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MONTANA DEPARTMENT OF FISH, WILDLIFE AND PARKS

FISHERIES DIVISION

JOB PROGRESS REPORT

STATE:	Montana	TITLE:	Southwestern Montana Fisheries Investigations
PROJECT NO.:	F-9-R-29		
JOB NO.:	I-c	TITLE:	Inventory and Survey of Waters of the Upper Yellowstone Drainage

PERIOD COVERED: July 1, 1980 through June 30, 1981

REPORT PERIOD: July 1, 1980 through June 30, 1981

ABSTRACT

Fish population estimates are presented for brown trout (Salmo trutta), and Yellowstone cutthroat trout (Salmo clarkii) from two study sections of the Yellowstone River during Fall, 1980. Population estimates for brown trout and mountain whitefish (Prosopium williamsoni) are presented for the Zimmerman section of the Shields River during Fall, 1980.

Instream flow requirements for trout in the Yellowstone River near Corwin Springs as measured by the wetted perimeter (WETP) technique are presented.

Water quality parameters for the Shields River are presented. They indicate that the Shields River is dewatered to some degree in the middle and lower reaches during the irrigation season. This is also the time of highest temperatures and conductivities.

Water temperatures at three sites Corwin Springs, Livingston and Greybear are presented. From March through August, temperatures exhibit a definite increase in a downstream direction.

Three years following rehabilitation of Dailey Lake, the average size of yellow perch (Perca flavescens) and rainbow trout has levelled off. Walleye (Stizostedion vitreum) which were stocked during 1979 average 8.0 inches in length.

BACKGROUND

As a result of several legislative actions, the Montana Department of Fish, Wildlife and Parks has obtained water rights or reservations for instream flows in numerous streams in Montana. The department has been studying correlations between instream flows and trout populations for several years and has refined the procedures required to identify the minimum instream flows required by trout in large rivers. In addition, the department will continue to study these relationships in an effort to understand the effects of instream flows on trout populations.

At the same time, fishing pressure remains heavy on the Yellowstone River. Long term population studies are continuing as a means of monitoring the number and size of the trout populations in the river.

The Shields River drainage continues to be plagued by problems including severe erosion, dewatering and frequent flooding. The effects of these conditions on trout populations in the Shields River will continue to be studied.

Dailey Lake receives heavy use by recreationists from throughout the state. Fish populations in this lake are being monitored so that an efficient management program will be maintained.

OBJECTIVES AND DEGREE OF ATTAINMENT

1. To determine fish populations on at least one established study section on the Yellowstone River and one established study section on the Shields River. Data included in this report.

2. To determine fishery flow needs using the wetted perimeter technique on two sections of the Yellowstone River. Data for one section included in this report. Data for a second section will be included in a later report.

3. To determine flow, water temperatures and selected water quality parameters at four established sites on the Shields River. Data included in this report.

4. To assess walleye planting success by gill netting Dailey Lake. Data included in this report.

PROCEDURES

Fish populations were sampled in the Yellowstone River using an 18 foot aluminum boat which was powered by an 80 horsepower outboard jet motor. The boat was equipped with a double boom electrode system which was designed in accordance with Novotny and Priegel (1974) as modified by Peterman, 1978.

Generally, three mark and three recapture runs were made on each section to obtain a population estimate. However, more or less runs may have been made depending upon the situation. In the Shields River, fish populations were sampled with a mobile electrode system. One marking run and one recapture run were completed on the Zimmerman section. Population estimates were calculated according to Vincent (1971).

The wetted perimeter method (Nelson, 1980) was used to determine the fishery flow needs near the Livingston and Corwin Springs USGS gauges. Water quality and flows were monitored on the Shields River at approximately weekly intervals during the spring through fall and monthly intervals during the winter. Water temperatures were monitored with max/min thermometers, turbidity and conductivity were measured weekly using a Hach Model 2100 A turbidimeter and a YSI Model 33 S-C-T meter, respectively and flow measurements were made with a hand held current meter, state measurements and flow rating tables. Flows were measured only at times in which the sites were wadable.

Fish populations in Dailey Lake were sampled using experimental, 125 ft. (3/4-2 inch) gill nets.

FINDINGS

Yellowstone River

Two study sections of the Yellowstone River were sampled during 1980. The Corwin Springs study section, which is 5.2 miles in length, was electrofished during September, 1980 (Figure 1). Table 1 lists this population estimate along with all other estimates collected during past years. A rainbow trout population estimate was not calculated during Fall, 1980 because of inadequate recaptures.

The 1980 population estimate is not directly comparable to the 1978 and 1979 estimates because 1980 is a fall estimate and the earlier years are spring estimates. The number of brown trout in the larger sizes (>14") have increased since 1978 and 1979. The number of smaller brown trout (<14") is smaller than in 1978 and 1979. Fisherman harvest does not appear to be heavy on the brown trout (Vincent and Clancy, 1980). Therefore, environmental factors such as flows and water temperatures are probably the limiting factor to the population. Yellowstone cutthroat numbers appear to be somewhat stable in this area, however, the number of Yellowstone cutthroat is fewer than brown trout, especially in the larger sizes (>14"). This could be a result of fishing pressure which appears to be affecting the larger cutthroat (Vincent and Clancy, 1980).

The Mill Creek study section was established in Fall, 1980. Population estimates for brown and cutthroat trout in this 5.75 mile section were made in Fall, 1980(Table 2). Overall numbers of brown trout appear to be similar to the Corwin Springs study section, however the Mill Creek Bridge section contains higher numbers of very large brown trout (>18"). The Mill Creek Bridge section contains smaller numbers of Yellowstone cutthroat than the Corwin Springs section. A rainbow trout population estimate was not calculated because of inadequate recaptures.

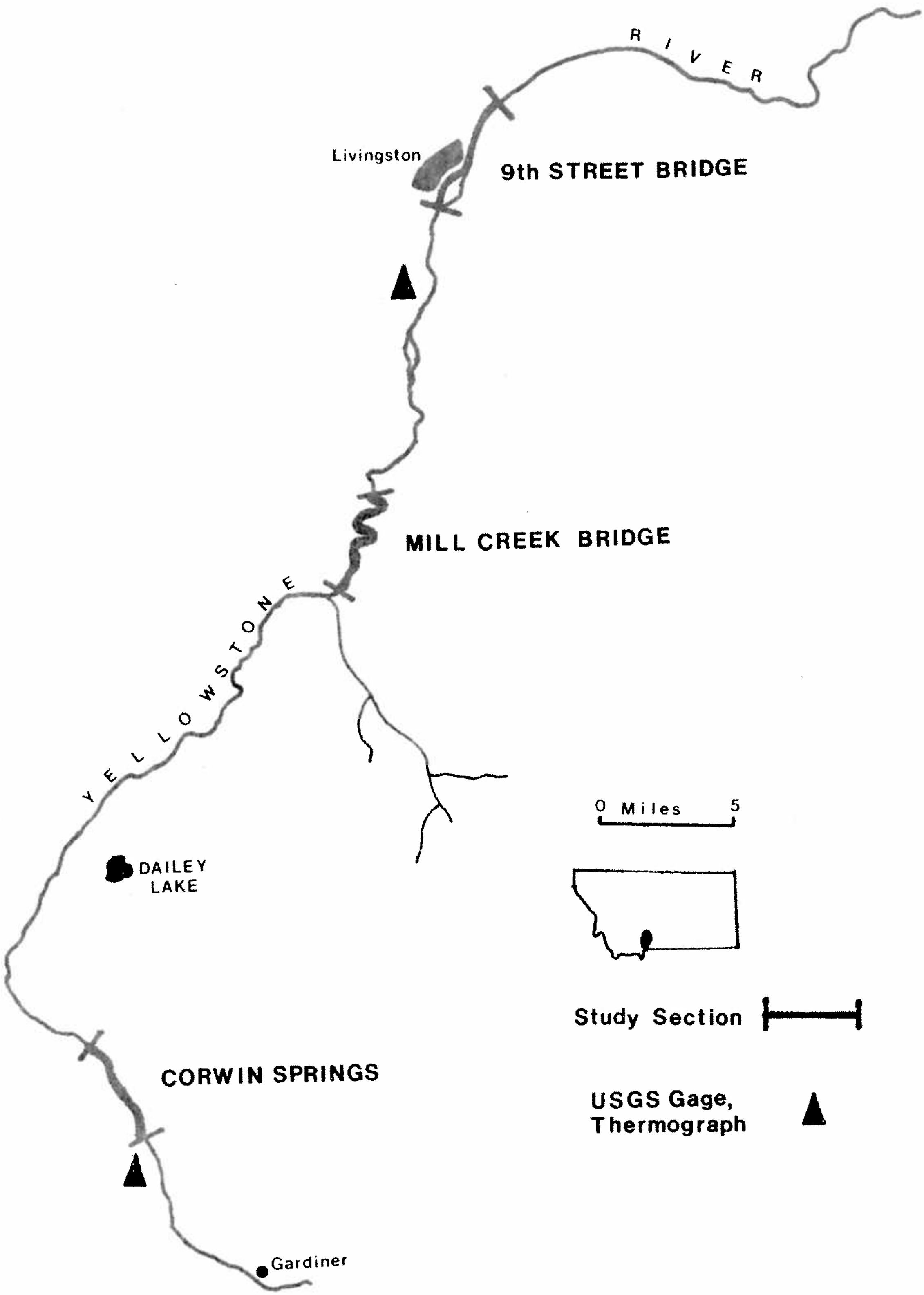

Figure 1. Map of the Upper Yellowstone River.

Table 1. Population estimates of brown, rainbow and cutthroat trout in the Corwin Springs study sections during the time periods indicated. Estimates are calculated per 1,000 feet of stream (80 percent confidence limits in parenthesis).

	Length Group (inches)				Total
	6.0 - 9.9	10.0 - 13.9	14.0 - 17.9	18.0+	6.0+
			Brown Trout		
Spring - 1978	35	42	38	4	119 (±20)
Spring - 1979	29	59	40	2	130 (±24)
Fall - 1980	--	40	73	3	--
			Rainbow Trout		
Spring - 1978	12	8	1	0	21 (±5)
Spring - 1979		37	9	0	--
			Yellowstone Cutthroat		
Spring - 1978	33	17	4	0	54 (±18)
Spring - 1979	15	24	0	0	39 (±10)
Fall - 1980	--	22	1	0	--

Table 2. Population estimates of brown and Yellowstone cutthroat trout in the Mill Creek Bridge section of the Yellowstone River during the time periods indicated. Estimates are calculated per 1,000 feet of stream. (80 percent confidence limits in parenthesis).

	Length Group (inches)				Total
	6.0 - 9.9	10.0 - 13.9	14.0 - 17.9	18.0+	6.0+
			Brown Trout		
Fall - 1980	61	11	42	12	126(±23)
			Yellowstone Cutthroat		
Fall - 1980	--	2	1	0	--

Shields River

One study section of the Shields River was sampled during September, 1980. The Zimmerman section was electrofished and population estimates were obtained for brown trout and mountain whitefish (Figure 2). Table 3 lists population estimates for these two species during 1978, 1979 and 1980.

Mountain whitefish are predominant in the smaller sizes (<14") and brown trout are more numerous in the larger sizes (>14").

Brown trout decreased approximately 50 percent between the fall of 1978 and the spring of 1979. Since that time, there has been some recovery as populations during the fall of 1980 were higher than in 1979. Mountain whitefish have shown an enormous increase in the 10-13.9 inch size. This could be the result of a particularly strong year class.

Since 1975, mountain whitefish numbers have increased in the range of 400-500 percent while brown trout total numbers have remained somewhat constant (Workman, 1976).

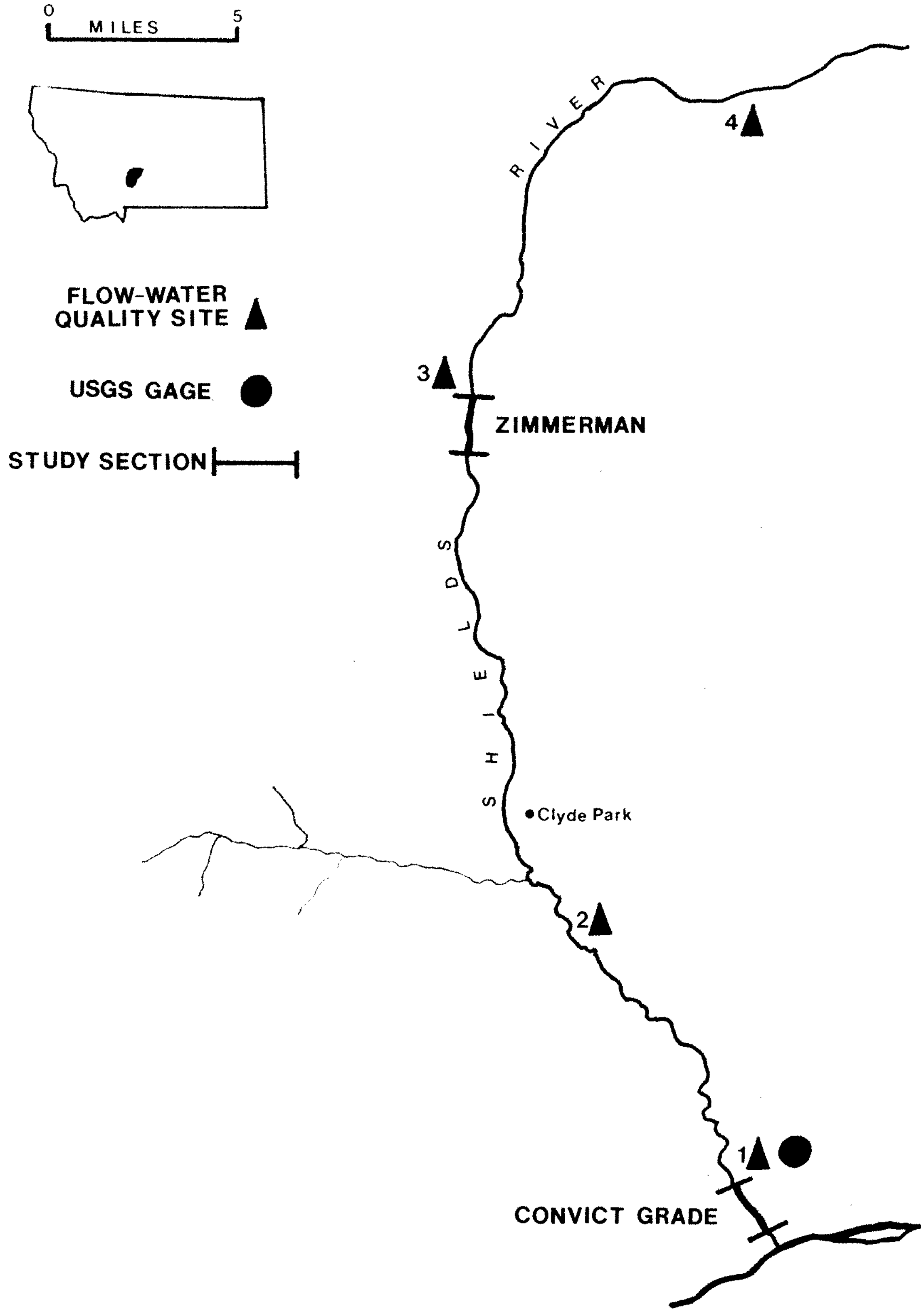

Figure 2. Map of the Shields River.

Table 3. Population estimates of brown trout and mountain whitefish in the Zimmerman section of the Shields River during the time periods indicated. Estimates are calculated per 1,000 feet of stream (80 percent confidence limits in parenthesis).

	Length Group (inches)				Total
	6.0 - 9.9	10.0 - 13.9	14.0 - 17.9	18.0+	6.0+
			Brown Trout		
Fall - 1978	63	29	46	5	143($\pm$35)
Spring - 1979	18	25	28	1	72($\pm$12)
Fall - 1980	16	41	33	3	93($\pm$19)
			Mountain Whitefish		
Fall - 1978	136	267	19	0	422($\pm$103)
Spring - 1979	74	270	21	1	366($\pm$103)
Fall - 1980	-	672	21	1	694($\pm$181)

INSTREAM FLOWS

Two sections of the Yellowstone River were measured during 1980 to ascertain the flow-fishery relationships. The wetted perimeter (WETP) technique (Nelson, 1980) was used at Corwin Springs and Livingston gauge sites. The measurements taken at Livingston were judged unreliable, therefore, they are not included in this report. They will be included in a later report.

The flow versus wetted perimeter relationship near Corwin Springs is presented in Figure 3. The inflection point on this figure is at 1500 cfs. This is the recommended flow for the low flow time of year near Corwin Springs.

Table 4 illustrates the flow recommendations for the entire year based on the wetted perimeter and dominant discharge techniques. Also included in Table 4 is the original volume of water filed on during 1973 and the final volume claimed as a result of Senate Bill 76 (Montana's Water Adjudication Act).

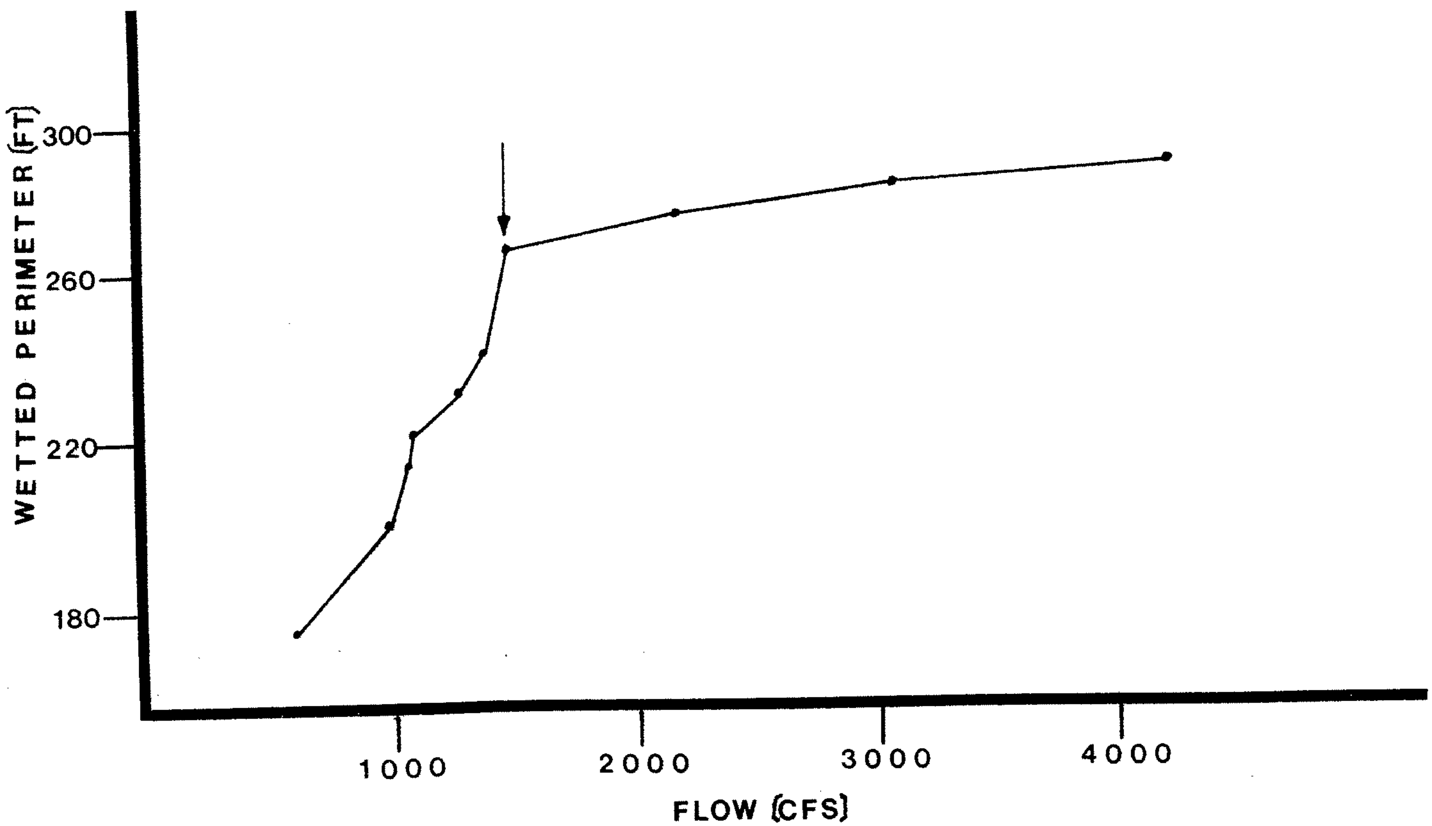

Figure 3. The relationship between wetted perimeter and flow for a composite of two riffle cross-sections in the Yellowstone River near Corwin Springs.

Table 4. Monthly flow recommendations for the Yellowstone River (Yellowstone Park boundary-mouth of Tom Miner Creek) compared to the original filing of December 23, 1970 and the final claim.

Time Period	Flow Recommendations (cfs)[a/]	Original Filing (cfs)[b/]	Final Claim (cfs)[c/]
Jan	1,500	800	800
Feb	1,500		
Mar	1,500		
Apr	1,500		
May 1 - 15	1,999		
May 16 - 31	4,792		
Jun 1 - 15	7,927[d/]		
Jun 16 - 30	7,622		
Jul 1 - 15	5,195		
Jul 16 - 31	3,568		
Aug	1,500		
Sep	1,500		
Oct	1,500		
Nov	1,500		
Dec	1,500	↓	↓

a/ - Derived from the wetted perimeter/inflection point method and the dominant discharge/channel morphology concept.

b/ - Flows as originally filed on December 23, 1970.

c/ - Derived by adjusting the flow recommendations to the constraints imposed by the original instream filing of December 23, 1970.

d/ - A flow of 14,600 cfs (the approximate bank-full discharge) should be maintained for 24 hours during this period.

WATER QUALITY

Water quality parameters including flow, conductivity, turbidity and temperature were studied at four sites on the Shields River (Figure 2).

Site 1: This site is at the U.S.G.S. gauging station on the lower Shields River. The lowest flow recorded was 45 cfs on January 28 (Figure 4). Peak flows occurred during June, however, the highest turbidities occurred in April during the first significant spring runoff (Figure 5). Conductivity was highest during the summer low flow period from mid-June through mid-September (Figure 6). This is also the irrigation season in the Shields River Valley. Water temperatures were also highest during this summer low flow period (Figure 7). During late July, water temperatures reached 76° F at this site.

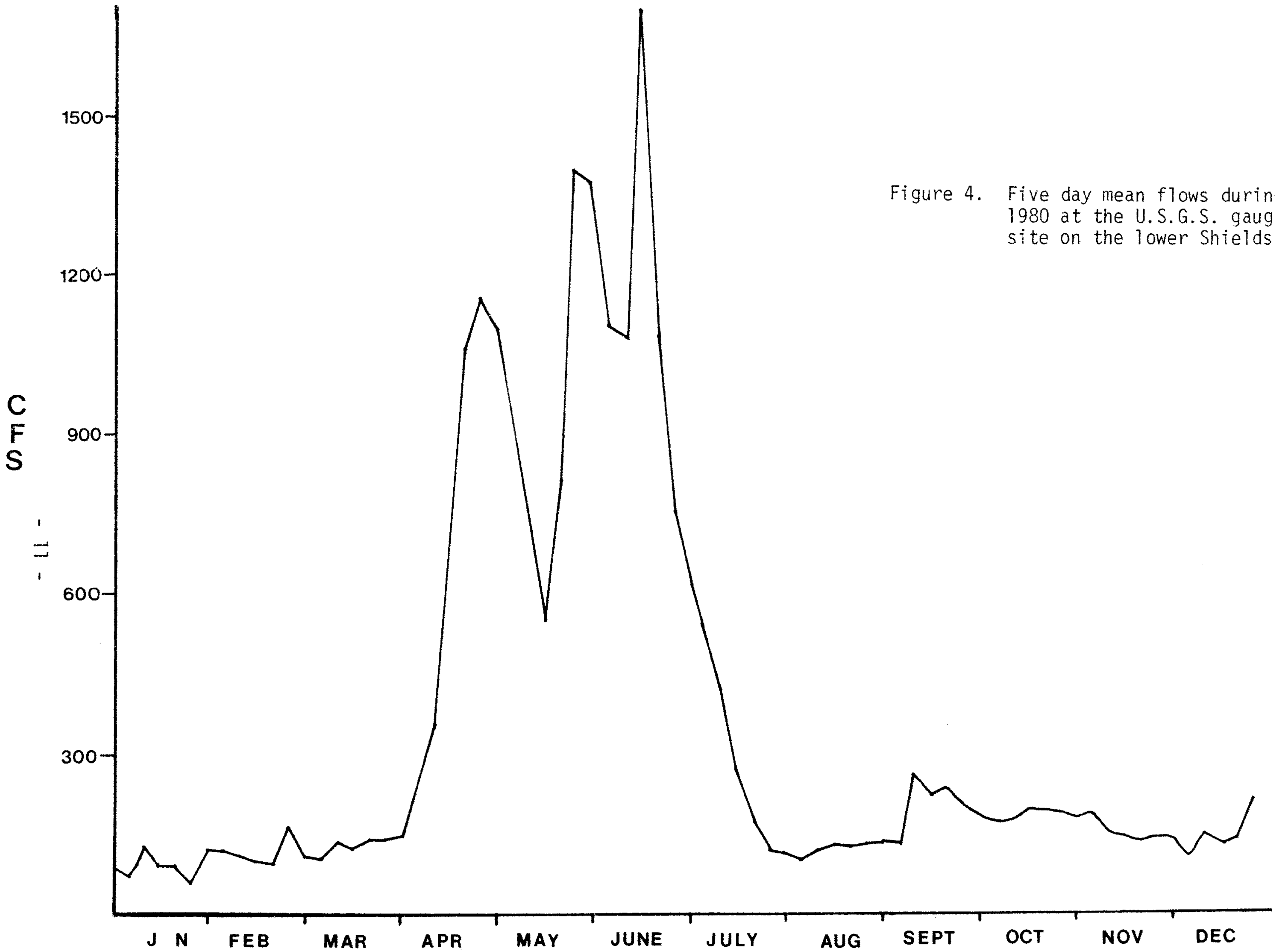

Figure 4. Five day mean flows during 1980 at the U.S.G.S. gauge site on the lower Shields River.

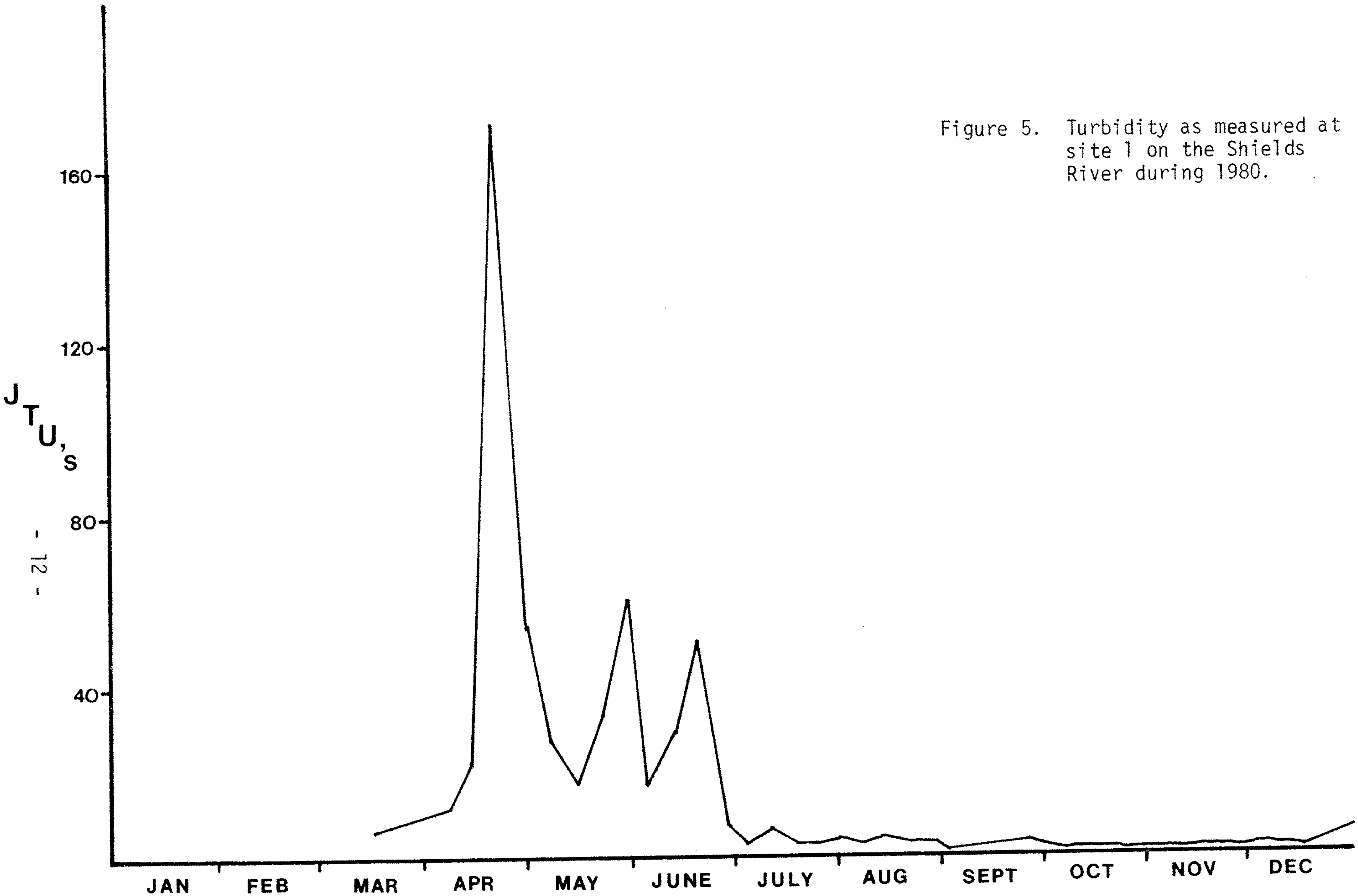

Figure 5. Turbidity as measured at site 1 on the Shields River during 1980.

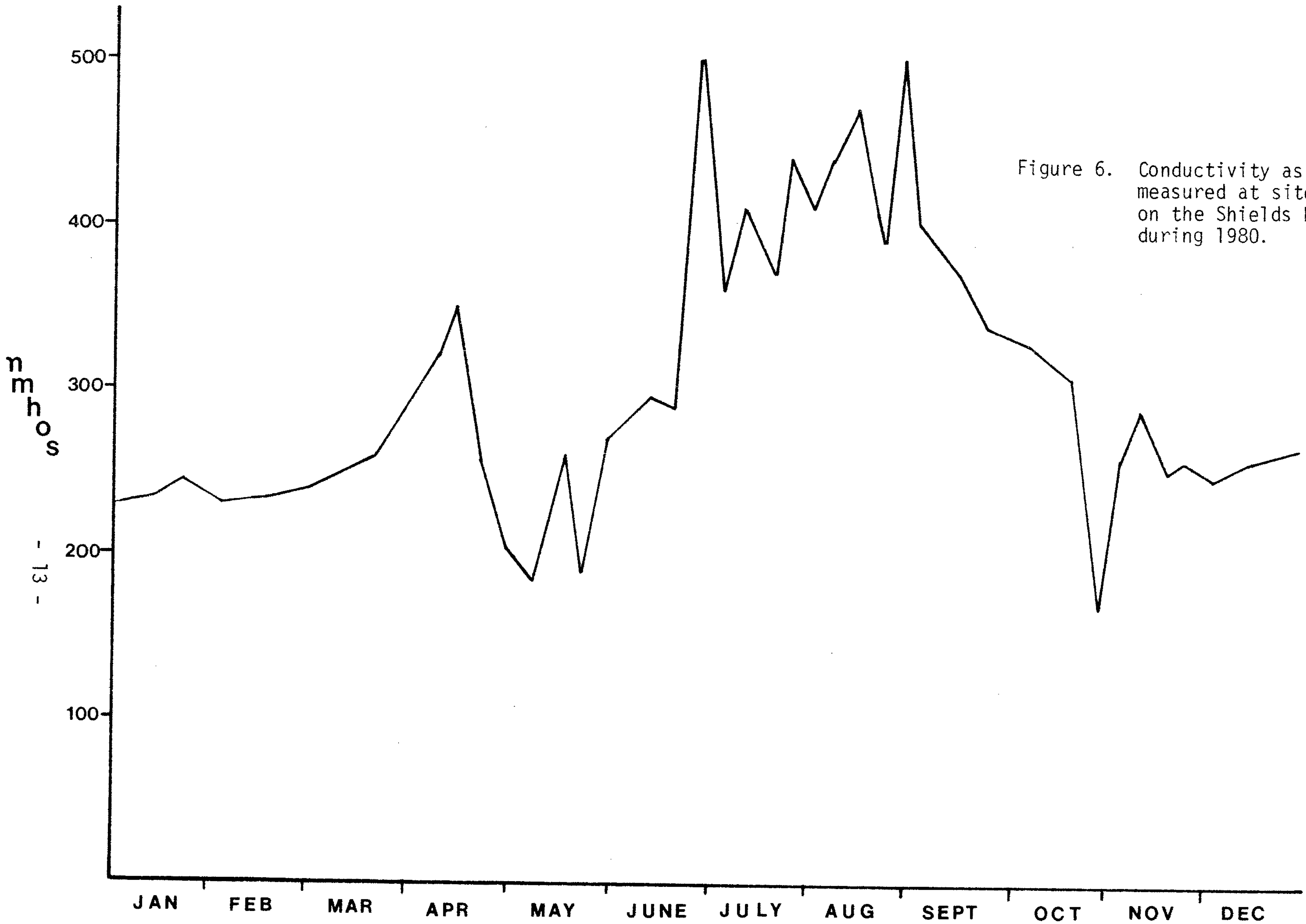

Figure 6. Conductivity as measured at site 1 on the Shields River during 1980.

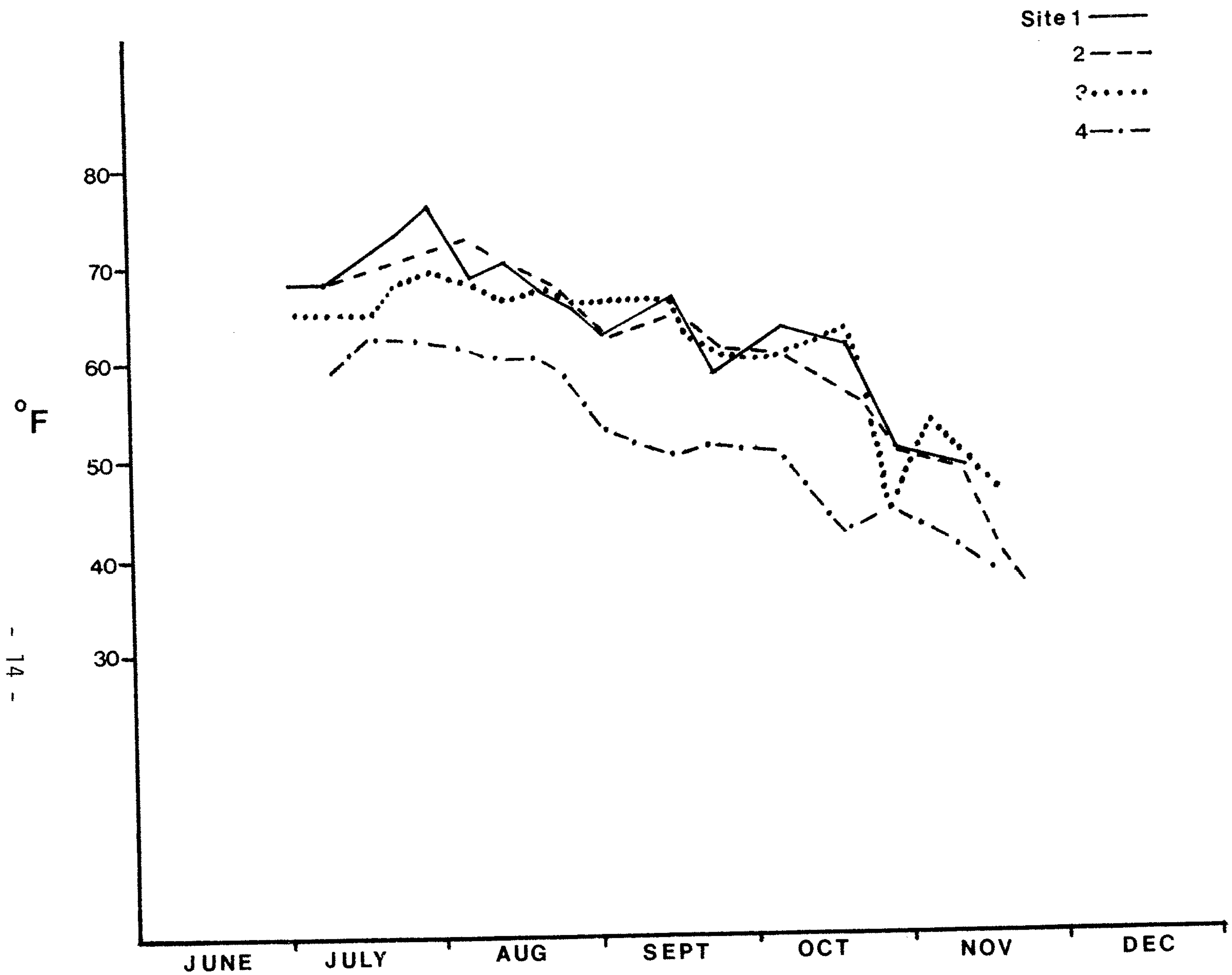

Figure 7. Maximum water temperatures during the June-November time period at the four water quality sites during 1980.

Site 2: This site is at the Highway 89 bridge near the Cowan School. Flows at this site are available for only the lowest flow periods because of difficulty in wading during higher flow periods (Figure 8). Flows during this low flow period were similar to those at site 1. Turbidity tends to be slightly lower than at site 1 during most of the year (Figure 9). Conductivity and temperature readings were similar at sites 1 and 2 during 1980 (Figure 6 and 10).

Site 3: This site is located at the first bridge upstream from the mouth of Elk Creek, a short distance north of Wilsall. Flows at this site are diagrammed in Figure 8. August was the month of lowest flows during 1980. This is similar to site 2 in this respect. The lowest flow recorded during 1980 was 15 cfs during late August. The highest temperature (69°F) occurred during early August (Figure 7). Turbidity readings were highest during the April runoff period (Figure 11). Turbidity tends to be much lower at this site than at sites 1 and 2. Conductivity is highest during the summer low flow period but also tends to be lower than sites 1 and 2 (Figure 12). This site is a transition between a mountain stream and the lowland stream at sites 1 and 2.

Site 4: This site is located at the first bridge crossing downstream of the mouth of the South Fork. Flows at this site during 1980 are diagrammed in Figure 8. This section appears to be less affected by irrigation than the downstream sites. Other than the August time period, this section contains a lower flow than site 3. The lowest flow recorded was 17 cfs in late October, 1980. Turbidity at this site was the lowest of the four sites, with highest readings during April (Figure 13). Conductivity was highest during August and was lower than the downstream sites at all times during 1980 (Figure 14). Temperatures were also lower at this site than the downstream sites (Figure 7). This site is typical of a mountain stream.

Summary of Shields River Water Quality

Flows

Flows are summarized in Figures 4 and 8. Spring runoff began in April and the highest flows occurred during June of 1980 (stage measurements not recorded in this report). The low flow period during 1980 tended to be during August. Sites 1 and 2 sustain considerably higher flows than sites 3 and 4. Site 4 appears to be least affected by irrigation. Flows increase in a downstream direction except during the summer irrigation period when site 4 maintains a higher flow than section 3.

Turbidity

Turbidity was highest at all sites during the early spring runoff during April and to a lesser degree during May and June (Figures 4, 9, 11 and 13). Turbidity increased in a downstream direction, with sites 1 and 2 showing considerably higher readings than sites 3 and 4. This indicates that the high turbidities originate primarily from downstream of the Wilsall area. Streambank erosion is excessive downstream of Wilsall and probably contributes most of this turbidity. Johnson (1964) found that over 20% of the Shields River had been altered by human activities and Workman, 1976 found that the Shields River had been shortened by 17.5% of its length. These types of activities are probably contributing to the instability of the river channel.

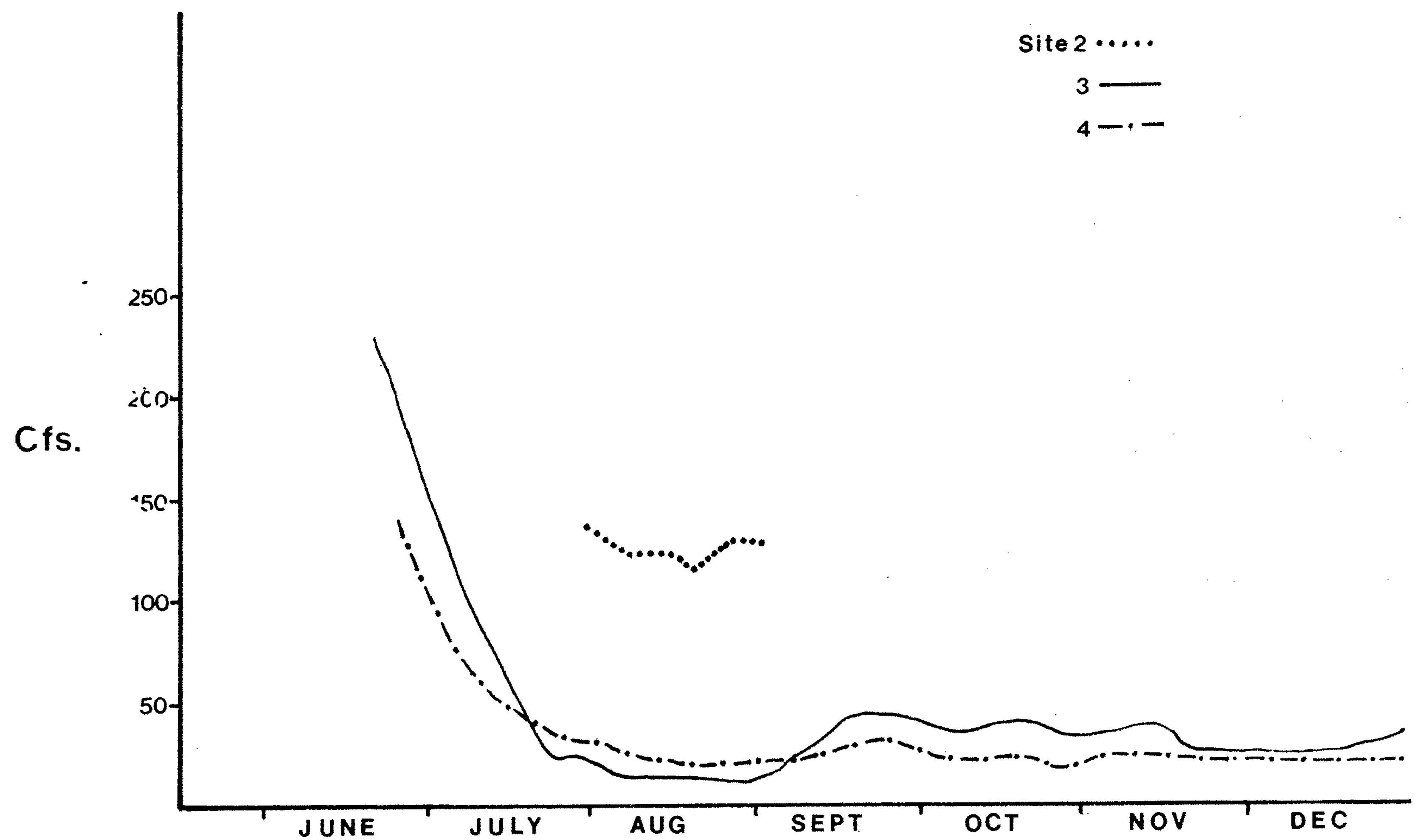

Figure 8. Flows at water quality sites 2, 3 and 4 in the Shields River during 1980.

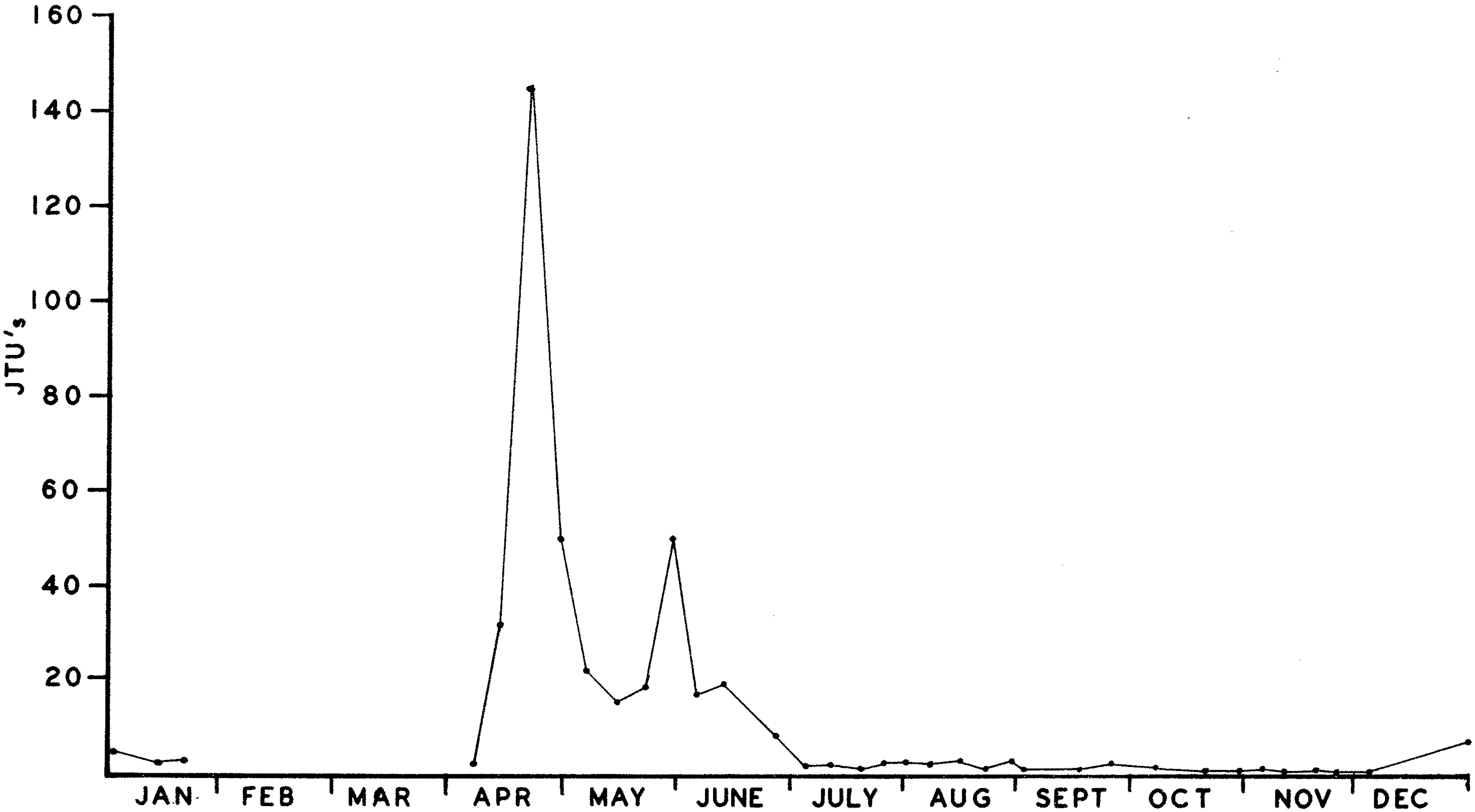

Figure 9. Turbidity as measured at Site 2 on the Shields River during 1980.

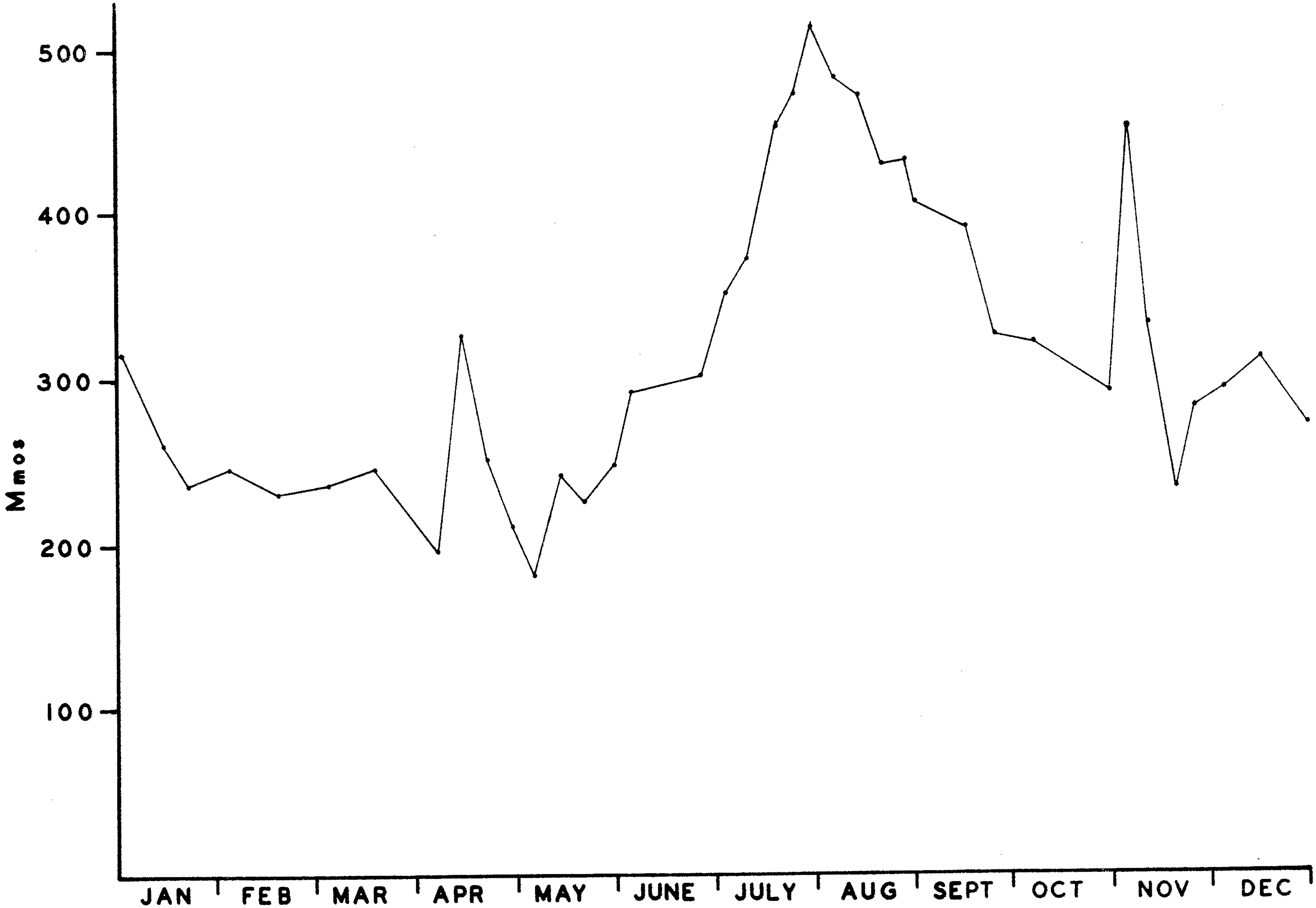

Figure 10. Conductivity as measured at Site 2 on the Shields River during 1980.

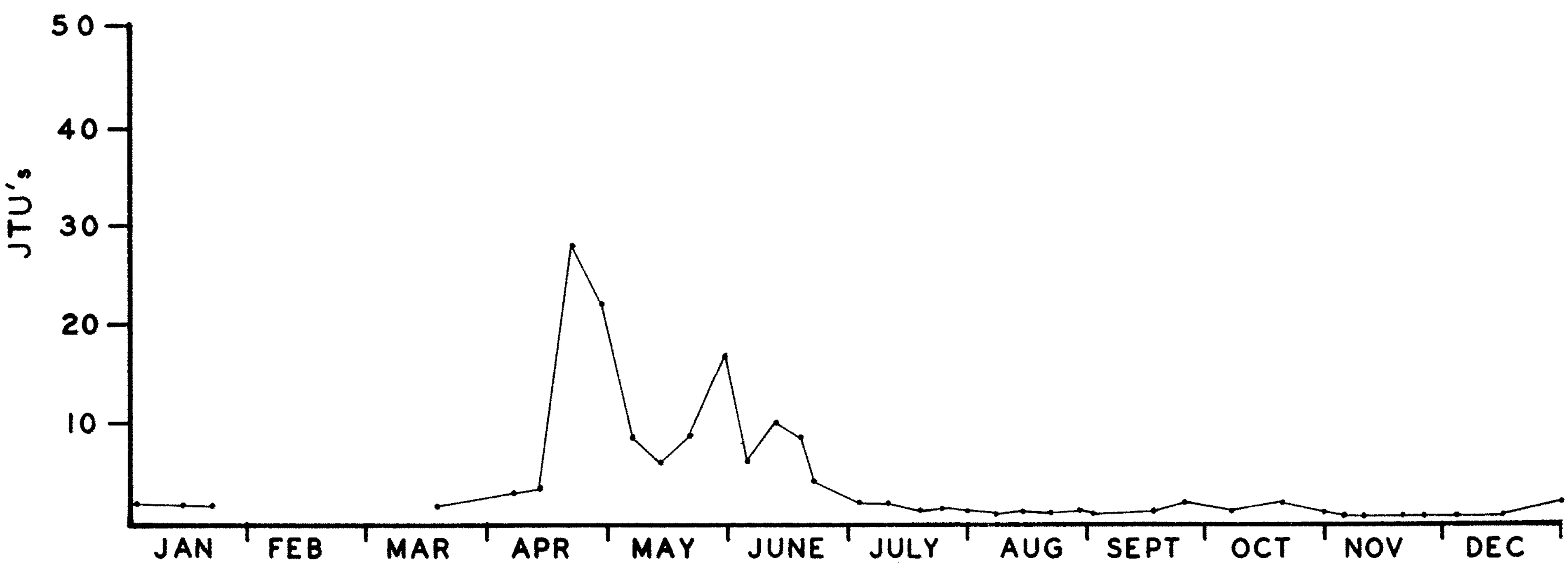

Figure 11. Turbidity as measured at Site 3 on the Shields River during 1980.

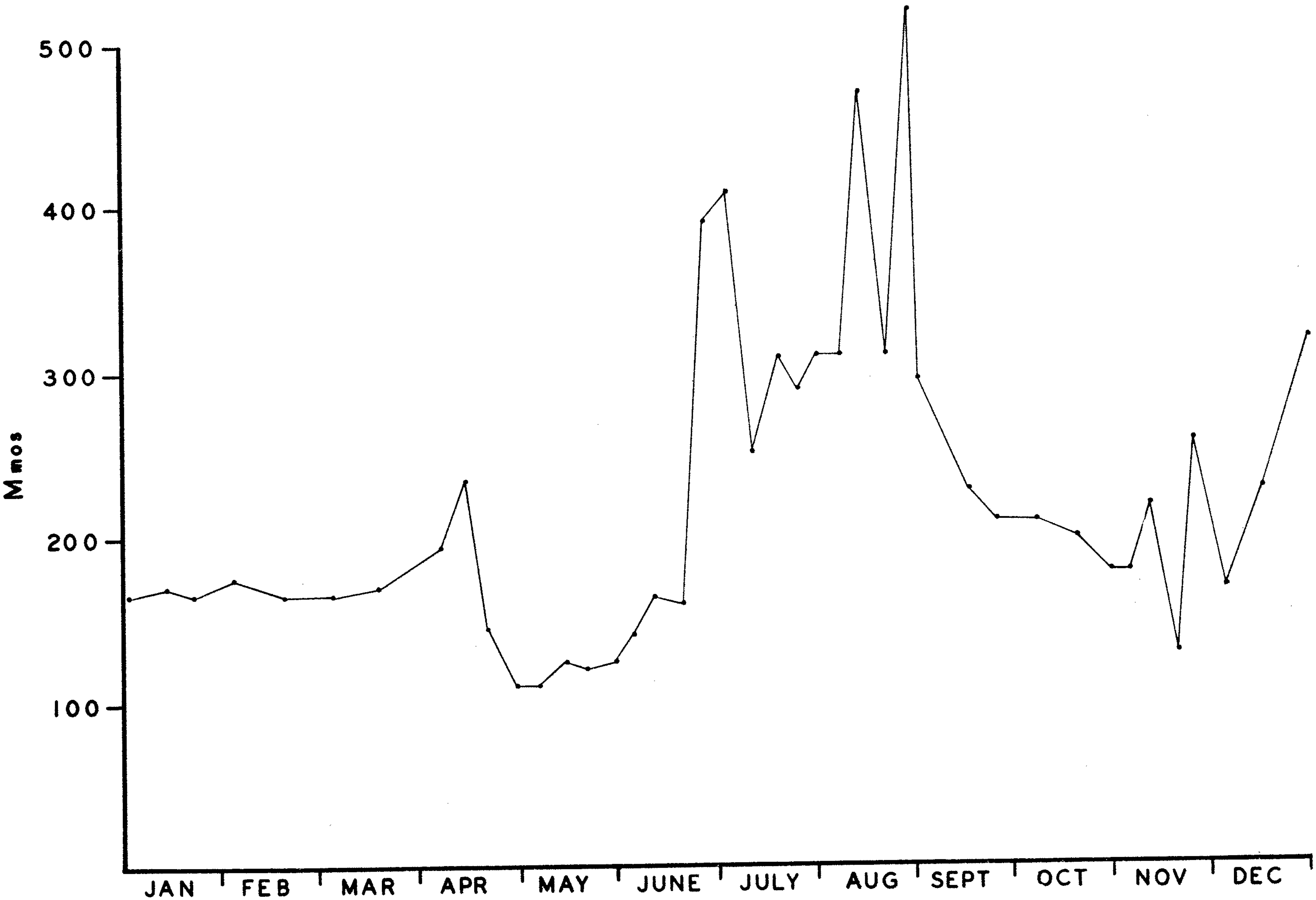

Figure 12. Conductivity as measured at Site 3 on the Shields River during 1980.

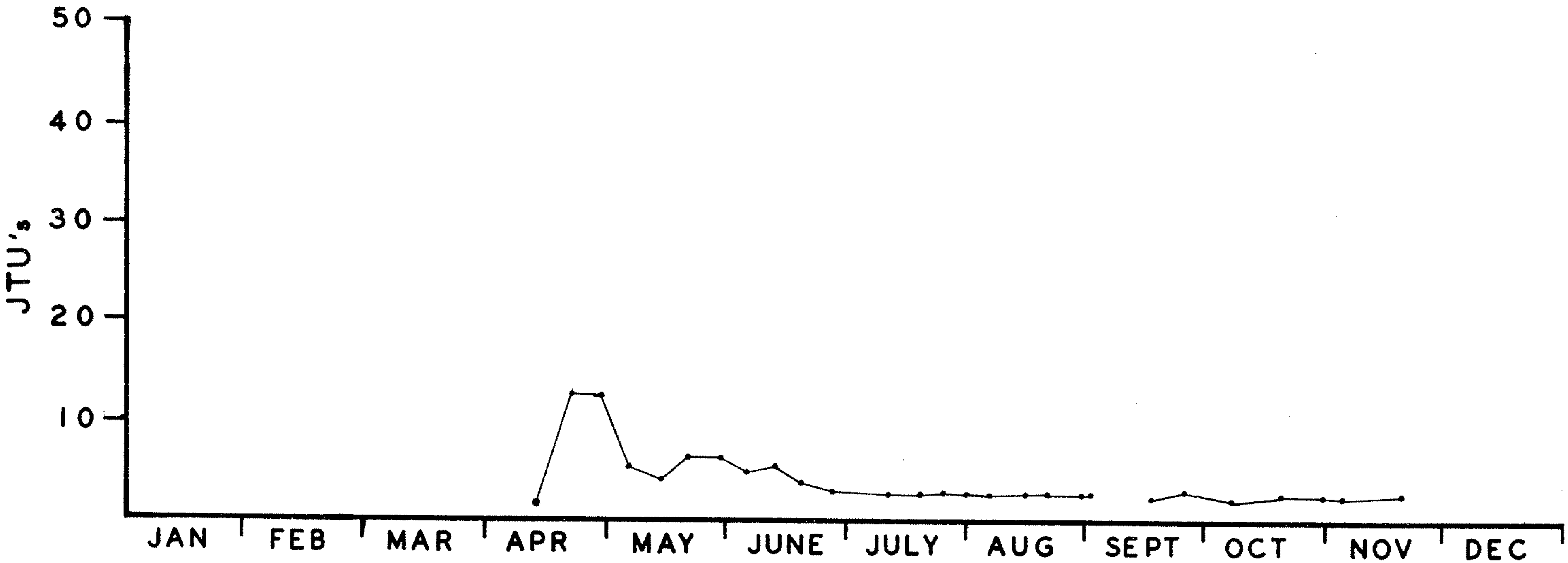

Figure 13. Turbidity as measured at Site 4 on the Shields River during 1980.

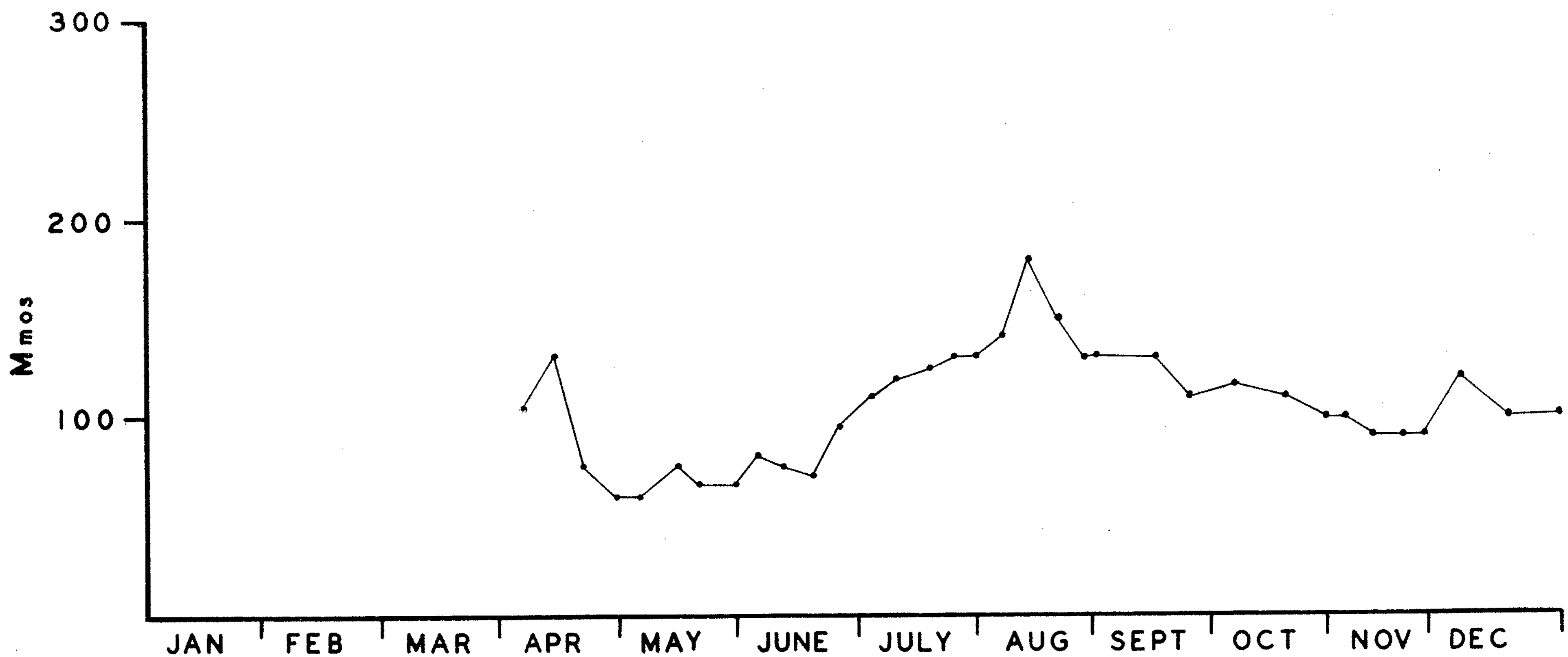

Figure 14. Conductivity as measured at Site 4 on the Shields River during 1980.

Conductivity

July through September were the months of highest conductivity at all sites (Figure 6, 10, 12 and 14). In general, conductivity increased in a downstream direction. Readings above 200 micromhos were normal at sites 1 and 2 but were never measured at site 4. The lowest readings, caused by snowmelt, were during May and June during the highest runoff period.

Temperature

Temperatures at all four sites are recorded in Figure 7. The temperature readings tend to increase in a downstream direction, however, site 4 is the only site which differs significantly from the others. Highest temperatures were during the late July period at all sites.

Yellowstone River

Water Temperatures

Five-day mean maximum water temperatures at three sites, Graybear, Livingston and Corwin Springs are presented in Figure 15. From mid-March through October, water temperatures tend to increase in a downstream direction.

The highest temperature recorded was at the Graybear site during July, 1980. This reading (72.0 F) is the highest ever recorded at that site since 1976 (Stevenson, 1980).

Late July was the time period in which maximum temperatures were reached in the Yellowstone during 1980.

Dailey Lake

The yellow perch population had severely overpopulated Dailey Lake by the mid-1970;s. As a result, growth of all gamefish in the lake had decreased to a point that fishermen were no longer catching fish of desirable size.

During the summer of 1977, the south third of the lake was poisoned and walleye were stocked in the lake in an attempt to introduce a predator which would keep the perch numbers at a lower level.

As a result of the poisoning, growth of all species increased until 1980, when it leveled off (Table 5).

The size of yellow perch decreased in 1980 and rainbow trout remained the same. Kokanee salmon were not captured during 1980. Most kokanee mature and die in their fourth year of life (Brown, 1971). They have not been stocked since 1976 and therefore, appear to be absent from the lake in 1980. Fishermen have expressed little interest in their re-introduction.

Walleye fingerlings averaged 8.0 inches long in 1980 after two growing seasons in the lake. It is hoped that they will prey on small yellow perch and control their numbers in the future. If this does not occur, and the size of perch and rainbow trout decreases, another poisoning effort will be considered.

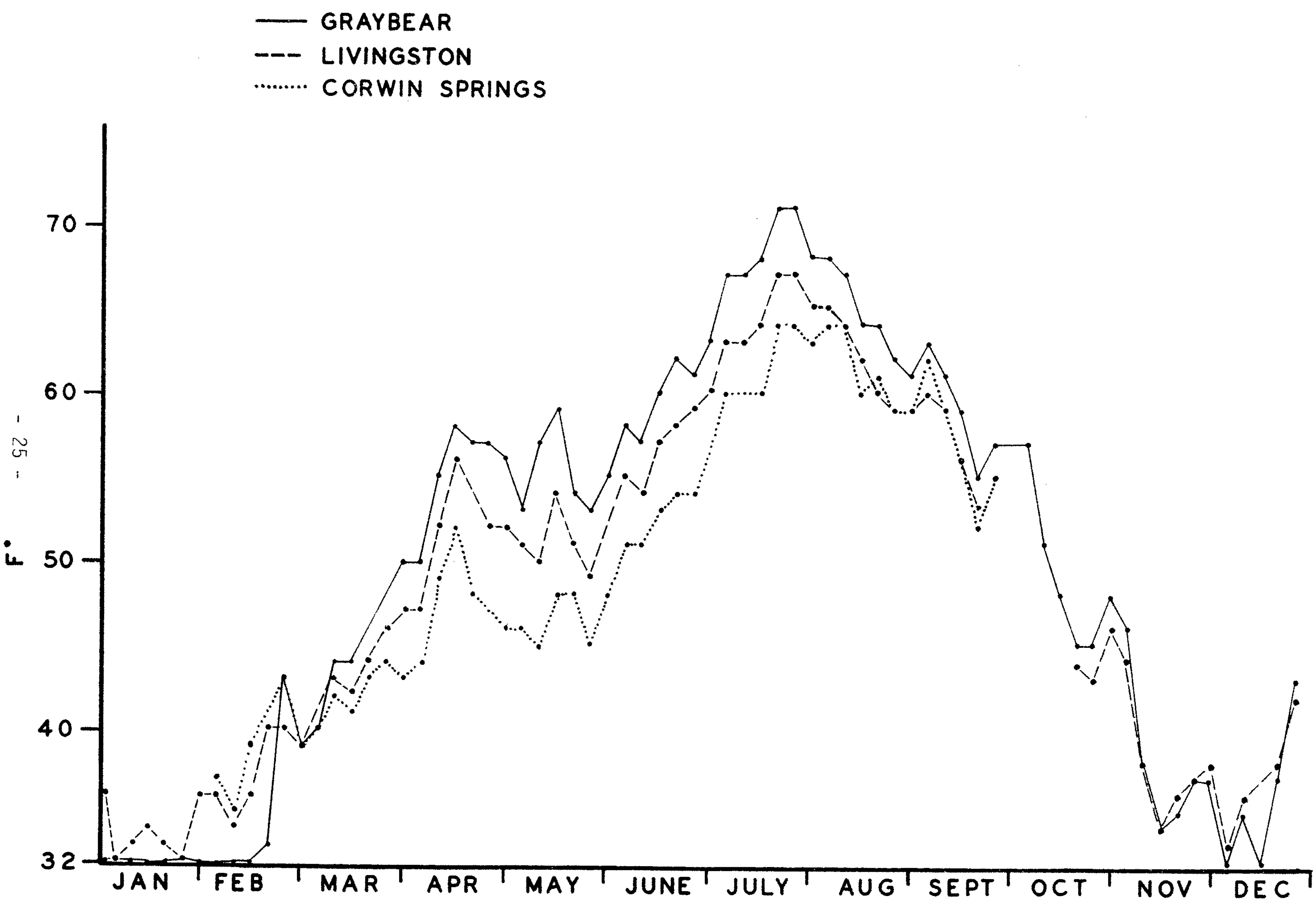

Figure 15. Five day mean maximum water temperatures at Greybear, Livingston and Corwin Springs during 1980.

Table 5. Mean length (in.) of yellow perch, rainbow trout, walleye, kokanee salmon and longnose suckers collected from Dailey Lake during 1977-1980.

Year	Y. Perch	R. Trout	Walleye	Kokanee	L. Sucker
1977	6.2	8.0	--	9.5	16.3
1978	7.3	9.1	--	13.9	15.6
1979	8.2	13.0	--	17.1	17.7
1980	7.9	13.0	8.0*	--	12.3

*Does not include adult walleye which were stocked during 1979.

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Key Words:

Trout, brown
Trout, rainbow
Whitefish, mountain
Population survey
Temperature/environment/
Turbidity
Conductivity
Instream flow needs

Waters Referred To:

Dailey Lake	3-22-7644-03
Shields River	3-22-5362-01
Shields River	3-22-5348-01
Shields River	3-22-5334-01
Yellowstone River	5-22-7056-01
Yellowstone River	3-22-7070-01
Yellowstone River	3-22-7084-01