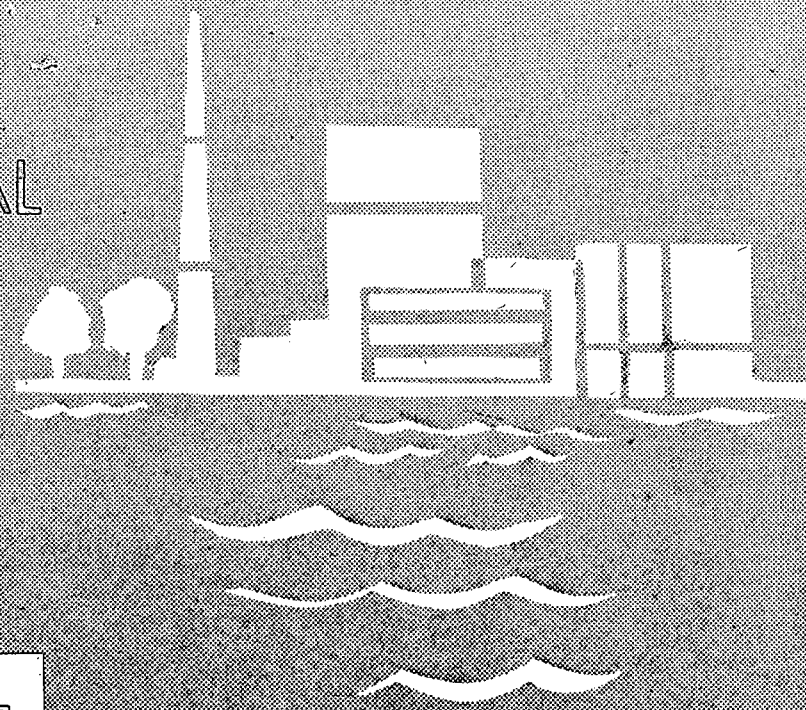
ENVIRONMENTAL MONITORING AND ECOLOGICAL STUDIES PROGRAM

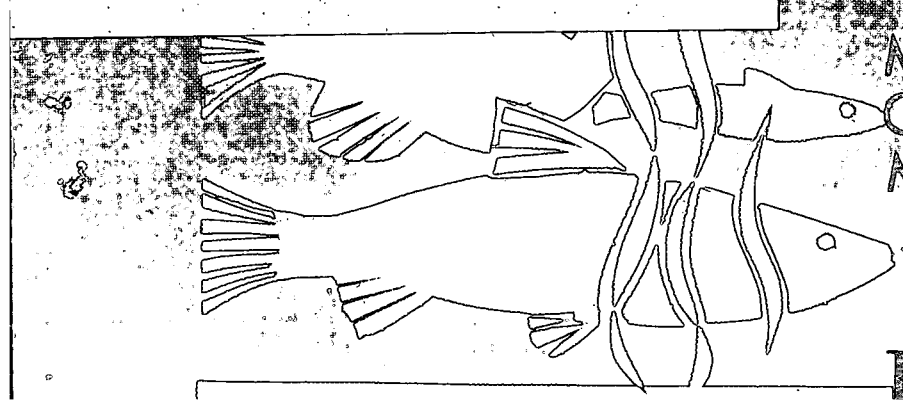


1978 ANNUAL REPORT

FOR THE

MONTICELLO NUCLEAR GENERATING PLANT

Monticello, Minnesota



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INTRODUCTION

Two general areas of water monitoring activities were conducted in 1978: Water Quality and Fishery Studies. The objective of the water quality study was to determine if plant operation was altering certain chemical parameters within the river and to determine if these changes (if any) had any effect on the fishery. Because the Mississippi River near Monticello is a large, turbulent stream with a boulder substrate, many of the conventional fishery sampling methods are impractical to use. Two techniques that have worked well for capturing specimens are electrofishing and seining. Large fishes are efficiently sampled by electrofishing, and small species and young fishes are captured by seining. The objective of the electrofishing and seining studies was to assess the relative abundance and seasonal distribution of fishes in response to the plant discharge plume. A creel census study was also conducted to assess the influence of plant operation on angling pressure and success.

This is the eleventh consecutive report (eighth operational) summarizing environmental monitoring activities for the Monticello Nuclear Generating Plant.

Science Services Section
Environmental and Regulatory Activities Department
Northern States Power Company (NSP)
June 1, 1979

MONTICELLO NUCLEAR GENERATING PLANT
ENVIRONMENTAL MONITORING PROGRAM
1978 ANNUAL REPORT

WATER MONITORING SUMMARY
(1.1)
(Physical Parameters)

Prepared for

Northern States Power Company
Minneapolis, Minnesota

by

Science Services Section
Environmental and Regulatory
Activities Department
Northern States Power Company

1.1 1978 MONTICELLO WATER MONITORING SUMMARY

1.1.1 PHYSICAL PARAMETERS

The Monticello Nuclear Generating Plant had six outages during 1978 (Table 1.1-1). These outages accumulated to slightly more than 49 days. The outage of greatest duration began on October 13 and terminated on November 17. This outage accounted for 70 percent of the total 1978 down time.

Data are collected hourly by the plant computer on the circulating water system at Monticello. These data were transformed into weekly averages and are listed in Table 1.1-2.

Above normal precipitation in 1978 created higher than average river discharge (4,400 cfs) throughout most of the year (Figure 1.1-1). Maximum river discharge occurred during spring run-off in early April. Minimum river discharges did not occur until tributary drainage systems froze in mid-November.

The rate of water withdrawal by the plant from the Mississippi River was generally between 500 and 600 cfs (Figure 1.1-2). The only deviations from this pumping rate occurred during plant outages and intake icing conditions.

Ambient river water temperatures are illustrated in Figure 1.1-3. Winter temperatures were consistently at 32°F, warming began in late March, and very rapid temperature changes occurred in April. Maximum weekly mean temperatures, of 76°F, occurred during mid-July and August. A gradual temperature decline transpired in the fall, reaching 32°F in mid-November.

Winter discharge canal water temperatures were generally near 70°F (Figure 1.1-4). Maximum discharge canal temperatures, slightly exceeding 90°F, occurred in mid-May and mid-September. Discharge temperatures throughout the summer were generally near 85°F, due to "helper mode" plant operation (once-through cooling tower operation) from May 18 to September 17.

Table 1.1-1 1978 Monticello off-line time

Date Off	Date On	Outage Time (days)
2/2	2/4	2.0
2/23	2/24	0.8
4/25	4/30	3.6
6/2	6/6	4.0
7/28	8/1	4.3
10/13	11/17	34.5
	TOTAL	49.2

Table 1.1-2 1978 Monticello water system summaries

Week of	River Discharge (cfs)	Plant Intake (cfs)	Ambient River Temp (°F)	Discharge Canal Temp (°F)
1/1/78	4918	546	32.1	69.8
1/8	6788	483	32.2	68.4
1/15	6946	562	32.3	69.4
1/22	5885	555	32.4	69.6
1/29	5884	480	32.3	60.9
2/5	5288	554	32.4	67.6
2/11	5013	549	32.3	70.2
2/19	4774	537	32.3	65.4
2/26	4589	555	32.2	70.4
3/5	4484	557	32.1	70.3
3/11	4304	549	32.1	70.7
3/18	5758	552	32.1	69.0
3/26	8763	377	32.5	68.9
4/2	12499	463	35.0	67.6
4/9	15409	537	39.6	70.9
4/16	12810	529	43.6	75.4
4/23	10478	418	49.2	67.3
4/30	7597	558	55.5	85.5
5/7	6217	552	57.1	87.2
5/14	5871	557	63.6	91.5
5/21	4434	588	69.6	90.4
5/28	6691	476	66.4	77.5
6/4	8301	506	66.2	83.1
6/11	7029	568	68.9	86.3
6/18	6471	580	69.4	81.1
6/25	6047	599	73.6	87.8
7/2	9271	605	73.9	86.4
7/9	11737	606	72.2	85.1
7/16	9143	603	76.0	88.2
7/23	6749	545	74.3	83.0
7/30	5472	506	72.2	78.4
8/6	4417	583	74.8	85.6
8/13	4354	583	76.2	87.5
8/20	6479	585	73.2	86.8
8/27	9110	593	69.9	83.7
9/3	7614	596	73.9	88.6
9/10	6873	581	68.9	84.6
9/17	6632	569	61.2	90.3
9/24	6177	577	59.7	86.0
10/1	5129	561	56.5	78.3

Table 1.1-2 (Continued)

Week of	River Discharge (cfs)	Plant Intake (cfs)	Ambient River Temp (°F)	Discharge Canal Temp (°F)
10/8	4774	510	52.8	76.5
10/15	4814	8	48.6	53.6
10/22	4643	8	46.8	50.9
10/29	4500	9	46.1	52.1
11/5	4405	9	43.5	46.7
11/12	4232	370	36.2	45.6
11/19	3214	554	32.2	66.1
11/26	2998	463	32.2	70.4
12/3	3531	218	32.9	75.8
12/10	3685	368	32.4	73.7
12/17	3994	568	32.4	73.7
12/24	3935	569	32.8	72.8

Figure 1.1-1. Monticello 1978 Weekly Average River Discharge (cfs).

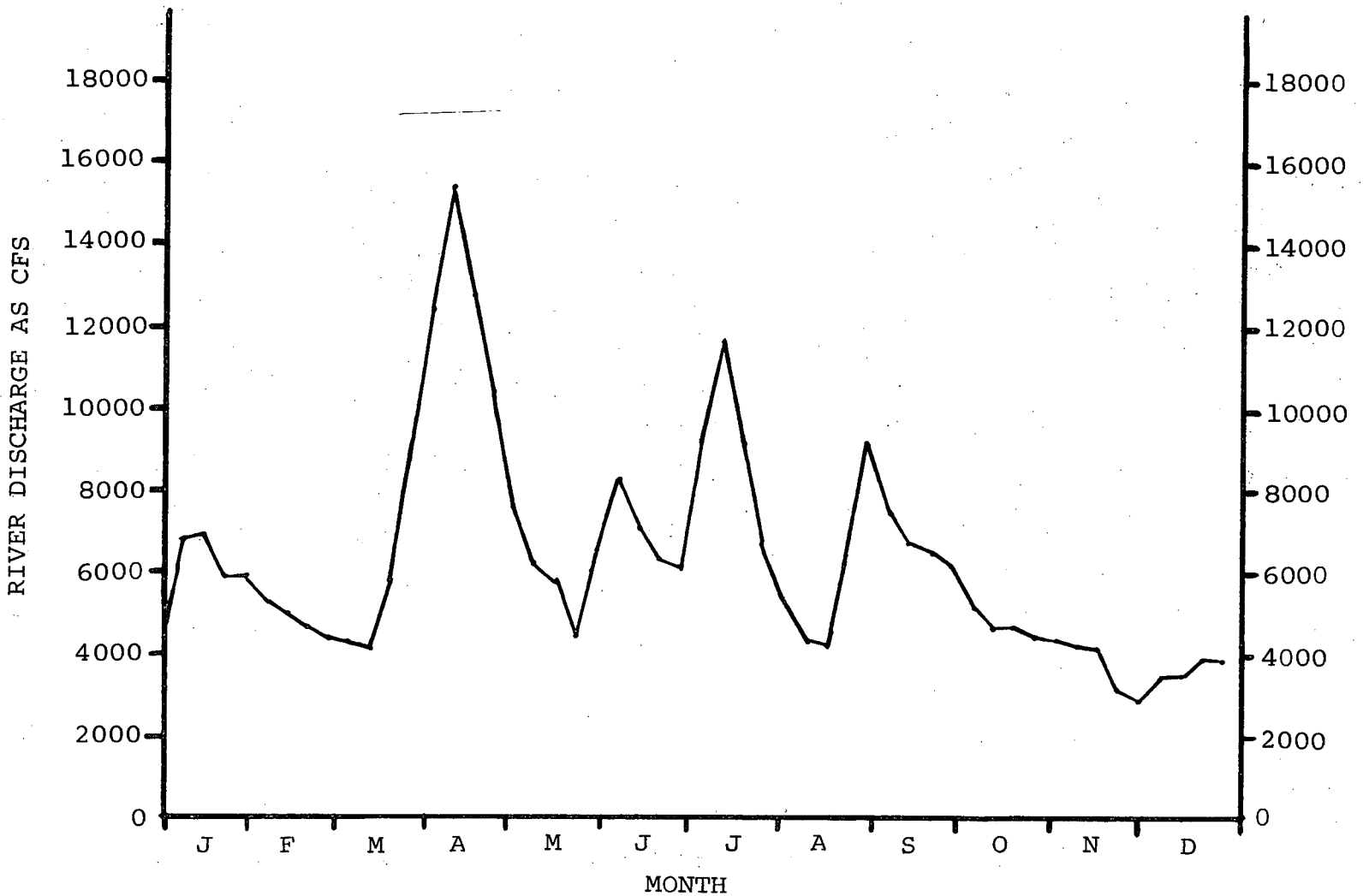


Figure 1.1-2. Monticello 1978 Weekly Average Plant Intake Withdrawal Rate (cfs).

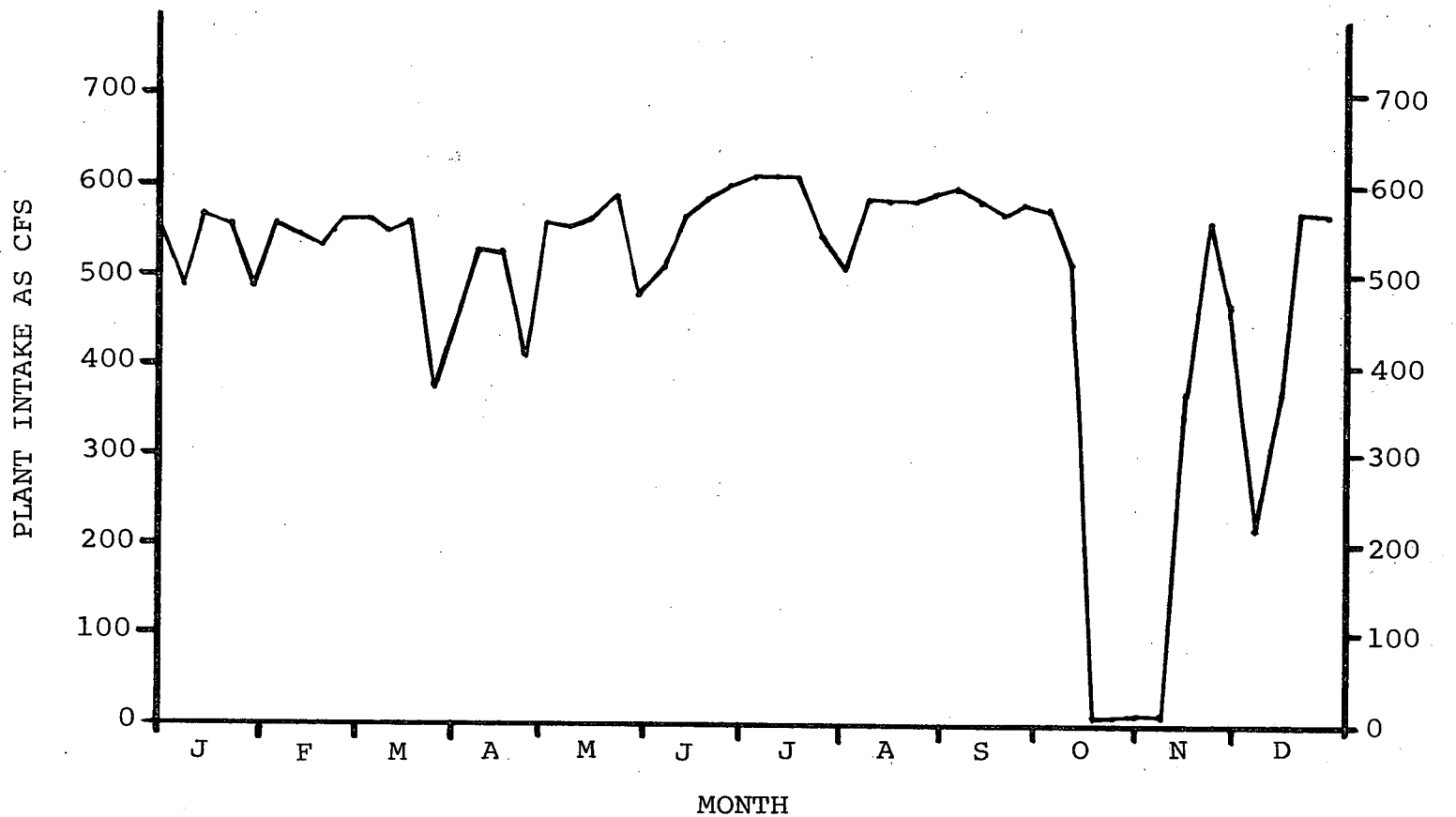


Figure 1.1-3. Monticello 1978 Weekly Average Ambient River Temperatures (°F).

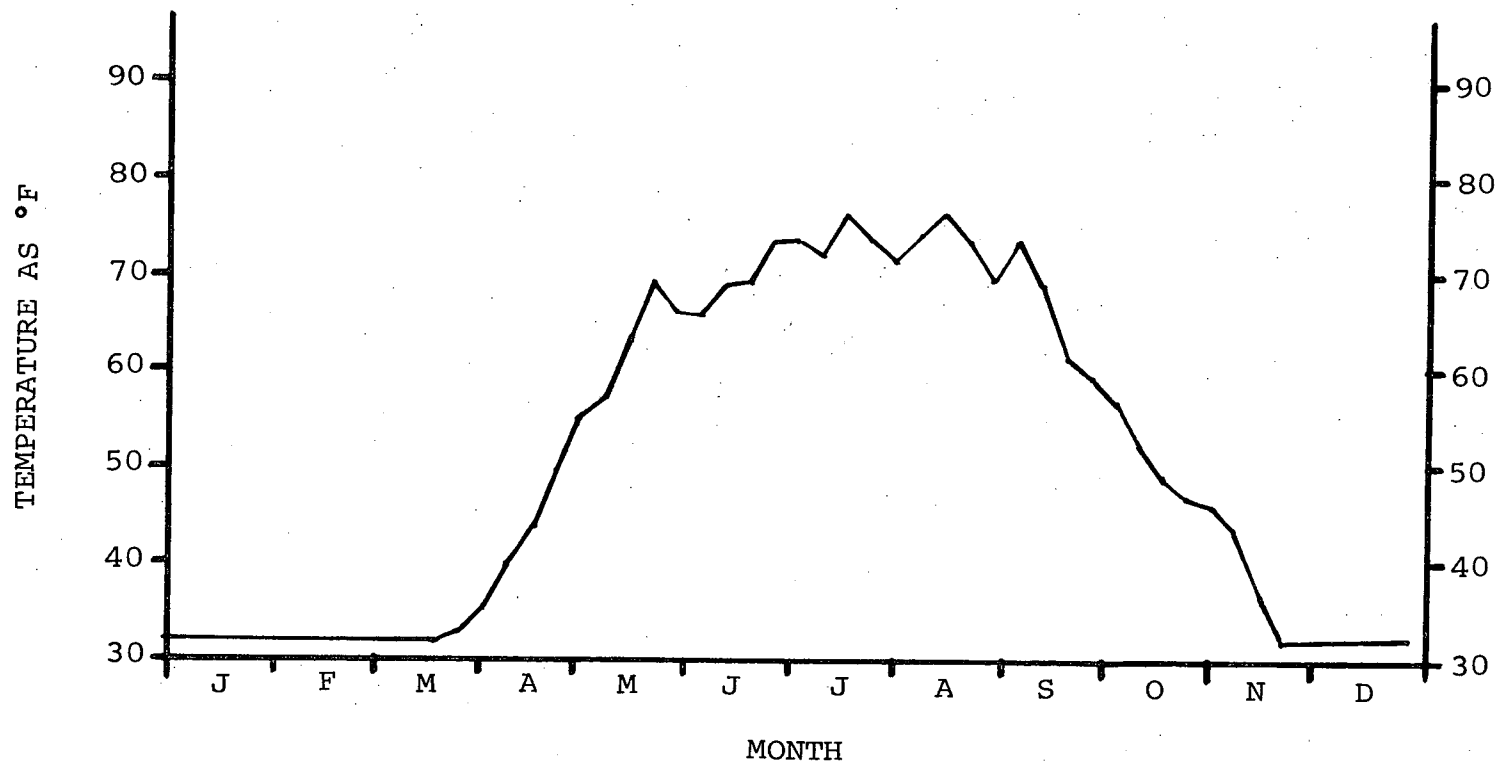
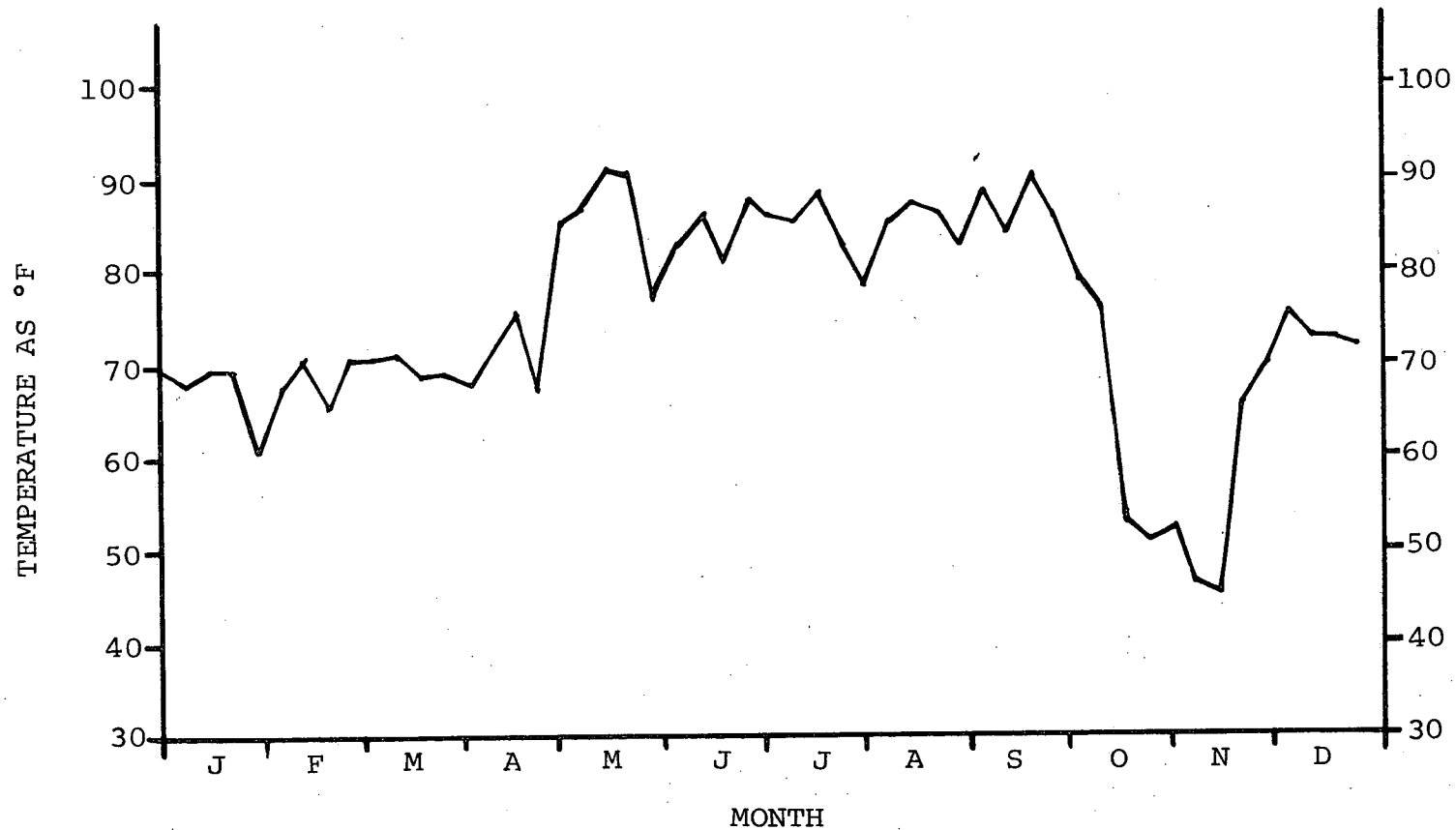


Figure 1.1-4. Monticello 1978 Weekly Average Discharge Canal Water Temperature (°F).



MONTICELLO NUCLEAR GENERATING PLANT

ENVIRONMENTAL MONITORING PROGRAM

1978 ANNUAL REPORT

WATER MONITORING SUMMARY

(1.2)
(Chemical Parameters)

Prepared for

Northern States Power Company
Minneapolis, Minnesota

by

Sciences Services Section

Environmental and Regulatory
Activities Department
Northern States Power Company

1.2 MISSISSIPPI RIVER WATER MONITORING PROGRAM

1.2.1 SUMMARY

Mississippi river water chemistry analyses were conducted on samples taken from the three sampling sites that have been used since 1972. The sample statistics were used as estimates of river water parameters. Statistical values from the discharge canal and downstream samples were compared with upstream sample statistical values. Significant differences were calculated with the use of a 95 percent confidence limit t-test, in an attempt to determined the impact of the Monticello Plant discharge on river water quality.

The three sampling sites included 1,000 feet upstream from the intake structure, the discharge canal, and 1,000 feet downstream from the outfall. Samples were collected during the last week of the month from January through December 1978 by NSP personnel. Sample analyses were performed at the NSP Chestnut Testing Laboratory. Both sample collection and analyses were done according to procedures outlined in the US EPA Manual of Methods for Chemical Analyses of Water and Wastes and APHA-AWWA-WPCF Standard Methods for the Examination of Water and Waste Water (14th Edition).

Results of the analyses are presented in Table 1.2-1. The t-test revealed differences between upstream sample statistics and discharge canal and downstream sample statistics only in the temperature parameter. Both the discharge canal and downstream samples had higher values than upstream, but only the discharge canal samples showed a significant higher difference. A graph of the temperature statistics is presented in Figure 1.2-1.

The observed temperature impact at the discharge canal is an expected consequence of the plant usage of water. The real significance, however, is the ability of the water system to rapidly disperse the excess heat as is observed by lack of significant difference between upstream and downstream statistical values.

Table 1.2-1. 1978 MISSISSIPPI RIVER WATER ANALYTICAL DATA ppm
MONTICELLO GENERATING PLANT

Date	B. O. D.			Temperature °C			Turbidity NTU		
	U	Disc	D	U	Disc	D	U	Disc	D
1/31/78	3.0	0.6	1.2	0	18	0	1.8	1.9	1.8
2/28/78	1.2	1.1	1.3	0	19	16.5	1.7	1.8	1.8
3/30/78	3.4	3.4	3.4	1.0	19	8.0	3.5	3.5	2.7
4/25/78	1.66	1.79	1.56	8.6	23.0	13.5	4.8	5.5	5.0
6/2/78	1.7	1.7	1.7	16	16	16	7.3	8.3	6.4
6/27/78	2.1	1.5	1.8	24	30	28.5	8.5	8.0	7.9
7/17/78	1.6	1.5	1.5	25.5	32	30.5	-	-	-
8/29/78	1.6	1.9	2.1	21.5	29	27	-	-	-
9/27/78	1.6	1.8	1.5	19	27	25	-	-	-
10/24/78	1.4	1.2	1.4	7	8.5	7	-	-	-
11/27/78	1.4	1.8	1.7	1.0	19.5	8	-	-	-
12/27/78	0.4	1.0	0.7	0	17.0	6.5	-	-	-
Total	21	19	20	124	258	186	28	29	26
Average	1.7	1.6	1.0	10	21	15	5	5	4
Lowest	0.4	0.6	0.7	0	8.5	0	1.7	1.8	1.8
Highest	3.4	3.4	3.4	25.5	32	30.5	8.5	8.3	7.9
S.D.				10	6.8	10			
t					3.2*	1.2			

*Significant
- The determination of the water property was discontinued.

Table 1.2-1 (Continued)

1978 MISSISSIPPI RIVER WATER ANALYTICAL DATA ppm

MONTICELLO GENERATING PLANT

Date	* Ryznar Index @ 25° C			Conductivity µmhós/cm @ 25° C			pH		
	U	Disc	D	U	Disc	D	U	Disc	D
1/31/78	7.7	7.6	7.7	360	355	360	7.3	7.5	7.3
2/28/78	7.3	7.2	7.2	364	368	370	7.8	7.7	7.7
3/30/78	7.4	7.3	7.4	298	295	293	8.0	8.1	8.0
4/25/78	7.2	7.1	7.1	235	235	237	8.4	8.4	8.4
6/2/78	7.2	7.1	7.0	305	310	310	8.1	8.2	8.1
6/27/78	7.2	7.0	7.0	275	279	279	8.2	8.4	8.4
7/17/78	-	-	-	260	270	270	8.1	8.4	8.3
8/29/78	-	-	-	550	520	520	8.0	7.6	8.2
9/27/78	-	-	-	270	270	270	8.0	8.0	8.0
10/24/78	-	-	-	280	300	280	8.4	8.3	8.3
11/27/78	-	-	-	320	310	320	8.4	8.1	8.2
12/27/78	-	-	-	350	340	350	8.2	8.3	8.4
Total	44	43	43	3867	3852	3859	97	97	97
Average	7.0	7.0	7.0	322	321	321	8.0	8.0	8.0
Lowest	7.2	7.0	7.0	235	270	310	7.3	7.5	7.3
Highest	7.7	7.6	7.7	550	520	520	8.4	8.4	8.4

*Ryznar Index -
Quantitative index of $CaCO_3$ scale formation at temperatures up to 200°F, and a prediction of corrosiveness of water that is non-scale forming.

Table 1.2-1 (Continued)

1978 MISSISSIPPI RIVER WATER ANALYTICAL DATA ppm
MONTICELLO GENERATING PLANT

Date	Dissolved Oxygen(O_2)			Ammonia Nitrogen(N)			Bicarbonate(HCO_3^-)		
	U	Disc	D	U	Disc	D	U	Disc	D
1/31/78	10	8	9.60	0.13	0.13	0.13	217	215	217
2/28/78	11	9.2	10.0	0.08	0.11	0.04	216	217	217
3/30/78	12.0	9.7	10.8	0.56	0.56	0.59	166	165	165
4/25/78	12.7	11.3	12.2	0.0	0.04	0.0	135	137	137
6/2/78	10.9	11.0	11.0	0.11	0.14	0.12	174	174	174
6/27/78	5.4	4.4	5.6	0.02	0.02	0.02	157	157	154
7/17/78	10.8	9.8	10.4	<0.01	0.02	0.02	-	-	-
8/29/78	9.0	7.8	8.8	<0.01	<0.01	0.01	-	-	-
9/27/78	8.9	7.8	8.1	<0.01	<0.01	<0.01	-	-	-
10/24/78	12.4	11.8	12.4	<0.01	<0.01	<0.01	-	-	-
11/27/78	13.2	11.7	12.8	<0.01	<0.01	<0.01	-	-	-
12/27/78	11.3	10.9	10.8	0.20	0.16	0.16	-	-	-
Total	128	124	122	<1.15	<1.22	<1.12	1065	1065	1064
Average	11	9.45	10	<0.09	<0.10	<0.09	177	177	177
Lowest	5.4	4.4	5.6	<0.01	<0.01	<0.01	135	137	137
Highest	13.2	11.8	12.8	0.56	0.56	0.59	217	217	217

Table 1.2-1 (Continued)

1978 MISSISSIPPI RIVER WATER ANALYTICAL DATA ppm

MONTICELLO GENERATING PLANT

	Chloride (Cl^-)			Nitrate Nitrogen (N)			Sulfate ($SO_4^=$)		
Date	U	Disc	D	U	Disc	D	U	Disc	D
1/31/78	5.0	5.5	5.5	0.38	0.37	0.35	9.5	8.7	9.7
2/28/78	1.3	0.8	.60	0.42	0.35	0.41	11	11.6	10.7
3/30/78	1.8	1.8	1.6	0.59	0.51	0.52	10.4	10.1	9.5
4/25/78	1.17	1.04	0.76	0.08	0.07	0.01	11.25	10.64	11.25
6/2/78	0.69	1.06	0.77	0.15	0.16	0.16	11.9	10.6	10.4
6/27/78	1.78	1.13	1.52	0.24	0.22	0.22	18.7	16.6	19
7/17/78	0.80	0.70	0.8	0.06	0.10	0.07	16.7	15.6	18.5
8/29/78	3	4	4	0.24	0.18	0.24	2	6	3
9/27/78	4	4	4	0.20	0.20	0.19	11	11	11
10/24/78	5	5	5	0.08	0.20	0.08	10	13	12
11/27/78	6	7	7	0.22	0.24	0.22	10	10	10
12/27/78	6	6	6	0.37	0.38	0.37	8	11	9
Total	36.5	38	37	3.03	2.98	2.84	130	135	134
Average	3.0	3.0	3.0	0.25	0.24	0.23	11	11	11
Lowest	0.8	0.7	0.6	0.06	0.07	0.01	2.0	10.0	3
Highest	6.0	7.0	7.0	0.59	0.51	0.52	18.7	16.6	18.5

Table 1.2-1 (Continued)
1978 MISSISSIPPI RIVER WATER ANALYTICAL DATA ppm
MONTICELLO GENERATING PLANT

Date	Total Soluble Phosphorous (P)			Silica (Si)			Calcium (Ca)		
	U	Disc	D	U	Disc	D	U	Disc	D
1/31/78	.039	.036	.039	12.3	12.3	12.3	46.5	43.3	46.5
2/28/78	.040	.042	.044	13.5	13.0	12.5	49.7	51.3	51.3
3/30/78	.109	.102	.110	9.8	8.8	9.6	37.7	38.1	37.7
4/25/78	.040	.018	.023	5.5	5.5	5.5	35.2	37.7	38.5
6/2/78	.048	.043	.051	7.9	7.9	7.9	40.1	40.9	40.9
6/27/78	.057	.068	.063	7.2	7.5	7.4	37.7	36.9	37.7
7/17/78	.067	.074	.071	-	-	-	-	-	-
8/29/78	.066	.074	.061	-	-	-	-	-	-
9/27/78	.053	.050	.047	-	-	-	-	-	-
10/24/78	.017	.017	.014	-	-	-	-	-	-
11/27/78	.011	.013	.011		-	-	-	-	-
12/27/78	.026	.026	.022	-	-	-	-	-	-
Total	.57	.56	.550	56.2	55	55.2	247	248	253
Average	.047	.046	.046	9	9	9	41	41	42
Lowest	.011	.013	.011	5.5	5.5	5.5	35.2	36.9	37.7
Highest	.109	.102	.110	13.5	13.0	12.3	49.7	51.3	46.5

Table 1.2-1 (Continued)

1978 MISSISSIPPI RIVER WATER ANALYTICAL DATA ppm

MONTICELLO GENERATING PLANT

Date	Magnesium (Mg)			Sodium (Na)			Total Iron (Fe)			Color APHA Units		
	U	Disc	D	U	Disc	D	U	Disc	D	U	Disc	D
1/31/78	17	19	17	6	6.0	6.0	0.16	0.16	0.16	30	30	30
2/28/78	14.8	13.6	13.6	6.3	6.2	6.3	0.30	0.28	0.25	15	15	20
3/30/78	11.7	11.4	11.2	4.5	4.5	4.4	0.71	0.71	0.64	30	30	30
4/25/78	8.75	7.8	6.8	3.5	3.7	3.7	0.82	1.12	0.82	70	70	70
6/2/78	12.6	11.7	11.7	4.9	5.0	4.9	0.55	0.75	0.45	50	50	50
6/27/78	11.2	12.2	11.2	4.55	4.6	4.55	0.55	0.55	0.50	70	70	70
7/17/78	-	-	-	-	-	-	-	-	-	-	-	-
8/29/78	-	-	-	-	-	-	-	-	-	-	-	-
9/27/78	-	-	-	-	-	-	-	-	-	-	-	-
10/24/78	-	-	-	-	-	-	-	-	-	-	-	-
11/27/78	-	-	-	-	-	-	-	-	-	-	-	-
12/27/78	-	-	-	-	-	-	-	-	-	-	-	-
Total	76	76	71	30	30	30	3	3	3	265	265	270
Average	13	13	12	5	5	5	0.5	0.5	0.5	44	44	45
Lowest	8.75	7.8	6.8	3.5	3.7	4.4	0.16	0.16	0.16	15	15	20
Highest	14.8	19	17	6.3	6.2	6.3	0.82	1.12	0.82	70	70	70

Table 1.2-1 (Continued)

1978 MISSISSIPPI RIVER WATER ANALYTICAL DATA ppm

MONTICELLO GENERATING PLANT

	SOLIDS								
	Total mg/l			Suspended mg/l			Dissolved mg/l		
Date	U	Disc	D	U	Disc	D	U	Disc	U
1/31/78	242	222	228	2.0	2.4	3.6	240	220	224
2/28/78	190	232	229	12.2	1.1	1.9	178	231	227
3/30/78	190	178	183	12.2	9.8	8.8	178	168	174
4/25/78	179	179	180	15.5	15.2	16	164	164	164
6/2/78	216	213	202	22	27	16.2	194	188	189
6/27/78	209	201	199	17.5	16	15.6	191	185	183
7/17/78	-	-	-	-	-	-	180	190	185
8/29/78	-	-	-	-	-	-	160	160	170
9/27/78	-	-	-	-	-	-	190	180	170
10/29/78	-	-	-	-	-	-	210	190	190
11/27/78	-	-	-	-	-	-	190	170	180
12/27/78	-	-	-	-	-	-	160	190	200
Total	1226	1225	1217	81	71	62	2235	2236	2256
Average	204	204	203	13	12	10	186	186	188
Lowest	179	178	180	2.0	1.1	1.9	160	160	164
Highest	242	232	229	17.5	27	16.2	240	231	227

Table 1.2-1 (Continued)

1978 MISSISSIPPI RIVER WATER ANALYTICAL DATA ppm

MONTICELLO GENERATING PLANT

	HARDNESS								
	Total ($CaCO_3$)			Calcium ($CaCO_3$)			Magnesium ($CaCO_3$)		
Date	U	Disc	D	U	Disc	D	U	Disc	U
1/31/78	186	186	188	116	108	108	70	78	80
2/28/78	142	184	184	94	128	128	48	56	56
3/30/78	142	142	140	94	95	94	48	47	46
4/25/78	124	126	124	88	94	96	36	32	28
6/2/78	152	150	150	100	102	102	52	48	48
6/27/78	140	142	140	94	92	94	46	50	46
7/17/78	-	-	-	-	-	-	-	-	-
8/29/78	-	-	-	-	-	-	-	-	-
9/27/78	-	-	-	-	-	-	-	-	-
10/29/78	-	-	-	-	-	-	-	-	-
11/27/78	-	-	-	-	-	-	-	-	-
12/27/78	-	-	-	-	-	-	-	-	-
Total	886	930	926	586	619	622	300	311	304
Average	148	155	154	98	103	103	50	52	51
Lowest	126	126	124	88	92	94	36	32	28
Highest	186	186	188	116	128	128	70	78	80

Table 1.2-1 (Continued)
1978 MISSISSIPPI RIVER WATER ANALYTICAL DATA ppm
MONTICELLO GENERATING PLANT

	ALKALINITY					
	Total ($CaCO_3$)			P ($CaCO_3$)		
Date	U	Disc	D	U	Disc	D
1/31/78	178	176	178	0	0	0
2/28/78	177	178	178	0	0	0
3/30/78	136	135	135	0	0	0
4/25/78	115	115	116	2	1.5	2
6/2/78	143	143	143	0	0	0
6/27/78	129	131	130	0	1.0	2
7/17/78	126	130	128	0	1.5	1.0
8/29/78	86	100	90	0	0	0
9/27/78	109	109	109	0	0	0
10/29/78	128	134	127	2	1	2
11/27/78	141	142	143	0	0	0
12/27/78	114	131	120	0	0	0
Total	1582	1624	1597	4	4	7
Average	132	135	133	0.3	0.3	0.5
Lowest	86	100	90	0	0	0
Highest	178	178	178	2	1.5	2

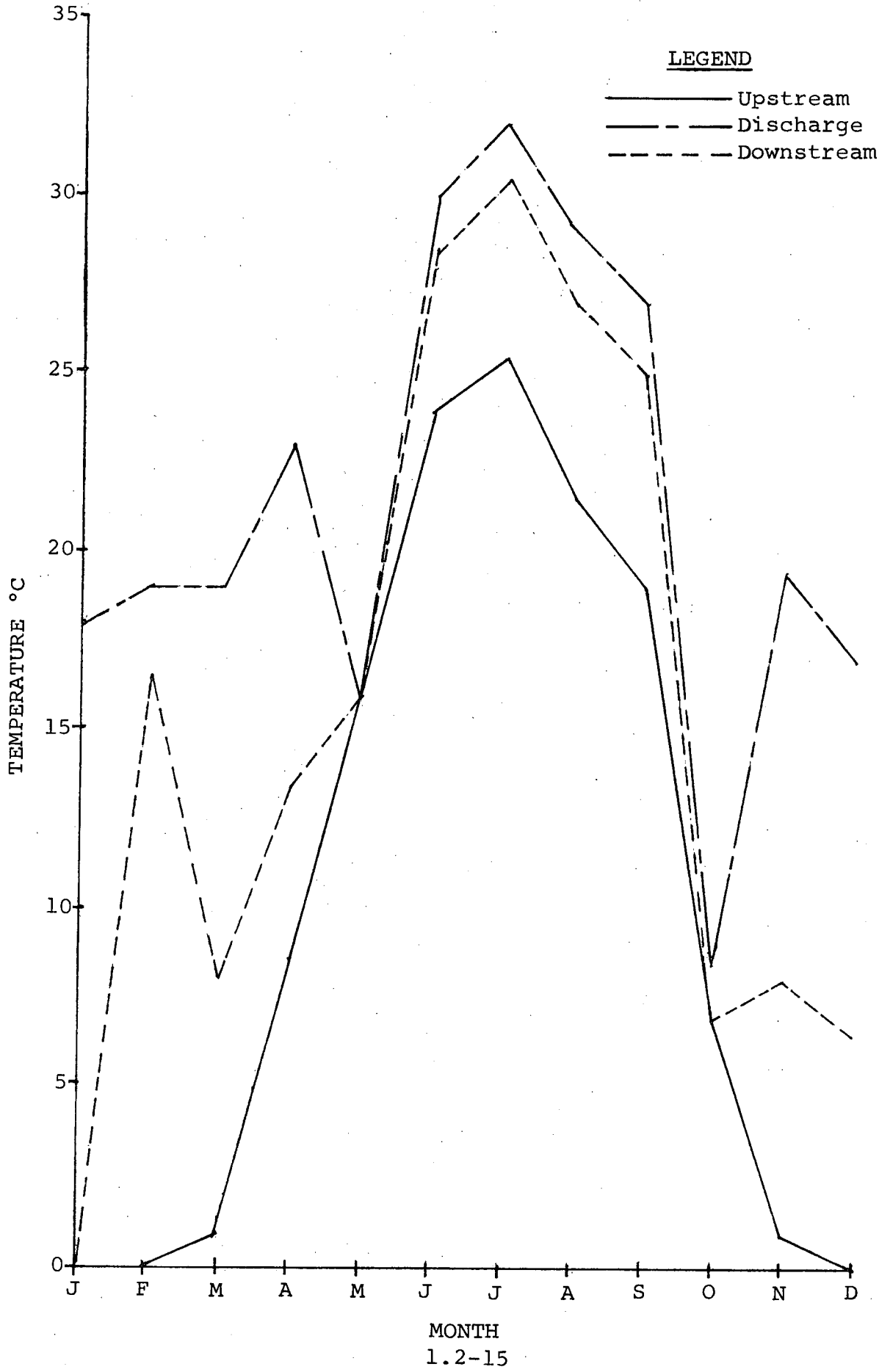
Table 1.2-1 (Continued)

1978 MISSISSIPPI RIVER WATER ANALYTICAL DATA ppm

MONTICELLO GENERATING PLANT

	Carbonate ($CO_3^{=}$)			Nitrite (N)		
Date	U	Disc	D	U	Disc	D
1/31/78	0	0	0	-	-	-
2/28/78	0	0	0	-	-	-
3/30/78	0	0	0	-	-	-
4/25/78	2.4	1.8	2.4	-	-	-
6/2/78	0	0	0	-	-	-
6/27/78	0	1.2	2.4	-	-	-
7/17/78	-	-	-	0.010	0.009	0.015
8/29/78	-	-	-	0.007	0.006	0.006
9/27/78	-	-	-	0.002	0.002	0.002
10/24/78	-	-	-	0.003	0.003	0.004
11/27/78	-	-	-	0.006	0.006	0.007
12/27/78	-	-	-	0.007	0.014	0.009
Total	2.4	3.0	4.8	0.035	0.040	0.043
Average	0.4	0.5	0.8	0.006	0.006	0.007
Median						
Lowest	0		2.4	0.002	0.002	0.002
Highest	2.4		2.4	0.010	0.014	0.015
S. D.						

Figure 1.2-1. 1978 Temperature Analyses of Mississippi River Water at Monticello.



MONTICELLO NUCLEAR GENERATING PLANT
ENVIRONMENTAL MONITORING PROGRAM
1978 ANNUAL REPORT

A SUMMARY OF THE 1978 MONTICELLO-SHERCO CREEL SURVEY

(2.1)

Prepared for

Northern States Power Company
Minneapolis, Minnesota

by

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and

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2.1 A SUMMARY OF THE 1978 MONTICELLO-SHERCO CREEL SURVEY

2.1.1 INTRODUCTION

This is the seventh season of a continuing angler creel survey on the Missisippi River near Monticello. An estimated 8,668 man-hours of angling pressure was tabulated during the 1978 survey. Sampling dates included May 13, through October 15, 1978. Ninety days were sampled during this 156-day period, which encompassed a majority of the river's annual fishing pressure.

Six creel survey stations were used to collect data on angling pressure and recreational use of the river (Figure 2.1-1). These stations were the same locations utilized during 1974 through 1977 studies.

2.1.2 MATERIALS AND METHODS

Angler population was sampled by a stratified random creel survey, as described in the 1974 NSP Monticello Annual Environmental Monitoring Report. As in previous years, the survey consisted of two parts: angler interviews and instantaneous counts on the number of fishermen and boats. Sampling was conducted on every weekend during this study period; two weekdays were also randomly sampled each week. The survey clerk was positioned at one station for a complete day. The clerk at the sampling site made ten instantaneous counts daily at hourly intervals. He also conducted as many interviews with fishermen as possible. Information from this survey was then compiled and submitted for analyses under the computer program "CRAPPIE" (Creel Results Application Program Providing for Industrial Ecology) for estimates of angler pressure and harvest.

2.1.3 RESULTS

Table 2.1-1 gives the number of instantaneous counts, number of fisherman counted, and estimated fisherman-hours per site. In total, 900 instantaneous counts were made, 597 fishermen were counted, and an estimated 8,668 man-hours were spent fishing.

Table 2.1-2 presents overall catch rates for species of fishes caught by sampling site. A total of 370 fishes were caught at a rate of 0.726 fish per man-hour.

Catch rates for species sought are presented in Table 2.1-3 by site. The overall rate of success for species sought was 0.259 fish per man-hour. Table 2.1-4 illustrates the annual catch rates for all species combined from 1972 through 1978.

Estimated harvest, in numbers and kilograms, was computed for each sampling site and is given in Table 2.1-5. Fishes not desired by anglers and released, were excluded from the harvest estimates. The total harvest estimate was 5,127 fishes, or 1,483 kg.

Most angling was done from shore; natural bait was used by 53.4 percent of the anglers, 24.9 percent used artificial, and 21.7 percent used a combination of artificial and natural bait. Thirty-six percent of the anglers were Twin City residents, 49.2 percent were from the Monticello area, and 14.8 percent were vacationers traveling distances greater than 50 miles. Daily fishing pressure had the following distribution: Sunday 10.4 percent, Monday 19.4 percent, Tuesday 10.5 percent, Wednesday 18.8 percent, Thursday 6.8 percent, Friday 6.1, and Saturday 28.1 percent.

2.1.4 DISCUSSION

The total 1978 fishing pressure estimate was 8,668 man-hours. This was a 26 percent decrease in angling pressure from 1977 (Table 2.1-4).

As in previous years, accessibility of fishing sites strongly governed specific fishing pressure. Montissippi Park had the highest angling pressure with 3,136 man-hours, Big Oaks Park had 2,062 man-hours, and River Terrace Park had 1,336 man-hours of fishing pressure. These three sites had good roads, parking areas, picnic tables, and restroom facilities. A poor road and controlled access to the Monticello discharge contributed to its low angling pressure. Tarzan Elms and Nelson's Landing also experienced minimum angler utilization because of poor access roads.

Twenty percent of the pressure was directed toward smallmouth bass compared with 75 percent in 1977. Forty percent of the anglers fished for anything, 21.4 percent for crappies, 16.5 percent for walleyes, 2.8 percent for northern pike, and 0.5 percent for carp.

The 1978 catch rates for all species combined was 0.726 fish per man-hour. Smallmouth bass had the highest catch rate at 0.345 fish per hour; black crappie was second at 0.251 fish per hour. The remaining catch rates were as follows: shorthead redhorse 0.031 fish per hour, walleye 0.029 fish per hour, black bullhead 0.027 fish per hour,rock bass 0.020 fish per hour, silver redhorse 0.010 fish per hour, northern pike 0.008 fish per hour, carp 0.002 fish per hour, and white sucker 0.002 fish per hour.

Nelson's landing had the highest rate of success; 2.926 fish were caught per hour of angling. Big Oaks Park was least productive, with a catch rate of 0.483 fish per hour.

Smallmouth bass and black crappie were the main contributors to the 1978 catch. Smallmouth bass is consistently the major species sought by anglers. Black crappie occurs more sporadically in the fishery; however, this species was a major constituent in the fisherman's creel in 1975 and 1978. These two pulses in black crappie catch rate are attributed to high water periods in the spring. It is hypothesized that excessive runoff flushed these fish from area lakes into the river system.

The influence of the strong 1976 year class of smallmouth bass began to be realized in the angling fishery in 1977. During that year, their abundance caused the catch rate for this species to dramatically increase to 1.233 fish per man-hour. Decreased angling success in 1978 is attributed to poor fishing conditions created by high river levels and natural attrition of the 1976 year class. This year class is undoubtedly becoming more "angler wise", and as time progresses they become less susceptible to the fisherman's offering.

Because smallmouth bass is the dominant species sought in the fishery, a reduction in their catch rate created a reduction in the overall angling pressure. This diminished fishing success apparently discouraged many anglers from additional outings in the census area.

The total 1978 harvest estimate for the six census sites was 5,127 fishes and 1,428 kg. Montissippi Park had the largest harvest estimate with 1,517 fishes and 401 kg. Nelson's landing was second with 1,402 fishes and 461 kg. The remaining sites had progressively lower harvest estimates; the discharge canal at the Monticello Plant had the lowest with 461 fishes and 122 kg.

2.1.5 SUMMARY

1. The 1978 angler creel survey was conducted on 90 days during a 156-day period between May 13 and October 15, 1978.

2. Total fishing pressure estimate for all sites was 8,668 man-hours.

3. The overall catch rate for all species combined was 0.726 fish per man-hour.

4. The total harvest estimate was 5,127 fishes and 1,483 kg.

5. The strong 1976 year class of smallmouth bass again was an important component in the angling fishery.

6. Black crappie became abundant in the fisherman's catch in 1978. Its presence is believed to arise from the "flushing" of lakes in the surrounding drainage system.

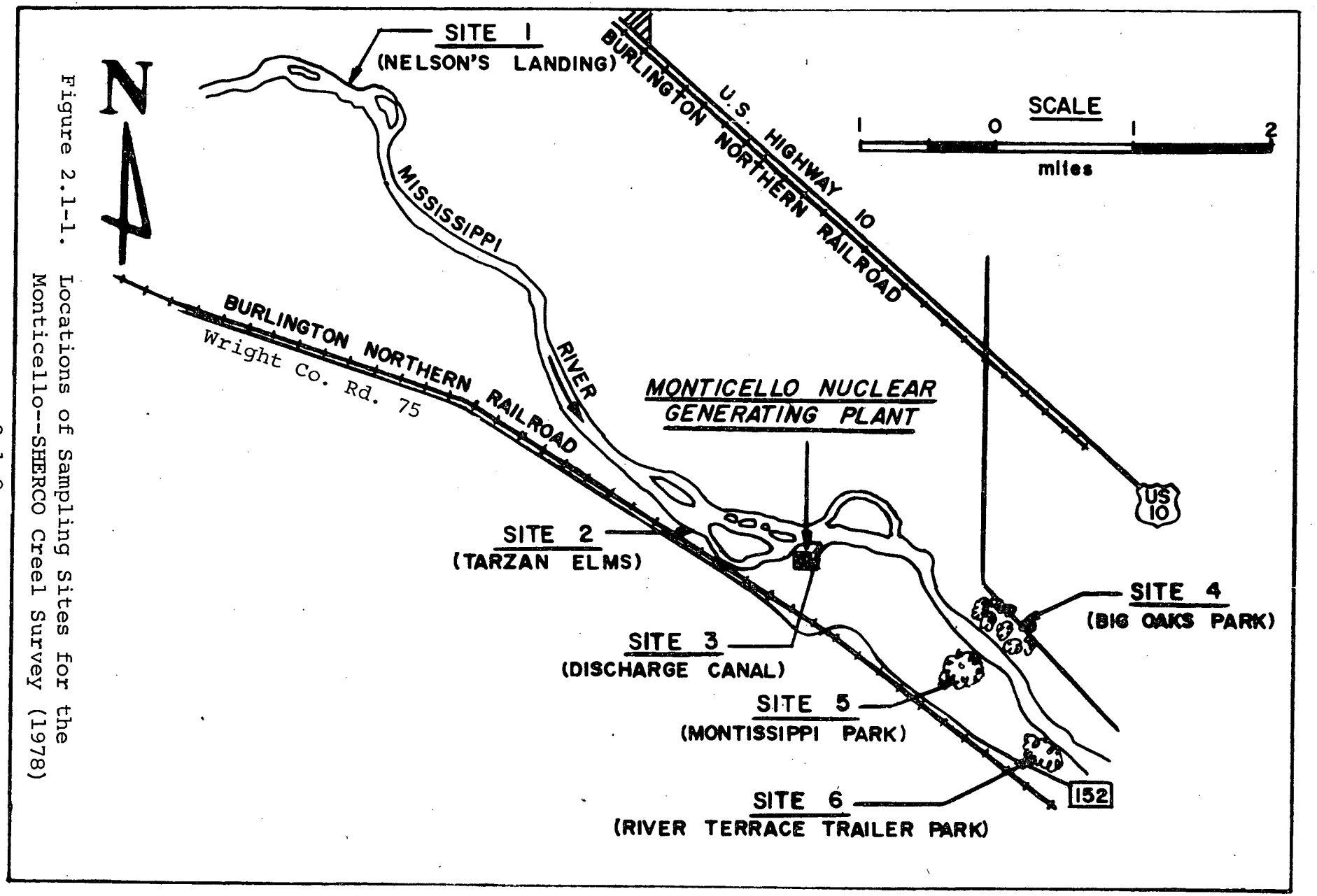

Figure 2.1-1. Locations of Sampling Sites for the Monticello--SHERCO Creel Survey (1978)

Table 2.1-1 MISCELLANEOUS STATISTICS

	Nelson's Landing Site 1	Tarzan Elms Site 2	Monticello Discharge Canal Site 3	Big Oaks Park Site 4	Montissippi Park Site 5	River Terrace Site 6	TOTAL
No. Fisherman Counted	33	67	47	142	216	92	597
No. Instantaneous Counts	150	150	150	150	150	150	900
Estimated Fisherman-Hours	479.16	972.84	682.44	2061.84	3136.32	1335.84	8668.44
Percent of Total - Fishing Pressure	5.5	11.2	7.9	23.8	36.2	15.4	

Table 2.1-2 Number of fish and real overall catch rates expressed as fish/hour for species caught.

Species	Site 1		Site 2		Site 3		Site 4		Site 5		Site 6		Total	
	Caught	Fish /mhr	Caught	Fish /mhr	Caught	Fish /mhr	Caught	Fish /mhr	Caught	Fish /mhr	Caught	Fish /mhr	Caught	Fish /mhr
Walleye	6	0.222	9	0.140	0	0.0	0	0.0	0	0.0	0	0.0	15	0.029
Smallmouth bass	73	2.704	13	0.202	22	0.512	30	0.345	30	0.153	8	0.087	176	0.345
Northern pike	0	0.0	1	0.016	0	0.0	0	0.0	1	0.005	2	0.022	4	0.008
White sucker	0	0.0	0	0.0	1	0.023	0	0.0	0	0.0	0	0.0	1	0.002
Crappie	0	0.0	15	0.233	11	0.256	1	0.011	62	0.316	39	0.426	128	0.251
Carp	0	0.0	0	0.0	0	0.0	0	0.0	1	0.005	0	0.0	1	0.002
Rock bass	0	0.0	4	0.062	2	0.047	3	0.034	1	0.005	0	0.0	10	0.020
Shortnose redhorse	0	0.0	0	0.0	0	0.0	6	0.069	10	0.051	0	0.0	16	0.031
Black bullhead	0	0.0	0	0.0	5	0.116	1	0.011	0	0.0	8	0.087	14	0.027
Silver redhorse	0	0.0	0	0.0	1	0.023	1	0.011	3	0.015	0	0.0	5	0.010
Total	79	2.926	42	0.651	42	0.977	42	0.483	108	0.550	57	0.623	370	0.726

Table 2.1-3 Number of fish caught and real sought catch rates for species sought expressed as fish/man-hour.

Species	Site 1		Site 2		Site 3		Site 4		Site 5		Site 6		Total	
	Caught	/hr	Caught	/hr	Caught	/hr	Caught	/hr	Caught	/hr	Caught	/hr	Caught	/hr
Walleye	6	0.261	9	0.202	0	0.0	0	0.0	0	0.0	0	0.0	15	0.179
Smallmouth bass	6	1.500	0	0.0	15	0.566	21	0.764	4	0.118	1	0.100	47	0.461
Northern pike	0	0.0	1	0.500	0	0.0	0	0.0	1	0.083	0	0.0	2	0.143
Crappie	0	0.0	0	0.0	0	0.0	0	0.0	51	0.729	17	0.436	68	0.624
Total	12	0.444	10	0.155	15	0.349	21	0.241	56	0.285	18	0.197	132	0.259

TABLE 2.1-4 MONTICELLO-SHERCO ANGLING PRESSURE AND CATCH/RATE (FISH/HOUR) FOR 1972 THROUGH 1978

SPECIES	1972	1973	1974	1975	1976	1977	1978
Walleye	0.005	0.031	0.083	0.010	0.010	0.029	0.029
Smallmouth Bass	0.081	0.078	0.050	0.185	0.078	1.233	0.345
Northern pike	0.006	0.150	0.023	0.008	0.006	0.005	0.008
White sucker	0.006	.0018	0.003	0	0	0.024	0.002
Black crappie	0.014	0.101	0.104	0.280	0.010	0.013	0.251
Carp	0.202	0.078	0.087	0.103	0.049	0.082	0.002
Rock bass	0.005	0	0.003	0.003	0	0	0.020
Black bullhead	0.062	0.053	0.200	0.026	0	0	0.027
Shorthead redhorse	0	0	0.003	0.021	0.003	0.010	0.031
Silver redhorse	0	0	0	0.008	0	0.002	0.010
TOTAL CATCH RATE	0.381	0.508	0.568	0.643	0.155	1.398	0.726
TOTAL FISHING PRESSURE	2570	2435	3700	4929	5772	11674	8668

Table 2.1-5 Estimated total harvest of fish expressed as kilograms and number of fish.

Species	Site 1		Site 2		Site 3		Site 4		Site 5		Site 6		Total	
	No of fish	Kg	No of fish	Kg	No of fish	Kg	No of fish	Kg	No of fish	Kg	No of fish	Kg	No of fish	Kg
Walleye	106	30.3	136	38.9	0	0.0	0	0.0	0	0.0	0	0.0	242	69.2
Smallmouth bass	1296	431.0	60	20.0	286	95.1	308	102.4	479	159.3	73	24.3	2502	832.1
Northern pike	0	0.0	15	18.0	0	0.0	0	0.0	16	19.2	29	34.8	60	72.0
Crappie	0	0.0	226	38.4	159	27.0	0	0.0	926	157.3	569	96.6	1880	319.3
Rock bass	0	0.0	60	10.5	0	0.0	71	12.4	16	2.8	0	0.0	147	25.7
Shorthead redhorse	0	0.0	0	0.0	0	0.0	142	91.4	48	30.9	0	0.0	190	122.3
Black bullhead	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	58	9.9	58	9.9
Silver redhorse	0	0.0	0	0.0	0	0.0	0	0.0	32	32.0	0	0.0	32	32.0
Total	1402	461.3	497	125.8	461	122.1	521	206.2	1517	401.5	729	165.6	5127	1482.5

MONTICELLO NUCLEAR GENERATING PLANT

ENVIRONMENTAL MONITORING PROGRAM

1978 ANNUAL REPORT

A SUMMARY OF THE 1978 MONTICELLO ELECTROFISHING SURVEY

(2.2)

Prepared for

Northern States Power Company
Minneapolis, Minnesota

by

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Environmental and Regulatory
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Northern States Power Company

2.2 A SUMMARY OF THE 1978 MONTICELLO ELECTROFISHING SURVEY

2.2.1 INTRODUCTION

Electrofishing studies were conducted in 1978 to assess the relative abundance and seasonal distribution of fishes in response to the Monticello Nuclear Generating Plant's thermal plume. The study areas (Figure 2.2-1) were sampled eight times between April 13 and October 26. Sector A encompasses an area of 21.6 ha and extends from the discharge canal outlet upstream 1.7 km to the top of Cedar Island. Sector B extends 1.5 km downstream from the discharge canal to the bottom of Boy Scout Rapids and includes an area of 27.1 ha.

In contrast to low river discharges in 1976 and 1977, 1978 had higher river levels throughout the electrofishing period.

Percentage composition, catch per unit effort, and condition factors, and length-weight relationships were determined for the predominant species in each sector. Comparisons with 1968-1977 data were also made.

2.2.2 MATERIALS AND METHODS

Equipment, sampling frequency, technique, and data computation were the same as in the 1976 and 1977 studies. Sampling was conducted with pulsed direct-current electrofishing equipment (Figure 2.2-2). A 16-foot, flat bottom boat was equipped with a railing, one anode, and ten cathodes. The power source was a 230-volt revolving field portable alternator. Current was maintained at five amperes at a rate of 60 pulses/second with a Smith-Root Model VI Electrofisher transforming unit.

Paired shocking runs were conducted along opposing shorelines as described in the 1975 report. Stunned fishes were captured with one-inch mesh landing nets equipped with eight-foot handles and placed in holding basins until completion of each sampling run. Elapsed shocking time was recorded for each run by a clock, which only tallied the seconds that the electrical field was energized.

Fishes were measured to the nearest millimeter and weighed to the nearest 10 grams. Scales were collected from key scale areas from specimens over the entire length range for future age and rate of growth analysis.

In an attempt to gain an understanding about fish movements, many specimens were marked with Floy #FD67C plastic anchor tags that were serially numbered. These tags were inserted into the fishes at the bases of their dorsal fins. All fishes, whether they were tagged or not, were allowed to recover before being released near the midpoint of each electro-fishing run.

Species catch per unit effort (cpe) was computed for both sectors on each sample date. Cpe's were determined for number (fish/hr.) and weight (kg/hr.) by dividing the total number and weight of fishes collected per area by the elapsed shocking time for that area.

Fishes were grouped into twenty-millimeter intervals, and mean total lengths and weights were computed for each group. Using these averages, condition factors were computed for the most abundant species with the formula:

$$K = \frac{W \times 10^5}{L^3} \quad ,$$

where K is the condition factor, W is weight in grams, and L is total length in millimeters.

Mean total lengths and weights for these twenty-millimeter interval groups were also used to compute length-weight relationships for the five dominant species. Data from both sectors were combined in this analysis. As with condition factors, all data were grouped and not segregated by sex. Metric measurements were transformed into logarithms, and simple linear regressions were computed. Length-weight formulas used to describe the data are presented in the following form:

$$\log W = \log a + b \log L,$$

where W is the weight in grams, L is the total length in millimeters, a is the W axis intercept, and b is the slope of the length-weight regression line.

2.2.3 RESULTS

A total of 3,577 fishes was collected in the 1978 survey, 1,474 from Sector A and 2,103 from Sector B. Most of the 17 species that comprised this catch have been common components of previous electrofishing surveys (Table 2.2-1).

Percentage contribution to the total catch by number was computed for each species from 1968 through 1978 (Table 2.2-2). Monthly catch per unit effort statistics were also computed by number (fish/hr.) and weight (kg/hr.) for each species (Tables 2.2-3 and 2.2-4). Seasonal abundance patterns for the prominent species and game fishes are presented in Figures 2.3-3 through 2.3-9. Comparisons of annual cpe are presented as fish/hr. and kg/hr. in Tables 2.2-5 and 2.2-6.

Condition factors were determined at twenty-millimeter intervals for the five predominant species (Table 2.2-7).

Length-weight relationships were also computed for these species and are presented in Table 2.2-8.

Numbered tags were installed on 197 fishes in Sector A and 102 in Sector B (Table 2.2-9). Two of these tagged fishes were recovered in 1978 with electrofishing equipment.

2.2.4 DISCUSSION

In contrast to the 1975-1977 drought (Table 2.2-10), drainage systems in 1978 were sufficiently charged to maintain high river discharges throughout the year. Some scouring occurred during the spring ice-out and runoff period. As a result, much of the rooted aquatic vegetation that had become established was dislodged. Consistent water levels in 1978 and increased turbidity prohibited reestablishment of these plants. Holding cover for fishes, previously created by aquatic vegetation, shifted to riparian areas which contained inundated sandbar willows (Salix interior). These willows provided suitable habitat for many species of small and juvenile fishes, and created favorable foraging, resting, and spawning areas for carp.

Large numbers of 1976 year-class smallmouth bass, silver redhorse, shorthead redhorse, and white sucker were present in 1978. The composite of this year-class for these four species constituted 58.9 percent of the total electrofishing catch by number.

This was the first year that brown bullhead was documented during the electrofishing surveys at Monticello. Black crappie was more abundant in 1978 than in 1976 and 1977.

Carp

Carp constituted 15.4 percent of the total catch by number in Sector A and 11.3 percent in Sector B. Mean annual

abundance for carp was 51.6 fish/hr. in Sector A and 67.7 fish/hr. in Sector B (Table 2.3-5). These averages are slightly lower than those of 1976 and 1977. Inundated shoreline willows, which often hindered capture, may have contributed to this decreased index. Sector comparisons of seasonal abundance (Figure 2.2-3) suggest, as in 1977, a preference for the heated water in April and no distinct response thereafter. June and July had slight increases in cpe due to spawning and inshore foraging activities of these fish.

Condition factors for Sectors A and B fish were very similar at 1.35 and 1.33, respectively. The 1976 and 1977 data compare well with these indices. The continuity of these mean condition factors indicates that carp were in the same physical condition during these three years.

The length-weight relationship for carp was:

$$\log W = -4.881 + 3.002 \log L.$$

This formula compares well with other North American studies cited in Carlander (1969), where similar regressions ranged from:

$$\log W = -3.982 + 2.664 \log L \text{ to}$$
$$\log W = -6.226 + 3.477 \log L.$$

Shorthead redhorse

Shorthead redhorse composed 32.2 percent of the catch by number in Sector A and 30.3 percent in Sector B. The mean annual abundance for shorthead redhorse was 108.1 fish/hr. for Sector A and 181.7 fish/hr. for Sector B (Table 2.2-5). The strong 1976 year class, which contributed to the high cpe's in 1977, was a major contributor to the 1978 catch.

Fish from 1976 year class (200-330 mm length) composed 48.9 percent of the total shorthead redhorse catch by number. Comparison of sector seasonal abundance (Figure 2.2-4) illustrates a preference for heated water in April, May, and August. Juvenile fish from the 1976 year class were attracted more to the thermal discharge than were adult fish.

Average condition factors for shorthead redhorse were 1.00 for Sector A and 0.99 for Sector B. These means are lower than in previous studies. Increased abundance and reduced food-producing areas (because of high water) resulted in increased competition for food and may have accounted for a reduction in the mean condition of fish.

The following length-weight relationship was developed for shorthead redhorse:

$$\log W = -5.133 + 3.052 \log L.$$

This regression is slightly higher than those cited in Carlander (1969), which range from:

$$\log W = -3.20 + 2.83 \log L \text{ to}$$
$$\log W = -4.042 + 3.021 \log L.$$

Silver redhorse

Silver redhorse constituted 26.4 percent of the catch by number in Sector A and 31.3 percent in Sector B.

Their abundance significantly increased over previous years (Table 2.2-5). Fish were collected at the rate of 88.5 fish/hr. in Sector A and 187.6 fish/hr. in Sector B. Figure 2.2-5 reveals that catch rates in Sector B were substantially higher than those in Sector A throughout the entire

sampling season. The large increase in cpe during 1978 was attributed to the 1976 year class (170-270 mm length), which comprised 83.2 percent of the silver redhorse catch by number. Abundance pulses were observed in May and August, when juvenile silver redhorse were inhabiting shallow riffle areas.

Condition factors for Sector A and Sector B fish compared well. The mean condition factor for Sector A fish was 1.10 and 1.09 for Sector B. These means were lower than those computed in previous years, and indicate that the 1978 fish were slightly lighter for a given length than fish from earlier studies. As with the shorthead redhorse, intraspecific and interspecific competition for food and space may have contributed to this effect.

Silver redhorse had a length-weight relationship of:

$$\log W + -5.215 + 3.099 \log L.$$

This regression closely approximates the formula reported in Carlander (1969), which was:

$$\log W = -4.263 + 3.124 \log L.$$

White sucker

White sucker comprised 5.0 percent of the catch by number in Sector A and 3.8 percent in Sector B (Table 2.2-2).

Catch per unit effort statistics (Table 2.2-5) indicate a trend of increased abundance since 1976. White sucker were collected at the rate of 16.6 fish/hr. in Sector A and 23.0 fish per hour in Sector B. These figures suggest a slight preference for the heated water zone. In earlier studies white sucker were generally more abundant in Sector A.

Elevated cpe's during 1978 are again attributed to a strong 1976 year class (200-300 mm length). This year class comprised 67.7 percent of the total white sucker catch. Figure 2.2-6 indicates that white sucker abundance was consistent throughout the sampling period.

The mean condition factor for Sector A and Sector B was 1.14 and 1.08, respectively. The mean condition factor for white sucker has declined since 1976, indicating less favorable growing conditions in 1977 and 1978. As with other catostomid members, white sucker appears to have had excellent reproductive success in 1976 and subsequent high survival rates, which have imposed slight limitations on the population through competition for food and habitat.

White sucker had a length-weight relationship of:

$$\log W = -4.998 + 3.016 \log L.$$

This regression compares well with the range reported in Carlander (1969) of:

$$\log W = -2.822 + 2.2303 \log L \text{ to}$$
$$\log W = -5.395 + 3.223 \log L.$$

Smallmouth bass

The 1976 year class (190-290 mm length) was a major contributor to the 1978 catch, comprising 96.0 percent of the total smallmouth catch by number. Smallmouth bass comprised 15.4 percent of the total catch in Sector A and 16.5 percent in Sector B. These indices are lower than the 1977 data (Table 2.2-5). Large additions from the catostomid members are responsible for alterations in the 1978 species dominance ranking. Smallmouth bass mean abundance, expressed as fish/hr., was similar to that of 1977 (Table 2.2-5). Catch

rates for Sectors A and Sector B were 51.7 fish/hr. and 99.0 fish/hr., respectively.

Seasonal abundance, illustrated in Figure 2.2-7, reveals a preference for the warm water of Sector B in April, May, and October. During the remainder of the study period, a similar abundance was observed in both sectors. The mean condition factor for smallmouth bass was 1.31 (Table 2.2-7) in both sectors. Average condition of these fish was less than that of previous years. Leaner fish in 1978 suggest a stressful condition, probably resulting from increased abundance of this species and interspecific competition.

The length-weight relationship for smallmouth bass was:

$$\log W = -5.616 + 3.301 \log L.$$

This formula compares well with the range of regressions reported in Carlander (1977):

$$\log W = -4.177 + 2.701 \log L \text{ to}$$
$$\log W = -5.841 + 3.372 \log L.$$

Walleye

As in most years, walleye comprised a very small portion of the 1978 catch. Their percentage contribution by number was 0.5 percent in Sector A and 0.6 percent in Sector B.

Catch per unit effort for walleye was 1.7 fish/hr. in Sector A and 3.3 fish/hr. in Sector B (Table 2.2-5). This species preference for deeper water, which is not efficiently electrofished, contributes to the paucity of walleye in this and previous studies. Figure 2.2-8 indicates no abundance pulses for this species. Walleye were generally

more common in Sector B and infrequently collected in Sector A. Insufficient numbers of walleye were collected in 1978 to warrant computation of condition factors or length-weight regressions.

Miscellaneous Species

Miscellaneous species comprised 5.1 percent of the total catch in Sector A and 4.2 percent in Sector B (Table 2.2-2). Their mean annual catch rate was 17.2 fish/hr. in Sector A and 37.3 fish/hr. in Sector B. These cpe statistics are substantially higher than in 1976 and 1977 (Table 2.2-5). The prominence of black crappie (45.8 percent of the miscellaneous catch) was the major contributor to this elevated cpe statistic. Black crappie abundance in 1978 is believed to arise from substantial lake discharges into the river. During 1976 and 1977, drought conditions prohibited lakes from "flushing", and accordingly no white crappie and few black crappie were expelled into the river. Seasonal abundance of black crappie, exhibited in Figure 2.2-9, illustrates that this species became abundant in May and was common through September.

The miscellaneous catch in Sector A was composed of one yellow bullhead, 5 northern pike, 4 greater redhorse, 5 black bullhead, 48 black crappie, 3 northern hogsucker, 6 white crappie, and 3 rock bass. The catch in Sector B was composed of 4 northern pike, 13 greater redhorse, 50 black bullhead, 50 black crappie, 4 northern hogsucker, 12 bluegill, 5 white crappie, 2 rock bass, 4 yellow bullhead, one yellow perch, and one brown bullhead. Warm water of Sector B attracts the uncommon species, especially centrachids and ictalurids.

Tagging Study

One thousand sixty-nine fishes were tagged during the 1977 and 1978 study at Monticello (Table 2.2-8). Of these, six were recaptured in 1978. These recaptures included two shorthead redhorse, two silver redhorse, and two carp. Also, one shorthead redhorse and two silver redhorse, which were tagged during the 1978 electrofishing study at the SHERCO Plant approximately four miles upstream, were recaptured. Excluding SHERCO tagged fishes, the recaptures at Monticello, as in 1977, demonstrated a sedentary nature. All fishes were collected in approximately the same area that they were released.

2.2.5 SUMMARY

1. The 1978 electrofishing study was conducted with a pulsed DC unit at four-week intervals from April through October.

2. A total of 3,577 fishes were collected from 17 species.

3. Sector A had the following dominance ranking: shorthead redhorse, silver redhorse, smallmouth bass, carp, and white sucker. In Sector B the dominance ranking was: silver redhorse, shorthead redhorse, smallmouth bass, carp, and white sucker.

4. Catch per unit effort was higher than 1976 and 1977 due to strong 1976 year classes of shorthead redhorse, silver redhorse, white sucker, and smallmouth bass, which became recruitable in 1977 and were collectable throughout the entire 1978 season. Additional growth of these fishes made them more vulnerable to capture in 1978.

5. Catch rates (cpe) were generally higher for the dominant species in Sector B. This condition also occurred in

1976 and 1977, suggesting a preference for warmer water by most species. This would be expected, because throughout most of the year, ambient temperatures are below the optimum or desired temperature range of most area species.

6. Condition factors were computed for the five dominant species. These indices indicate that:

    1) In general, 1978 fishes in both sectors have the same weight for a given length.

    2) Shorthead redhorse, silver redhorse, white sucker, and smallmouth bass had reduced physical conditions over earlier studies. It is theorized that intraspecific and interspecific competition, generated by large numbers of 1976 year class fishes, is creating an adverse effect on individual growth.

7. Length-weight relationships computed for the five dominant species compared well with regressions reported by Carlander (1969 and 1977).

8. One thousand sixty-nine fishes were marked with Floy #FD67C plastic anchor tags during 1977 and 1978 to study their movements. Six were recaptured in 1978 in approximately the same area in which they were released.

Note: See Table 2.2-11 for a list of common and scientific names of fishes collected in 1976-1978.

2.2.6 LITERATURE CITED

Carlander, K.D. 1969. Handbook of Freshwater Fishery Biology, Volume I, 752 pp. The Iowa State University Press, Ames, Iowa.

Carlander, K.D. 1977. Handbook of Freshwater Fishery Biology, Volume II, 431 pp. The Iowa State University Press, Ames, Iowa.

Figure 2.2-1. 1978 Monticello Electrofishing Areas.

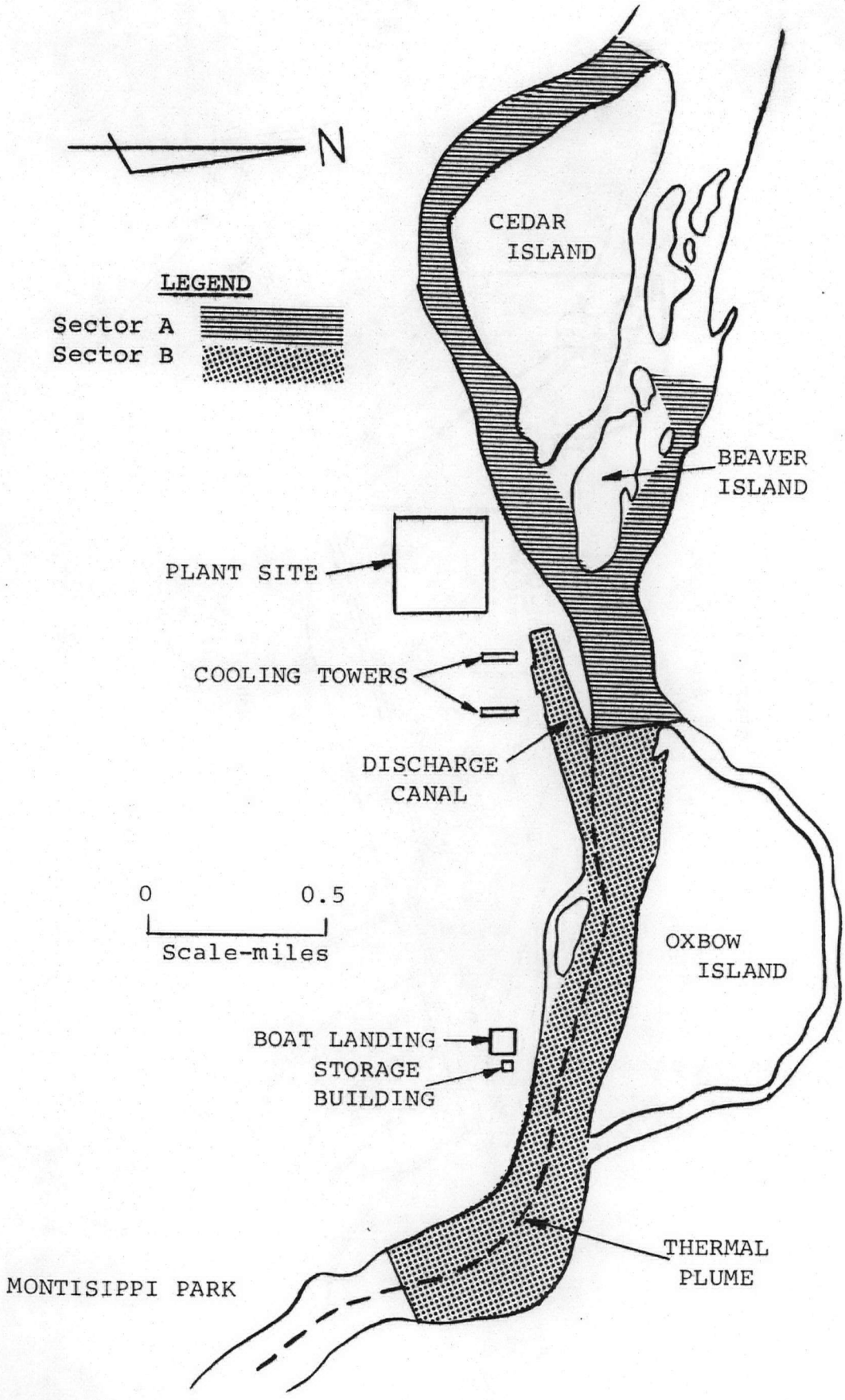

Figure 2.2-2

ELECTROFISHING BOAT (16 FT.)

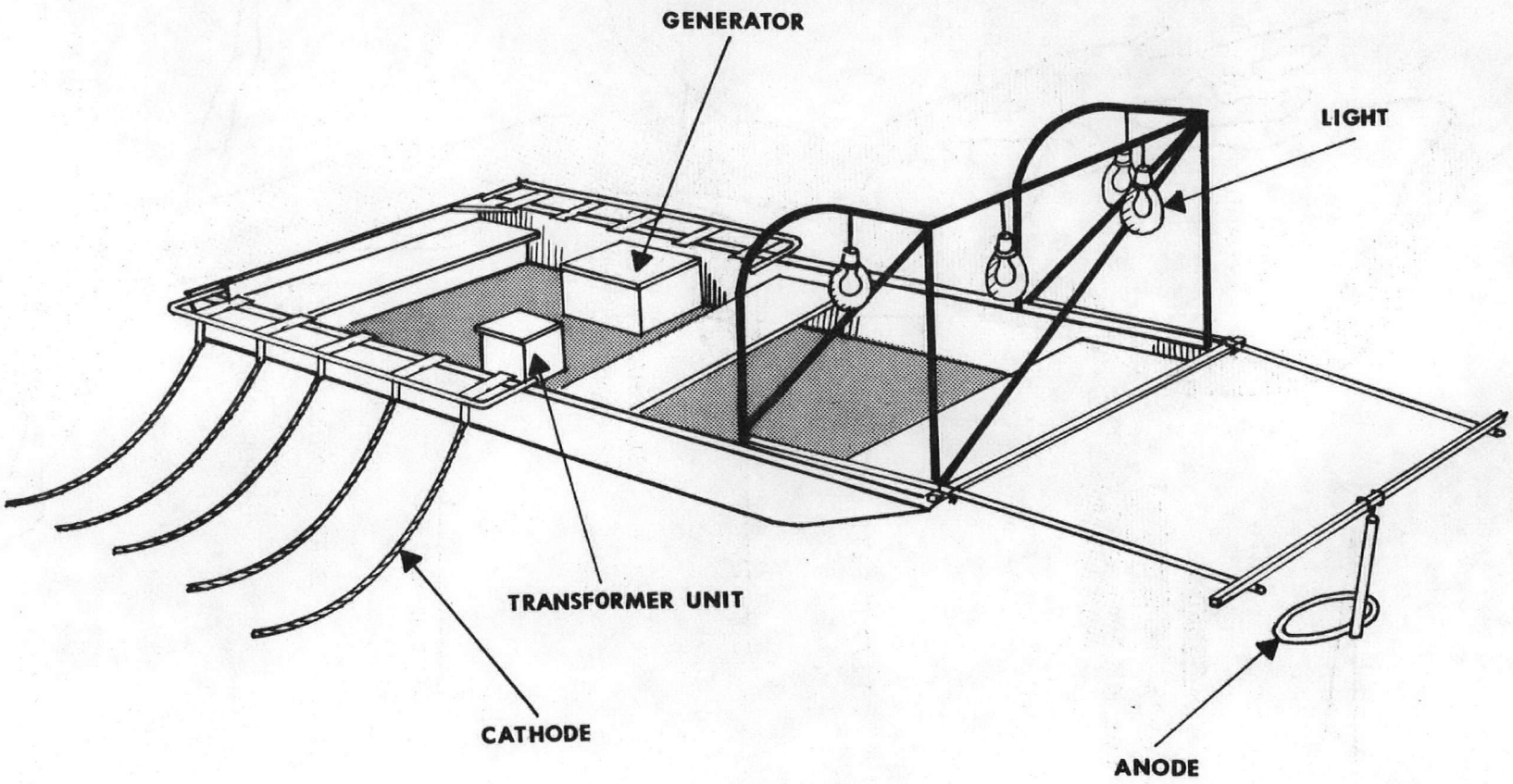

Figure 2.2-3. 1978 Monticello Electrofishing Carp Catch per Unit Effort.

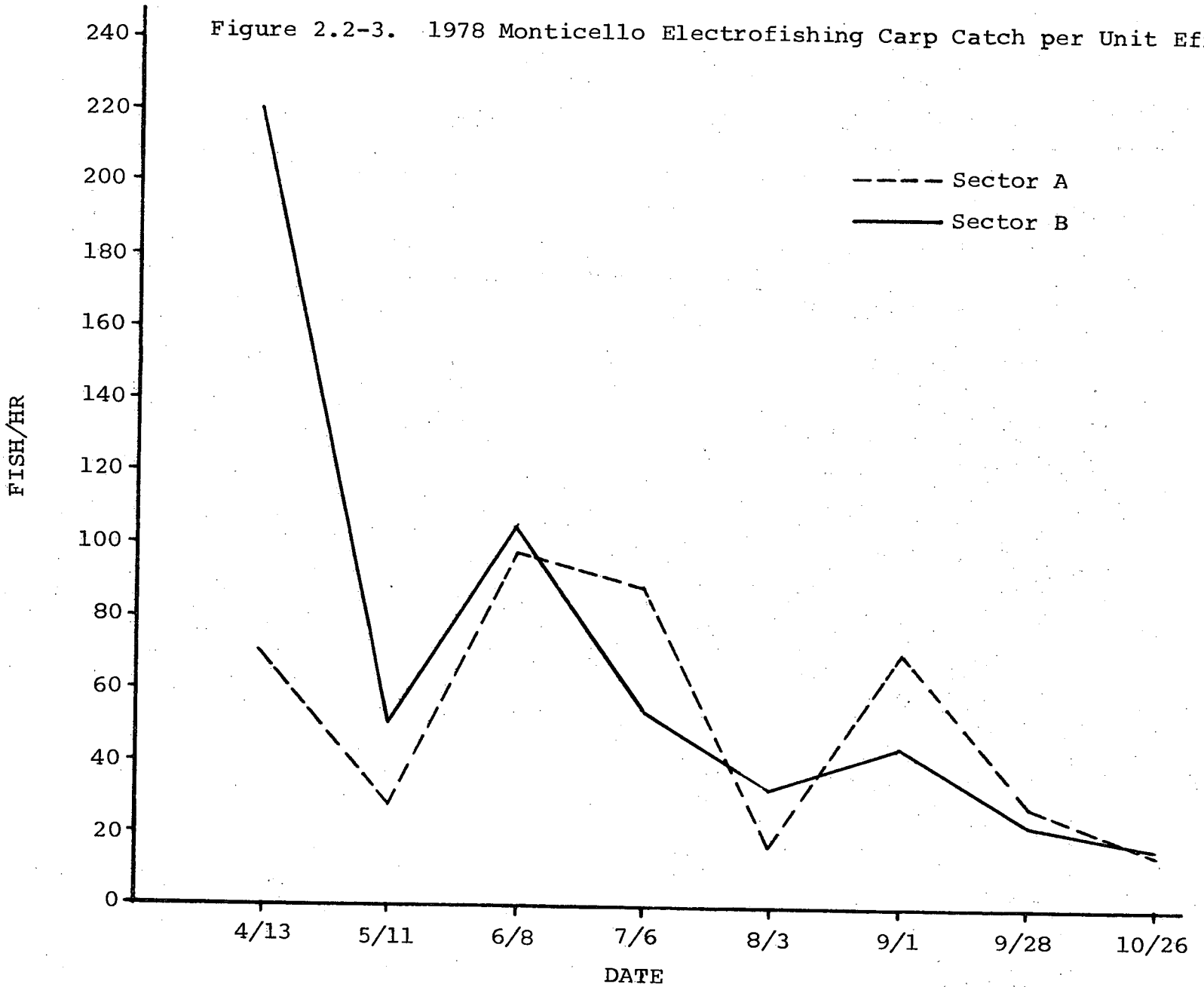

Figure 2.2-4. 1978 Monticello Electrofishing Shorthead Redhorse Catch per Unit Effort.

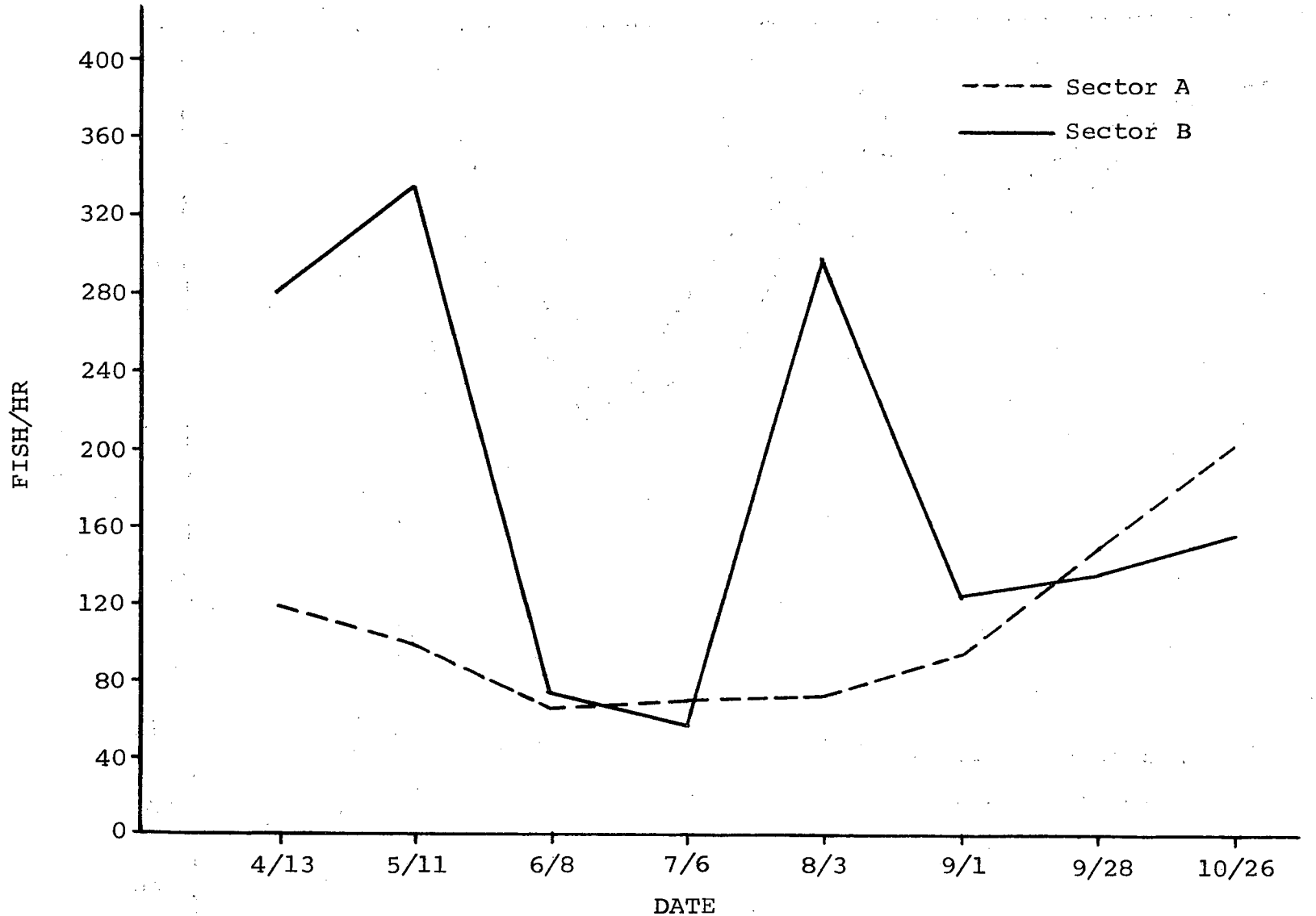

Figure 2.2-5. 1978 Monticello Electrofishing Silver Redhorse Catch per Unit Effort.

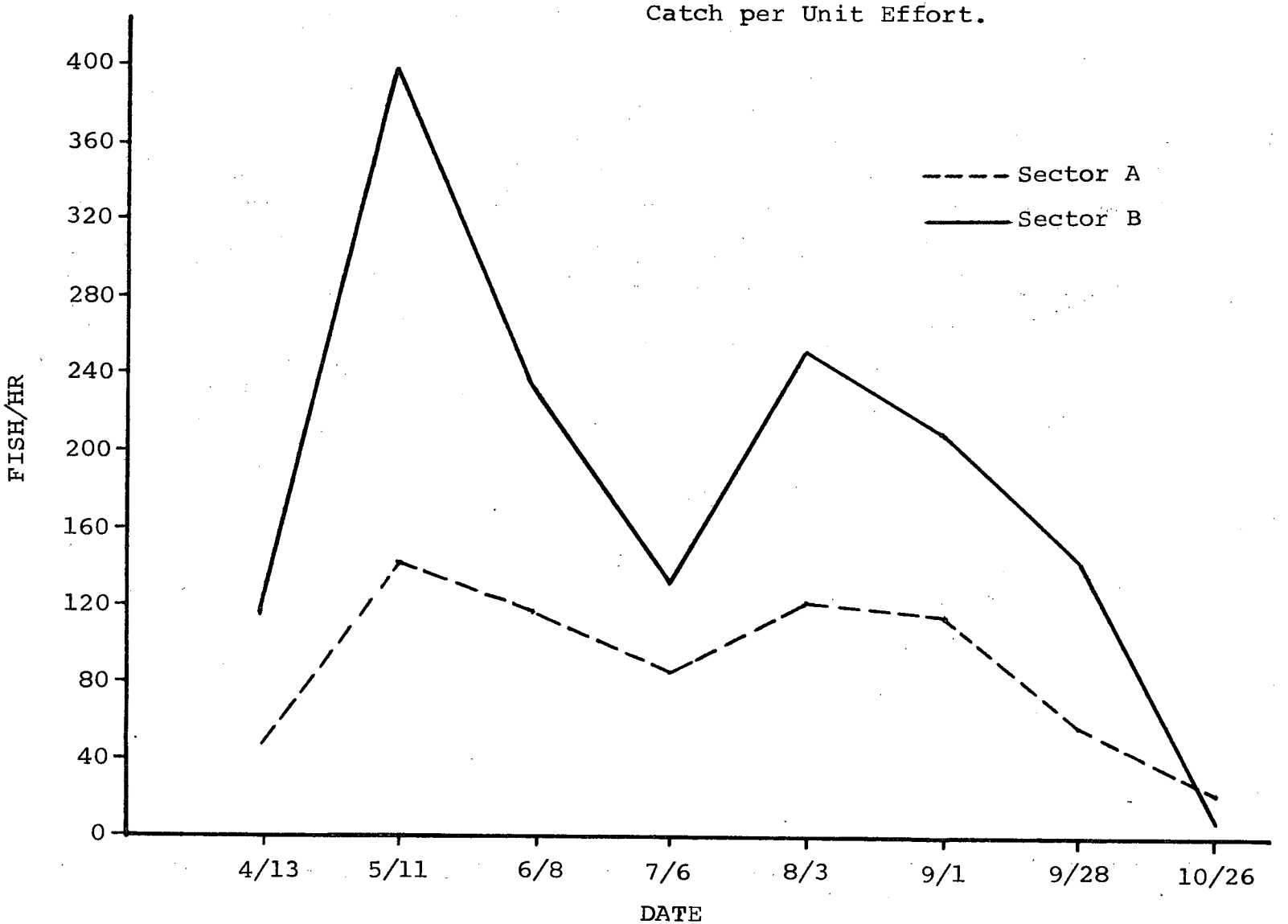

Figure 2.2-6. 1978 Monticello Electrofishing White Sucker Catch per Unit Effort.

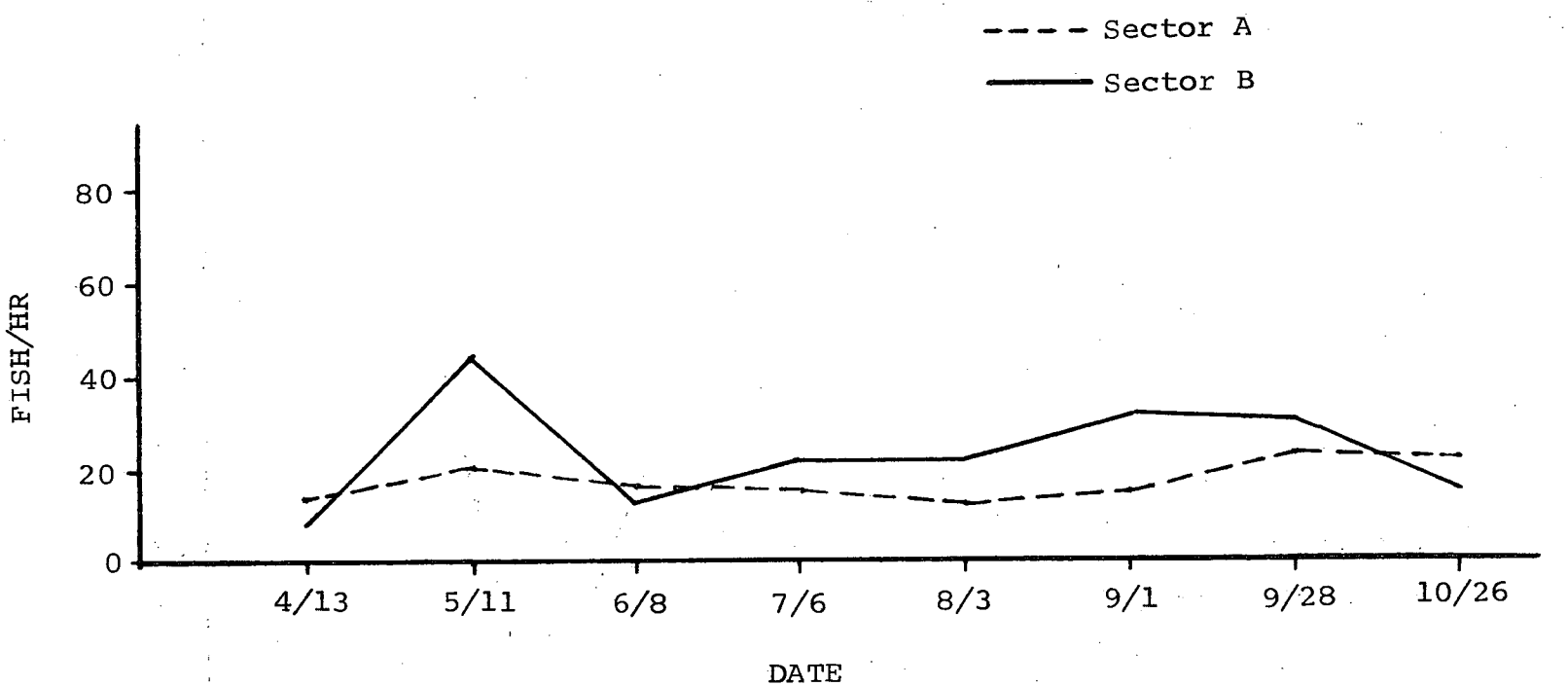

Figure 2.2-7. 1978 Monticello Electrofishing Smallmouth Bass Catch per Unit Effort.

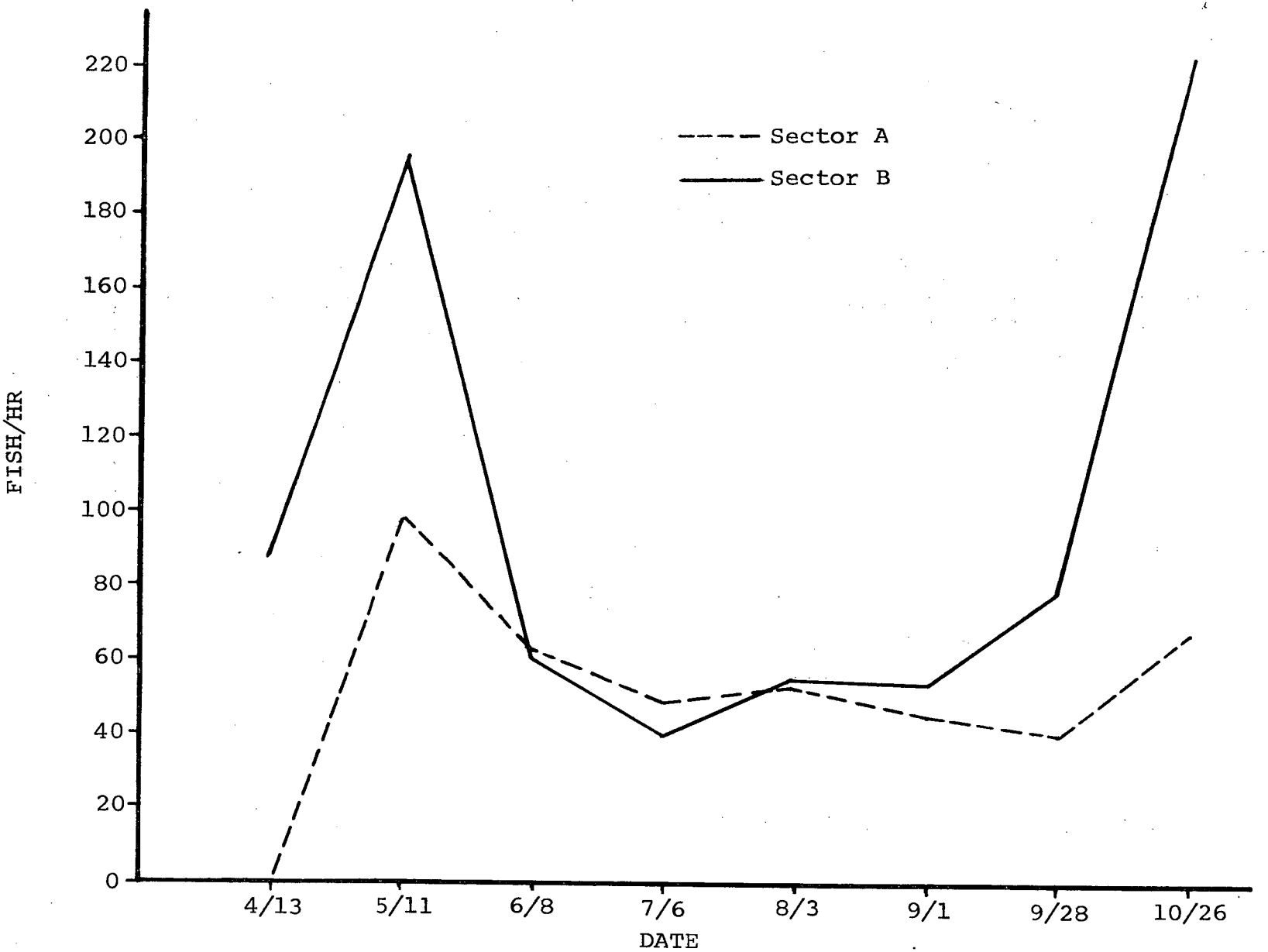

Figure 2.2-8. 1978 Monticello Electrofishing Walleye Catch per Unit Effort.

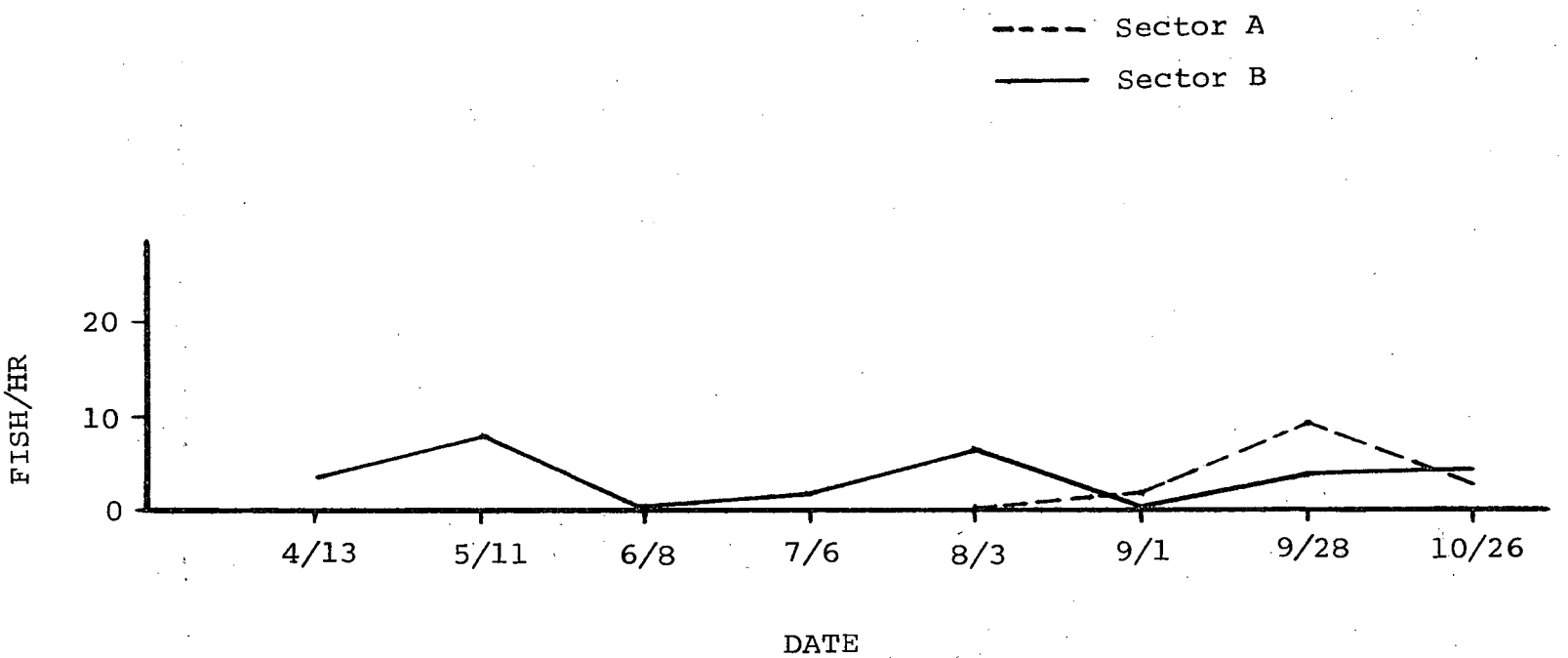

Figure 2.2-9. 1978 Monticello Electrofishing Black Crappie Catch per Unit Effort.

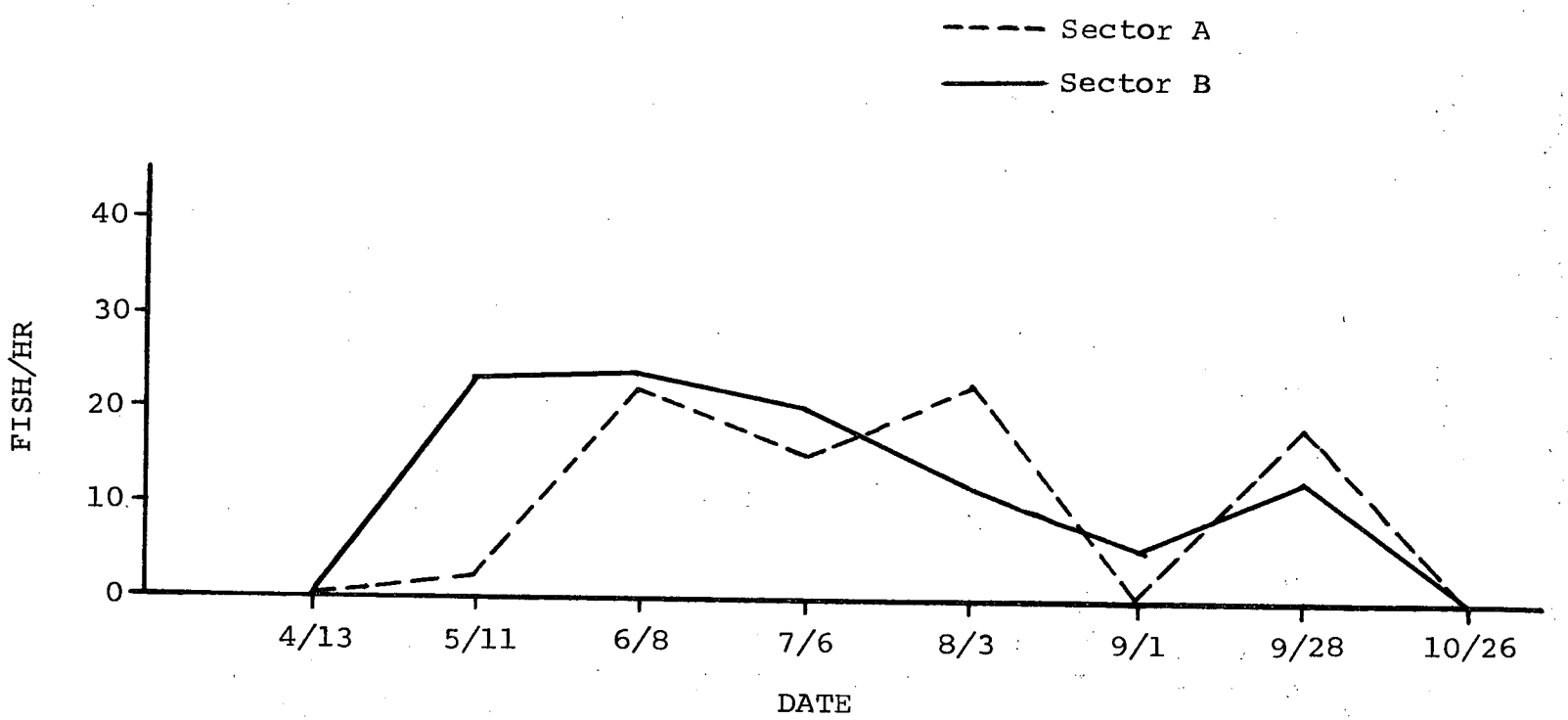

Table 2.2-1 Monticello Electrofishing Species List

Species	1976	1977	1978
Northern Pike	X	X	X
Muskellunge	X		
Shorthead redhorse	X	X	X
Silver redhorse	X	X	X
Greater redhorse			X
White sucker	X	X	X
Bigmouth buffalofish	X		
Northern hogsucker	X	X	X
Carp	X	X	X
Black bullhead	X	X	X
Yellow bullhead	X	X	X
Brown bullhead			X
Smallmouth bass	X	X	X
Largemouth bass		X	
Rock bass	X	X	X
Bluegill		X	X
Black crappie	X	X	X
White crappie			X
Walleye	X	X	X
Yellow perch			X

Table 2.2-2 1977 Monticello electrofishing percent of total catch by number

	Carp	Shorthead redhorse	Silver redhorse	White sucker	Smallmouth bass	Walleye	Misc
Sector A							
1968	50.7	34.5	4.4	2.7	1.5	4.8	1.4
1969	29.4	48.6	7.4	4.5	1.8	2.0	6.3
1971	25.3	36.9	9.1	13.1	7.6	7.1	0.9
1972	45.1	26.1	9.1	4.1	7.0	1.1	7.5
1973	39.9	34.8	13.0	4.9	2.0	0.7	4.7
1974	44.3	20.3	16.7	9.2	1.5	0.1	7.9
1975	53.5	27.0	9.3	3.7	0.9	0.5	5.1
1976	41.0	36.4	12.3	3.5	3.4	1.4	2.0
1977	19.6	40.3	12.7	3.4	20.4	0.8	2.8
1978	15.4	32.2	26.4	5.0	15.4	0.5	5.1
Sector B							
1968	34.3	58.9	2.9	3.0	0.4	0.3	0.3
1969	17.3	65.1	9.6	4.8	2.0	1.2	0.4
1971	27.2	35.9	7.8	6.3	12.6	6.8	3.4
1972	38.4	33.4	8.2	3.3	5.9	2.0	8.8
1973	31.2	41.3	11.5	4.0	2.9	1.2	7.9
1974	47.9	22.6	15.2	6.4	0.9	0.6	6.4
1975	40.8	37.6	10.8	1.9	3.8	1.3	3.8
1976	32.4	40.1	12.6	1.6	9.3	1.5	2.5
1977	21.2	33.1	15.3	2.1	22.8	1.0	4.6
1978	11.3	30.3	31.3	3.8	16.5	0.6	6.2

Table 2.2-3 1978 Monticello electrofishing catch per unit effort by number (fish/hr)

	Carp	Shorthead redhorse	Silver redhorse	White sucker	Smallmouth bass	Walleye	Black Crappie	Misc	Total
Sector A									
4/13	70.8	119.1	47.6	13.6	0	0	0	0	251.1
5/11	27.7	99.5	141.9	20.3	97.7	0	1.8	16.4	405.3
6/8	97.0	64.7	117.6	16.2	63.2	0	22.1	19.2	400.0
7/6	86.0	69.5	84.2	14.6	47.6	0	14.6	7.2	323.7
8/3	17.6	70.4	121.4	10.6	52.8	0	22.9	5.3	301.0
9/1	70.4	93.9	115.4	13.7	45.0	2.0	0	2.0	342.4
9/28	27.9	147.6	57.4	23.0	39.4	8.2	18.0	8.1	329.6
10/26	15.7	200.1	22.6	20.9	67.9	3.5	0	0	330.7
Mean	51.6	108.1	88.5	16.6	51.7	1.7	9.9	7.3	335.5
Sector B									
4/13	220.0	280.0	116.0	8.0	88.0	4.0	0	8.0	724.0
5/11	50.3	336.2	398.9	43.5	194.4	6.9	22.9	105.2	1158.3
6/8	104.0	71.9	234.1	12.2	59.7	0	23.0	27.6	532.5
7/6	54.4	57.8	133.6	21.4	39.6	1.6	19.8	8.1	336.3
8/3	33.1	295.0	252.8	21.1	54.2	6.0	12.0	9.0	683.2
9/1	42.7	122.3	210.8	31.2	54.7	0	5.2	7.8	474.7
9/28	20.9	134.9	142.5	30.4	79.8	3.8	13.3	28.5	454.1
10/26	16.4	155.8	12.3	16.4	221.4	4.1	0	8.1	434.5
Mean	67.7	181.7	187.6	23.0	99.0	3.3	12.0	25.3	599.7

Table 2.2-4 1978 Monticello electrofishing catch per unit effort by weight (kg/hr)

	Carp	Shorthead redhorse	Silver redhorse	White sucker	Smallmouth bass	Walleye	Black Crappie	Misc	Total
Sector A									
4/13	106.6	124.6	86.8	11.3	0	0	0	0	329.1
5/11	24.9	28.5	53.6	4.6	16.7	0	0.4	6.1	134.8
6/8	142.6	33.5	37.3	5.7	9.6	0	2.8	9.3	240.8
7/6	121.9	32.5	24.1	4.4	6.7	0	1.9	1.5	193.0
8/3	35.0	45.1	27.1	4.8	10.0	0	2.3	1.1	125.4
9/1	102.5	67.6	91.5	8.2	9.3	0.3	0	1.0	280.4
9/28	41.1	104.0	32.7	0.7	6.0	1.6	2.4	2.8	191.3
10/26	23.8	125.9	24.8	8.5	15.0	0.8	0	0	198.8
Mean	74.8	70.2	47.2	6.0	9.2	0.3	1.2	2.7	211.6
Sector B									
4/13	309.0	220.0	158.3	7.2	16.9	12.3	0	2.3	726.0
5/11	57.1	83.6	88.2	9.5	41.2	1.8	3.1	15.2	299.7
6/8	120.8	33.9	56.1	2.6	10.4	0	2.7	4.8	231.3
7/6	67.2	28.4	25.2	4.8	5.6	0.3	2.2	2.4	136.1
8/3	41.0	197.7	50.6	5.0	7.3	1.3	1.3	2.4	306.6
9/1	50.8	58.0	66.3	9.1	6.8	0	0.5	2.0	193.5
9/28	27.5	104.7	28.4	10.9	13.6	1.0	1.4	4.0	191.5
10/26	14.7	122.9	9.8	7.1	37.4	4.1	0	3.3	199.3
Mean	86.0	106.2	60.4	7.0	17.4	2.6	1.4	4.6	285.5

Table 2.2-5 1976-1978 Monticello electrofishing catch per unit effort by number (fish/hr)

	Carp	Shorthead redhorse	Silver redhorse	White sucker	Smallmouth bass	Walleye	Misc	Total
Sector A								
1976	67.4	59.9	20.3	5.8	5.7	2.3	3.2	164.6
1977	61.3	126.1	39.7	10.5	63.7	2.4	8.9	312.6
1978	51.6	108.1	88.5	16.6	51.7	1.7	17.2	335.5
Sector B								
1976	77.0	95.2	29.9	3.8	22.2	3.5	6.0	231.6
1977	79.3	123.8	57.2	7.8	85.2	3.8	17.3	374.4
1978	67.7	181.7	187.6	23.0	99.0	3.3	37.3	599.7
* 3 yr. $\bar{X}$	67.4	115.8	70.5	11.2	54.6	2.8	15.0	336.4

*For both sectors combined.

Table 2.2-6 Monticello electrofishing 1976, 1977, and 1978 catch per unit effort by weight (Kg/hr).

	Carp	Shorthead redhorse	Silver redhorse	White sucker	Smallmouth bass	Walleye	Misc	Total
Sector A								
1976	97.5	46.1	23.3	4.2	1.6	0.6	1.7	185.0
1977	103.6	109.4	64.4	5.7	13.0	1.1	4.6	301.8
1978	74.8	70.2	47.2	6.0	9.2	0.3	3.9	211.6
Sector B								
1976	75.2	89.0	34.4	2.9	4.5	1.4	1.4	209.3
1977	99.7	85.7	61.9	11.7	15.6	2.1	2.5	279.2
1978	86.0	106.2	60.4	7.0	17.4	2.6	6.0	285.5
*3 yr. $\bar{X}$	89.5	84.4	48.6	6.2	10.2	1.4	3.4	245.4

*For both sectors combined.

Table 2.2-7 1978 Monticello condition factors for Sectors A & B

Length mm	Carp		Shorthead redhorse		Silver redhorse		White sucker		Smallmouth bass	
	A	B	A	B	A	B	A	B	A	B
100										
120										
140										
160			0.94	0.90	0.94			1.11	1.08	1.34
180			0.84		1.13	1.19	1.05	0.93	1.31	1.26
200		1.25	1.05	1.00	1.06	1.11	1.33	1.00	1.26	1.17
220			1.02	1.05	1.00	1.04	1.11	1.26	1.21	1.16
240		1.48	1.09	0.97	1.05	1.00	1.13	1.01	1.26	1.18
260		1.53	1.04	1.03	1.03	1.01	1.16	1.07	1.26	1.21
280	1.52	1.52	0.99	1.00	1.03	1.00	1.15	1.11	1.32	1.28
300	1.50	1.36	0.97	0.96	1.05	0.90	1.10	1.11	1.32	1.22
320	1.33	1.53	1.00	0.97			1.12	1.11	1.15	1.22
340	1.39	1.57	1.09	0.95				1.07	1.46	1.26
360	1.44	1.27	0.97	1.01		1.16	1.16		1.44	1.59
380	1.39	1.28	1.02	0.97	1.16	1.08	1.06	1.28		1.55
400	1.31	1.23	1.05	1.03		1.07	1.15		1.59	
420	1.36	1.29	1.03	1.02	1.15	1.13	1.04	1.08		1.65
440	1.31	1.31	0.99	0.99	1.14	1.11	1.03	1.03		
460	1.29	1.27	1.00	0.98	1.20	1.08	1.13	1.03		
480	1.28	1.27	0.97	0.97	1.13	1.09	1.32	0.94		
500	1.31	1.25	0.97	1.03	1.12	1.11				
520	1.30	1.23	1.00	1.01	1.07	1.11				
540	1.31	1.29			1.12	1.13				
560	1.37	1.21			1.15	1.13				
580	1.18	1.13			1.25	1.18				
600	1.32									
620		1.34								
640										
Average	1.35	1.33	1.00	0.99	1.10	1.09	1.14	1.08	1.31	1.31

Table 2.2-8 1978 Monticello electrofishing length-weight relationships

	Formula	Length range (mm)
Carp	$\log W = -4.881 + 3.002 \log L$	282 - 717
Shorthead redhorse	$\log W = -5.133 + 3.052 \log L$	162 - 515
Silver redhorse	$\log W = -5.215 + 3.099 \log L$	162 - 575
White sucker	$\log W = -4.998 + 3.016 \log L$	181 - 475
Smallmouth bass	$\log W = -5.616 + 3.301 \log L$	162 - 400

W = weight in grams

L = total length in millimeters

Table 2.2-9 1977 & 1978 Monticello electrofishing number of fishes marked with plastic anchor tag

	Carp	Shorthead redhorse	Silver redhorse	White sucker	Smallmouth bass	Walleye	Northern pike	Black crappie	Rock bass	Black bullhead	Yellow bullhead	Total
Sector A												
1977	91	210	67	15	14	3	7	7	1	-	-	415
1978	94	22	20	3	0	0	3	3	0	0	0	145
Sector B												
1977	89	140	83	4	18	6	1	4	1	7	2	355
1978	84	23	16	1	1	0	0	0	1	0	0	126
Total	358	395	186	23	33	9	11	14	3	7	2	1041

Table 2.2-10 1975 - 1978 Monthly average Mississippi River discharge during Monticello electrofishing studies (cfs)

Month	1975	1976	1977	1978
April	18122	11700	3350	10500
May	26355	3815	2202	7000
June	9323	1903	2475	6500
July	12137	1852	2323	5500
August	3654	1203	1275	6000
September	3325	1052	3420	6500
October	3133	1151	5617	4700
November	3625	1331	6783	4000

Table 2.2-11 Common and scientific names of fishes collected in 1976-1978

Common Name	Scientific Name
Northern pike	Esox lucius
Muskellunge	Esox masquinongy
Shorthead redhorse	Moxostoma macrolepidotum
Silver redhorse	Moxostoma anisurum
Greater redhorse	Moxostoma valenciennesi
White sucker	Catostomus commersoni
Northern hogsucker	Hypentelium nigricans
Bigmouth buffalofish	Ictiobus cyprinellus
Carp	Cyprinus carpio
Black bullhead	Ictalurus melas
Yellow bullhead	Ictalurus natalis
Brown bullhead	Ictalurus nebulosus
Smallmouth bass	Micropterus dolomieui
Largemouth bass	Micropterus salmoides
Rock bass	Ambloplites rupestris
Bluegill	Lepomis macrochirus
Black crappie	Pomoxis nigromaculatus
White crappie	Pomoxis annularis
Walleye	Stizostedium vitreum
Yellow perch	Perca flavescens

MONTICELLO NUCLEAR GENERATING PLANT
ENVIRONMENTAL MONITORING PROGRAM
1978 ANNUAL REPORT

SEINING STUDY
(2.3)

Prepared for
Northern States Power Company
Minneapolis, Minnesota

by
J. W. Weinhold
Environmental and Regulatory
Activities Department
Northern States Power Company

2.3 MONTICELLO SEINING STUDY 1978

2.3.1 INTRODUCTION

Seining studies for the fifth year were conducted at Monticello in 1978. Study objectives were to determine species composition and relative abundance of small fishes in the Mississippi River within the vicinity of the Monticello Nuclear Generating Plant.

Seining was conducted between June 5, and August 21, 1978. Reduced river levels of 1975-1977 exposed extensive portions of the river bed and created a productive environment for riparian vegetation. Rising river levels in 1978 inundated this three-year growth of vegetation and created an inefficient and often unseinable situation. Frequently, large portions of a potential catch escaped while seining activity was detained by the inundated willows.

The 1978 study area was the same as 1977 (Figure 2.3-1). Two sites upstream and two sites downstream from the discharge canal outlet were sampled.

2.3.2 MATERIALS AND METHODS

A 15-foot seine with 1/4" mesh was used for sampling. Hauls were directed downstream with the current. The distance of each seining haul was determined and recorded. Captured fishes were immediately placed in a water-filled basin and were identified, tabulated, and released. Voucher specimens were preserved in a 10 percent formalin solution.

Computation of the area sampled was accomplished by multiplying the length of the haul by the width of the seine. Species abundance indices, or catch per effort (cpe), were computed by expanding the number of fishes captured per area

seined to the number of fishes that would have been captured in a hectare. Abundance indices were utilized to calculate percentage composition of each species in the total catch.

2.3.3 RESULTS

A total of 20 species were collected in 1978 (Table 2.3-1). Eighteen species were found in upstream seining areas and 17 were collected downstream.

Abundance indices (Table 2.3-2) reveal that three upstream species comprised 92 percent of the total catch by number. These species in descending abundance were: bluntnose minnow, bigmouth shiner, and spotfin shiner. Three downstream species comprised 90 percent of the total catch by number. These species in descending abundance were: spotfin shiner, bluntnose minnow, and bigmouth shiner.

Variations in fish community structure between individual seining stations are presented in Table 2.3-3 as percent of total catch. Table 2.3-4 presents the 1973, 1974, 1977, and 1978 catch per unit effort statistics for smallmouth bass, white sucker, and Moxostoma species.

2.3.4 DISCUSSION

Inundation of sandbar willow (Salix interior) and other riparian vegetation during 1978, which had flourished during the low water period of 1975 to 1977 (Table 2.3-5), created a habitat that did not exist in 1977. These areas generally had a current of less than 0.5 meter per second and a depth of 0.5 to 1.0 meter.

In 1977 variations in physical parameters between stations resulted in different species compositions for each sampling site. In contrast, 1978 sampling sites were similar in

depth and current; slight variations in these parameters between sites created differences in the dominance ranking of the major species.

A total of 20 species were collected in 1978. Eighteen species were found in the upstream seining areas and 17 were collected downstream (Table 2.3-2). Fathead minnow, blacknose dace, and sand shiner were found in the upstream section exclusively, whereas brook silverside, bluegill, and yellow perch were found only in the downstream area. Creek chub, river shiner, carp, longnose dace, and rock bass were found in 1977 but not in 1978, while white crappie was collected only in 1978.

In dominance ranking order, bluntnose minnow, bigmouth shiner, and spotfin shiner were major species in the upstream area. Spotfin shiner, bluntnose minnow, and bigmouth shiner comprised the dominance ranking in the downstream area. These species composed 91 percent of the overall catch in 1978 and 60 percent in 1977. This lower diversity found in 1978 is attributed to high river levels and inundated shoreline vegetation creating a homogeneous habitat. It is hypothesized that species that contributed to the 1977 diversity occupied a different habitat or eluded capture due to difficult seining conditions in 1978.

It was observed that young-of-the-year smallmouth bass, silver redhorse, shorthead redhorse, and white sucker (Table 2.4-4), which are major components of the "large fish" fishery, were present in small numbers. This suggests, as in 1977, poor 1978 reproductive success.

2.3.5 SUMMARY

1. Twenty species were collected in 1978. Eighteen species were found in the upstreams area and 17 species were found in the downstream areas.

2. The dominance order of the major upstream species was: bluntnose minnow, bigmouth shiner, and spotfin shiner. The downstream community had the following dominance: spotfin shiner, bluntnose minnow, and bigmouth shiner.

3. The continuity of fish community structure between stations is attributed to high river levels and inundation of riparian vegetation.

4. As in 1977, paucity of young-of-the-year silver redhorse shorthead redhorse, white sucker, and small-mouth indicates poor first year survival for the 1978 year class.

Note: See Table 2.3-6 for species list.

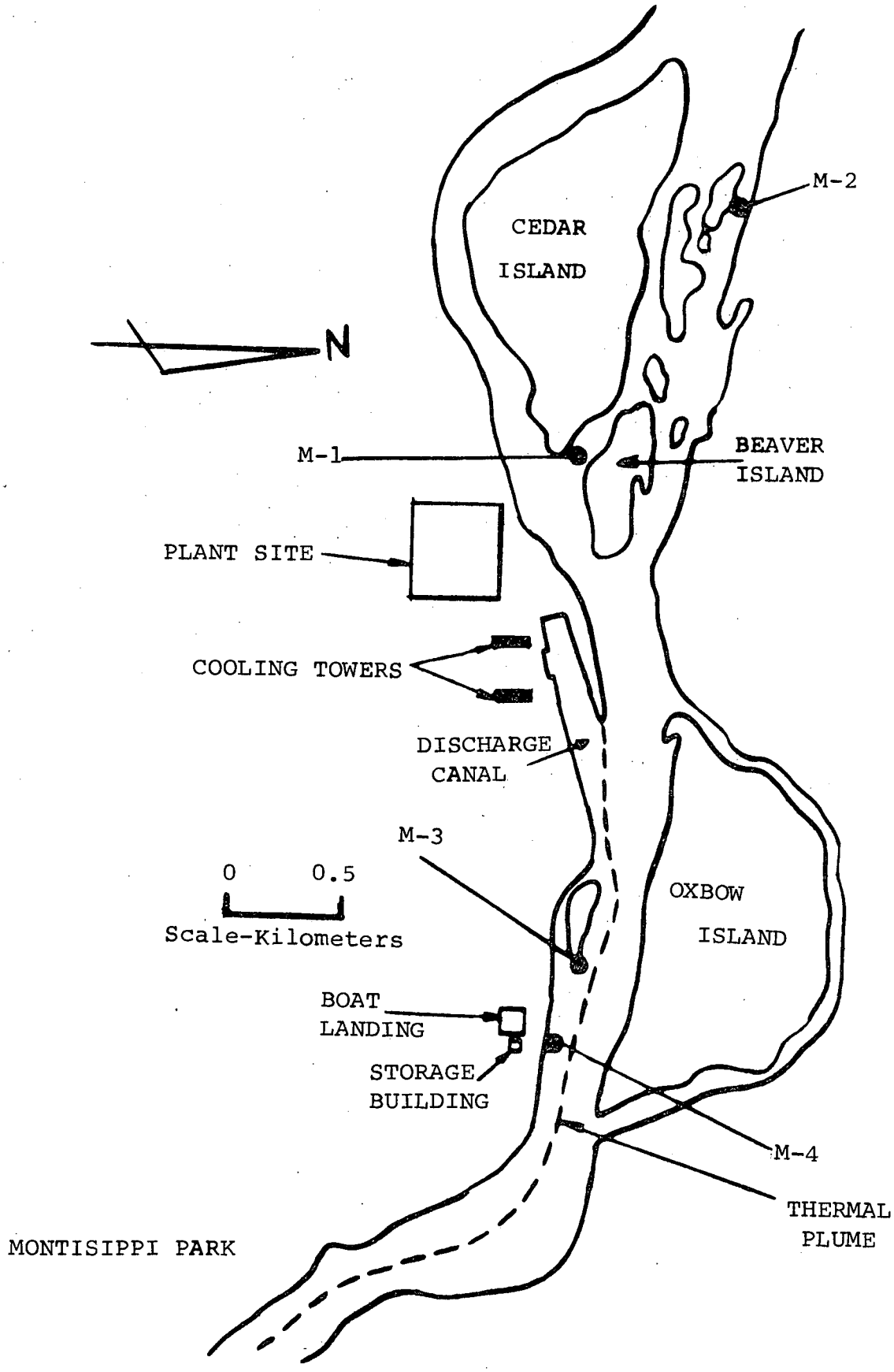

Figure 2.3-1. 1978 Monticello Seining Station Locations.

Table 2.3-1 1978 Monticello Seining Study
Species Lists for 1970, 1973, 1976, 1977, and 1978

Species	1970	1973	1976	1977	1978
Hornyhead chub	X	X	X	X	X
Creek chub	X	X		X	
Fathead chub		X	X	X	X
Bluntnose minnow	X	X	X	X	X
Brassy minnow		X			
Spotfin shiner	X	X	X	X	X
Bigmouth shiner	X	X	X	X	X
Sand shiner	X	X	X	X	X
River shiner				X	
Spottail shiner	X	X		X	X
Common shiner	X	X	X	X	X
Golden shiner	X				
Mimic shiner			X		
Carp			X	X	
Longnose dace	X	X	X	X	
Blacknose dace	X	X	X	X	X
Northern redbelly dace		X			
Silver redhorse	X	X	X	X	X
Shorthead redhorse	X	X	X	X	X
White sucker	X	X	X	X	X
Black bullhead	X				
Trout perch		X		X	X
Brook silverside				X	X
Smallmouth bass	X	X	X	X	X
Largemouth bass		X			
Black crappie	X				X
White crappie					X
Rock bass	X			X	
Bluegill			X	X	X
Logperch		X	X	X	X
Johnny darter	X	X	X	X	X

X - Denotes presence

Table 2.3-2 1978 Monticello Seining Study
Species percentage contribution to total catch by number for upstream and downstream areas.

Upstream	%	Downstream	%
Bluntnose minnow	46.8	Spotfin shiner	51.5
Bigmouth shiner	33.7	Bluntnose shiner	21.9
Spotfin shiner	11.3	Bigmouth shiner	15.8
Johnny darter	1.5	Smallmouth bass	2.6
White sucker	1.5	Moxostoma species	1.8
Trout perch	1.2	Black crappie	1.5
Silver redhorse	1.1	Common shiner	1.5
Fathead minnow	0.7	White sucker	1.0
Smallmouth bass	0.6	Johnny darter	0.5
Common shiner	0.6	Brook silverside	0.4
Black crappie	0.2	Shorthead redhorse	0.3
Spottail shiner	0.2	Shiner species	0.2
Hornyhead chub	0.1	White crappie	0.2
White crappie	0.1	Hornyhead chub	0.2
Moxostoma species	0.1	Yellow perch	0.2
Shiner species	0.1	Log perch	0.2
Shorthead redhorse	0.1	Bluegill	0.2
Sand shiner	0.1	Spottail shiner	0.2
Logperch	0.1	Silver redhorse	0.1
Blacknose dace	0.1		

Table 2.3-3 1978 Monticello Seining Study
Species percentage contribution to total catch by number for each station

Station #1	%	Station #2	%	Station #3	%	Station #4	%
Bluntnose minnow	41.5	Bluntnose minnow	49.2	Spotfin shiner	54.9	Spotfin shiner	47.6
Bigmouth shiner	36.1	Bigmouth shiner	32.5	Bluntnose minnow	25.4	Bluntnose minnow	18.2
Spotfin shiner	16.1	Spotfin shiner	9.1	Bigmouth shiner	13.2	Bigmouth shiner	18.0
Johnny darter	1.7	Trout perch	1.8	Common shiner	3.0	Smallmouth bass	4.6
Smallmouth bass	1.2	White sucker	1.7	Black crappie	1.0	Moxostoma species	2.3
White sucker	1.0	Silver redhorse	1.5	White sucker	0.8	Hornyhead chub	2.0
Common shiner	0.6	Johnny darter	1.5	Moxostoma species	0.8	Black crappie	1.9
Logperch	0.6	Fathead minnow	1.0	Smallmouth bass	0.4	White crappie	1.2
Hornyhead chub	0.4	Common shiner	0.6	Shorthead redhorse	0.3	Johnny darter	0.9
Shorthead redhorse	0.2	Smallmouth bass	0.4	Silver redhorse	0.3	Brook silverside	0.7
Sand shiner	0.2	Black crappie	0.3			Shiner species	0.6
Shiner species	0.2	Spottail shiner	0.2			White crappie	0.4
Silver redhorse	0.2	White crappie	0.2			Shorthead redhorse	0.3
Blacknose dace	0.1	Moxostoma species	0.1			Bluegill	0.3
						Logperch	0.3
						Yellow perch	0.3
						Spottail shiner	0.3

Table 2.3-4 1978 Monticello Seining Study
Average number of smallmouth bass, white sucker, and Moxostoma sp. collected per hectare in upstream and downstream areas in 1973, 1974, 1977, and 1978.

Smallmouth bass

	Upstream Fish/ha	Downstream Fish/ha
1973	256	92
1974	380	152
1977	101	12
1978	101	167

White sucker

	Upstream Fish/ha	Downstream Fish/ha
1973	1881	1416
1974	250	78
1977	2401	157
1978	240	65

Moxostoma species

	Upstream Fish/ha	Downstream Fish/ha
1973	989	1140
1974	841	797
1977	405	494
1978	201	125

Table 2.3-5 Monthly average river discharge 1975 - 1978

	River Flow in cfs			
	1975	1976	1977	1978
January	6908	3459	1295	5800
February	6297	3763	1754	4800
March	5620	7796	3341	7500
April	18122	11700	3350	10500
May	26355	3815	2202	7000
June	9323	1903	2475	6500
July	12137	1852	2323	5500
August	3654	1203	1275	6000
September	3325	1053	3420	6500
October	3133	1151	5617	4700
November	3625	1331	6783	3996
December	3340	1286	6046	3376

Table 2.3-6 1978 Monticello Seining Study
Species list of fish discussed in this text

Common Name	Latin Name
Hornyhead chub	Nocomis biguttatus
Creek chub	Semotilus atromaculatus
Fathead minnow	Pimephales promelas
Bluntnose minnow	Pimephales notatus
Brassy minnow	Hybognathus hankinsoni
Spotfin shiner	Notropis spilopterus
Bigmouth shiner	Notropis dorsalis
Sand shiner	Notropis stramineus
River shiner	Notropis blennius
Spottail shiner	Notropis hudsonius
Common shiner	Notropis cornutus
Golden shiner	Notemigonus crysoleucas
Mimic shiner	Notropis volucellus
Carp	Cyprinus carpio
Longnose dace	Rhinichthys atratulus
Blacknose dace	Rhinichthys atratulus
Northern redbelly dace	Chrosomus eos
Silver redhorse	Moxostoma anisurum
Shorthead redhorse	Moxostoma macrolepidotum
White sucker	Catostomus commersoni
Black bullhead	Ictalurus melas
Trout perch	Percopsis omiscomaycus
Brook silverside	Labidesthes sicculus
Smallmouth bass	Micropterus dolomieui
Largemouth bass	Micropterus salmoides
Black crappie	Pomoxis nigromaculatus
White crappie	Pomoxis annularis
Rock bass	Ambloplites rupestris
Bluegill	Lepomis macrochirus
Yellow perch	Perca flavescens
Logperch	Percina caprodes
Johnny darter	Etheostoma nigrum