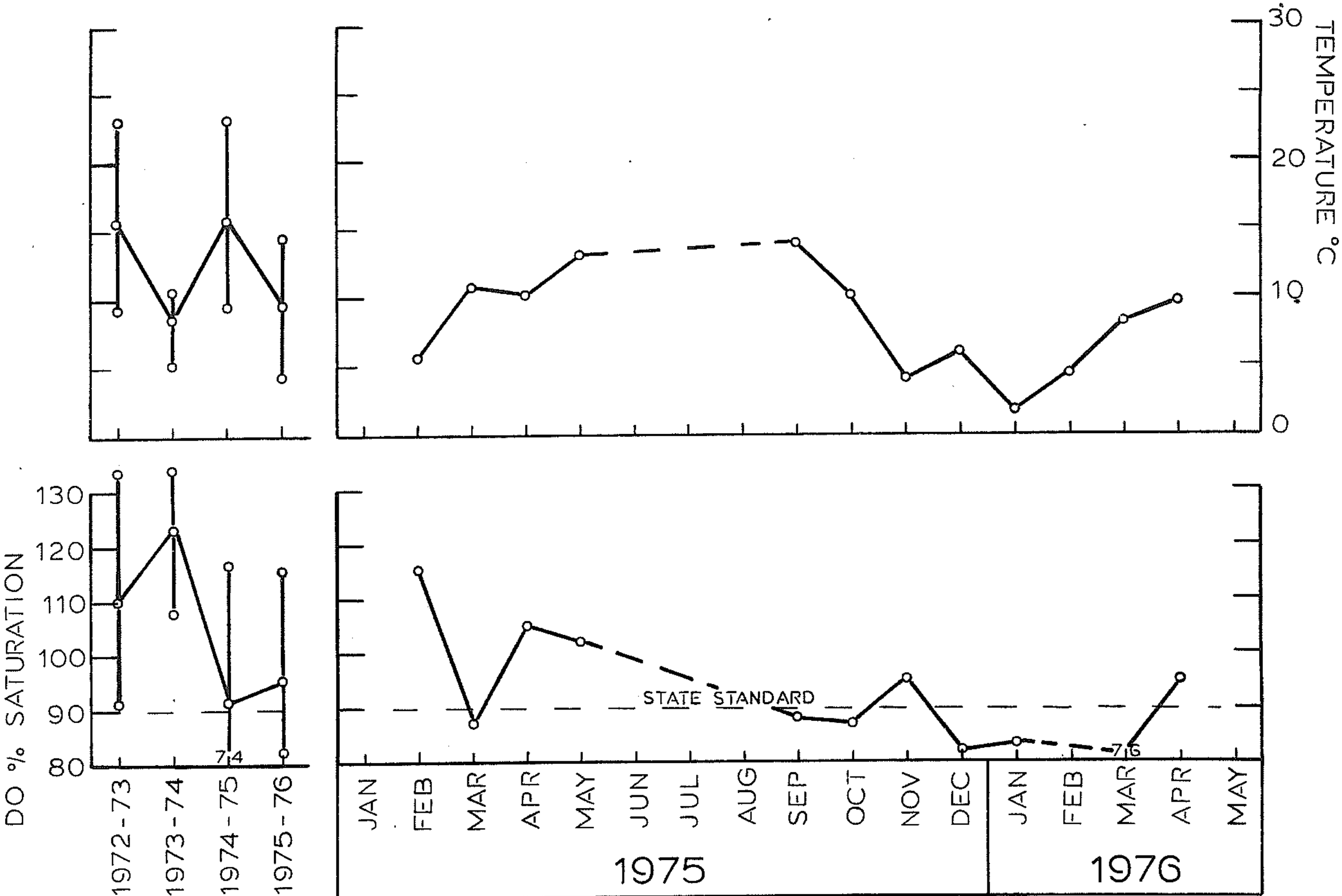


FIGURE 2. Dissolved oxygen (% Saturation - compared with the State Standard) and temperature, Station 1 (near mouth) Bruneau River, 1972-1976.

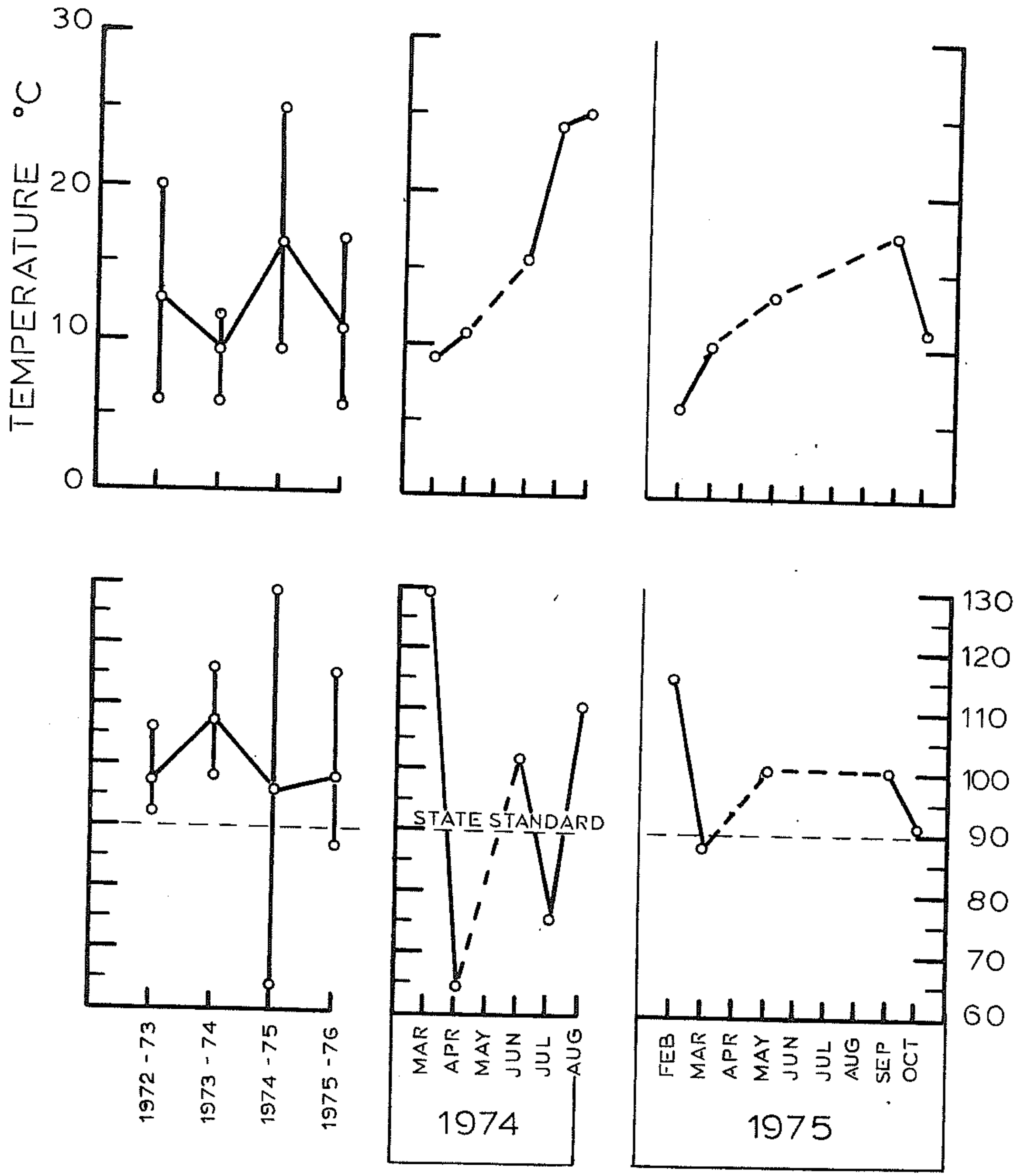


FIGURE 3. Dissolved oxygen (% Saturation - compared with the State Standard) and temperature, Station 2 (Hot Springs) Bruneau River, 1972-1975.

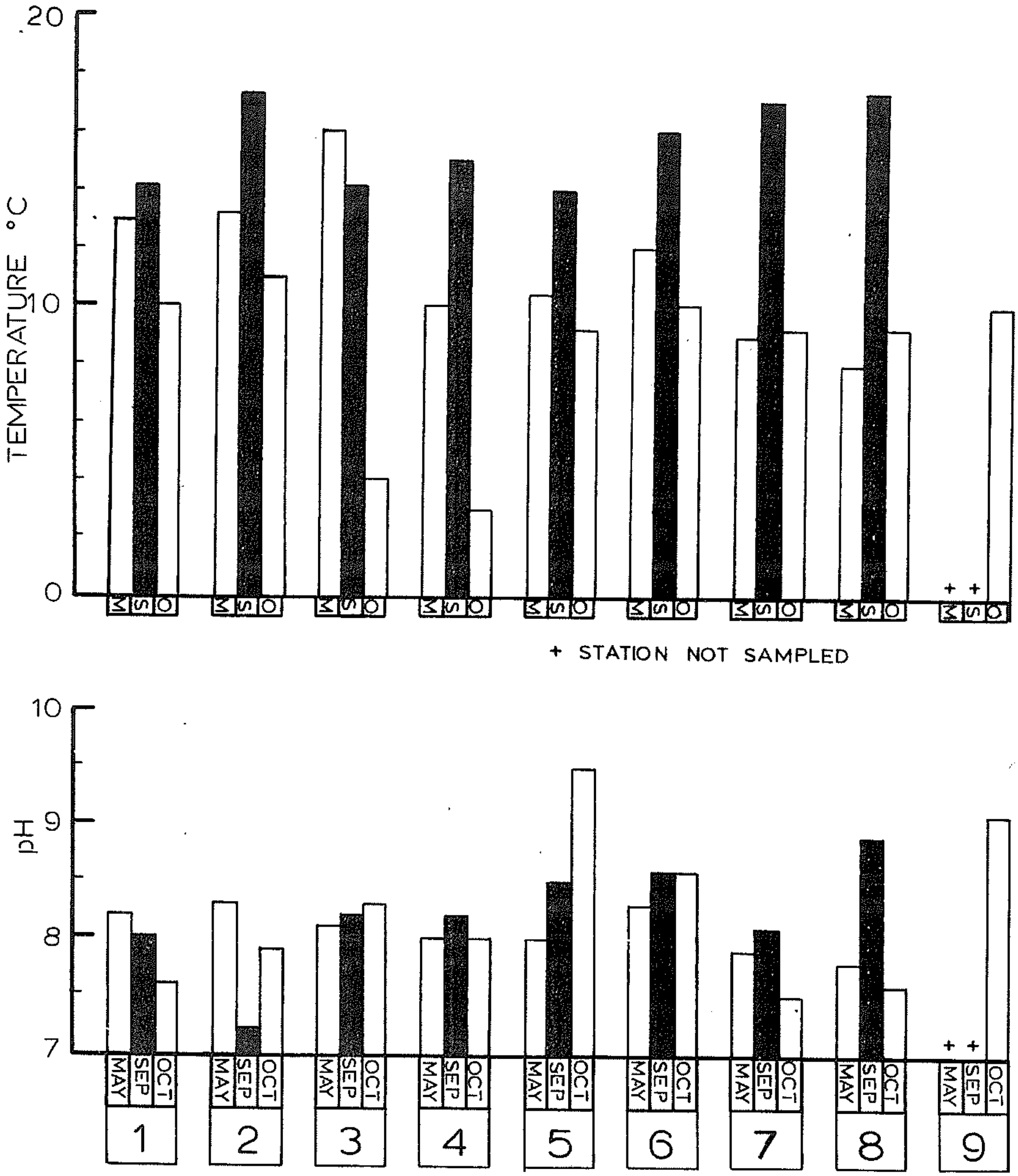


FIGURE 4. Temperature and pH for Stations 1-9, Bruneau River Survey, 1975.

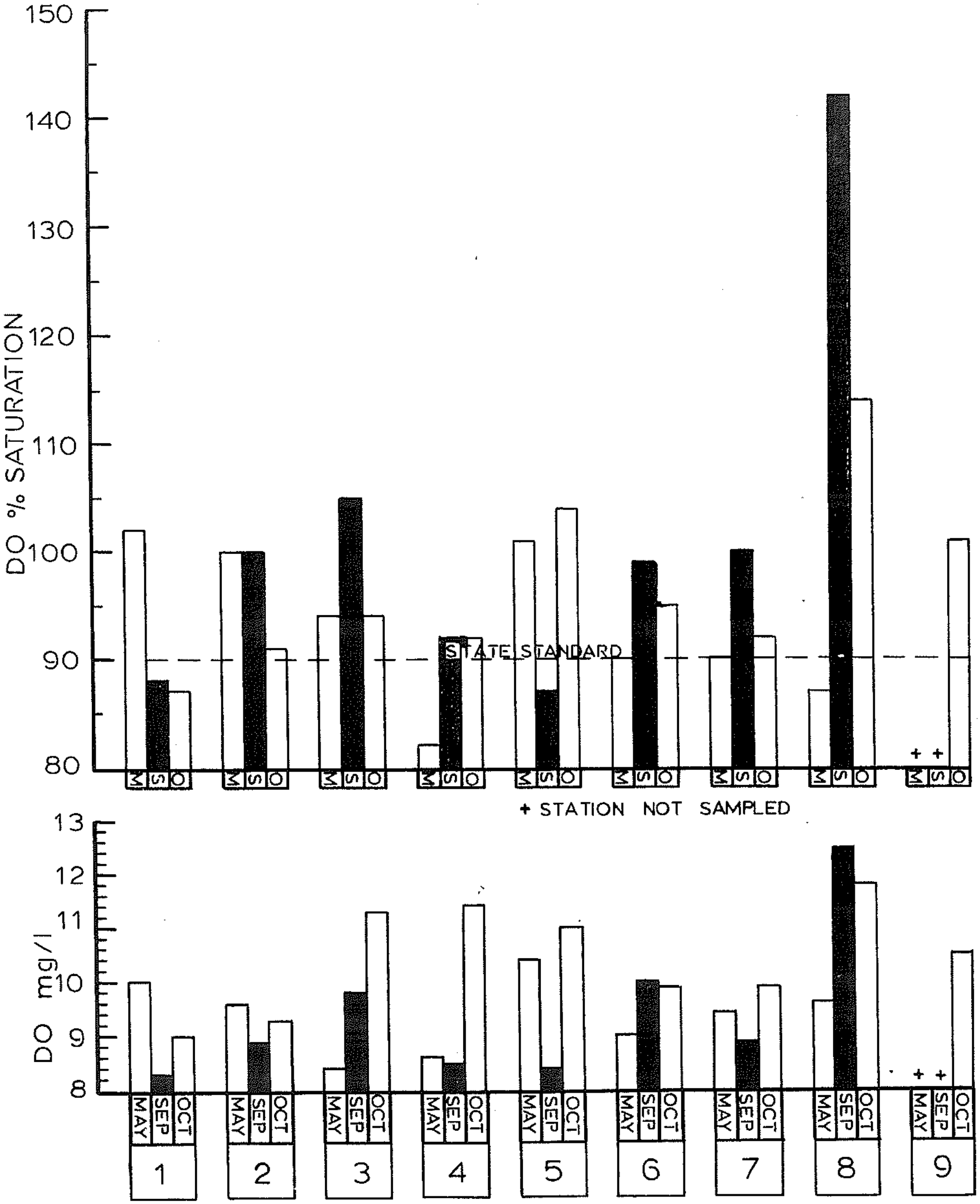


FIGURE 5. Dissolved oxygen for Stations 1-9, Bruneau River Survey, 1975, compared with the State Standards.

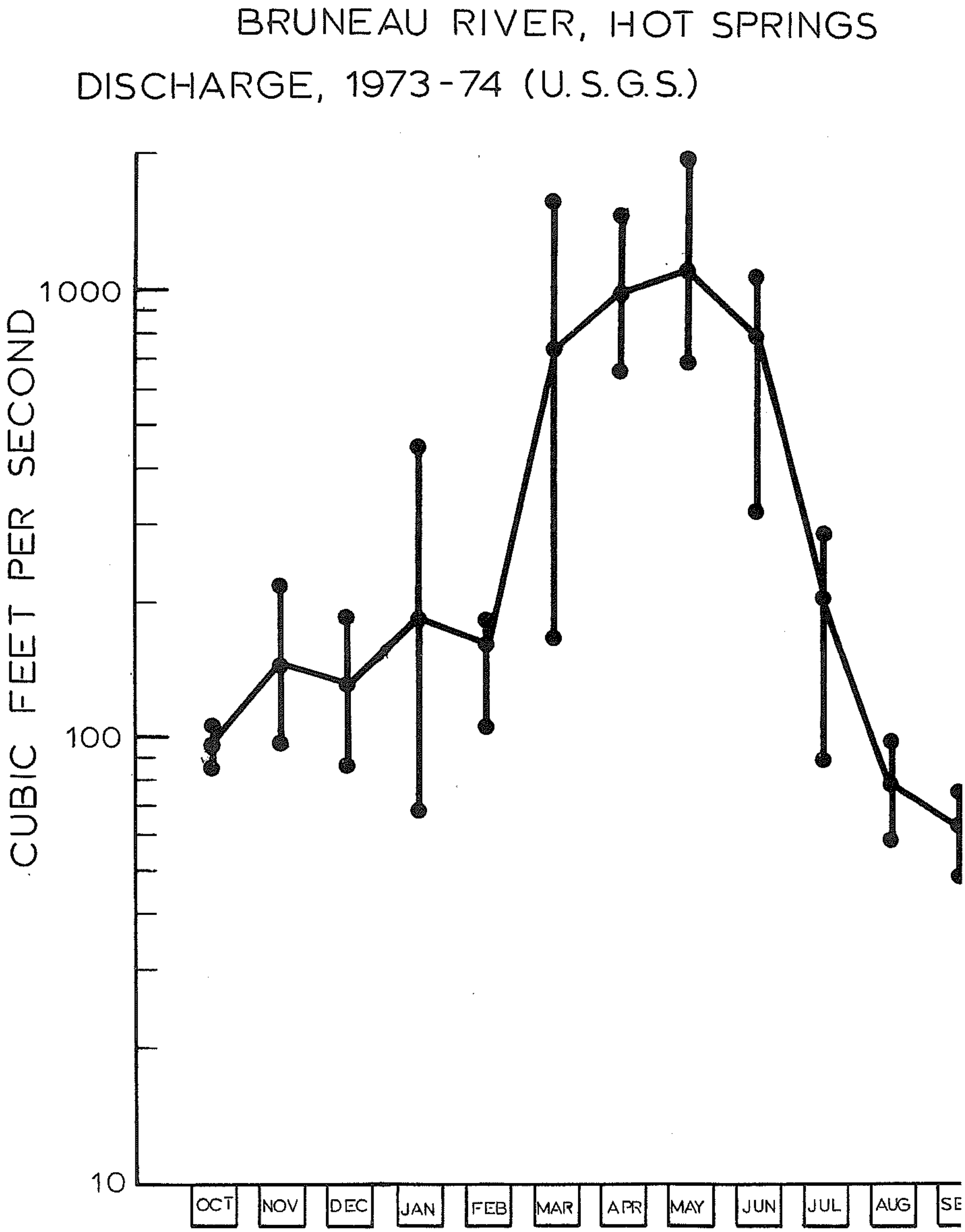


FIGURE 6. Discharge (CFS) for the Bruneau River at Hot Springs, 1973-1974 (USGS 1975).

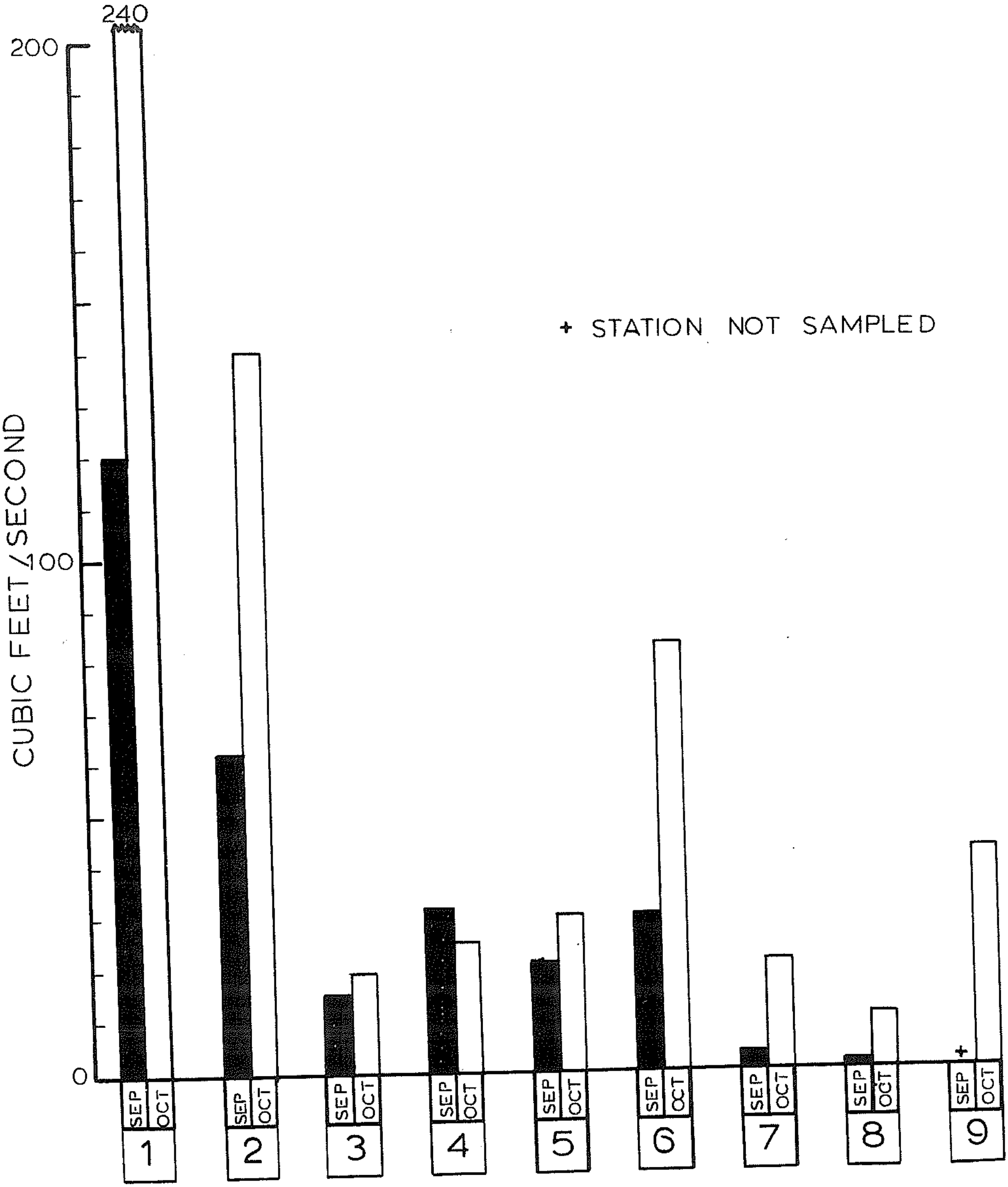


FIGURE 7. Discharge (CFS) for the Bruneau River Survey, 1975.

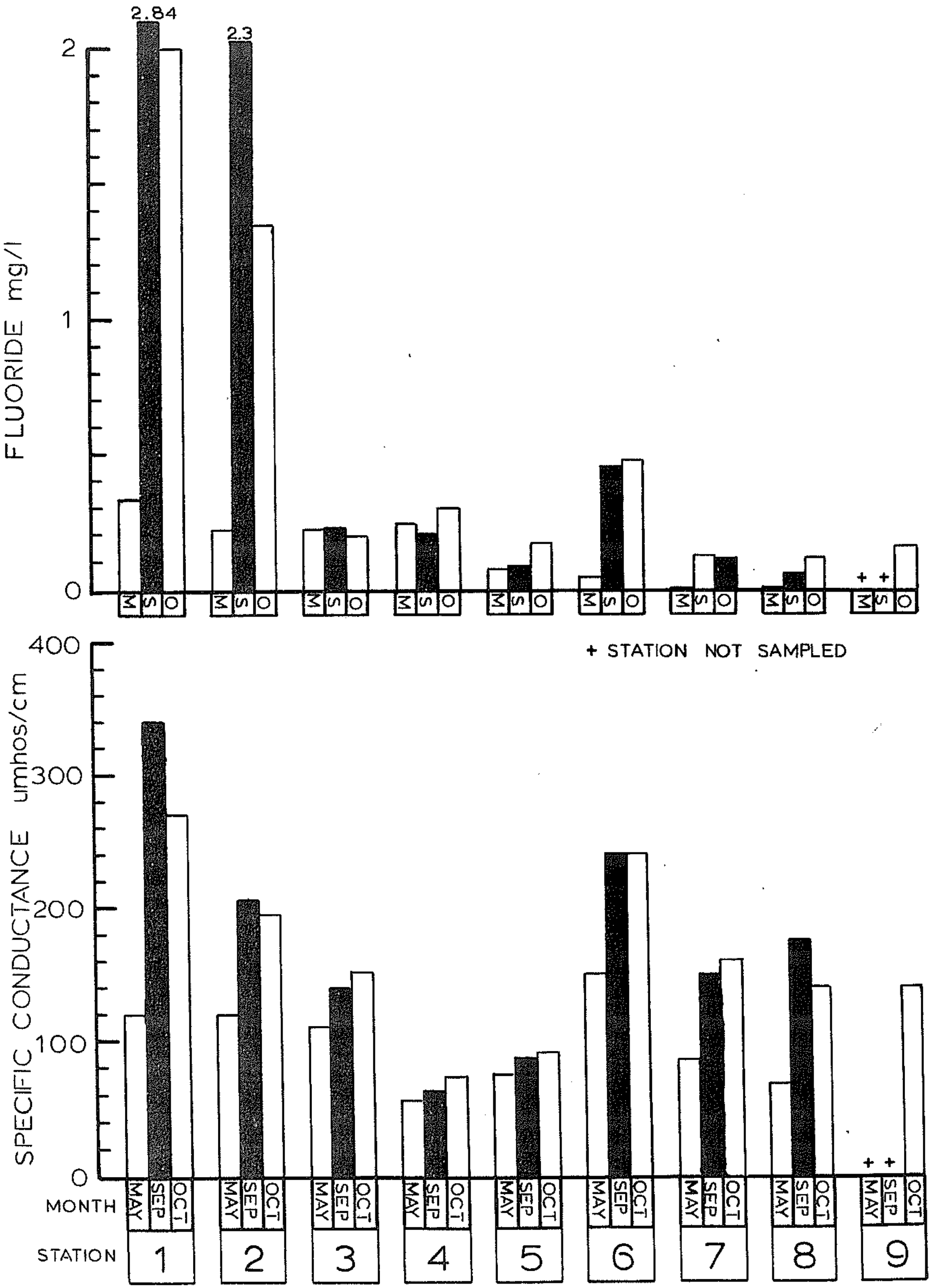


FIGURE 8. Fluoride concentrations and specific conductance values for the Bruneau River Survey, 1975.

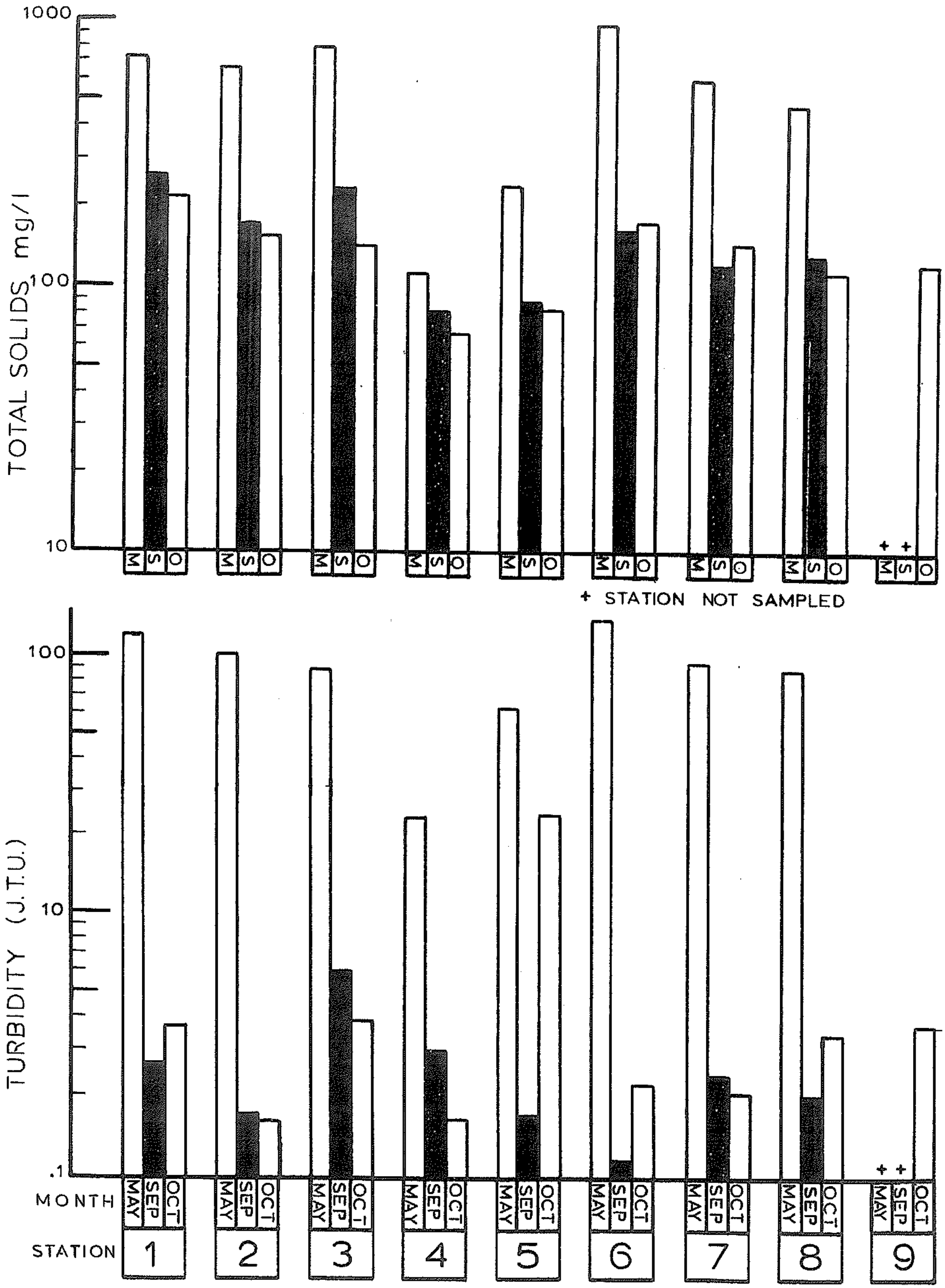


FIGURE 9. Total solids concentrations and turbidity values for the Bruneau River Survey, 1975.

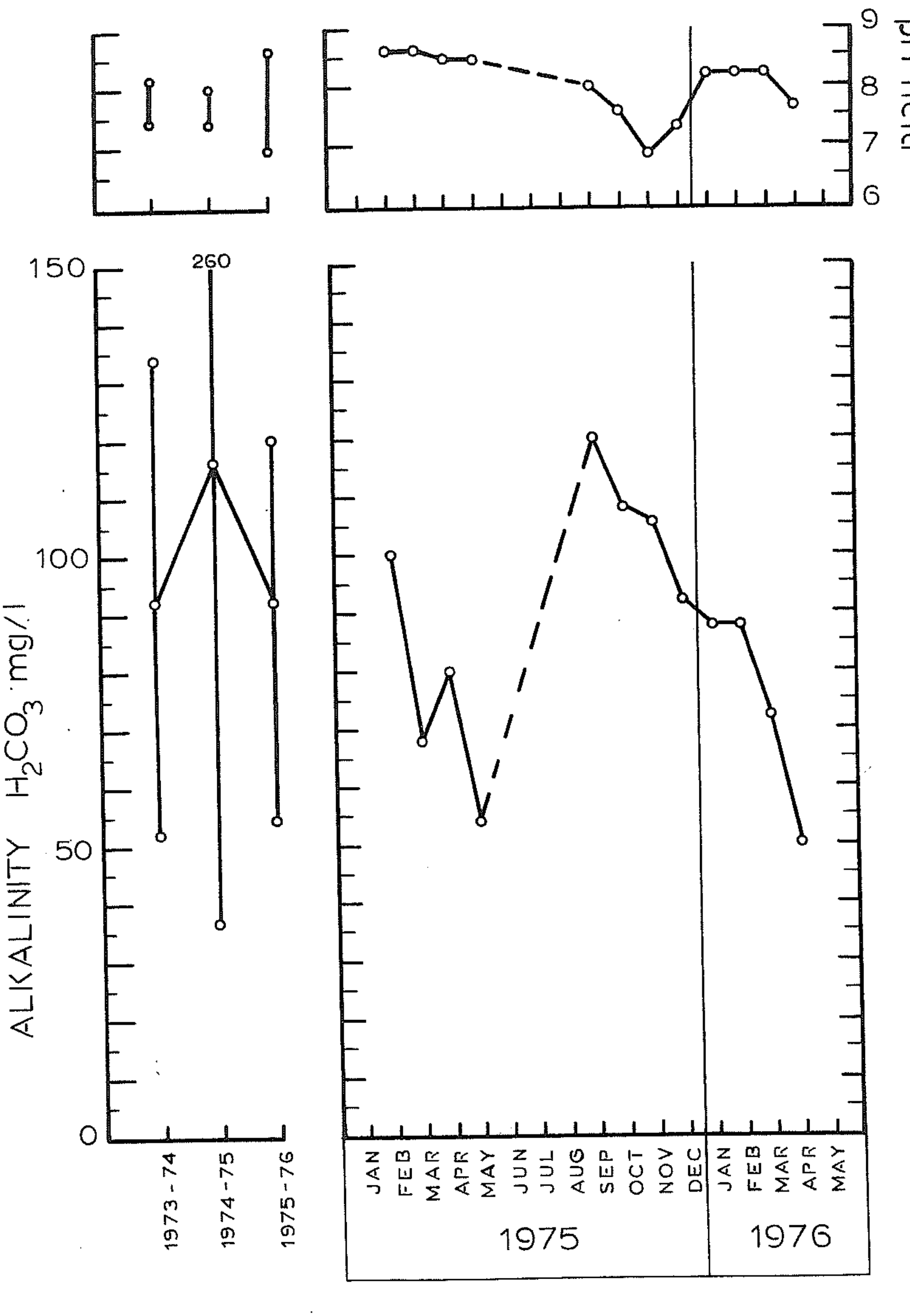


FIGURE 10. Alkalinity concentrations in relation to field pH for Station 1 (Mouth of Bruneau River), 1973-1976.

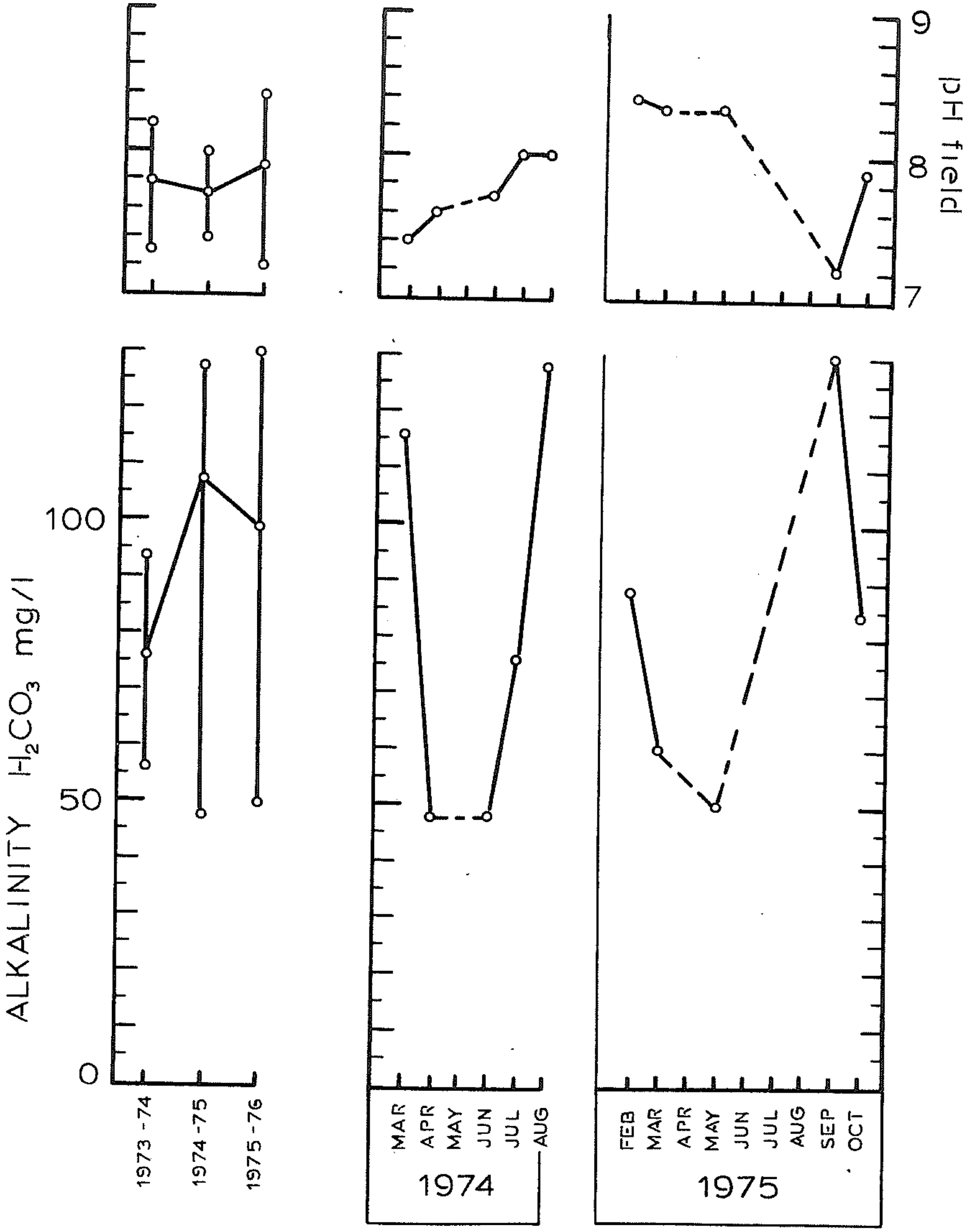


FIGURE 11. Alkalinity concentrations in relation to field pH for Station 2 (Hot Springs, Bruneau River), 1973-1975.

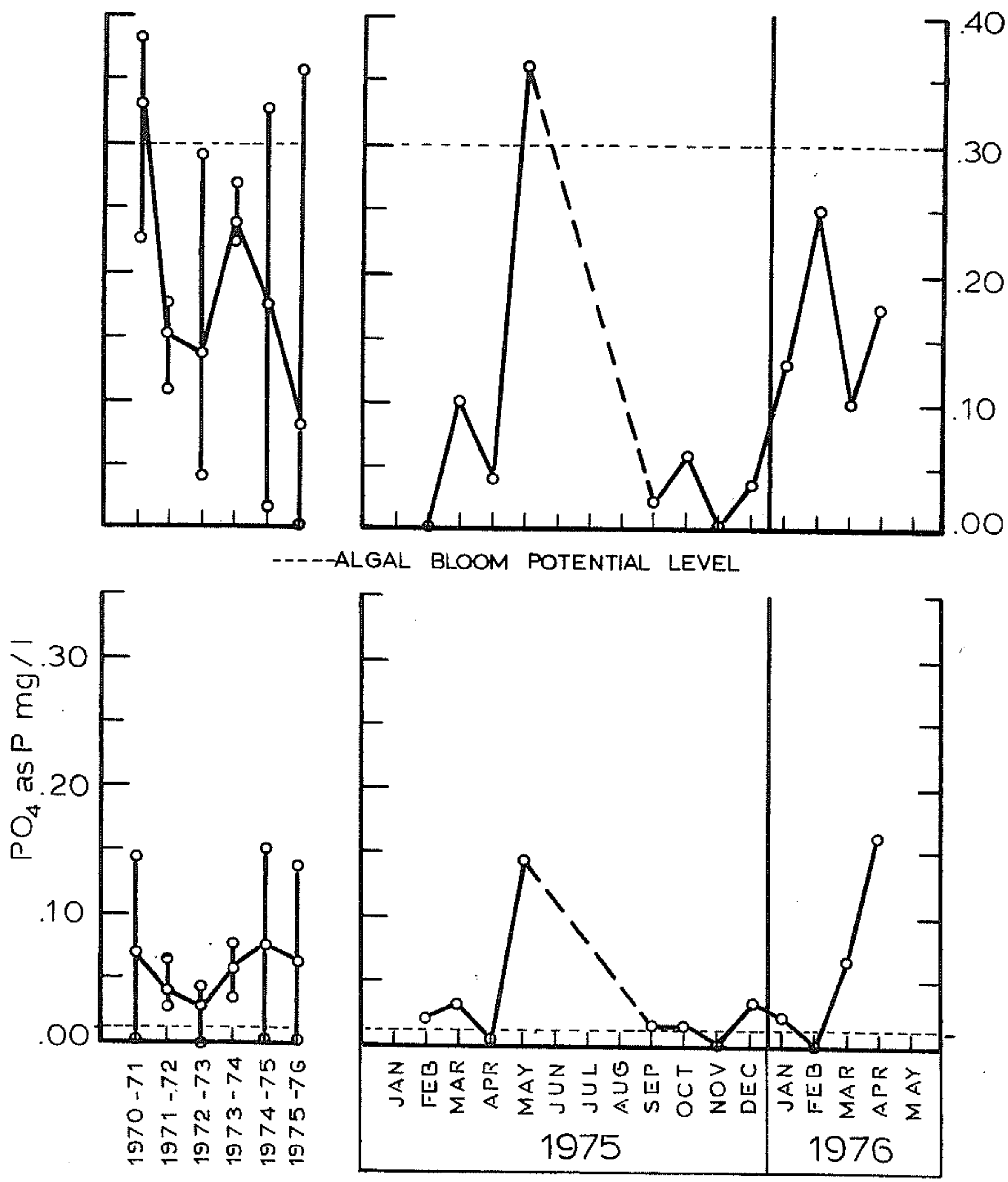


FIGURE 12. Phosphate and Nitrate Concentrations for Station 1 (Mouth of Bruneau River) compared with algal bloom potential levels for Total Inorganic Nitrogen and Orthophosphate, 1970-1976.

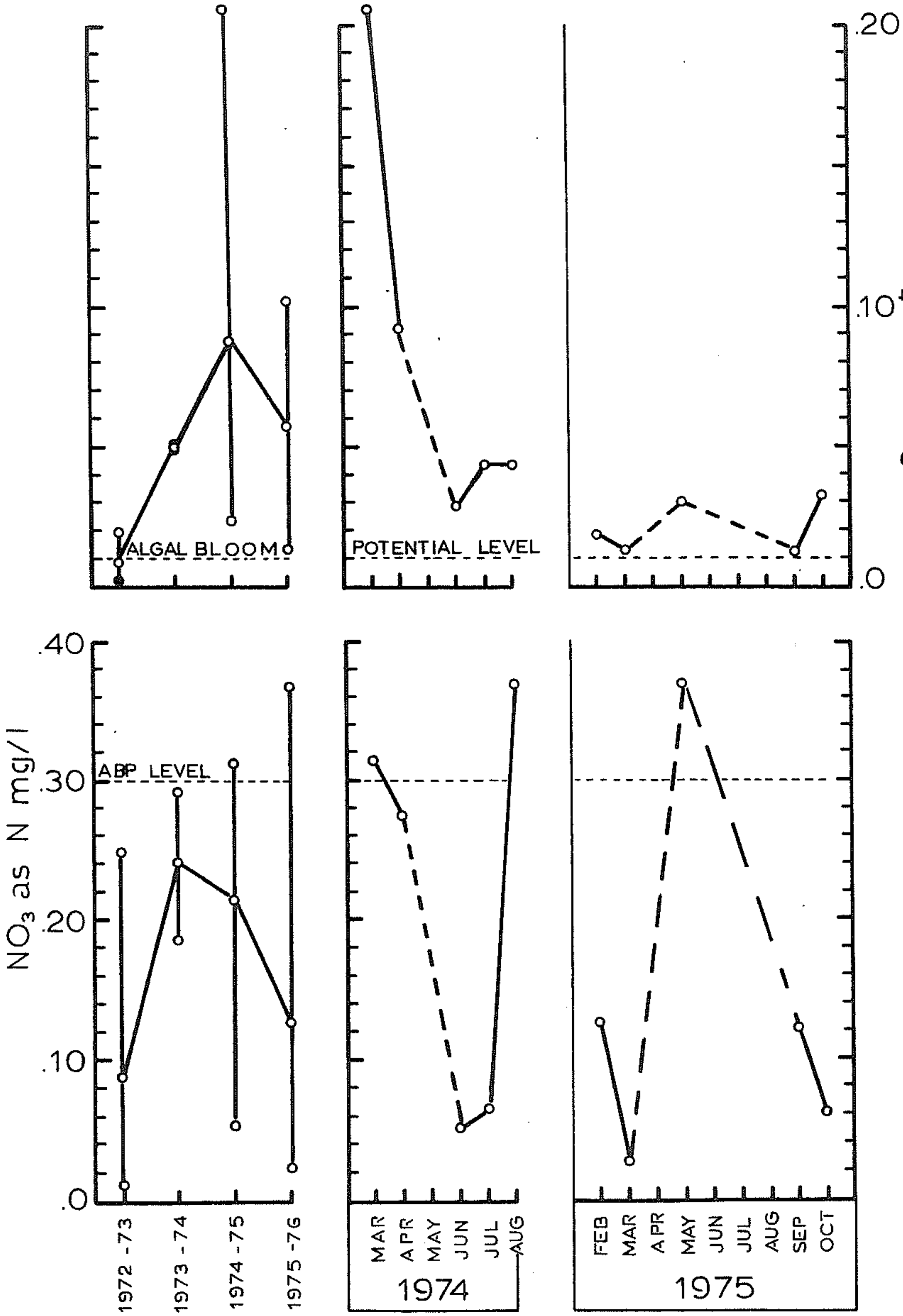


FIGURE 13. Phosphate and nitrate concentrations for Station 2 (Hot Springs, Bruneau River) compared with algal bloom potential levels for Total Inorganic Nitrogen and Orthophosphate, 1972-1975.

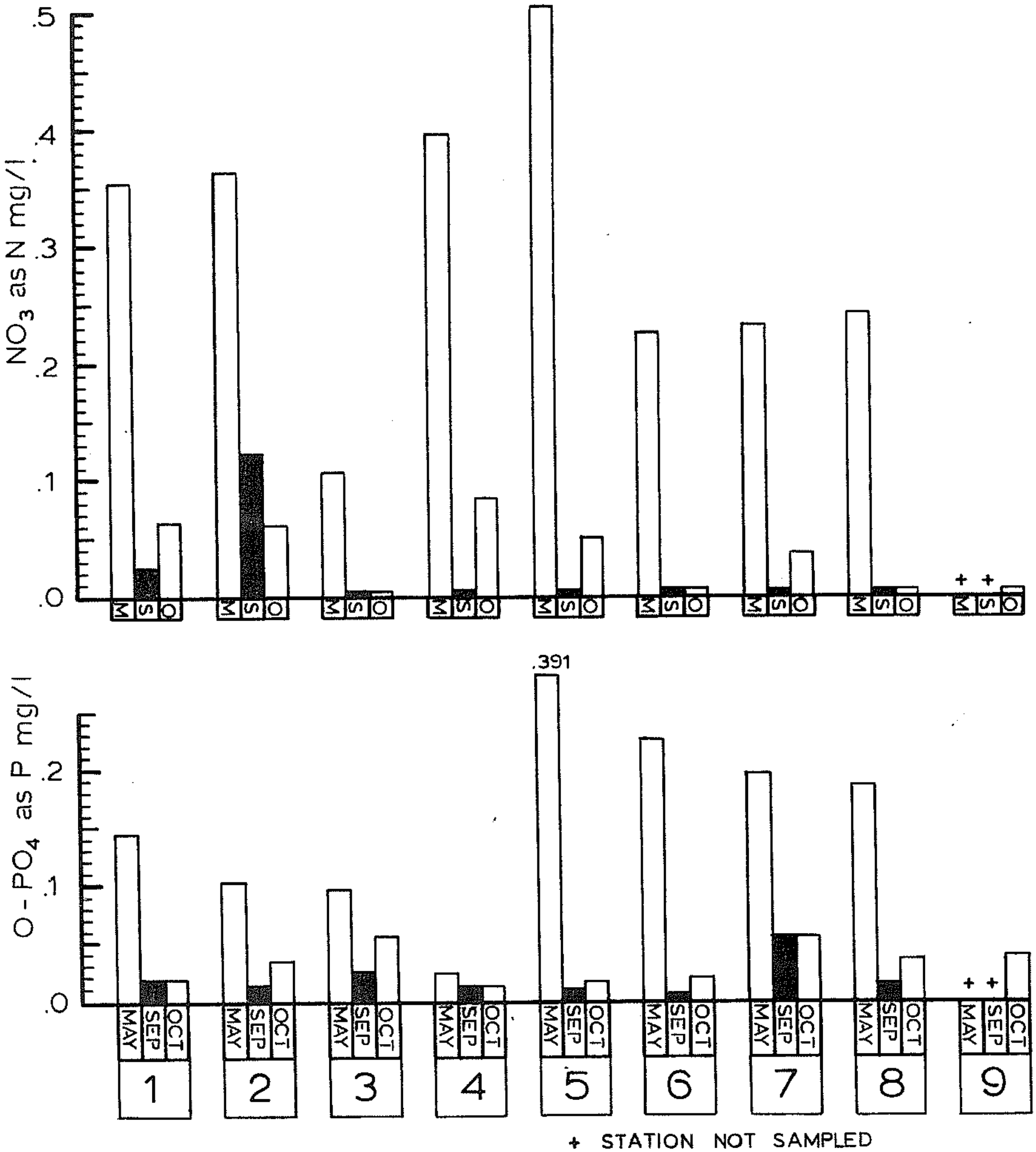


FIGURE 14. Phosphate and nitrate concentrations for the Bruneau River Survey, 1975.

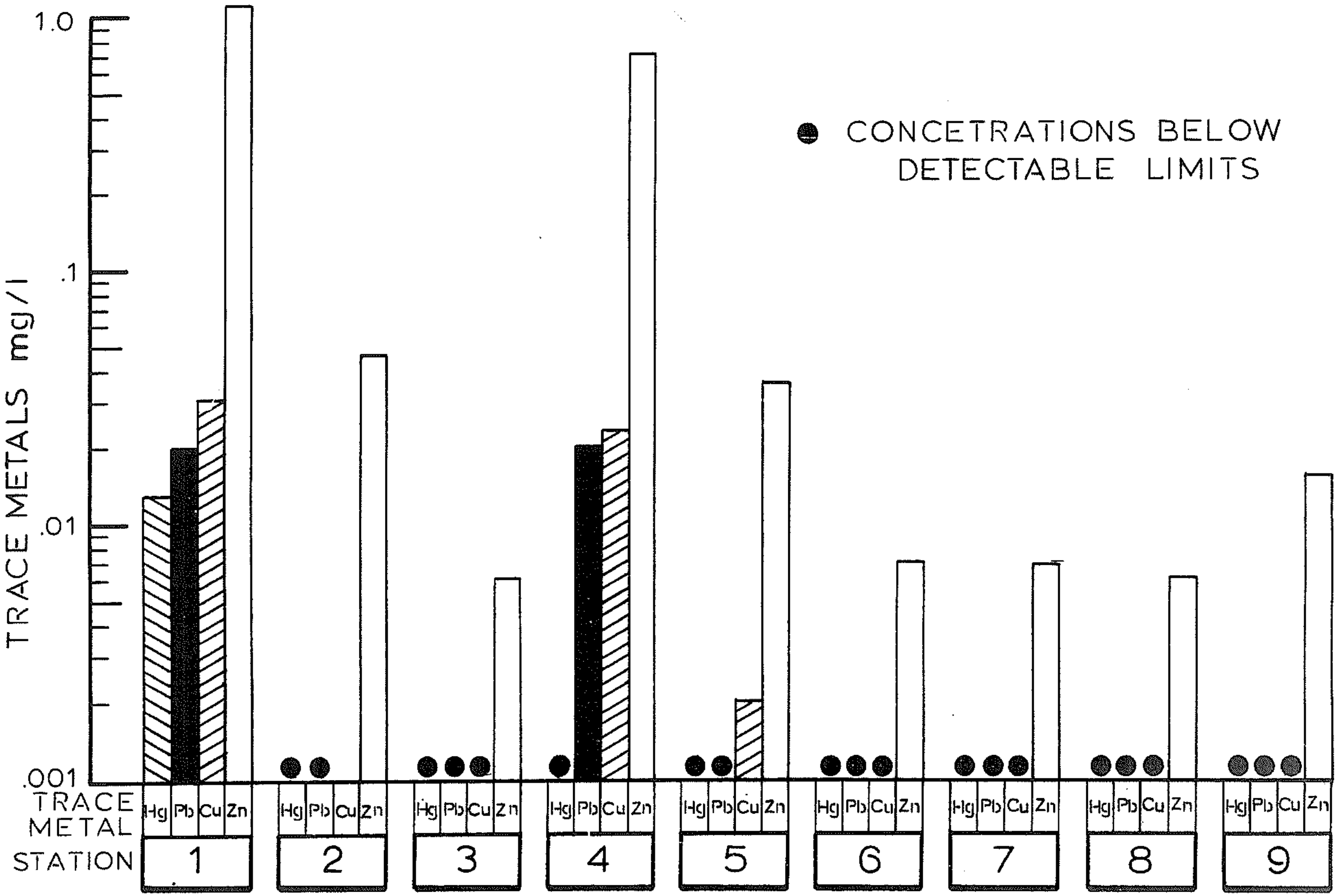


FIGURE 15. Trace metal concentrations for the Bruneau River Survey, October, 1975.

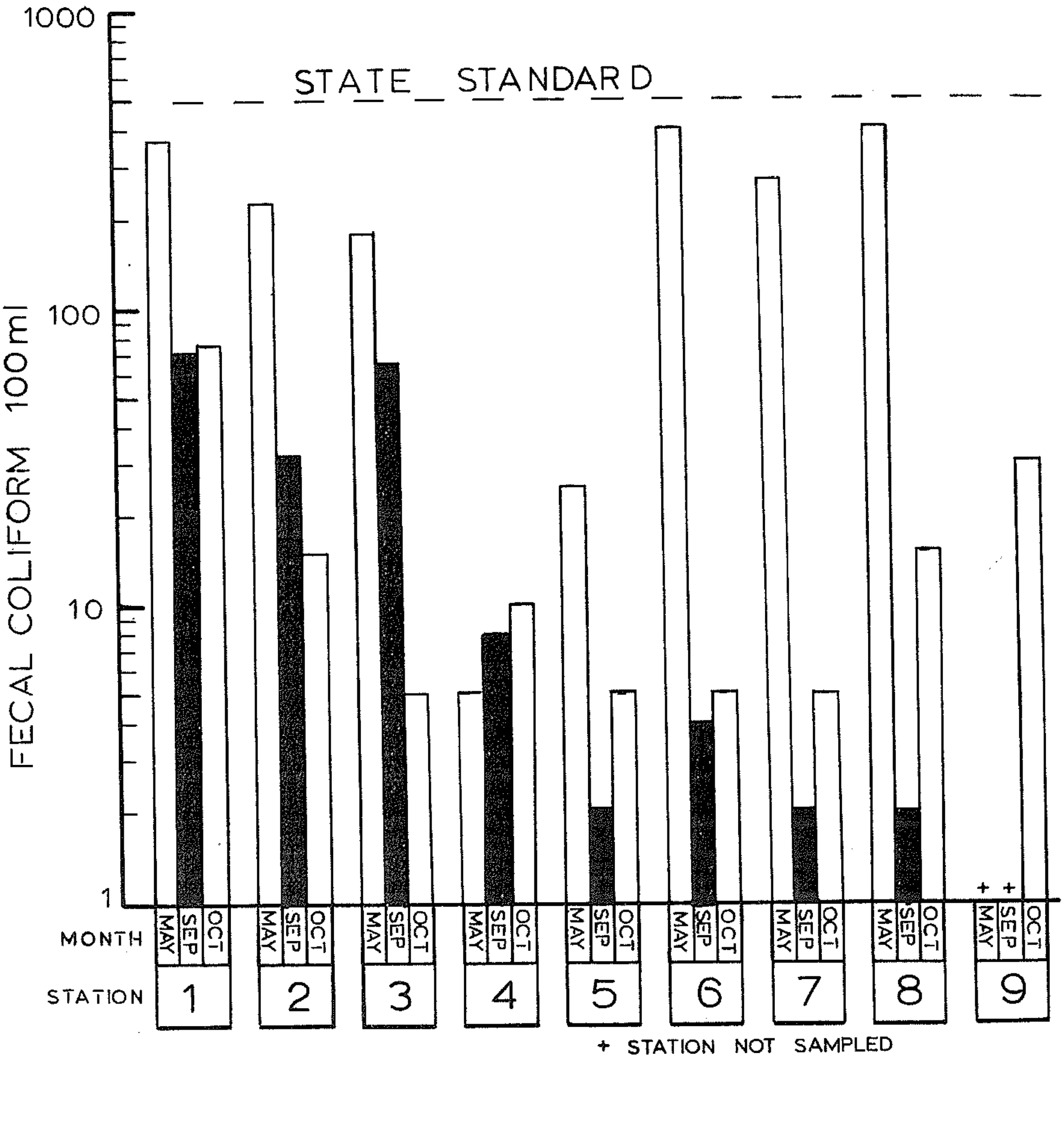


FIGURE 16. Fecal coliform bacteria concentrations for the Bruneau River Survey, 1975.

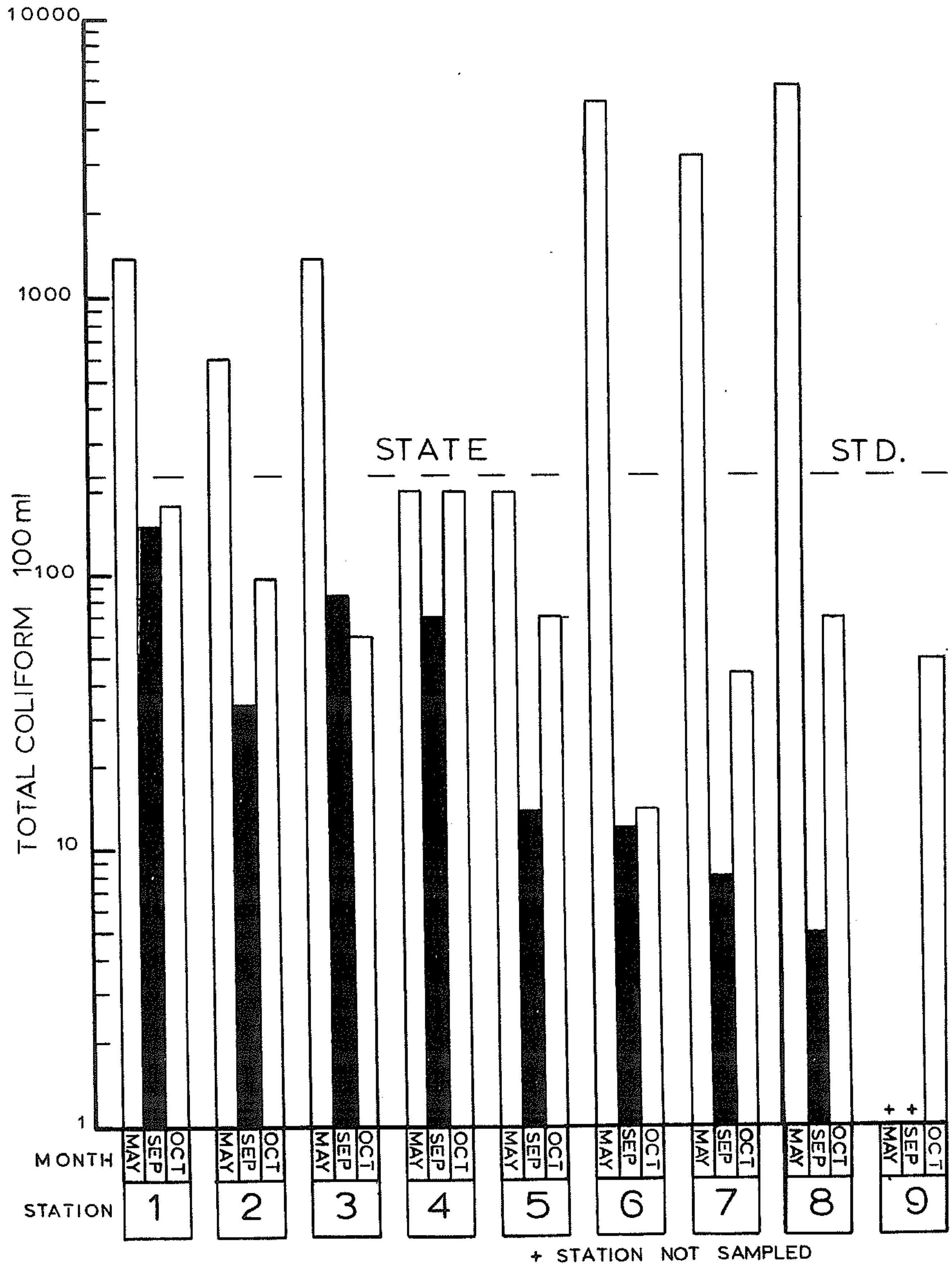


FIGURE 17. Total coliform bacteria concentrations for the Bruneau River Survey, 1975.

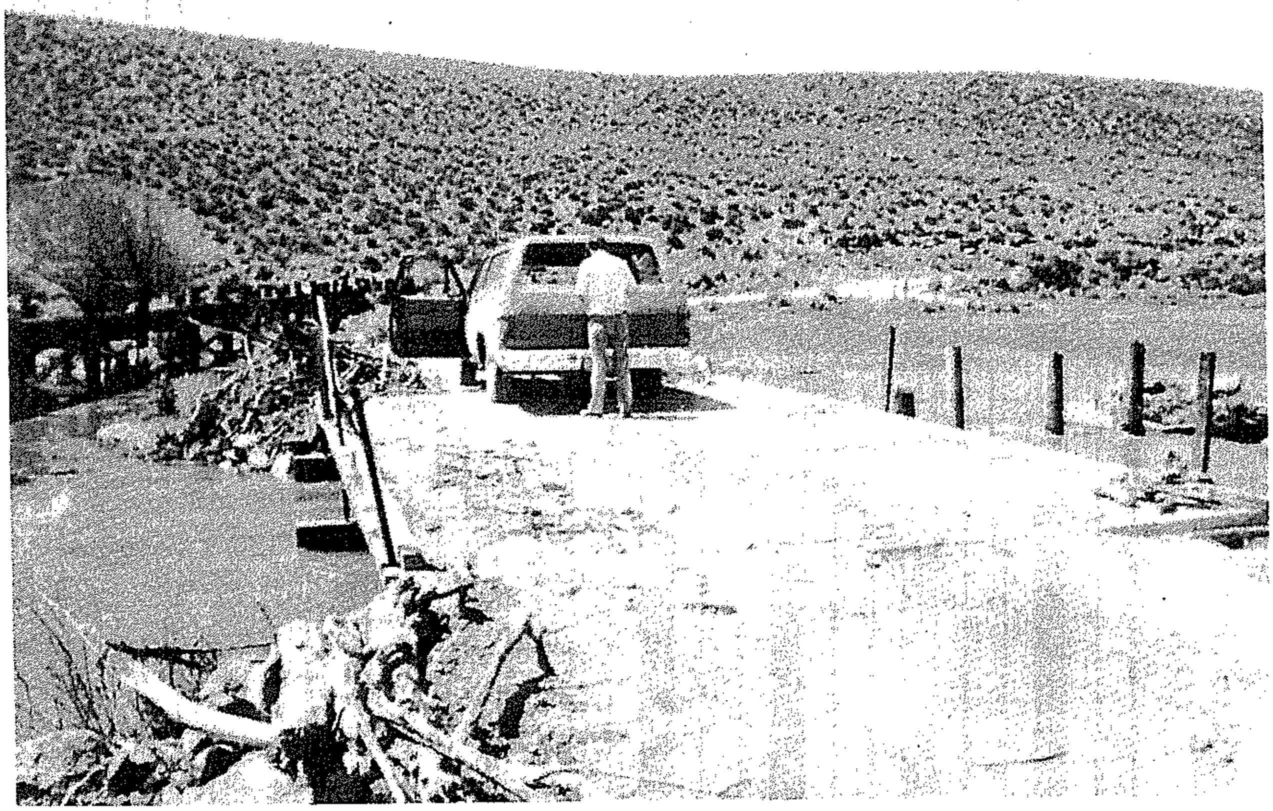


FIGURE 18. East Fork of Bruneau River at Clover Crossing (Station 3) on May 14, 1975 (facing West).

Note: High, turbid water and evidence (debris) of higher water on and near the bridge. Irrigation diversion pipe is on left and a diversion pipe is on the right. Photo by author.

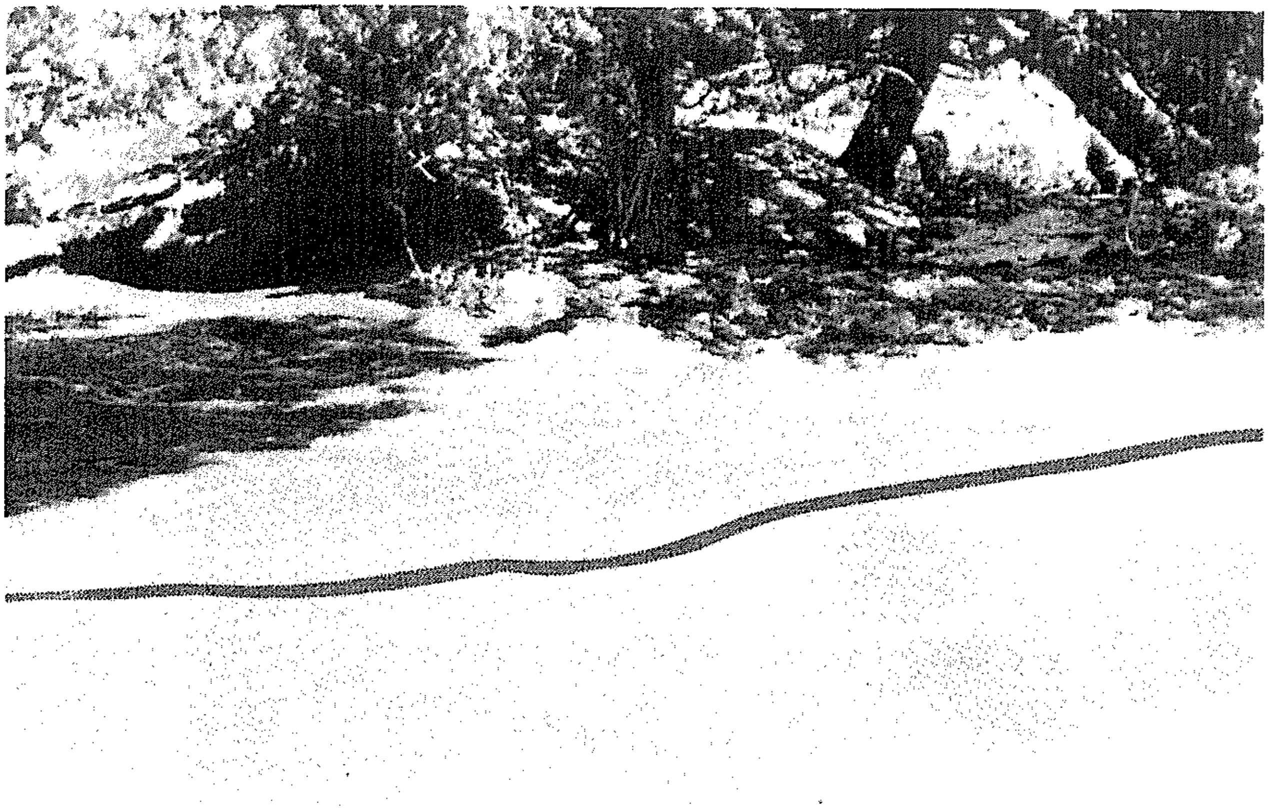


FIGURE 19. West Fork of the Jarbidge River (Station 5) at its confluence with Buck Creek on May 14, 1975 (facing West). This location is just above the confluence of the West Fork and East Fork of the Jarbidge River.

Note: The increased turbidity of the Buck Creek water. Evidently this influence of Buck Creek caused the West Fork to be higher in coliform bacteria, turbidity, total and suspended solids, nitrate COD and specific conductance. Photo by author.

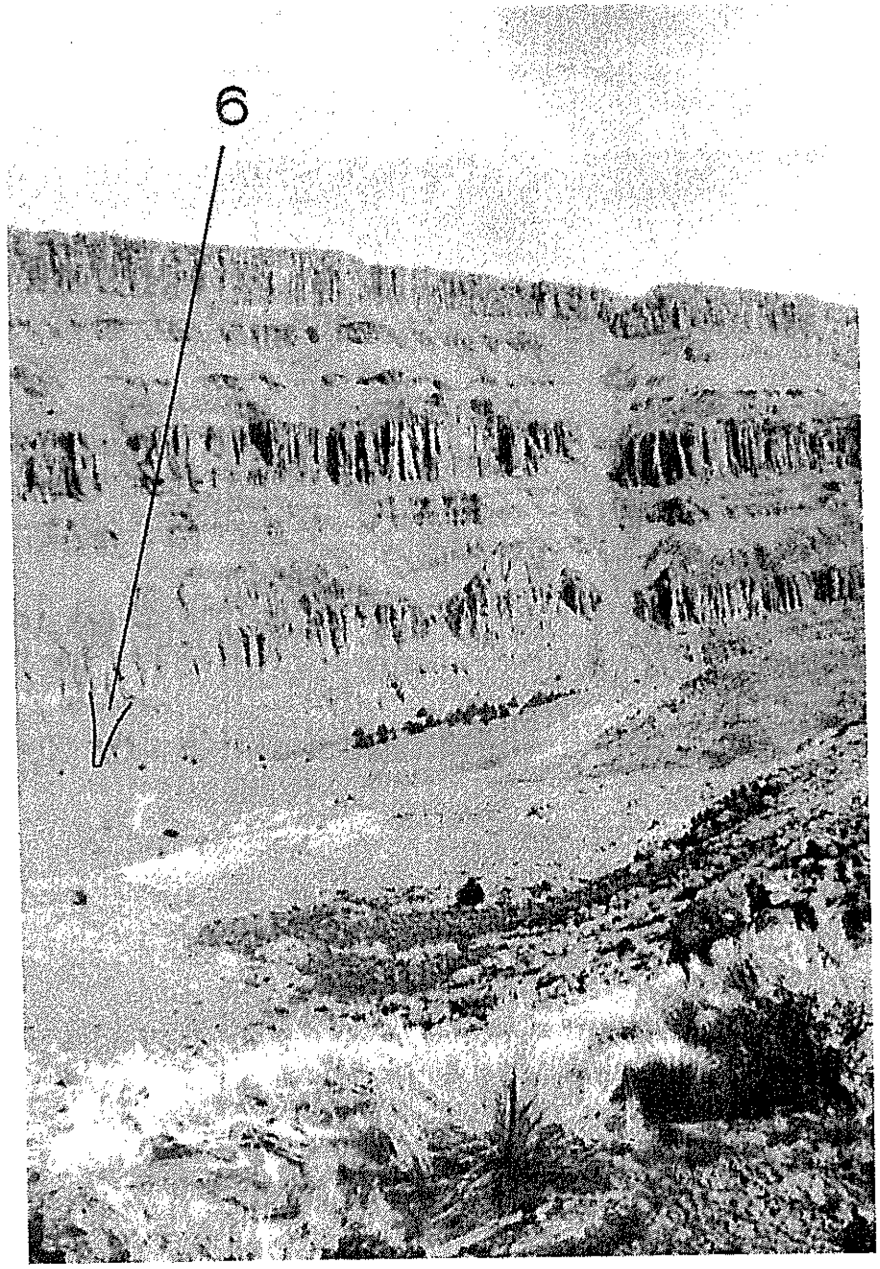


FIGURE 20. West Fork of the Bruneau River (Station 6) Canyon on May 15, 1975 (facing East). Location is about 4 miles north of the Idaho/Nevada border.

Note: Juniper trees along the river. The vertical drop from the east rim to the river is about 457 m (1,500'). Photo by author.

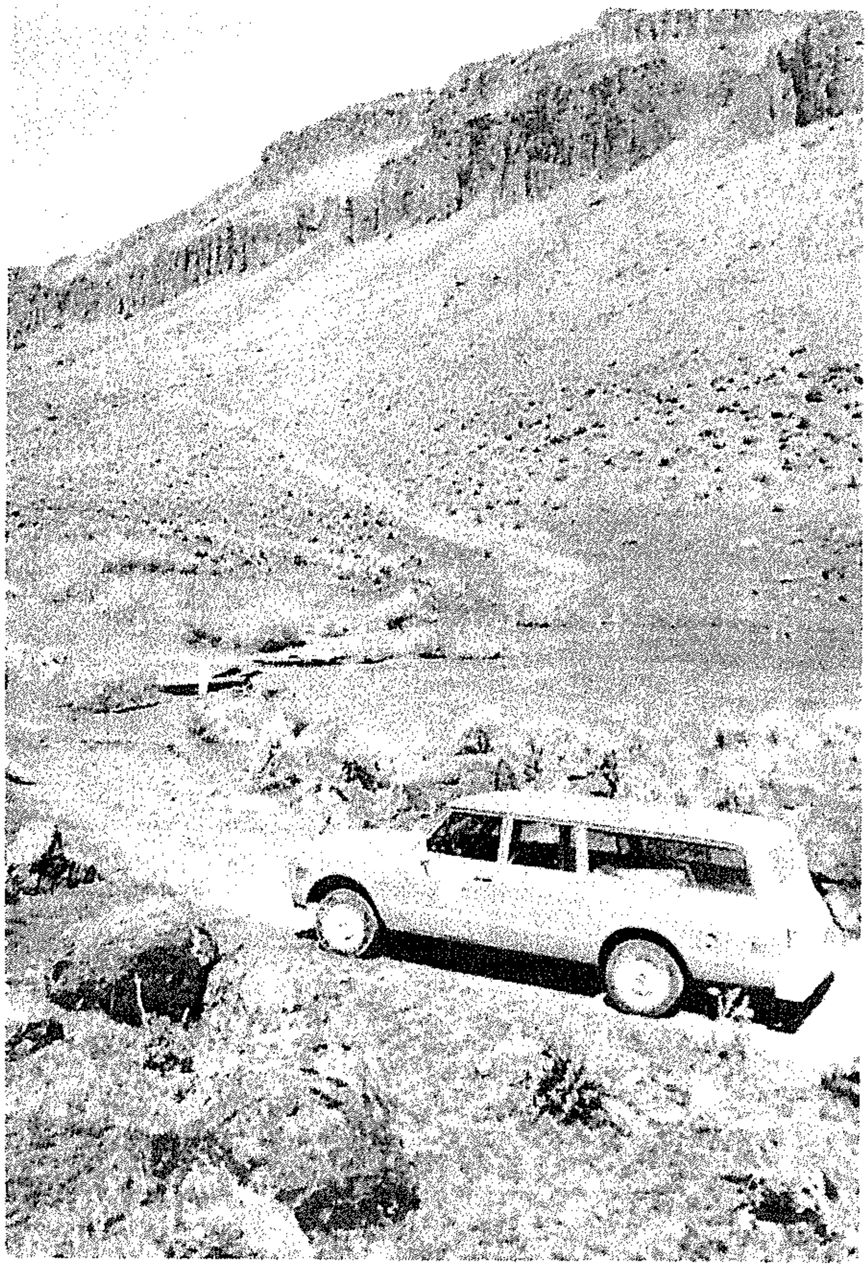


FIGURE 21. West Fork of Bruneau River (Station 6) May 15, 1975 (facing East).

Note: High water level, turbid water and washed-out bridge. Photo by author.

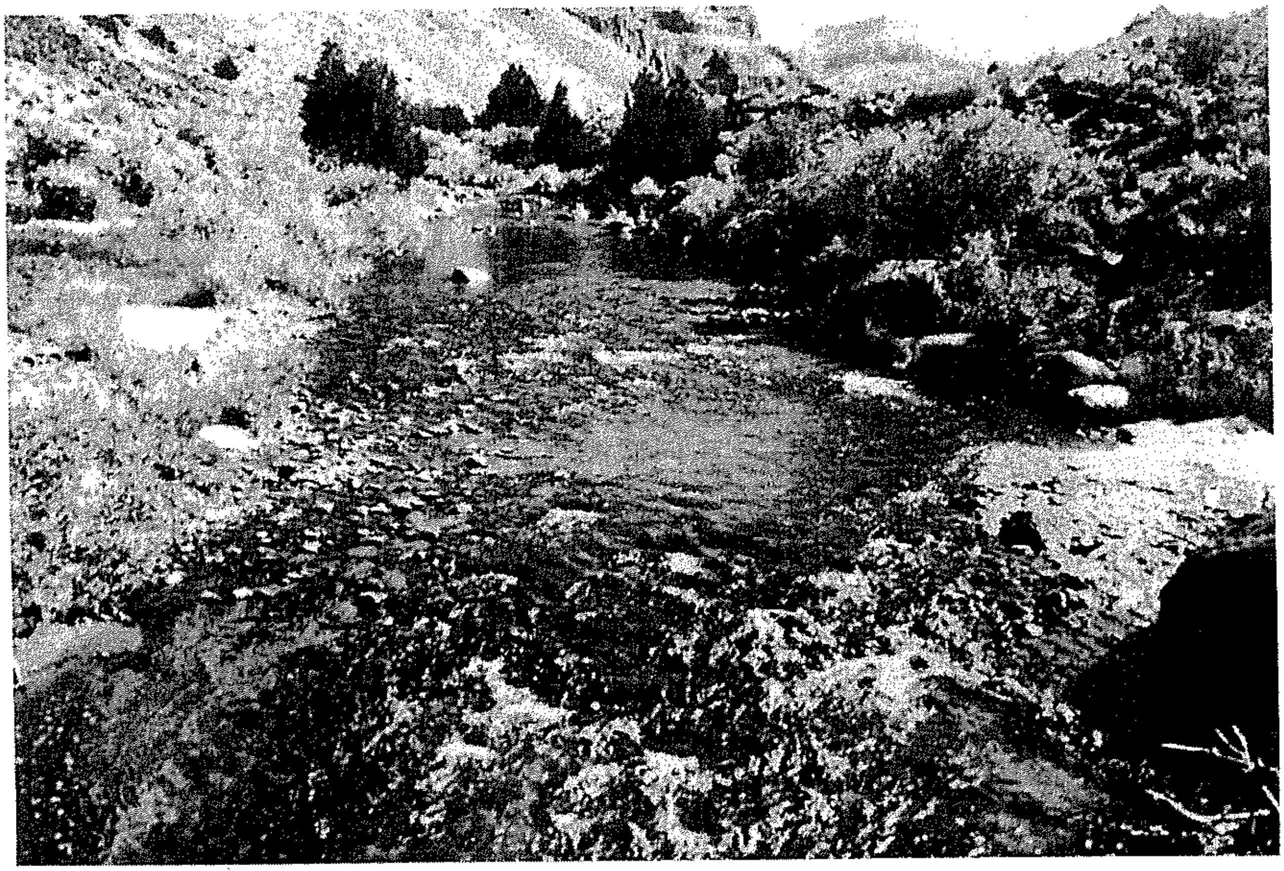


FIGURE 22. West Fork of the Bruneau River (Station 6) September 4, 1975 (facing South). Same location as Figure 5.

Note: The difference in water level and clarity. Photo by author.

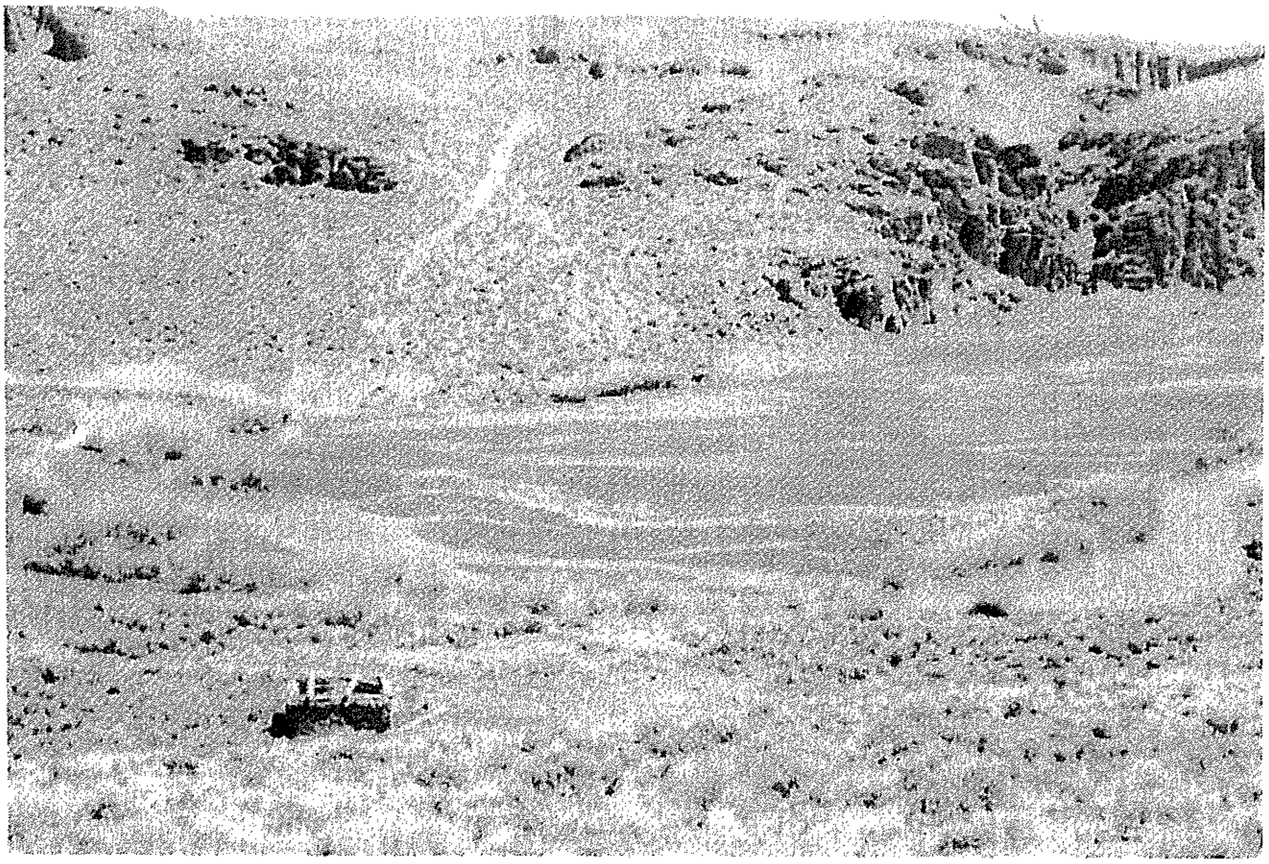


FIGURE 23. Sheep Creek (near Station 8) May 15, 1975.

Note: High, turbid water. Photo by author.