

Quantitative Chemical Analysis of Specific Components of the Waters of Lost Creek and the Wabash River, Vigo County, Indiana

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Abstract

The surface waters of Lost Creek and the Wabash River were sampled February-May 1972 at several sites in Vigo County. Dissolved and total concentrations of iron, lead, sodium, and zinc were measured. The river stage, water temperature, specific conductance, pH, and concentrations of chloride and fluoride ions and dissolved oxygen were determined. Fluoride, iron, lead and zinc concentrations were found to be higher in the Wabash River than in Lost Creek. The pH and sodium concentration were higher in Lost Creek than in the Wabash River.

Introduction

Lost Creek is contained entirely within Vigo County. It originates south of Seelyville at the eastern edge of Vigo County and flows 14 miles northwesterly to its confluence with the Wabash River near the northwest boundary of the Terre Haute city limits. Sampling sites were chosen at the North 13th Street bridge and at the north side of U.S. 40 where the highway crosses Lost Creek about 8 miles east of the Wabash River. The distance between sampling sites was about 6 miles. The North 13th Street site is less than 2 miles from the confluence of Lost Creek and the Wabash River.

The Wabash River flows from north to south through Vigo County. U.S. Highway 40 crosses the Wabash River at Terre Haute near the geographical center of Vigo County. The U.S. 40 bridge served as the principal sampling site for the present study. The Fort Harrison Road boat dock, located about 4 miles upstream from the U.S. 40 bridge, served as the northernmost sampling site. Samples were taken during February from the Indiana Highway 63 bridge, located about 3.5 miles north of the U.S. 40 bridge, and from the Interstate Highway 70 bridge, located about 2 miles south of the U.S. 40 bridge. The southernmost sampling site was about 100 yards north of the Public Service Company Dresser Station, located about 8 miles south of the U.S. 40 bridge.

The drainage area of the Wabash River at Terre Haute is 12,200 square miles. The instantaneous flow averages about 15,000 feet³/sec.

Experimental

In situ analyses were performed for dissolved oxygen concentration, specific conductance, and temperature measurement. Dissolved oxygen concentration was determined with a Model 54 Yellow Springs Oxygen Meter; specific conductance was measured with a Beckman Enviro-

meter Model EV6. As each of the instruments has a temperature scale, the temperature of the water was checked with both meters. The total concentration of ions (ppm or mg/l) was estimated from the specific conductance and the temperature of the water.

An Orion Model 801 Analyzer was used for chloride, fluoride, and pH determinations. All three determinations were made immediately on return to the laboratory with original, unfiltered stream water. Chloride ion concentrations were determined by a selective ion electrode and double junction reference electrode; fluoride ion concentrations were determined by a selective ion electrode and single junction reference electrode.

Metal ion concentrations were determined with an atomic absorption spectrophotometer (1). Analyses were performed on both filtered and unfiltered samples. Samples used in the determination of dissolved metals were obtained by filtration of the original samples through a 0.45μ filter. These filtrates were acidified and concentrated ten-fold by evaporation. To determine the total metal concentrations, the unfiltered samples were acidified and digested at a temperature near the boiling point for several days. Samples were aspirated into the flame of the atomic absorption instrument and quantitative analyses were made by comparison to calibration standards.

Results and Discussion

A summary of data taken from Lost Creek and the Wabash River is shown in Table 1. The Lost Creek samples were more basic and contained more sodium than Wabash River samples. The average pH was about 0.5 unit higher and the range was greater for Lost Creek, indicating that the Wabash River is more highly buffered. For Lost Creek, the concentration of dissolved ionic species was about 10% higher upstream at U.S. 40 than at 13th Street. The average for the two sites was about the same as the average for Wabash River samples. There were generally negligible differences in the results from the two Lost Creek sites, as is evident upon inspection of the data in Table 1. Further, there was general agreement between concentrations of the analyzed substances in Lost Creek and the Wabash River, except for the total concentration of iron, which was more than twice as high in the Wabash River. This is probably due to acid mine drainage which the Wabash River receives from streams such as Coal Creek and Sugar Creek in the western part of Vigo County. These waters of low pH contain high concentrations of suspended iron, and thus increase the concentration of total iron in the Wabash River. With regard to the substances analyzed, Lost Creek appears to be a stream of fairly high purity.

For many of the elements analyzed quantitatively, the data indicated an inverse relationship between concentration and river stage. This was the behavior of chloride, fluoride, lead, and sodium. The river stage is an indication of the volume of the river and the rate of flow. When the river stage is high after considerable precipitation, these chemical species seem to be diluted by the rain water. On the other hand, the concentrations of iron and zinc were directly proportional to the

TABLE 1. *Maximum, minimum and average values for selected Lost Creek and Wabash River collection stations, February through May, 1972.*

Variable Determined	Lost Creek		Wabash River		Dresser Station
	13th	U.S. 40	Ft. Harrison	U.S. 40	
River Stage (ft)					
Max				20.2	
Min				2.5	
Ave				7.3	
Lab pH					
Max	9.26	9.41	8.24	8.24	8.25
Min	8.04	7.86	7.90	7.89	7.90
Ave	8.76	8.48	8.12	8.10	8.12
Cond Ions (mg/l)					
Max	420	600	470	470	470
Min	300	320	280	265	298
Ave	370	408	388	380	395
Diss O ₂ (mg/l)					
Max	11.0	11.2	11.8	12.5	11.8
Min	7.9	7.7	7.5	7.4	7.3
Ave	9.4	9.6	9.8	10.5	10.2
Diss Cl ⁻ (mg/l)					
Max	31	27	35	34	33
Min	19	18	18	18	17
Ave	27	22	26	27	26
Diss F ⁻ (mg/l)					
Max	0.25	0.25	0.29	0.32	0.27
Min	0.16	0.16	0.19	0.19	0.19
Ave	0.18	0.20	0.23	0.25	0.23
Diss Fe (mg/l)					
Max	0.22	0.31	0.67	0.56	0.51
Min	0.11	0.11	0.14	0.12	0.18
Ave	0.14	0.25	0.38	0.30	0.31
Total Fe (mg/l)					
Max	2.1	1.4	7.3	7.7	7.3
Min	0.5	0.5	0.7	0.6	0.5
Ave	0.9	0.8	3.2	2.2	3.1
Diss Pb (mg/l)					
Max	0.05	0.04	0.06	0.06	0.05
Min	0.02	0.02	0.03	0.02	0.02
Ave	0.03	0.03	0.05	0.04	0.04
Total Pb (mg/l)					
Max	0.06	0.04	0.10	0.10	0.11
Min	0.02	0.03	0.03	0.02	0.03
Ave	0.04	0.03	0.05	0.05	0.05
Diss Na (mg/l)					
Max	10.5	12.0	11.0	6.8	7.1
Min	4.7	4.2	3.0	3.1	3.4
Ave	8.1	7.3	5.4	5.2	5.2
Total Na (mg/l)					
Max	33.5	31.4	15.2	18.8	15.7
Min	8.9	11.5	5.8	5.0	5.7
Ave	22.5	20.6	10.2	12.0	11.2
Diss Zn (mg/l)					
Max	0.07	0.07	0.10	0.14	0.13
Min	0.02	0.03	0.04	0.05	0.06
Ave	0.05	0.04	0.08	0.08	0.08
Total Zn (mg/l)					
Max	0.08	0.08	0.15	0.26	0.43
Min	0.04	0.04	0.05	0.06	0.05
Ave	0.05	0.05	0.08	0.11	0.11

river stage. The rain apparently washes iron and zinc into the river and increases the concentrations of these elements. The dissolved oxygen concentrations generally were about 85% of the values expected for water saturated with air at the experimental temperature. The various Wabash River sampling stations always gave practically identical results for samples taken on the same day. The concentrations of dissolved chloride, iron, and sodium can be compared to results given by Harneson and Larson (2) for the Wabash River at Riverton, Indiana, about 40 miles south of Terre Haute. Table 1 shows the average chloride ion concentration to be about 27 ppm. This agrees with Harneson's value, within experimental error. Their average for dissolved iron and sodium is about 0.1 and 18 mg/l, respectively, compared to our average of about 0.2 and 6 mg/l.

Kopp and Kroner (4) give results of analyses for iron, lead, and zinc concentrations in the Wabash River at New Harmony, Indiana. For iron they give an average of 0.027 compared to our value of 0.2 ppm. For lead and zinc they report an average of 0.035 and 0.051, respectively, compared to our average of 0.045 and 0.08 ppm. There seems to be a significant difference only in the results for the iron analyses, with the concentration of iron apparently higher in the Wabash River at Terre Haute than at New Harmony.

A comparison can be made between the results of some of our analyses and the records published by the Indiana State Board of Health (3) for the Wabash River at Terre Haute. Our average laboratory pH of 8.1 was higher than their average values of 7.3 for laboratory pH and 7.8 for *in situ* pH. Our value of 27 for average chloride ion concentration was considerably higher than their average of 17 ppm recorded for 1969. Their values for specific conductance seem to indicate a total concentration of ions approximately 100 ppm higher than our average of about 390.

Literature Cited

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