

A SURVEY OF HALFWAY CREEK, LA CROSSE COUNTY, WISCONSIN TO  
DETERMINE TEMPERATURES, NITRATE-NITROGEN, NITRITE- NITROGEN,  
ORTHO-PHOSPHATE, AND SEDIMENT PRESENT IN THE CREEK

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A Seminar

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## ABSTRACT

The concentration of nitrate-nitrogen, nitrite-nitrogen, and ortho phosphate were determined from samples taken at six different locations, every two weeks for a year, on Halfway Creek in La Crosse County, Wisconsin. The temperature and the amount of sedimentation were also recorded for each station. The sampling and analysis began July 22, 1971 and ended June 28, 1972. The six stations were located between the mouth of Halfway Creek on Lake Onalaska and a point about two miles downstream from its source in the coulee.

The results show a considerable variation in the amounts of nitrate, nitrite, and phosphate present at different times of the year and at the different locations on the stream. The average ortho phosphate level of the stream was 1.82 ppm, with very high levels recorded in the spring. The nitrate level of Halfway Creek was highest in the farmland near its source, decreasing as it moved toward its mouth. The average amount of nitrate present in the entire stream for the year was about 34 ppm. The nitrite level averaged 0.112 ppm over the entire stream for the measuring period. Sedimentation was very low with very little suspended material leaving the stream at its mouth in Lake Onalaska. While most of the temperatures recorded produced characteristic results, those recorded at the

mouth of the stream were exceptions. They were generally lower than the next two stations upstream because of large amounts of water entering the stream just before it empties into the lake.

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## INTRODUCTION

This study was done on Halfway Creek, which originates in one of the coulees east of the Village of Holmen, in La Crosse County (Figure 1). The stream flows for about ten miles through farmland, the Village of Holmen, and across a corner of Brice Prairie before it empties into the Black River in Lake Onalaska.

The purpose of this study was to take water samples every two weeks at six different locations along Halfway Creek (Figure 1). From the samples the temperatures and sedimentation were measured, and the amount of nitrate-nitrogen, nitrite-nitrogen, and ortho phosphate in parts per million were determined.

The data collected was studied and analyzed to determine what is happening to the stream, and what the stream in turn is doing to Lake Onalaska.

## LITERATURE REVIEW

The presence of nitrites in water is a result of bacteria action upon ammonia and organic nitrogen. Nitrites are then quickly oxidized to nitrates. The presence of nitrites does not always signify pollution, and very small amounts may actually stimulate growth of some plankton. (McKee and Wolf 1970)

Nitrites are poisonous, and water supplies for humans should contain less than two mg/liter. It has been found that 50 mg/liter of  $\text{NaNO}_3$  is fatal to fish in fourteen days. (Wilber 1909)

Nitrates occur in water primarily as a result of five causes: 1. the end product of aerobic stabilization of organic nitrogen; 2. percolating ground water as a result of excessive fertilizer on farm land; 3. leeching from cesspools; 4. rain and snow; and 5. insignificant amounts from industrial wastes and chemical fertilizer plants. (USPHS 1971)

From a health standpoint, and then only in cases of very young babies, nitrate above 10-20 ppm in drinking water can cause methemoglobinemia, a blood disorder. Most cases of methemoglobinemia appear where the nitrate content is over 60 ppm. (Norde11 1971) However, research has also shown that all infants are not affected equally by high nitrate concentration, with some showing no effect at any nitrate level.

The primary effect of nitrates in the water is the fertilizing effect on micro organisms, particularly Scenedesmus. It appears that this fertilizing effect is dependent on the simultaneous presence of phosphates. (Klein 1966) It has been found that bodies of water with good fish populations have a certain amount of nitrates present. Research shows that 95 per cent of bodies of water have less than 4.2 mg/liter, and 5 per cent have less than 0.2 mg/liter. (Nordell 1971)

At present no standards have been set on the amount of nitrates found in water; however, it is recommended that drinking water have less than 45 mg/liter and less than 10 mg/liter for infants. (USPHS 1971)

Basically phosphorus is present in three groups: ortho phosphate, organic compounds, and phosphates of industrial and biological compounds. It has been found that ortho phosphate usually makes up 25-30 per cent of the total. (Gloyna 1968) Phosphates find their way into the water by several methods: leeching from mineral ores, agricultural drainage, result of industrial waste, stabilized products of decomposition of organic matter, and municipal sewage (detergents). (McKee and Wolf 1970) Phosphorus in springs and ground water is usually negligible as it is not easily leached from the soil. (Gloyna 1968)

The effects of phosphates in water are its fertilizing effects, taste, odor, and interference with coagulation in

water treatment plants. Phosphates are seldom toxic; however, certain phosphate compounds are toxic to some fish and other small organisms. A test with rats found that 200 ppm of phosphates had no ill effects. (McKee and Wolf 1970) Large amounts of phosphates in the water will cause an undesirable odor and taste. The threshold of taste is 180 ppm to 225 ppm. (McKee and Wolf 1970)

The primary effect of phosphates in the water is that it causes over-abundant growth of algae which can be harmful to fish and other organisms, and it will then cause an increase in the eutrophication of a lake. Good indicators of eutrophication are the blue green algae, *oscillatoria*, *anabaena*, *microcystis*, and various green algae. Adding to the problem of the effect of phosphates on bodies of water is the fact that numerous plants will store up to ten times the amount of phosphate they need. (Warren 1971)

At present there is considerable disagreement as to the amount of influence phosphates and nitrates have on eutrophication. Some researchers find that nitrates have to be present in amounts 10 times greater than phosphates to be absorbed at the same rate. (Gloyna 1968) Some people think that phosphates are the limiting factor; others think that nitrates are the limiting factor, while still others think that neither one of them is. In spite of a lot of talk and writing, there is little conclusive evidence because the research has been rather limited until now. An area which

needs to be explored extensively, but where little has been done, is one which studies the effect of the presence of various trace elements. There are indications that they may have drastic effects on the process of eutrophication.

## METHODS AND MATERIALS

Six stations were selected as sites on Halfway Creek where the water samples were to be taken. Station I was located at a large culvert on County Trunk Z where Halfway Creek enters Lake Onalaska and the Black River. (Figure 2) Station II was located about one mile upstream where County Trunk ZN crosses the stream. (Figure 3) Station III was located farther upstream where U.S. Highway 53 crosses Halfway Creek. (Figure 4) This station is on the western edge of the Village of Holmen, several hundred feet downstream from the outflow of the sewage treatment plant. Station IV was located on the east side of the Village of Holmen. (Figure 5) Station V was located where County Trunk D crosses the stream about two miles east of the Village. (Figure 6) Station VI about two miles farther upstream, was located about two miles from the origin of the stream. (Figure 7)

The water samples were taken approximately every two weeks, using one-gallon plastic milk containers. The samples were collected in the evening, usually between four and eight o'clock, by holding the mouth of the container about two inches under the surface of the water. The sampling was done in two sections; stations I, II, III were collected and analyzed, then stations IV, V, and VI were collected and analyzed. By following this procedure, all samples were

completely processed within three-quarters of an hour. The water samples were taken to the Biology Laboratory at Holmen High School to be analyzed. The tests for the measurement of nitrate-nitrogen, nitrite-nitrogen, and ortho phosphate were completed according to the procedure outlined in a Hach Kit. The sediment load was determined by using one-liter Imhoff cones. The temperature of the water was recorded at each site while the water sample was obtained.

## RESULTS AND CONCLUSIONS

The temperatures recorded during the year at each station followed a similar pattern. The temperatures were the highest in the summer, reaching a maximum of 22.8° C in August, 1971 at Station VI which is farthest upstream, and a maximum of 27.0° C on the 28th of June, 1972 at Station I. (Figures 8 - 13) The temperature at Stations V and VI remained high enough to remain free of ice all winter. Station I was partially frozen over much of the winter, and completely for about one month during February and March. The other three stations were covered with eight to twelve inches of ice during January, February, and part of March. In general, the temperature recorded at each station decreased going upstream, which would be expected. However, much of the time Station I recorded a lower temperature than Station II, which was less than a mile upstream. It was observed that the volume of water passing through the culvert at Station I was two to three times that of the volume passing through the culvert at Station II. The terrain between the two stations is very low, and marshy to swampy in nature. Apparently there are additional sources of water in this area that have an effect upon the character of Halfway Creek at this point.

The concentration of ortho phosphate present in each sample was determined by the Hach Kit method. The values obtained are recorded in Tables 1 - 6. The level of ortho

phosphate present varied considerably from station to station, and from one sampling period to the next. (Figures 14 - 19) The largest amounts of ortho phosphate were recorded March 19 and April 1 for each station on the stream. At this particular time the ortho phosphate averaged over 6.5 ppm for the entire stream. Station VI consistently recorded a lower ortho phosphate reading than the other five stations downstream. The average amount of ortho phosphate at the mouth of Halfway Creek (Station I) was lower than that recorded at Stations II, III, and IV, and about the same as that for Station V and VI. Partial explanation may be in the large increase in volume of water between Stations I and II. Station III recorded the largest average amount of ortho phosphate present. (Figure 32) Station III is located only a short distance from the outflow of the Village of Holmen's sewage treatment plant. The average amount of the ortho phosphate present in the entire stream was 1.82 ppm. The effect of this amount upon the stream itself would probably be small; however, the effect on the waters of Lake Onalaska may be more noticeable in algae and plant growth.

The presence of poisonous nitrite in Halfway Creek was also determined by using the Hach Kit method. (Tables 1 - 6) The greatest amounts of nitrites were recorded during the summer and early fall. On the average the nitrite level was lowest at Station VI and increased to a high at Station II downstream. There was a rather severe drop in the amount of

nitrite present at Station I (Figures 20-25 and 33) The results obtained at Station I are probably due again to the large increase in volume of water, thus changing the physical character of the stream. The original measurements show the ppm of nitrite-nitrogen present as determined by using the Hach Kit procedures. (Tables 1-6) The actual amount of nitrite present can be determined by multiplying by a factor of 3.3. The average ppm of nitrite at each station was determined and the calculated average amount of nitrite for the entire stream was 0.112ppm. (Table 7, Figure 33) This is much less than the 2.0 ppm danger level set for human water supplies.

The concentration of nitrate present at each of the six stations on Halfway Creek, as determined by using a Hach Kit, was recorded as ppm of Nitrate-nitrogen. (Tables 1-6) The results when plotted revealed considerable fluctuation from one measuring time to the next at each station. (Figures 26-31) There appeared to be a greater amount of nitrate-nitrogen present in the stream in the spring of the year; otherwise, no patterns are evident in the data recorded at any given location. The average nitrate-nitrogen concentration present for each station shows a decrease as the water moves downstream. (Table 7, Figure 34) This may indicate that much of the nitrate enters the stream from the farm land upstream and then is either leached out or diluted as the stream increases in size and moves downstream. This process appears to be most rapid between Stations I and II. To determine the

actual amount of nitrate present, the amount of nitrite present must be subtracted from the nitrate-nitrogen reading and the result multiplied by a factor of 4.4 (Table 7, Figure 34) Using this method the average concentration of nitrate in Halfway Creek at Station I as it enters Lake Onalaska was calculated to be 26.84 ppm. The average amount of nitrate in the entire stream was calculated to be 34.28 ppm. This indicates that Halfway Creek is receiving nitrates well above the levels found in good fishing waters; however, good catches of trout are taken from this stream every spring. The levels of nitrate recorded on this stream are still well under the recommended 45 ppm level for human drinking water.

The amount of suspended material carried by Halfway Creek is very low most of the year, usually less than 0.3 ml/liter. (Tables 1-6) The collected data indicated the greatest amount of sediment during March when the spring thaw occurred. The spring of 1972 was unusual as it remained cool for a long period and the snow melted much more slowly than normal. This caused the run-off to be much more gradual and Halfway Creek did not increase in volume as it normally does. The sediment in the water at Station I was usually considerably less than at the other stations. Investigation revealed that after the water leaves Station II, it travels about one-half mile, then spreads out and slows down, depositing much of the suspended material that it was carrying. The results would indicate that for most of the year very

little suspended material is leaving the stream at its mouth.

## SUMMARY

1. The temperatures recorded at each of the stations followed a standard pattern. The temperatures decreased from station to station going upstream with the exception of Station I which usually had a lower temperature reading than Station II during the summer. This is apparently caused by underground water source.
2. The amount of suspended material present in Halfway Creek is very small during most of the year. There was an increase during the spring thaw as was expected. The amount of suspended material was usually the least at Stations I, either because of increased volume or some settling action just above this station.
3. The ortho phosphate concentration in Halfway Creek was highest during the spring, reaching a high of over 8.0 ppm at several stations. Station III, which is just below the Village of Holmen's sewage treatment plant, consistently recorded the highest reading on the stream throughout the year. The amount of ortho phosphate in the stream does not appear to be excessive; however, it could easily contribute to algae growth in Lake Onalaska.
4. Nitrites are found at various levels throughout Halfway Creek; however, they are normally found in concentrations well below the danger level of 2.0 ppm set for drinking water. Apparently the overall effect of nitrites in the Creek is limited.

5. The nitrate concentration in Halfway Creek is rather high, averaging 34.28 ppm. This could have a nutrient effect on the algae and plant growth in Lake Onalaska. The source of the nitrate appears to be in the upper part of the stream, which is a drainage area for farmland.

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A P P E N D I X

Table 1. The recorded levels of temperature, ortho phosphate, nitrate-nitrogen, nitrite-nitrogen, and sediment for Station I, Halfway Creek, La Crosse County, Wisconsin. July 1971 - June 1972.

Date	Temperature degrees C.	Ortho Phosphate ppm	Nitrate- Nitrogen ppm	Nitrite- Nitrogen ppm	Sediment ml/liter
7-22-71	23.0	.28	6.0	.018	trace
8-6	20.5	.21	4.0	.018	.20
8-22	23.6	1.49	2.2	.005	.02
9-6	22.9	.54	13.0	.00	.05
9-25	12.5	1.90	3.0	.0275	.00
10-9	13.6	1.10	3.5	.03	.05
10-16	12.0	.35	9.5	.015	.05
10-31	11.0	-	4.0	.009	.00
11-14	9.0	6.00	13.0	.059	.00
12-4	1.2	.99	.05	.025	.01
1-8-72	.8	1.20	1.0	.045	.00
1-22	1.0	.20	2.0	.015	.05
2-6	0.0	1.80	5.0	.042	.00
2-19	.5	.40	12.0	.02	trace
3-5	0.0	4.30	6.0	.001	.05
3-19	.2	3.60	14.5	.055	.40
4-1	1.5	5.75	3.0	.06	trace
4-16	11.0	.60	3.0	.015	.00
5-6	12.5	3.60	4.0	-	.05
5-19	16.0	.90	11.0	-	trace
6-4	24.0	-	-	-	trace
6-19	26.8	2.10	.2	.02	trace
6-28	27.0	1.40	4.0	.028	trace
Average		1.84	6.17	.025	

Table 2. The recorded levels of temperature, ortho phosphate, nitrate-nitrogen, nitrite-nitrogen, and sediment, for Station II, Halfway Creek, LaCrosse County, Wisconsin. July 1971 - June 1972.

Date	Temperature degrees C.	Ortho Phosphate ppm	Nitrate Nitrogen ppm	Nitrite- Nitrogen ppm	Sediment ml/liter
7-22-71	24.6	.98	3.0	-	.4
8-6	25.5	1.2	7.0	.002	.2
8-22	25.0	1.65	4.5	.08	.125
9-6	23.3	1.08	15.5	.092	.05
9-25	12.0	1.15	2.0	.0925	.1
10-9	15.5	1.25	2.0	.14	.05
10-16	13.2	1.6	10.5	.2	.1
10-31	10.1	-	5.5	.045	-
11-14	11.1	1.95	12.5	.056	.15
12.4	.2	.7	3.0	.002	.3
1-8-72	.2	1.5	4.0	.024	0
1-22	.1	.7	.5	.03	.05
2-6	-	.6	6.0	.025	0
2-19	-	1.7	13.5	.005	.01
3.5	-	.55	15.0	.025	.05
3-19	1.0	8.4	22.5	.065	2.00
4-1	5.0	1.2	.5	.03	.1
4-16	12.0	1.9	2.0	.0225	.2
5-6	14.0	1.7	5.0	-	.1
5-19	17.0	2.8	13.0	-	.05
6-4	21.5	-	-	-	.15
6-18	24.0	2.8	12.5	.13	.2
6-28	25.0	2.8	8.0	.105	.2
Average		1.80	7.64	.058	.2

Table 3. The recorded levels of temperature, ortho phosphate, nitrate-nitrogen, nitrite-nitrogen, and sediment for Station III, Halfway Creek, La Crosse County, Wisconsin. July 1971 - June 1972.

Date	Temperature degrees C.	Ortho Phosphate ppm	Nitrate- Nitrogen ppm	Nitrite- Nitrogen ppm	Sediment ml/liter
7-22-71	20.5	1.6	5.5	-	.5
8-6	18.4	1.64	4.5	.008	.3
8-22	23.4	2.4	5.0	.119	.06
9-6	22.5	1.45	10.8	.08	.2
9-25	11.8	3.8	1.0	.0275	.5
10-9	11.8	.98	3.0	.041	.075
10-16	10.5	1.95	8.50	.019	.2
10-31	8.5	-	10.2	.006	0
11-14	10.0	2.4	11.0	.025	.1
12-4	2.0	2.1	1.0	.02	.1
1-8-72	.5	.1	4.0	.01	0
1-22	0	1.2	.5	.015	.01
2-6	0	.6	15.0	.0225	0
2-19	0	1.9	13.0	-	0
3-5	0	2.0	7.0	.025	.05
3-19	.5	8.7	18.0	.02	3.00
4-1	4.0	3.6	5.0	.004	trace
4-16	10.0	3.5	3.0	.0475	.1
5-6	11.0	2.6	5.0	-	.1
5-19	15.0	5.0	13.0	-	trace
6-4	22.0	-	-	-	.02
6-18	23.0	3.7	13.0	.12	.05
6-28	23.0	3.4	5.0	.134	.05
Average		2.57	7.364	.033	.27

Table 4. The recorded levels of temperature, ortho phosphate, nitrate-nitrogen, nitrite-nitrogen, and sediment, for Station IV, Halfway Creek, La Crosse County, Wisconsin. July 1971 - June 1972.

Date	Temperature degrees C.	Ortho Phosphate ppm	Nitrate- Nitrogen ppm	Nitrite- Nitrogen ppm	Sediment ml/liter
7-22-71	20.2	.45	5.0	-	.25
8-6	21.0	.44	4.0	.008	.10
8-22	23.5	.98	4.6	.129	.15
9-6	21.6	.68	9.0	.077	.11
9-25	11.5	3.60	8.0	.045	.05
10-9	13.0	.425	2.0	.016	.025
10-16	11.0	.60	1.5	.018	.00
10-31	9.0	-	5.0	.02	.00
11-14	10.0	2.40	11.0	.025	.05
12-4	3.0	.80	-	.01	.05
1-8-72	.1	.10	17.5	.001	trace
1-22	0.0	.95	12.0	.005	.05
2-6	0	.70	14.0	.015	.01
2-19	0	.60	13.5	.02	.01
3-5	0	.30	3.5	.005	.01
3-19	2.0	7.50	12.5	.035	3.50
4-1	4.0	8.50	14.0	.028	.05
4-16	14.5	1.30	2.5	-	.10
5-6	16.0	4.40	8.0	-	.10
5-19	19.0	1.45	7.5	-	.05
6-4	22.2	1.50	11.0	-	.05
6-18	23.0	1.60	11.5	.08	.20
6-28	23.0	3.80	12.0	.092	.20
Average		1.96	7.55	.035	.23

Table 5. The recorded levels of temperature, ortho phosphate, nitrate-nitrogen, nitrite-nitrogen, and sediment for Station V, Halfway Creek, La Crosse County, Wisconsin. July 1971 - June 1972.

Date	Temperature degrees C.	Ortho Phosphate ppm	Nitrate- Nitrogen ppm	Nitrite- Nitrogen ppm	Sediment ml/liter
7-22-71	19.6	.35	5.5	-	.25
8-6	19.6	.44	7.0	.005	.10
8-22	23.0	.95	4.0	.065	.20
9-6	20.0	.49	10.5	.049	.09
9-25	11.5	4.40	7.5	.0425	.025
10-9	14.0	.38	1.0	.015	.01
10-16	11.5	.60	3.0	.015	trace
10-31	9.0	-	4.0	.02	.00
11-14	11.0	1.20	12.0	.005	.10
12-4	4.0	.25	1.0	.01	.01
1-8-72	.5	.25	19.0	.005	.00
1-22	1.0	.80	13.5	.001	.01
2-6	1.0	.55	19.0	.015	.00
2-19	.5	1.00	14.5	.001	.05
3-5	0.0	.30	11.0	.02	trace
3-19	2.0	7.00	11.5	-	1.50
4-1	3.2	6.00	22.0	.002	.10
4-16	14.5	1.30	7.0	.005	.10
5-6	16.0	.90	13.0	-	.10
5-19	18.0	1.55	5.5	-	.02
6-4	22.5	1.55	3.0	-	.12
6-18	22.5	1.20	11.0	.062	.10
6-28	22.9	.48	10.5	.045	.10
Average		1.45	9.39	.021	.14

Table 6. The recorded levels of temperature, ortho phosphate, nitrate-nitrogen, nitrite-nitrogen, and sediment for Station VI, Halfway Creek, La Crosse County, Wisconsin. July 1971 - June 1972.

Date	Temperature degrees C.	Ortho Phosphate ppm	Nitrate- Nitrogen ppm	Nitrite- Nitrogen ppm	Sediment ml/liter
7-22-71	16.9	.31	4.0	-	.2
8-6	16.0	.32	3.5	.012	.1
8-22	22.8	.68	3.5	.032	.1
9-6	16.8	.48	9.6	.017	.05
9-25	11.1	4.40	7.5	.0425	.025
10-9	13.0	.35	2.0	.004	trace
10-16	10.2	1.10	8.0	.001	.00
10-31	9.2	-	4.2	.001	.00
11.14	11.0	.98	10.0	.001	.10
12-4	5.8	.15	12.0	.02	.00
1-8-72	5.5	.60	13.0	.025	.00
1-22	4.5	.60	11.5	.005	.075
2-6	3.0	.55	19.0	.015	.00
2-19	4.0	.65	13.0	.0075	trace
3-5	4.0	.05	15.0	.0375	.05
3-19	1.8	5.50	18.5	.032	1.40
4-1	4.0	3.50	12.0	.02	.05
4-16	13.0	.50	7.0	.005	.10
5-6	15.5	1.00	8.0	-	.05
5-19	16.5	.60	6.0	-	trace
6-4	19.5	.60	3.5	-	.18
6-18	19.0	5.20	11.5	.03	trace
6-28	19.5	.48	11.5	.005	trace
Average		1.30	9.3	.016	.14

Table 7. The average of the recorded levels of ortho phosphate, nitrate-nitrogen, nitrate, nitrite-nitrogen, and nitrite for each sampling station on Halfway Creek, LaCrosse County, Wisconsin. 1971 - 1972.

Station	Average ortho phosphate ppm	Average nitrate- nitrogen ppm	Average nitrate ppm	Average nitrite- nitrogen ppm	Average nitrite ppm
I	1.84	6.17	26.84	.025	.08
II	1.80	7.64	32.78	.058	.19
III	2.57	7.36	31.90	.033	.11
IV	1.96	7.56	32.69	.035	.12
V	1.45	9.39	41.01	.021	.07
VI	1.30	9.30	40.70	.016	.05

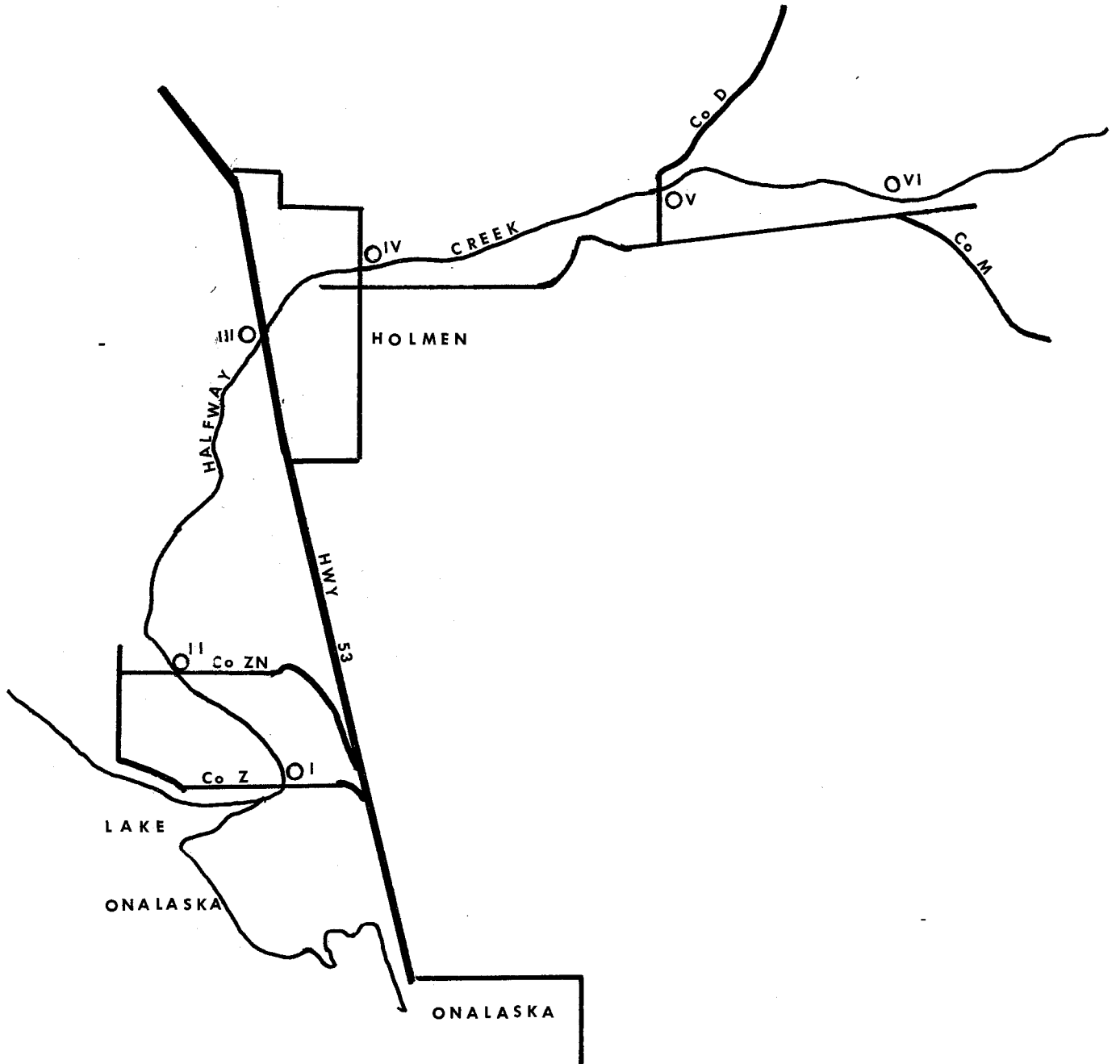


Figure 1. Map showing Sampling Stations I - VI on Halfway Creek, LaCrosse County, Wisconsin. 1971 - 1972.

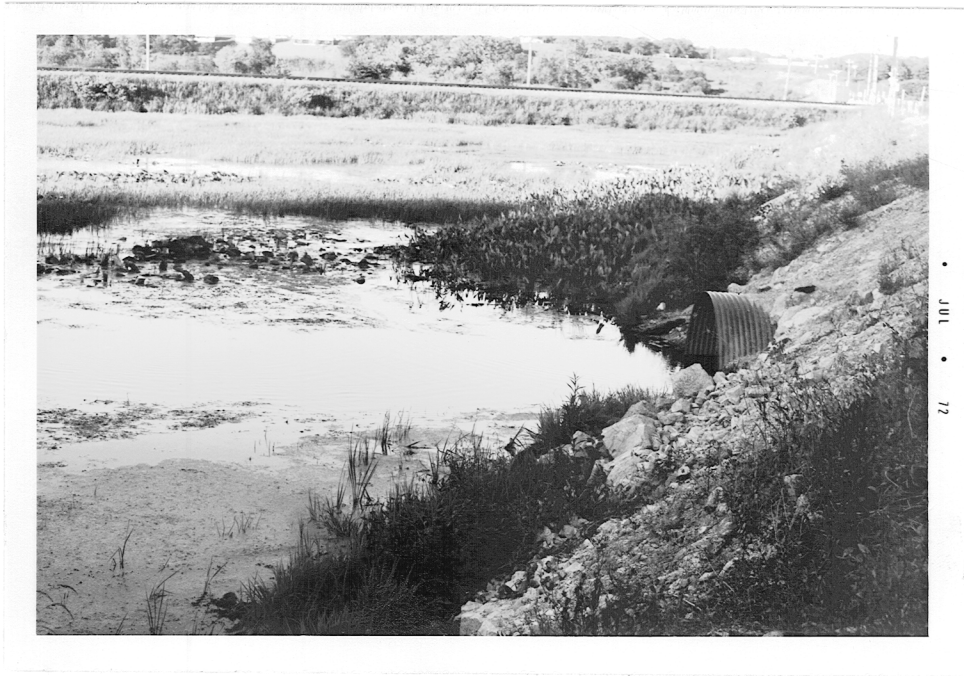


Figure 2. Sampling Station I, Halfway Creek, Section 30, Township 17 N, Range 7 W, LaCrosse County, Wisconsin.

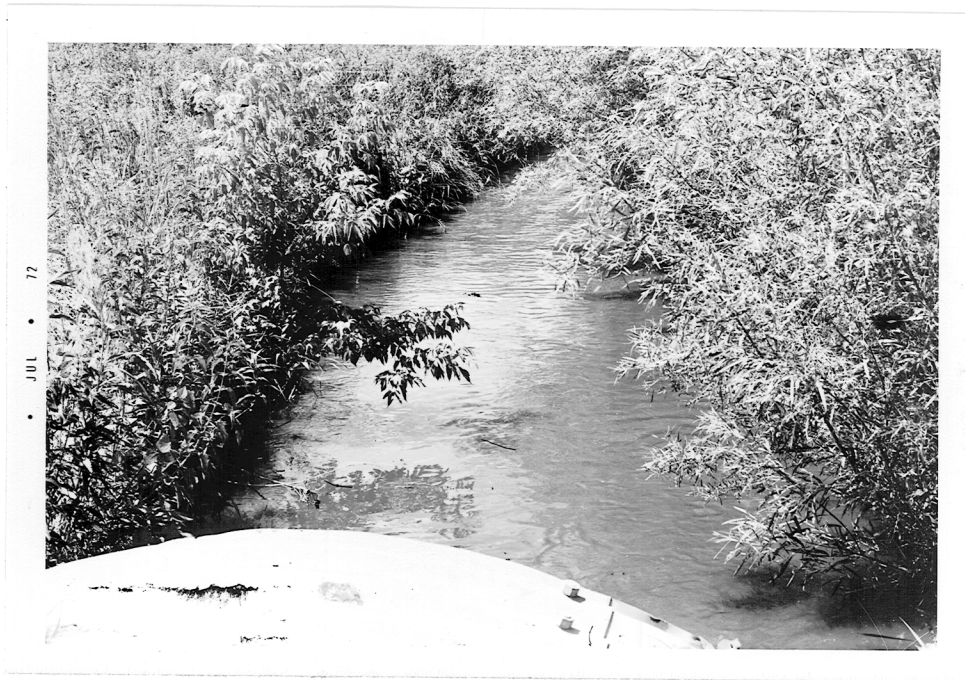


Figure 3. Sampling Station II, Halfway Creek, Section 24, Township 17 N, Range 8 W, LaCrosse County, Wisconsin.

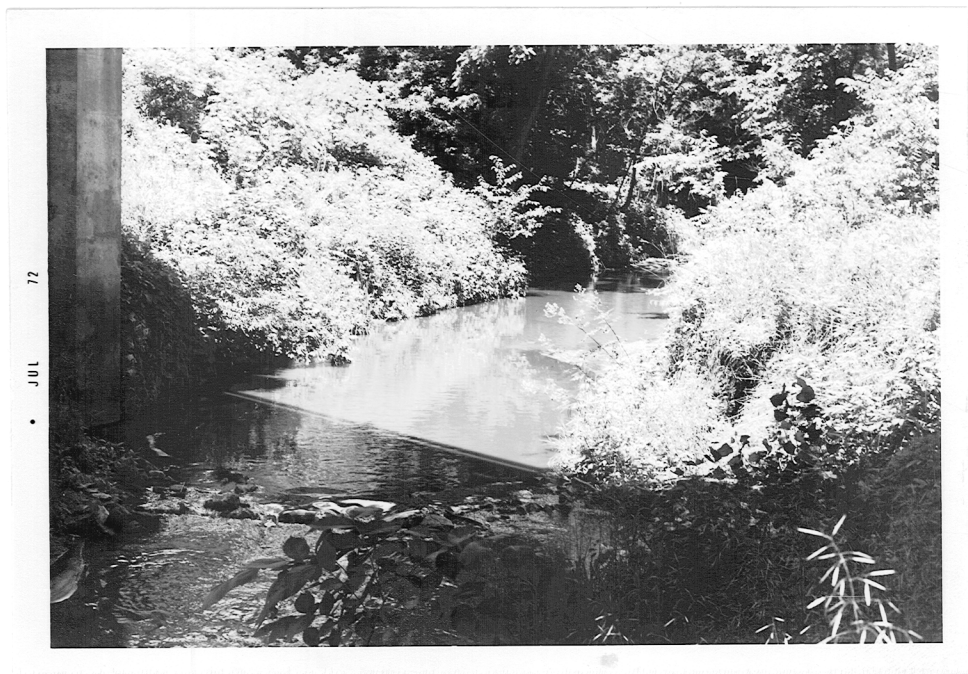


Figure 4. Sampling Station III, Halfway Creek, Section 12, Township 17 N, Range 7 W., LaCrosse County, Wisconsin.



Figure 5. Sampling Station IV, Halfway Creek, Section 8, Township 17 N., Range 7 W., LaCrosse County, Wisconsin.



Figure 6. Sampling Station V, Halfway Creek, Section 3, Township 17 N., Range 7 W., LaCrosse County, Wisconsin.



Figure 7. Sampling Station VI, Halfway Creek, Section 2, Township 17 N., Range 7 W., LaCrosse County, Wisconsin.

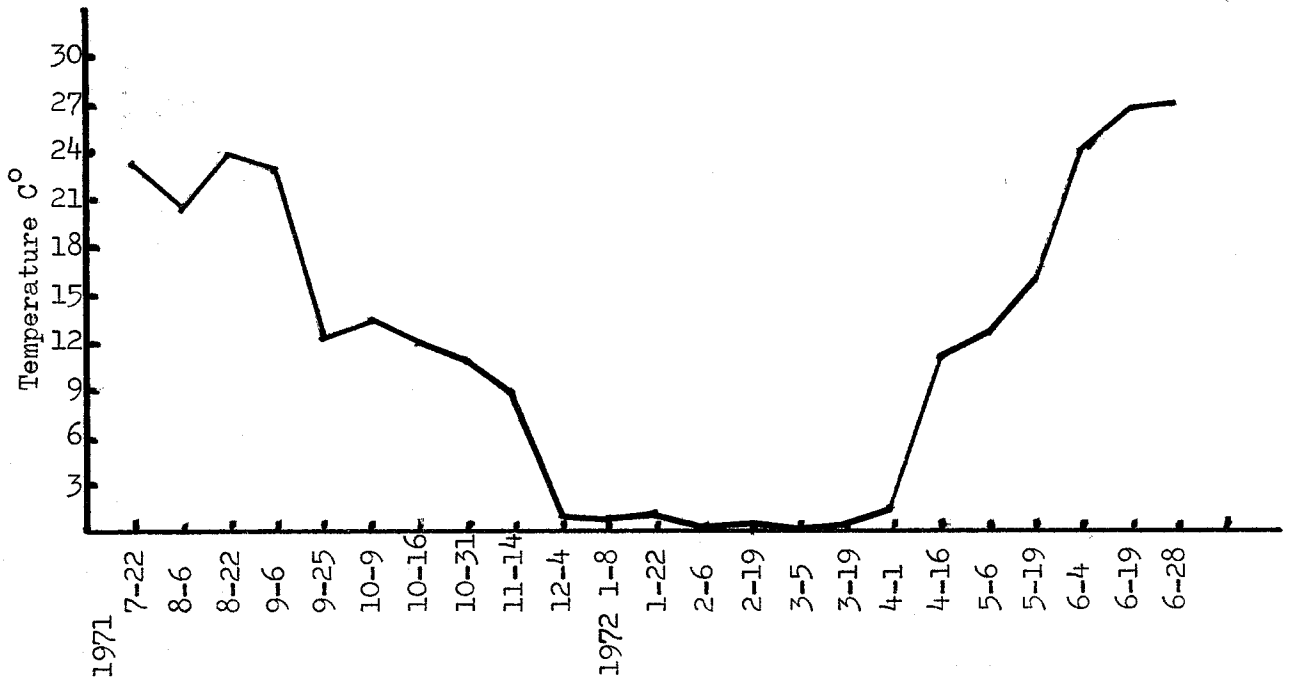


Figure 8. The centigrade temperatures recorded at Station I, on Halfway Creek, LaCrosse County, Wisconsin. 1971-1972.

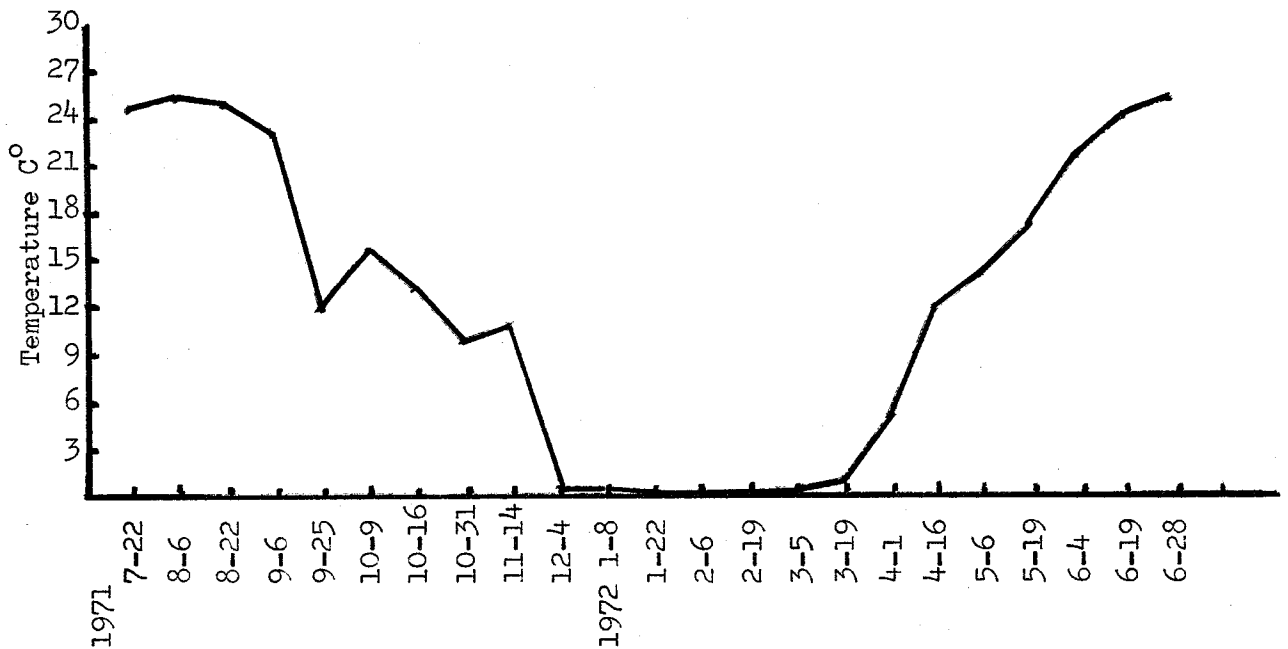


Figure 9. The centigrade temperatures recorded at Station II, on Halfway Creek, LaCrosse County, Wisconsin. 1971-1972.

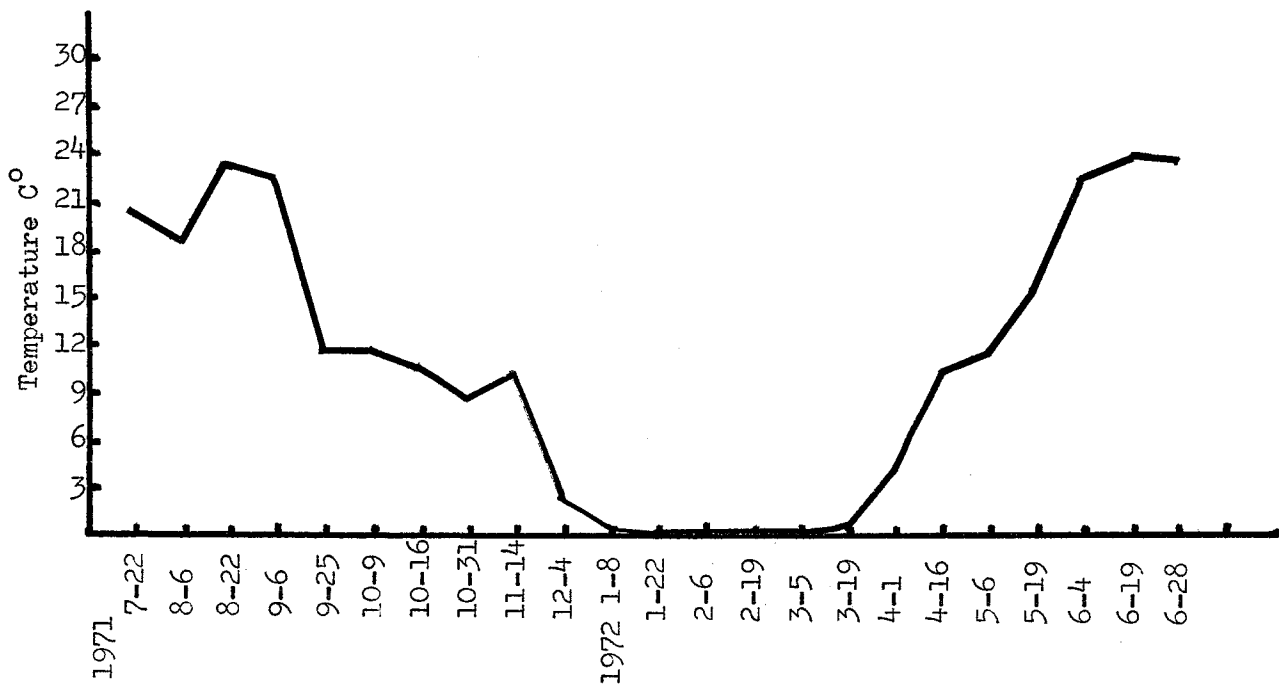


Figure 10. The centigrade temperatures recorded at Station III, on Halfway Creek, LaCrosse County, Wisconsin, 1971-1972.

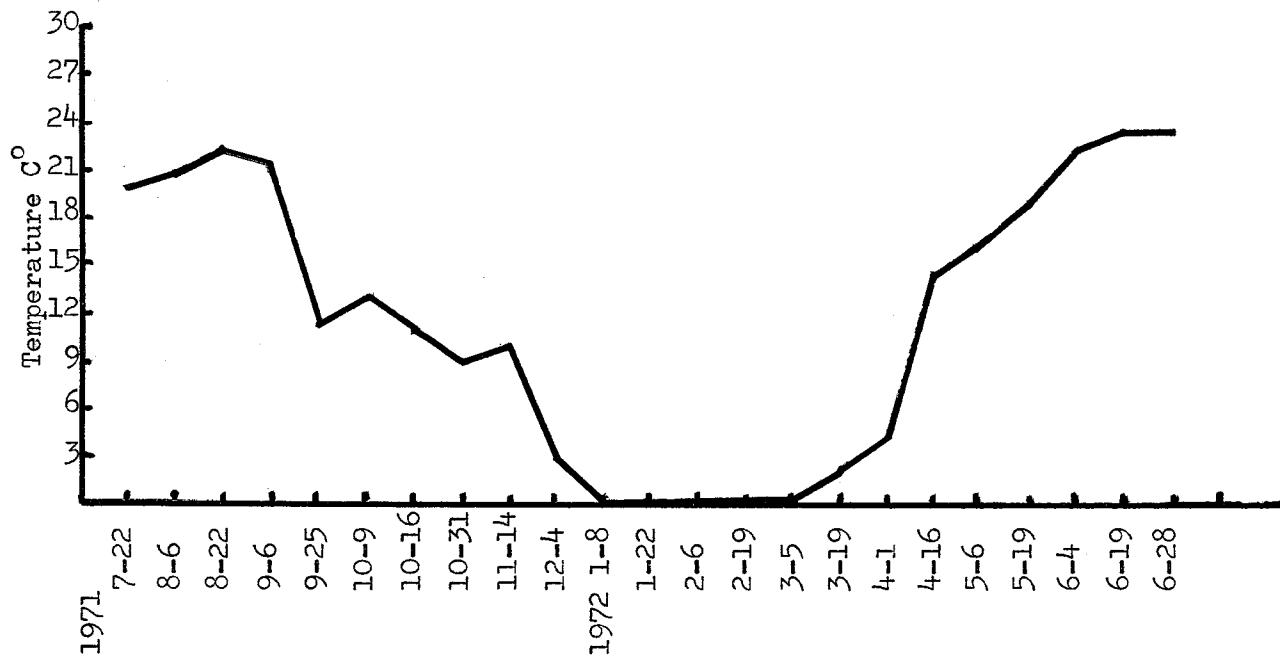


Figure 11. The centigrade temperatures recorded at Station IV, on Halfway Creek, LaCrosse County, Wisconsin. 1971-1972.

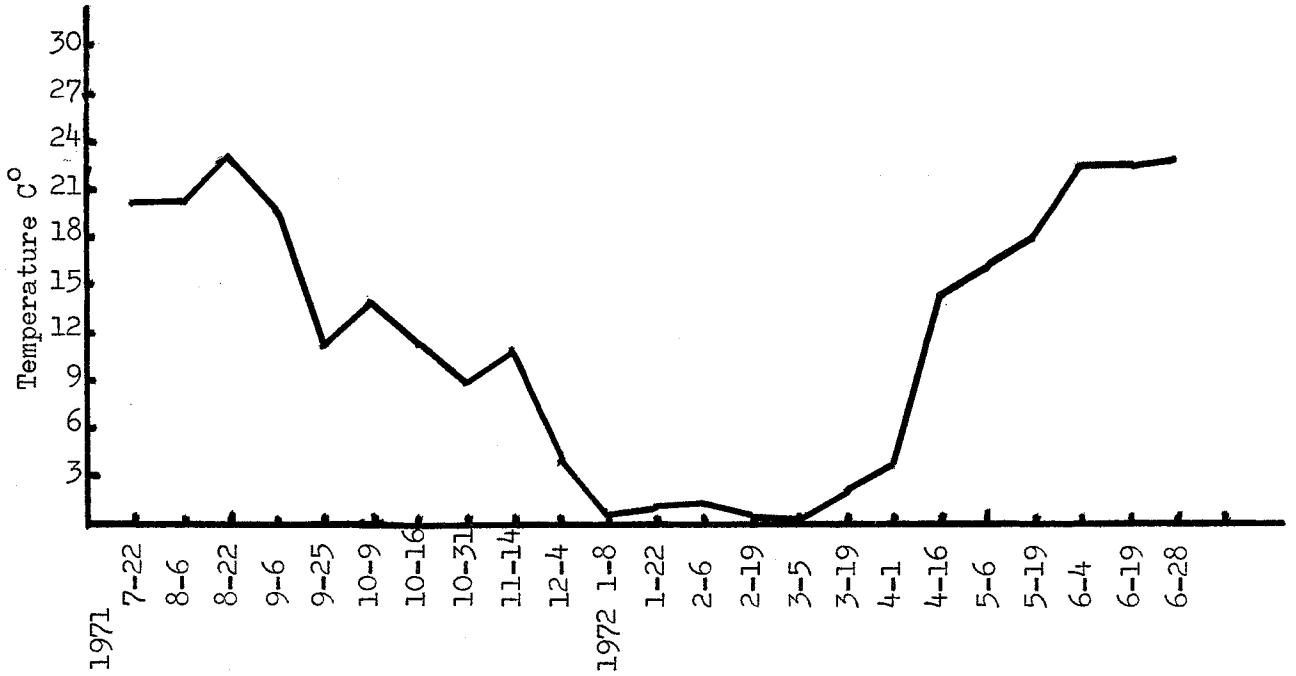


Figure 12. The centigrade temperatures recorded at Station V, on Halfway Creek, LaCrosse County, Wisconsin. 1971-1972.

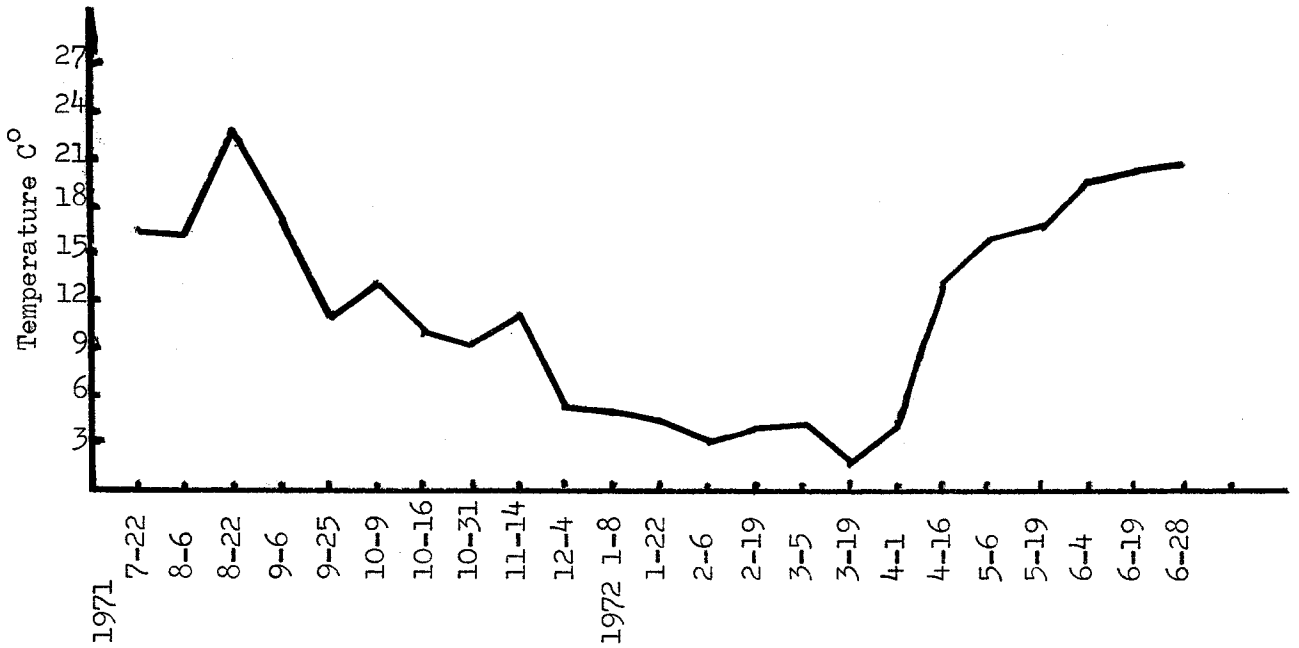


Figure 13. The centigrade temperatures recorded at Station VI, on Halfway Creek, LaCrosse County, Wisconsin. 1971-1972.

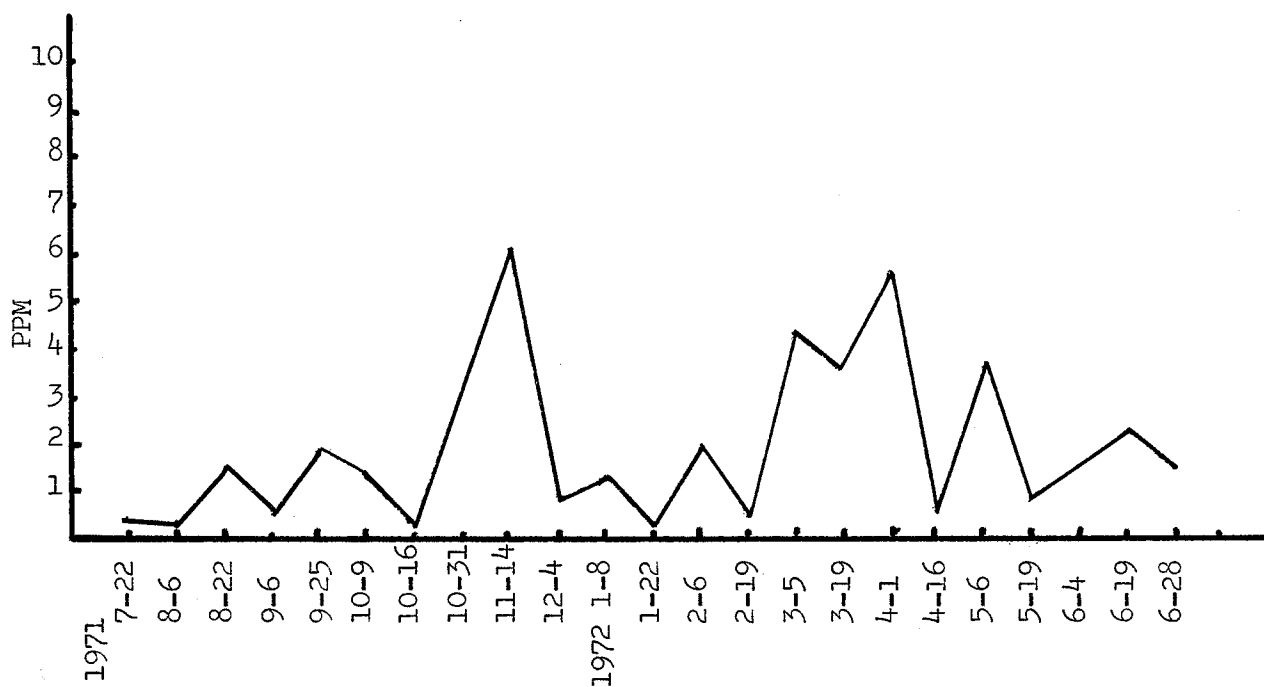


Figure 14. The ortho phosphate levels, in parts per million, as recorded at Station I, on Halfway Creek, LaCrosse County, Wisconsin, 1971-1972.

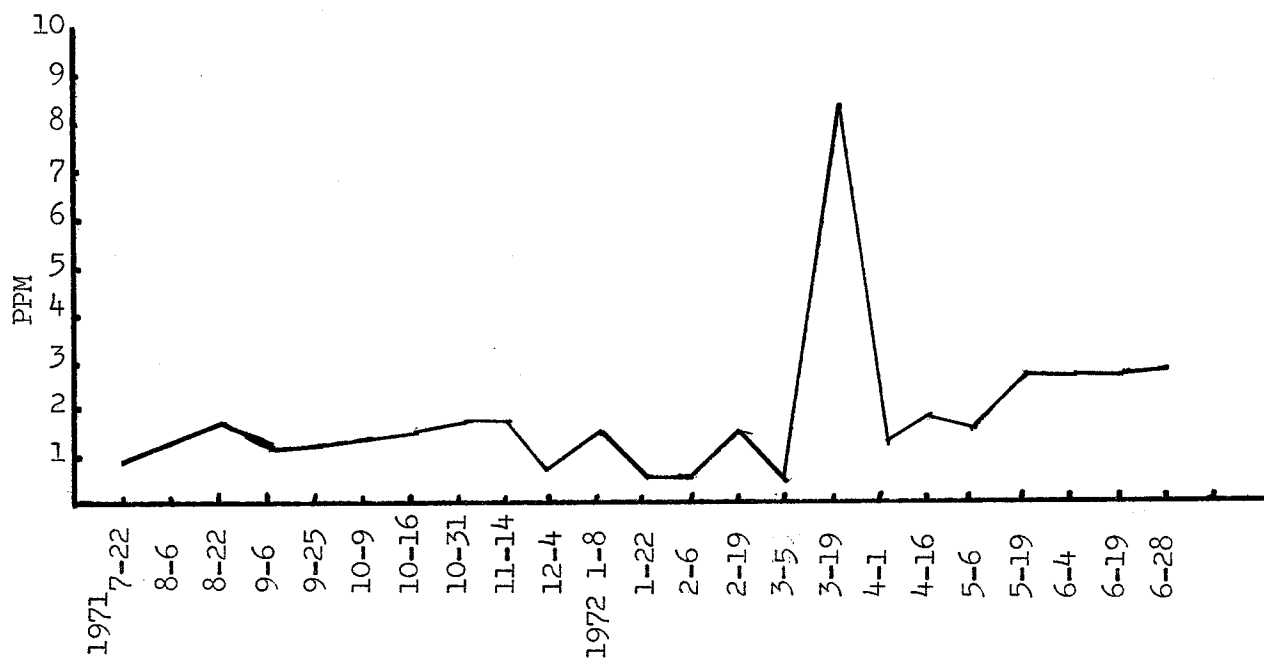


Figure 15. The ortho phosphate levels, in parts per million, as recorded at Station II, on Halfway Creek, LaCrosse County, Wisconsin, 1971-1972.

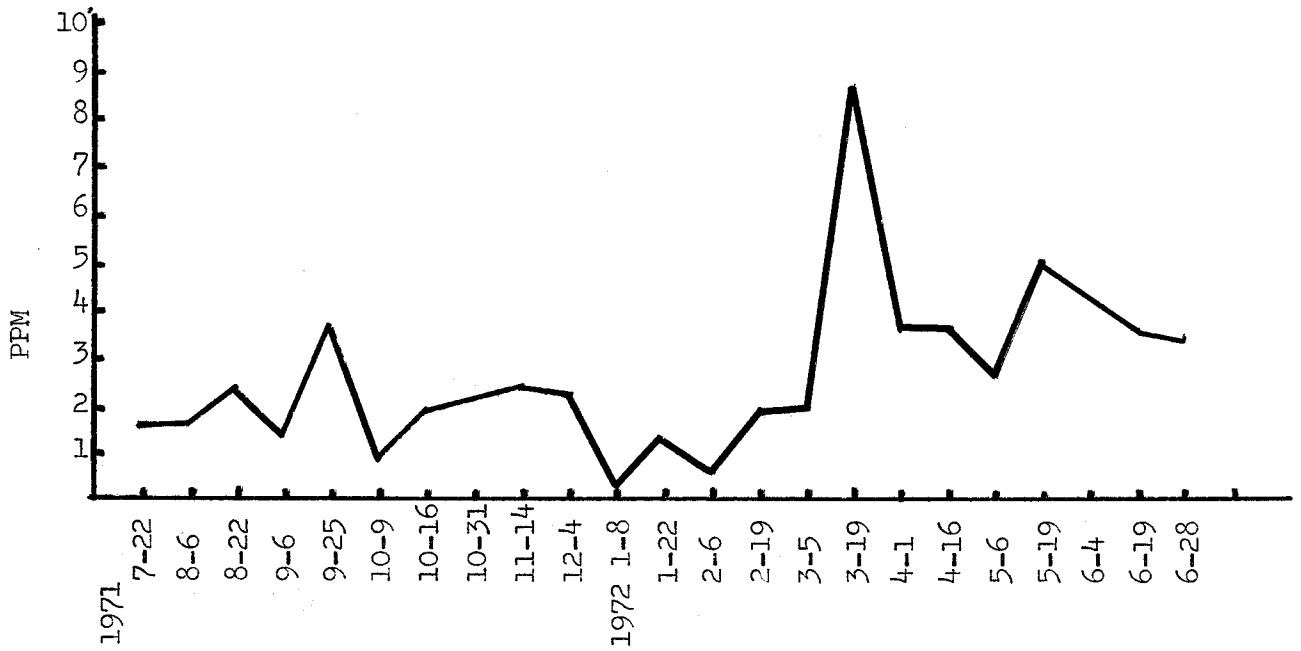


Figure 16. The ortho phosphate levels, in parts per million, as recorded at Station III, on Halfway Creek, LaCrosse County, Wisconsin. 1971-1972.

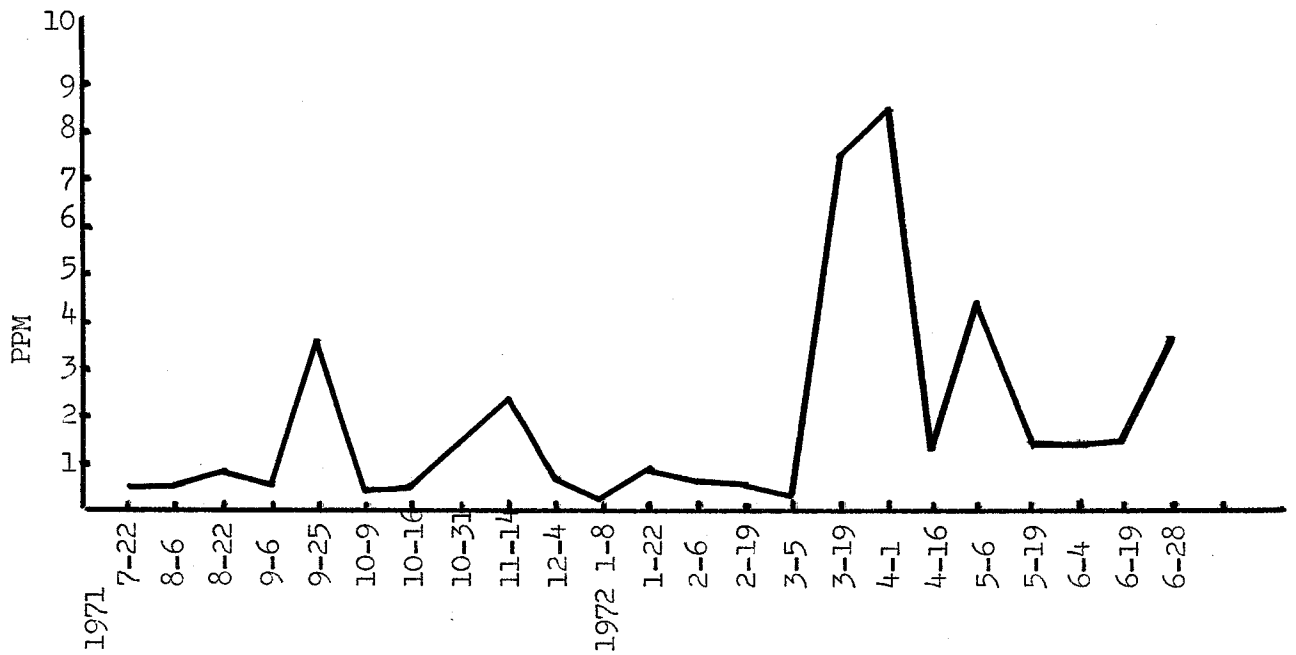


Figure 17. The ortho phosphate levels, in parts per million, as recorded at Station IV, on Halfway Creek LaCrosse County, Wisconsin. 1971-1972.

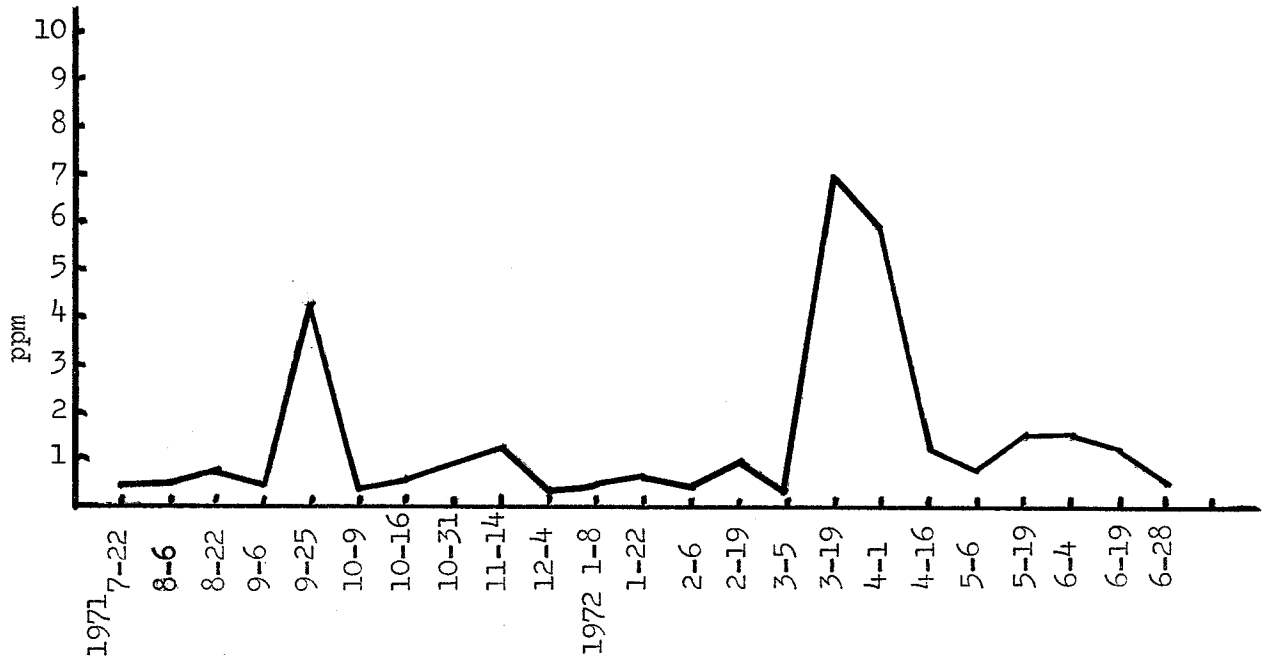


Figure 18. The ortho phosphate levels, in parts per million, as recorded at Station V, on Halfway Creek, LaCrosse County, Wisconsin. 1971-1972.

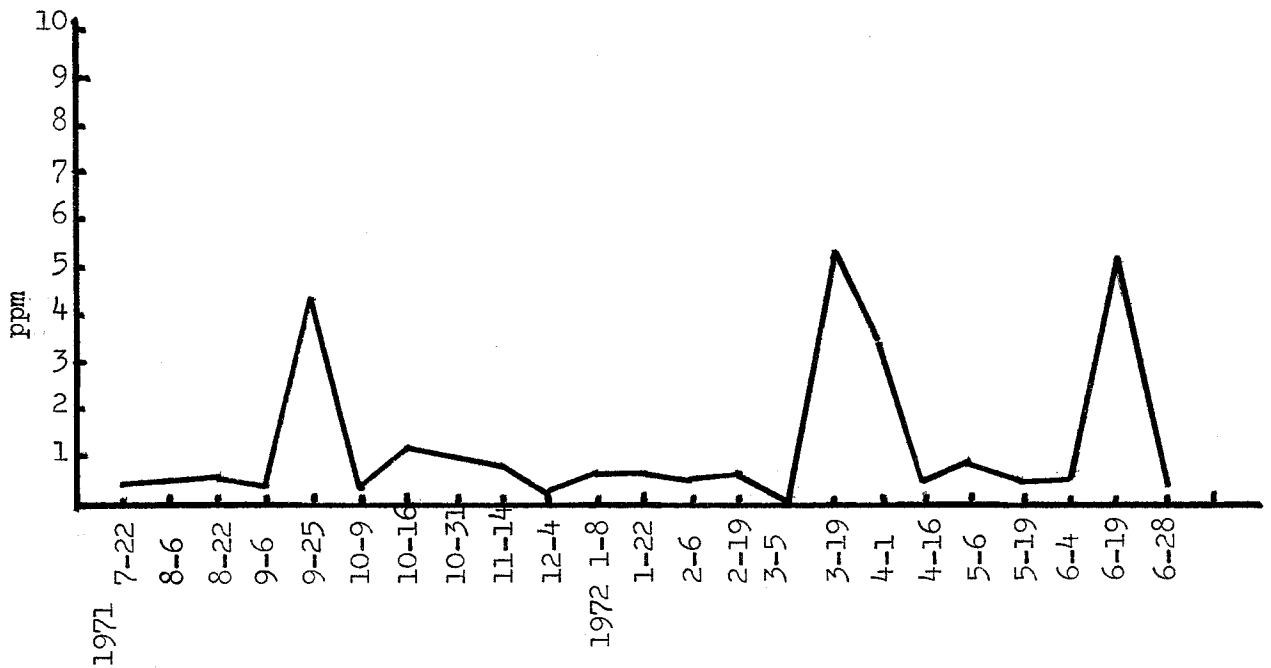


Figure 19. The ortho phosphate levels, in parts per million, as recorded at Station VI, on Halfway Creek, LaCrosse County, Wisconsin. 1971-1972.

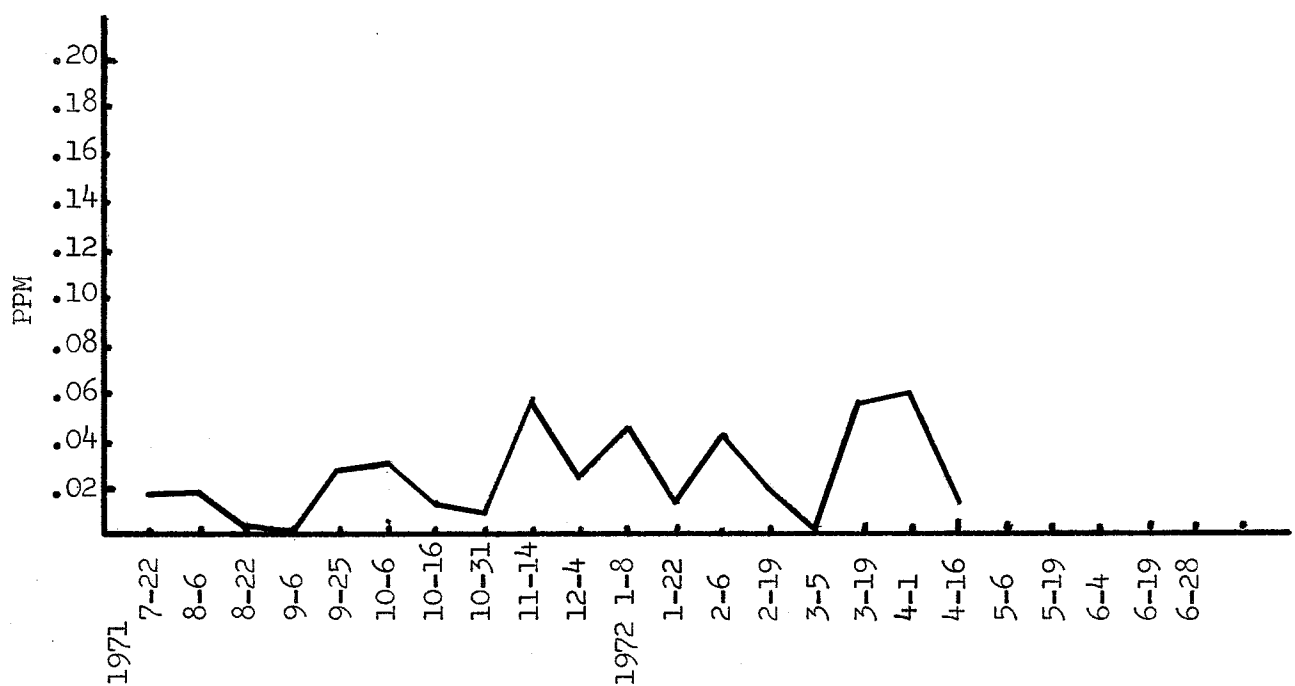


Figure 20. The nitrite-nitrogen levels, in parts per million, as recorded at Station I, on Halfway Creek, LaCrosse County, Wisconsin. 1971-1972.

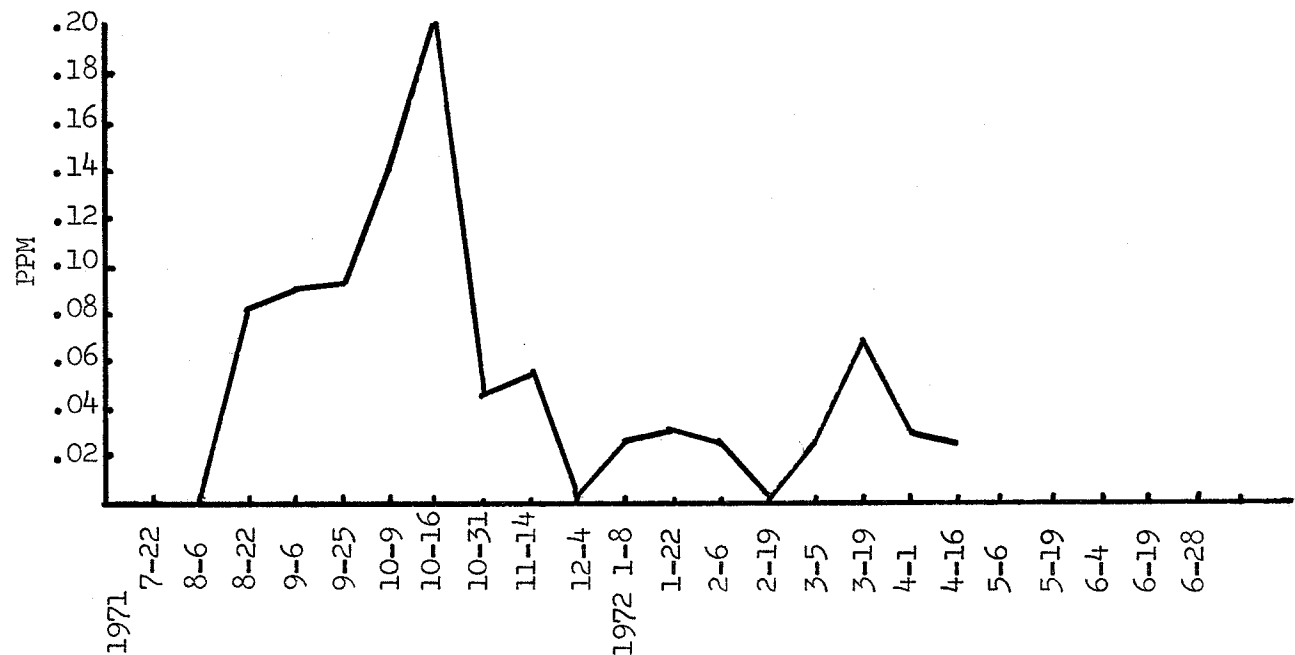


Figure 21. The nitrite-nitrogen levels, in parts per million, as recorded at Station II, on Halfway Creek, LaCrosse County, Wisconsin. 1971-1972.

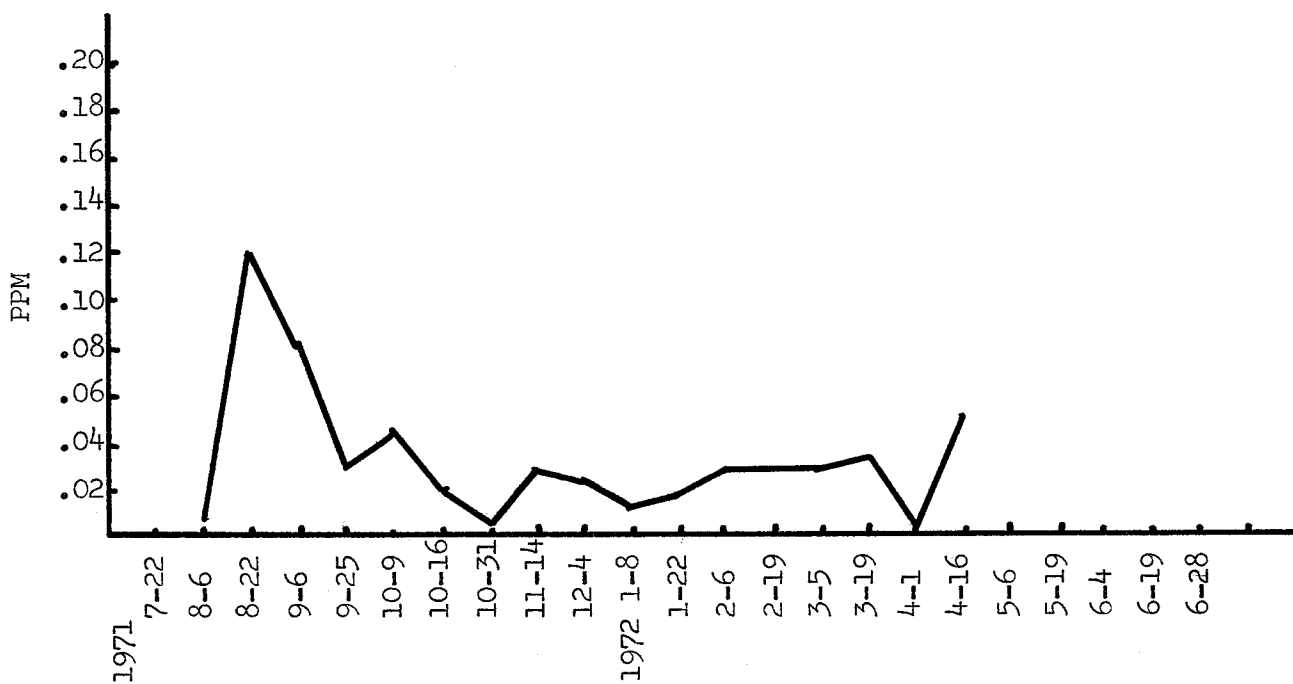


Figure 22. The nitrite-nitrogen levels, in parts per million, as recorded at Station III, on Halfway Creek, LaCrosse County, Wisconsin. 1971-1972.

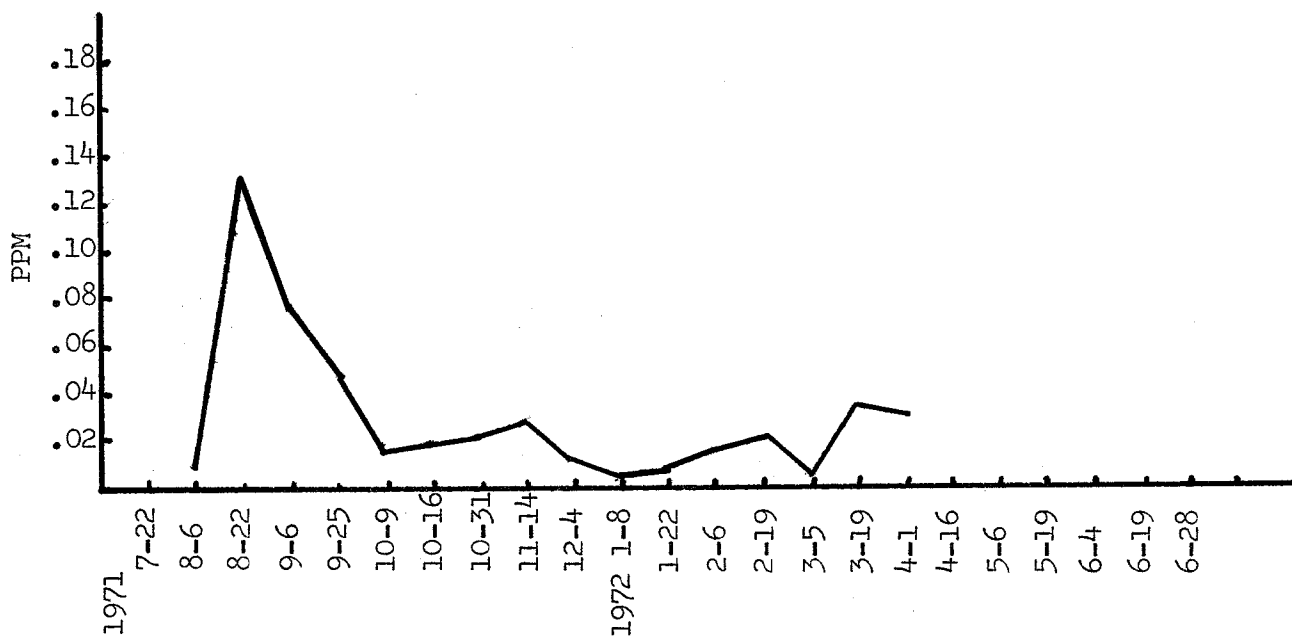


Figure 23. The nitrite-nitrogen levels, in parts per million, as recorded at Station IV, on Halfway Creek, LaCrosse County, Wisconsin. 1971-1972.

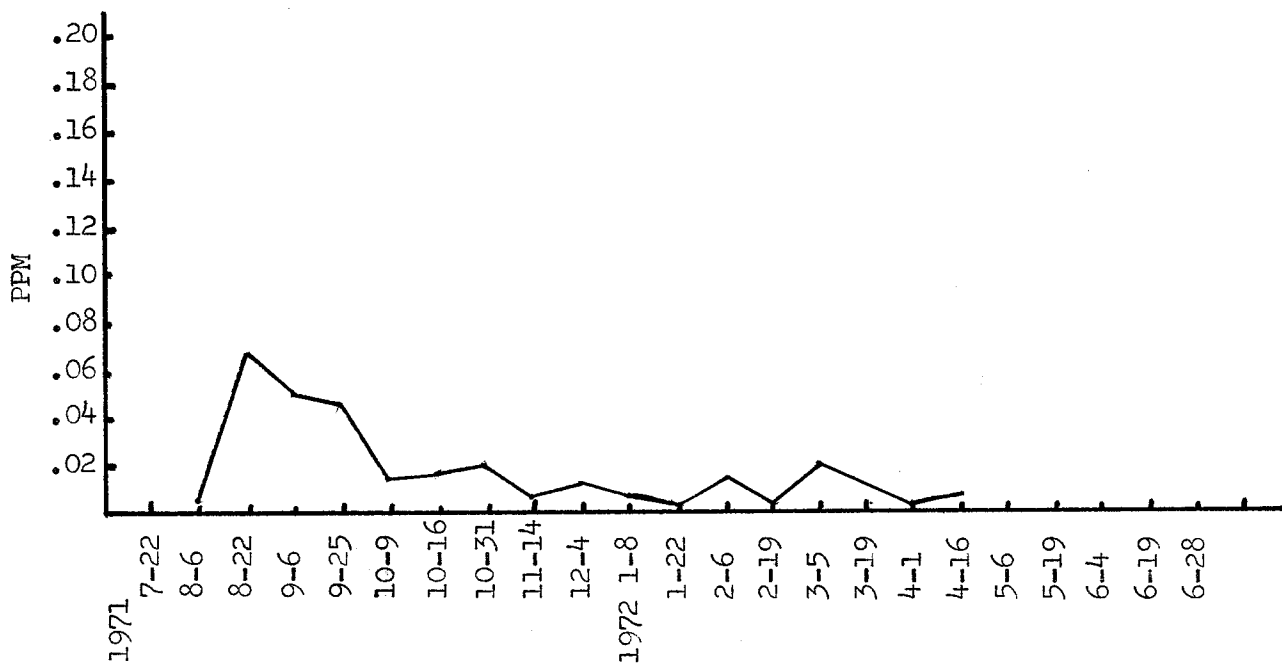


Figure 24. The nitrite-nitrogen levels, in parts per million, as recorded at Station V, on Halfway Creek, LaCrosse County, Wisconsin. 1971-1972.

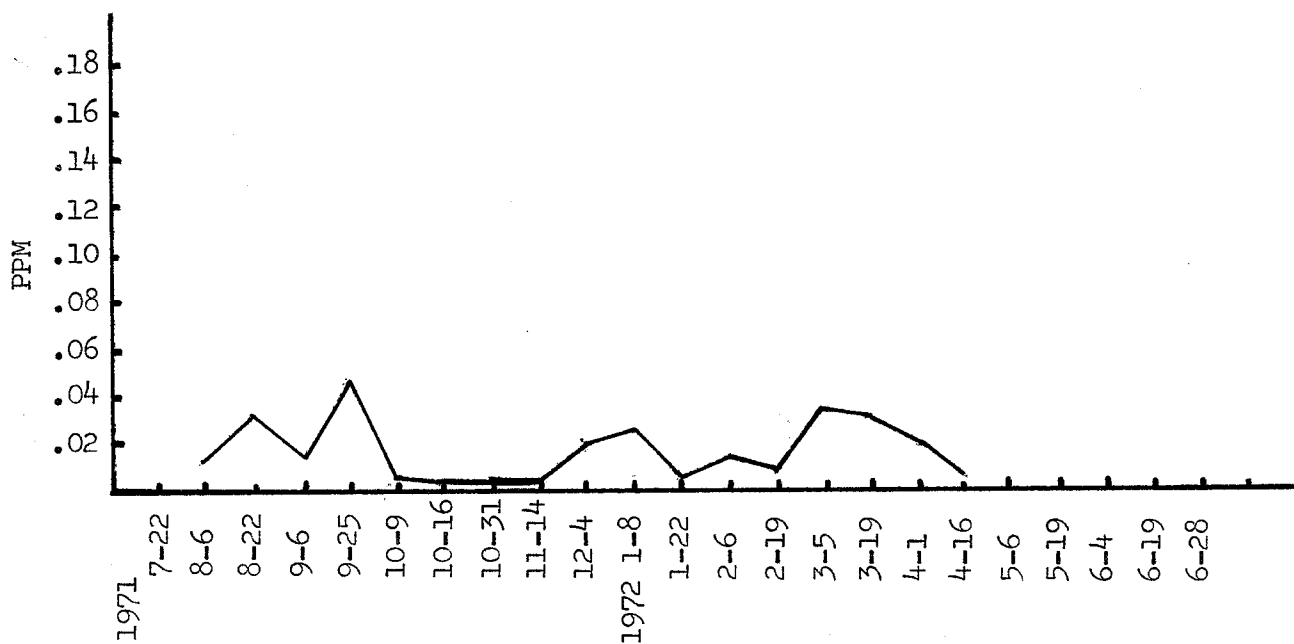


Figure 25. The nitrite-nitrogen levels, in parts per million, as recorded at Station VI, on Halfway Creek, LaCrosse County, Wisconsin. 1971-1972.

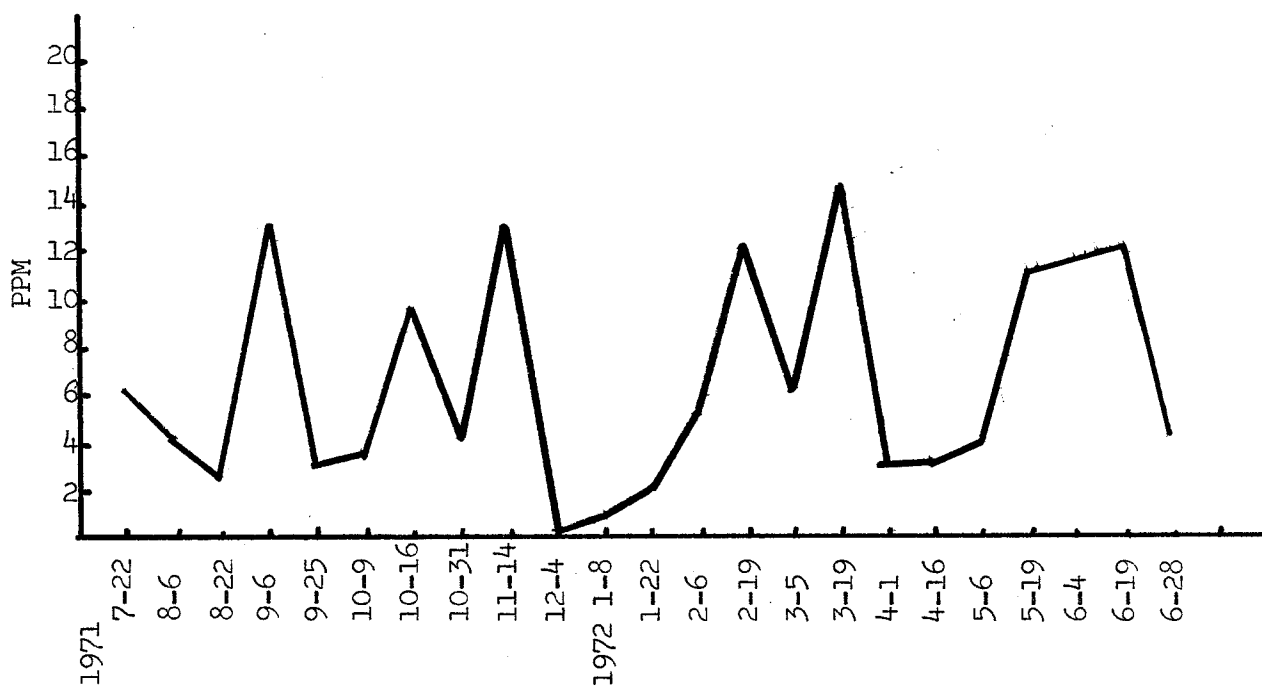


Figure 26. The nitrate-nitrogen levels, in parts per million, as recorded at Station I, on Halfway Creek, LaCrosse County, Wisconsin. 1971-1972.

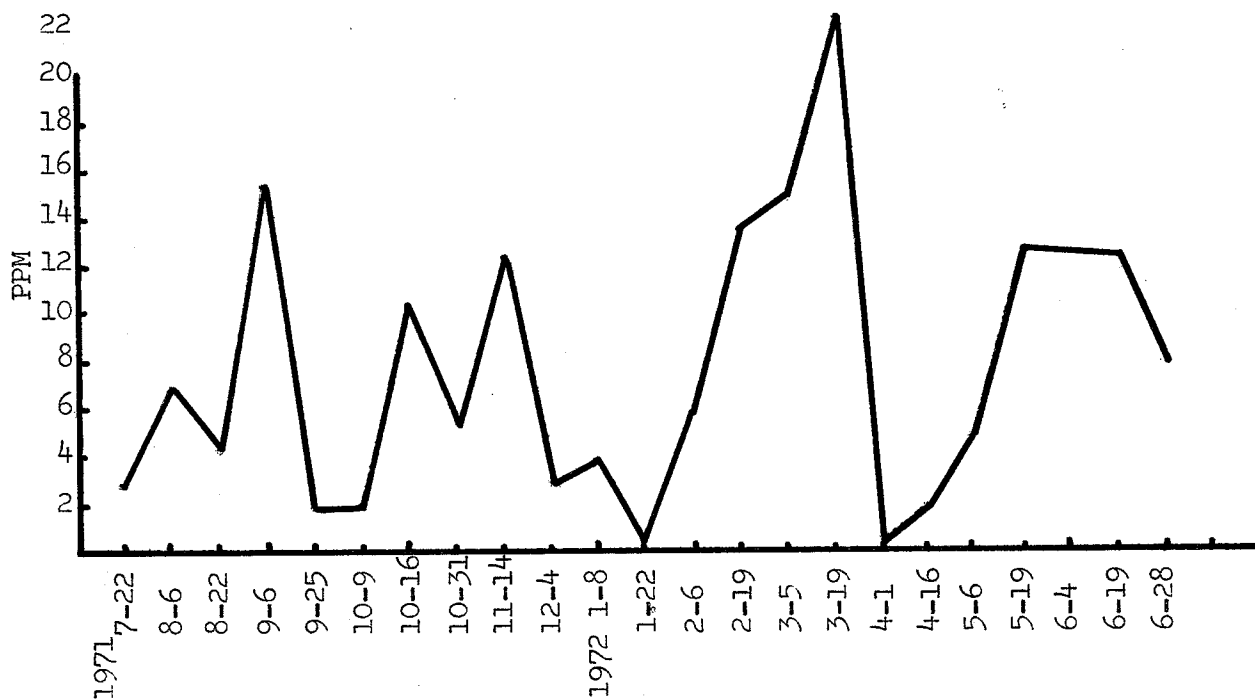


Figure 27. The nitrate-nitrogen levels, in parts per million, as recorded at Station II, on Halfway Creek, LaCrosse County, Wisconsin. 1971-1972.

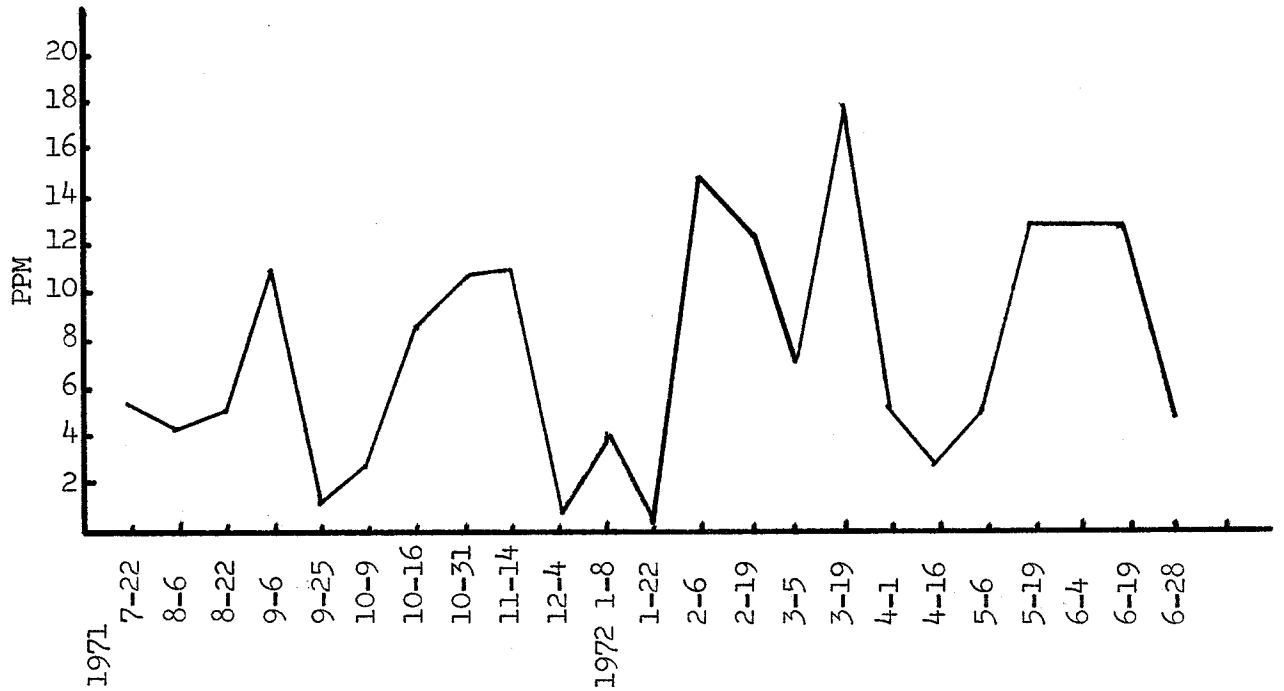


Figure 28. The nitrate-nitrogen levels, in parts per million, as recorded at Station III, on Halfway Creek, LaCrosse County, Wisconsin. 1971-1972.

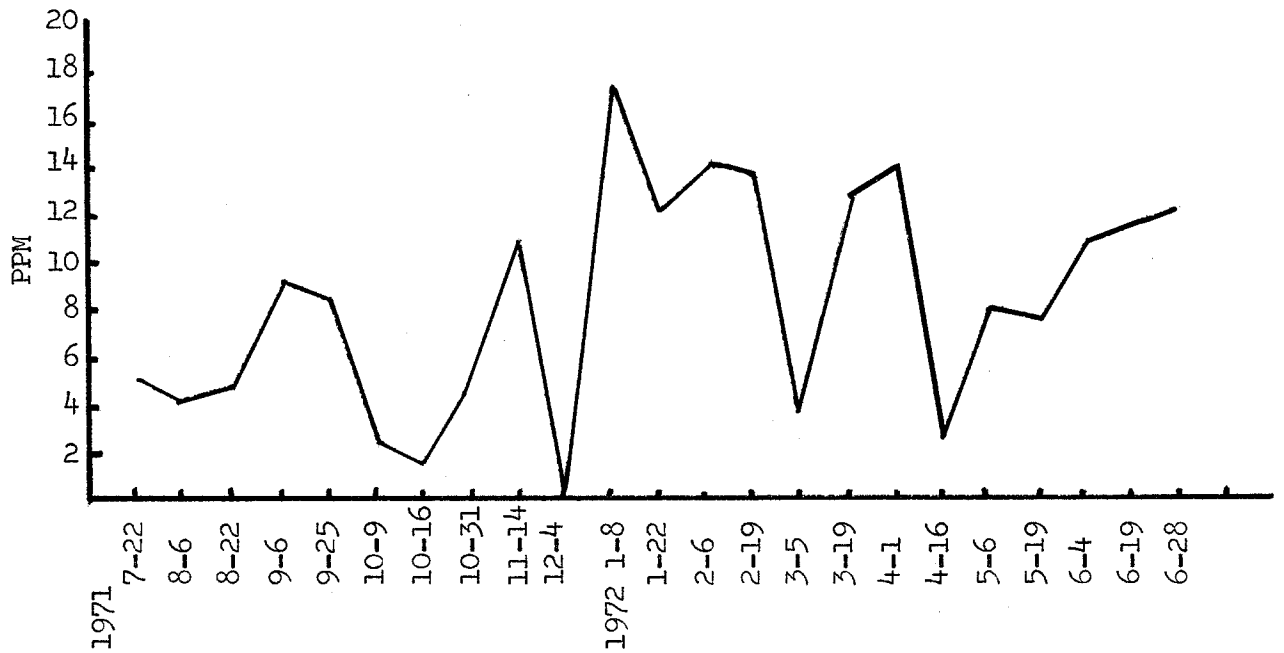


Figure 29. The nitrate-nitrogen levels, in parts per million, as recorded at Station IV, on Halfway Creek, LaCrosse County, Wisconsin. 1971-1972.

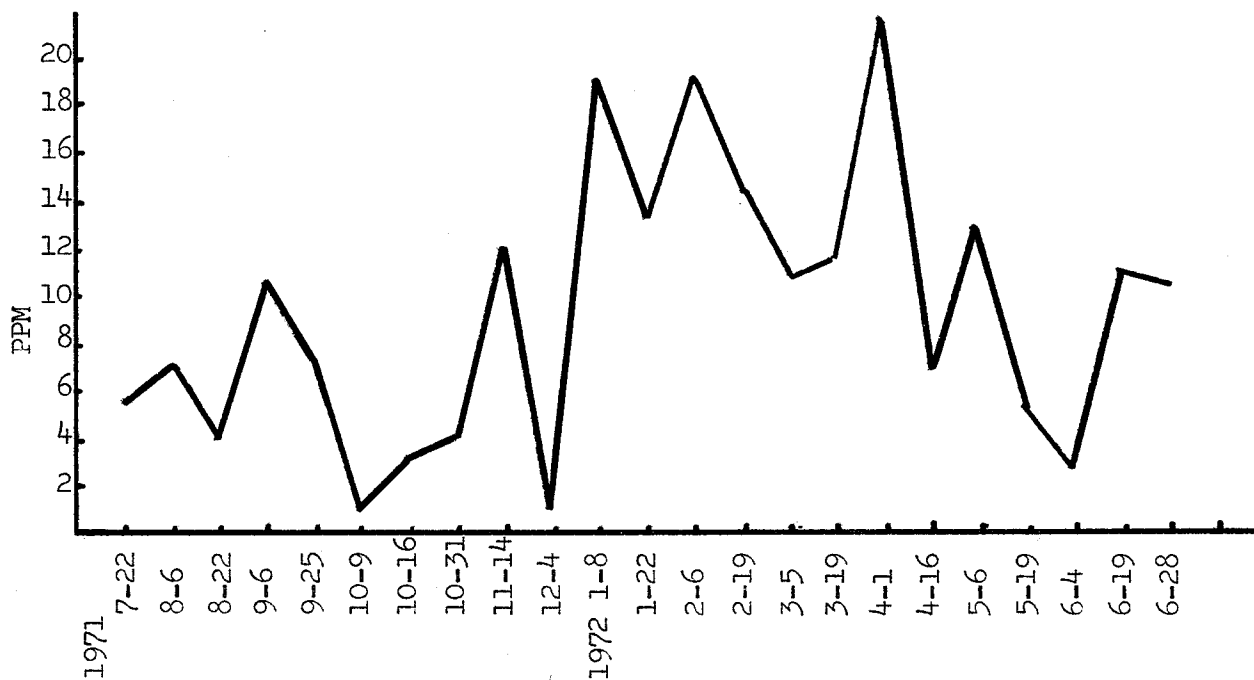


Figure 30. The nitrate-nitrogen levels, in parts per million, as recorded at Station V, on Halfway Creek, LaCrosse County, Wisconsin. 1971-1972.

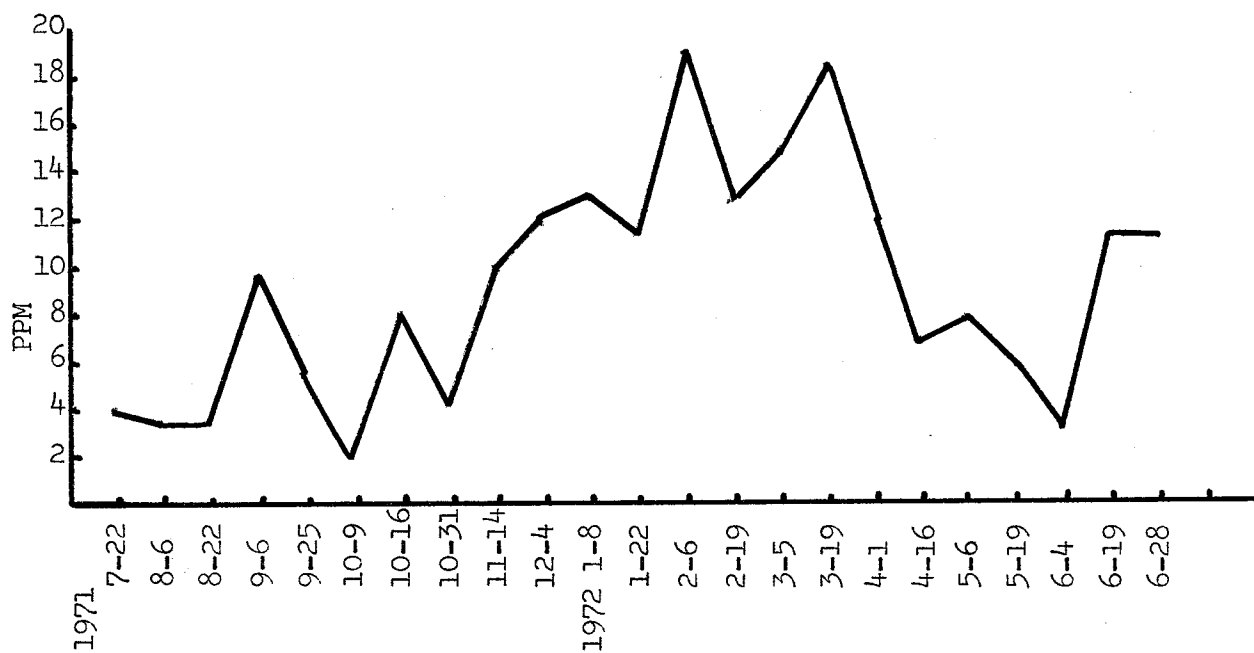


Figure 31. The nitrate-nitrogen levels, in parts per million, as recorded at Station VI, on Halfway Creek, LaCrosse County, Wisconsin. 1971-1972.

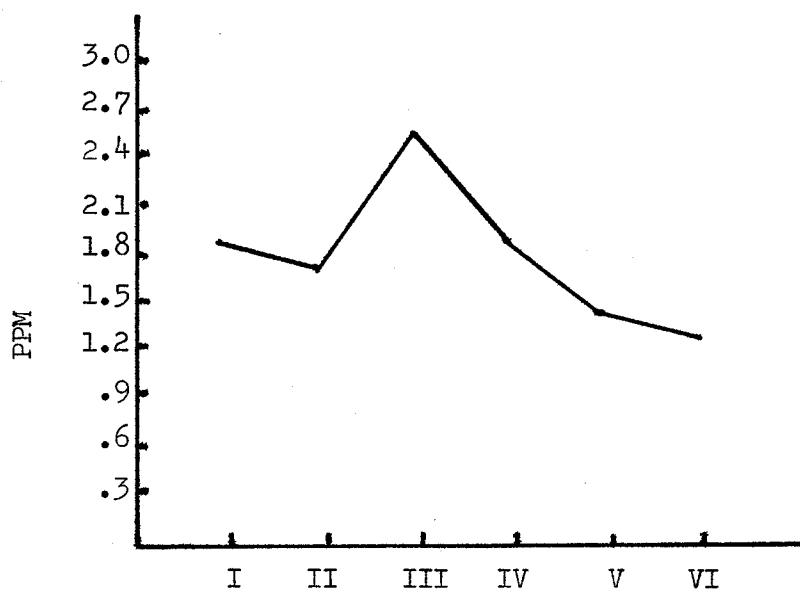


Figure 32. The Average of the recorded levels of ortho phosphate for each sampling station(I-VI), on Halfway Creek, LaCrosse County, Wisconsin. 1971 - 1972.

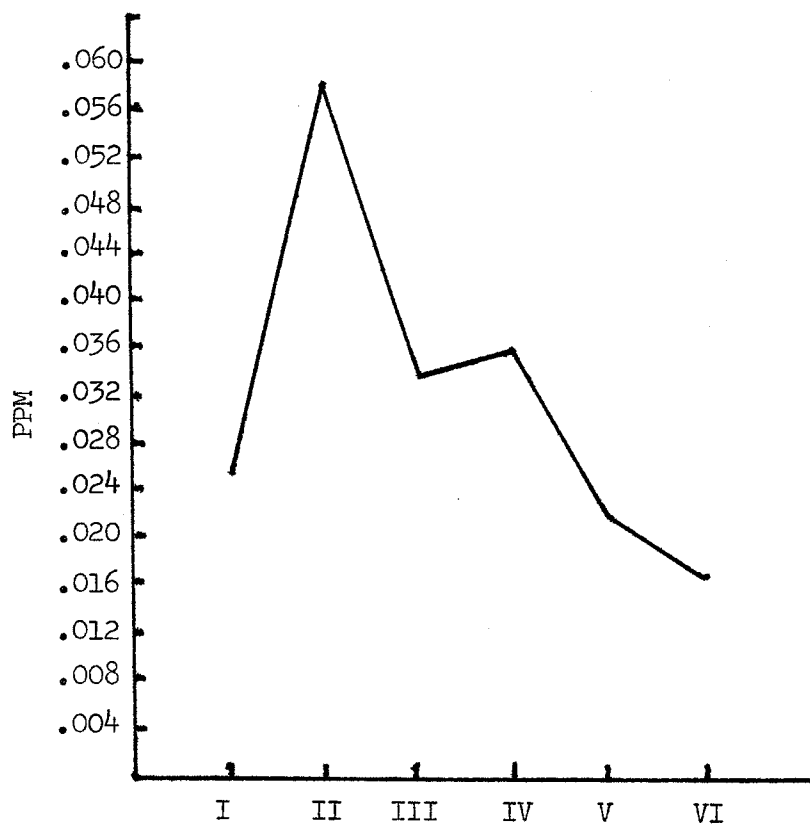


Figure 33. The average of the recorded levels of nitrite-nitrogen for each sampling station(I-VI), on Halfway Creek, LaCrosse County, Wisconsin. 1971 - 1972.

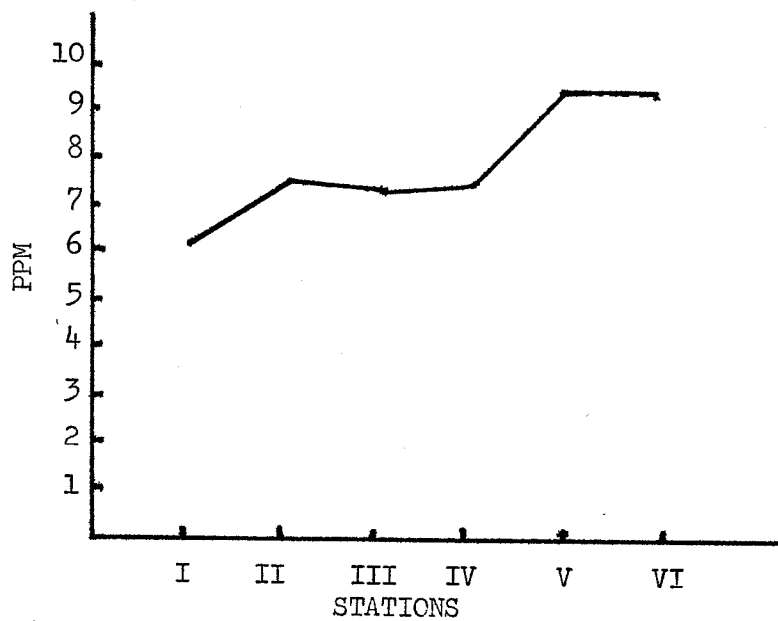


Figure 34. The average of the recorded levels of nitrate-nitrogen for each sampling station(I-VI), on Halfway Creek, LaCrosse County, Wisconsin. 1971 - 1972.