Proceedings of the Iowa Academy of Science

Volume 77 | Annual Issue Article 26

1970

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Krohn, Milbert H. (1970) "A Physio-Chemical Analysis of the Headwaters of the Little Sioux River," *Proceedings of the Iowa Academy of Science, 77(1),* 172-176.
Available at: https://scholarworks.uni.edu/pias/vol77/iss1/26

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A Physio-Chemical Analysis of the Headwaters of the Little Sioux River

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Abstract. The magnitude and seasonal variation of 11 selected physio-chemical characteristics at four collection sites in the headwater region of the Little Sioux River are reported for a 12-month perod from March 1969 through February 1970. Little variation was found between study sites for given sampling times.

For several decades the headwaters and adjacent terrestrial areas of the Little Sioux River have been th object of considerable scientific investigation. This study, by students in summer courses at the Iowa Lakeside Laboratory, has resulted in limited information through publication. However, at the present time a number of specific research projects are in progress which primarily concern the aquatic flora and fauna of this region (Bovbjerg, personal communication). Because of the interest in this region, particularly the current biological investigations, a record of the magnitude and annual variation of selected physio-chemical characteristics of the river in this region seemed desirable. The twelve month study which is reported here was initiated in March 1969.

MATERIALS AND METHODS

Four sampling sites were selected along approximately 40 kilometers of the upper reach of the Little Sioux River. The relative positions of these sampling sites are shown in Figure 1. The general criteria for site selection were to sample approximately equal stretches of the river and to concentrate on those areas of greatest interest to current biological investigators. This latter point was the reason for placing the two upper stations on the East, rather than West, Branch of the Little Sioux with Site 1 near its source in Minnesota and Site 2 near the bridge on Iowa Highway 9. The effect of the West Branch of the Little Sioux was monitored by establishing Site 3 below its confluence with the East Branch. The specific location of Site 3 was near the bridge on County Road A-22 in Section 21 of Lakeville Township in Dickinson County, Iowa. Site 4, also in Dickinson County, Iowa, was located in Section 14 of Okoboji Township. This site was just downstream from the confluence of Milford Creek with the Little Sioux River. This location was selected because Milford Creek, in addition to flowing through the city dump of Milford, Iowa receives the effluent discharge of the Iowa Great Lakes Sanitary District and also the washings from a sizable gravel pit.

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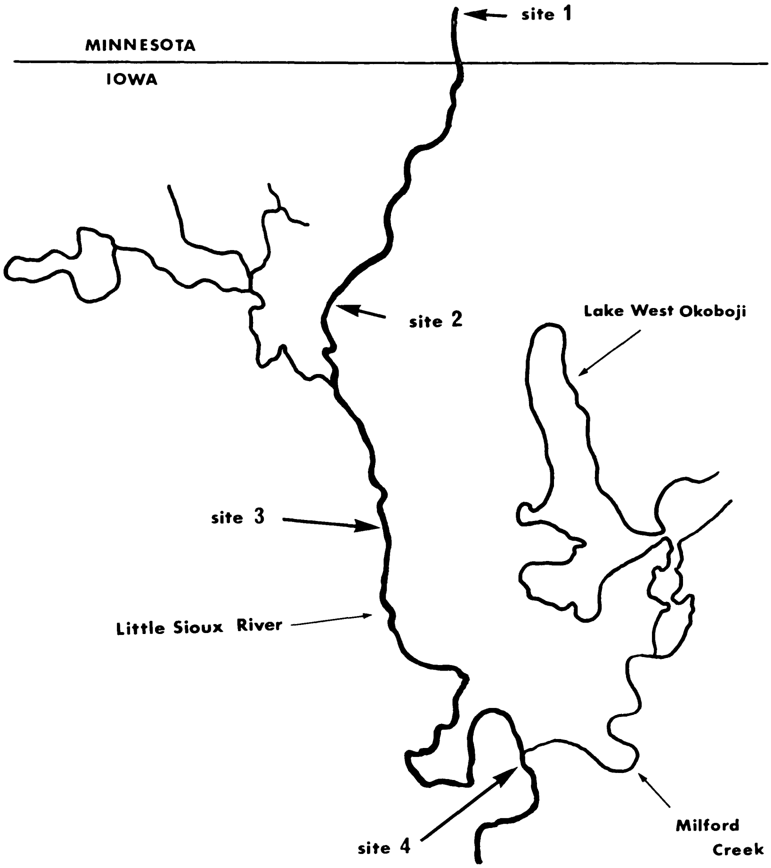

Figure 1. Headwater region of The Little Sioux River showing relative positions of collection sites.

Water samples from the four sites were collected on a monthly basis. The samples were analyzed for 10 chemical characteristics in the local high school science laboratory using a Hach Portable Engineer's Laboratory (Model DR-EL) and methods described by Hach. Temperature measurements were made at the collection sites.

Results and Discussion

Examination of data (Table 1) indicates quite clearly that the limnology of this stretch of river changes with the seasons. However, with the exception of certain parameters at Site 4, there does not seem to be a great deal of variation from one station to another. Site 4, located below the confluence with Milford Creek does seem to reflect the effects of a waste discharge with higher phosphate

Table 1. Results of the physio-chemical analyses of the headwaters of the Little Sioux River. (Temperature=°C.; *=river frozen entirely to bottom; Others=ppm.)

	Date 1969-70 Site	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.
Calcium Hardness	1	360	80	250	300	240	250	190	245	270	100	260	280
	2	*	90	250	280	160	140	150	260	290	300	330	390
	3	410	140	245	270	150	200	180	230	270	190	340	370
	4	320	150	115	240	130	110	140	220	230	240	250	250
Magnesium Hardness	1	280	15	140	230	110	150	165	145	200	250	220	150
	2	*	10	130	170	90	190	215	220	210	200	20	170
	3	250	20	125	185	60	160	190	150	160	210	80	100
	4	170	20	105	210	60	140	140	110	160	150	140	130
Total Hardness	1	640	95	390	530	350	400	360	390	470	360	480	430
	2	*	100	380	450	250	330	365	480	500	500	350	560
	3	660	160	370	455	210	360	390	380	430	400	420	470
	4	490	170	220	450	190	250	280	330	390	390	390	380
Alkalinity	1	350	90	200	230	250	250	240	250	310	360	350	300
	2	*	80	210	250	200	170	260	225	265	320	340	340
	3	370	110	200	260	155	210	210	210	210	310	350	330
	4	280	130	180	240	200	230	230	230	240	250	285	310
Chloride	1	25	15	20	25	15	20	20	15	15	40	25	10
	2	*	10	25	25	15	15	15	15	20	20	15	10
	3	35	20	15	30	20	20	25	25	25	20	30	15
	4	25	15	20	20	10	15	20	25	30	20	25	25
Sulfate	1	200	30	275	350	130	190	250	175	230	260	255	150
	2	*	30	240	310	110	250	300	300	260	250	270	350
	3	350	70	245	340	120	200	280	290	250	340	350	350
	4	260	55	50	300	30	40	215	175	180	190	150	160

Table 1. (Continued)

	Date 1969-70 Site	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.
Ortho-Phosphate	1	0.6	0.7	0	0.2	0.4	0.6	0.1	0.4	0.6	1.3	0.8	0.4
	2	*	0.8	0.1	0.3	1.0	0.2	0.2	0.3	0.3	0.2	0.1	0.2
	3	1.4	3.6	0.1	0.1	1.1	0.5	0.1	0.1	0.2	3.0	0.2	0.2
	4	3.0	1.1	0.8	0.5	1.2	1.2	1.7	2.0	2.3	3.6	0.2	4.0
Nitrate-Nitrogen	1	18.0	3.0	4.0	1.3	8.0	4.0	6.0	8.0	6.5	8.0	8.0	7.0
	2	*	3.5	1.9	1.1	5.0	6.0	7.0	8.5	5.0	5.5	5.0	6.0
	3	40.0	20.1	5.0	1.2	5.0	6.0	7.0	9.0	8.5	5.8	12.0	0.7
	4	26.0	36.0	3.5	5.0	6.0	8.0	9.5	9.0	7.5	7.0	6.0	0.4
Silica	1	4.2	4.9	0.2	5.6	11.8	10.2	3.4	5.4	4.3	6.2	4.1	12.6
	2	*	4.8	0.2	4.8	5.0	5.3	4.9	5.6	4.7	4.7	4.4	11.6
	3	3.3	5.6	0.9	7.2	7.4	7.9	2.9	6.4	3.5	7.2	6.2	8.7
	4	4.2	5.2	3.2	8.4	10.8	14.2	5.8	7.2	5.8	6.1	6.3	8.8
pH	1	7.1	7.4	9.3	8.5	8.1	8.5	7.7	8.3	8.5	7.5	7.1	7.0
	2	*	7.2	9.1	7.5	8.4	8.5	7.0	8.2	7.8	7.2	6.6	7.2
	3	7.6	7.5	9.0	8.3	8.1	8.3	7.2	7.6	7.9	7.1	7.2	7.1
	4	7.5	7.6	9.2	8.5	8.0	8.3	7.6	7.4	8.4	7.2	8.6	7.1
Temperature	1	0	11.7	16.1	19.4	22.8	25.0	20.0	8.3	2.8	0	0	0
	2	*	11.7	16.1	18.8	22.8	26.1	22.2	8.3	2.8	0	0	0
	3	2.2	11.7	15.0	20.0	22.8	22.8	22.2	7.2	4.4	0	0	0
	4	3.9	16.1	20.0	21.1	20.0	18.3	16.6	7.8	2.8	3.3	1.1	1.1

levels, periodically elevated levels of nitrate and the fact that this station did not freeze during the winter. The Little Sioux River had a higher calcium hardness than magnesium hardness while other investigators (Bachmann, 1965; Cooke, 1966) have found that water in near-by Lake West Okoboji had a higher magnesium to calcium hardness ratio.

Stream flows in the upper Basin of the Little Sioux River were much higher than usual during the period of study (U.S.G.S., in press). This was particularly true for the months of April and July 1969 when the Little Sioux River was greatly swollen by heavy rainfalls. The diluting effects of the increased run-off during these periods are readily indicated by the lower ionic concentrations for these months. It is planned that this study will be continued to provide comparative data for periods of lower flows.

Acknowledgements

I wish to thank Dr. Richard V. Bovbjerg whose suggestion and encouragement led to this study. I also wish to express my appreciation to Dr. W. Randall Shobe for his criticism and aid in preparing this manuscript.

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