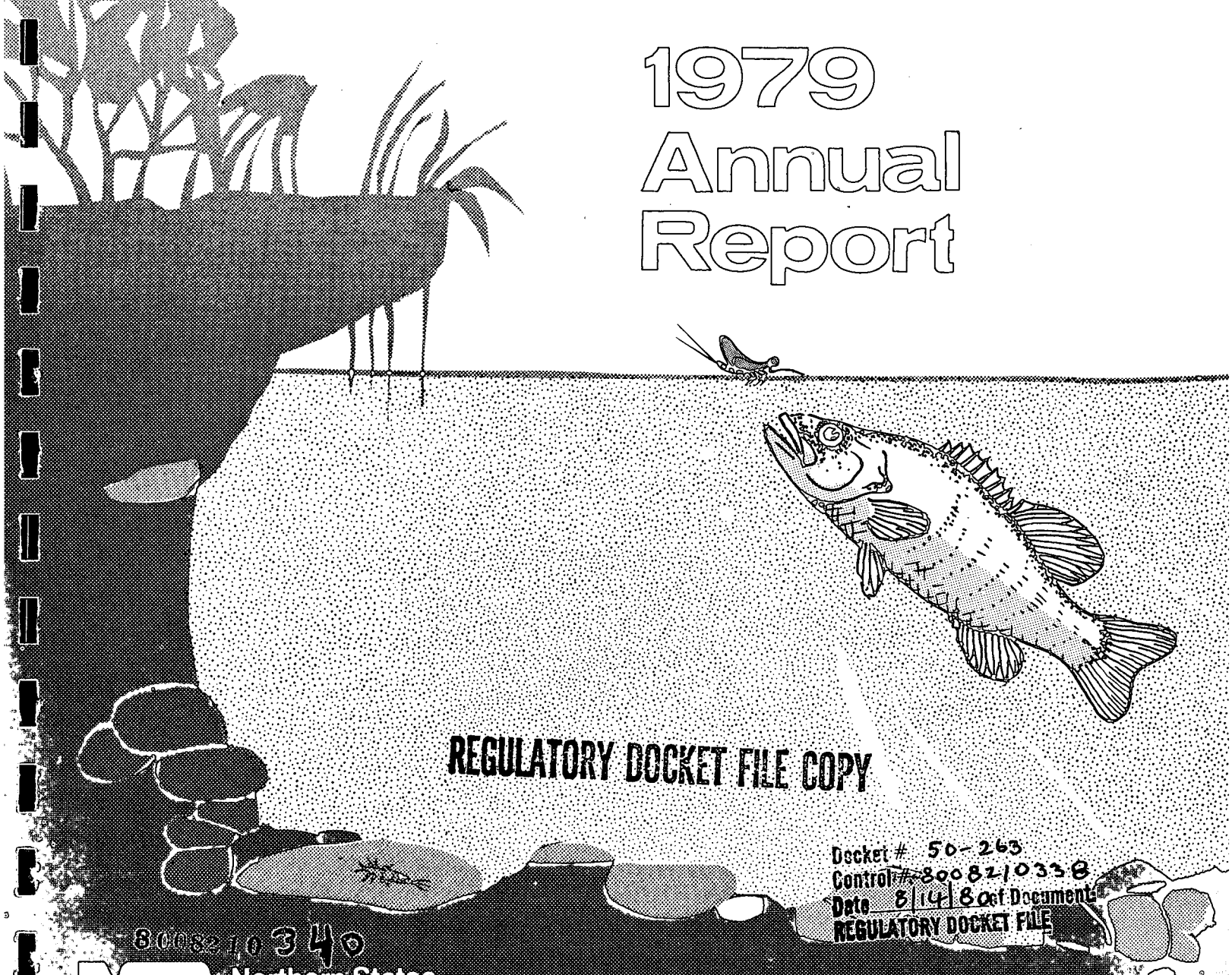
Environmental Monitoring and Ecological Studies Program

for the
MONTICELLO NUCLEAR GENERATING PLANT
Monticello, Minnesota

1979 Annual Report



Northern States Power Company

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INTRODUCTION

Two general areas of water monitoring activities were conducted in 1979: 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 twelfth consecutive report (ninth operational) summarizing environmental monitoring activities for the Monticello Nuclear Generating Plant (MNGP).

Science Services Section
Environmental and Regulatory Activities Department
Northern States Power Company (NSP)
July 15, 1980

MONTICELLO NUCLEAR GENERATING PLANT
ENVIRONMENTAL MONITORING PROGRAM
1979 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 1979 MONTICELLO WATER MONITORING SUMMARY

1.1.1 PHYSICAL PARAMETERS

The Monticello Nuclear Generating Plant (MNGP) had six outages during 1979 (Table 1.1-1). These outages accumulated to slightly less than nine days. The outage of greatest duration began on March 29 and terminated on April 2. MNGP had an amazing performance record in 1979, operating nearly 98 percent of the 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 1979 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 late April. Minimum river discharges occurred in September and October, but this condition was quickly reversed by fall rains.

The rate of water withdrawal from the Mississippi River by the plant 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 did not begin until early April. Maximum weekly mean temperatures of 75°F occurred during mid-July. Temperatures gradually declined in the fall, reaching 32°F in early December.

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-September. Discharge temperatures throughout the summer were generally near 85°F, due to "helper mode" plant operation (once-through cooling tower operation) from late May to September.

Table 1.1-1 1979 Monticello Off-line Time

Date Off		Date On		Outage Time (Hrs.)
2/14	(1143)	2/14	(2357)	12.2
3/16	(1548)	3/18	(2213)	54.4
3/28	(1122)	3/29	(0640)	19.3
3/29	(0759)	4/2	(1718)	105.3
7/20	(1150)	7/20	(2240)	10.8
7/22	(2149)	7/23	(0437)	6.8
			Total	208.8 (8.7 days)

Table 1.1-2 1979 Monticello Water System Summaries

Week of	River Discharge (cfs)	Plant Intake (cfs)	Ambient River Temp (°F)	Discharge Canal Temp (°F)
12/31/78	3820	547	32.5	71.8
1/7/79	4502	565	32.5	71.6
1/14/79	4728	544	32.3	70.5
1/21/79	5833	558	32.3	74.0
1/28/79	5331	535	32.6	73.1
2/4/79	5468	520	32.5	70.9
2/11/79	5764	502	32.2	65.3
2/18/79	5450	513	32.1	68.6
2/25/79	4990	512	32.1	73.0
3/4/79	5173	512	32.1	73.4
3/11/79	5631	442	32.1	65.6
3/18/79	6897	501	32.1	59.2
3/25/79	8339	461	32.1	46.3
4/1/79	7593	494	32.6	58.0
4/8/79	9615	544	33.4	69.9
4/15/79	18055	534	38.7	70.2
4/22/79	30938	505	46.5	64.5
4/29/79	23316	480	47.2	68.8
5/6/79	20654	470	46.8	71.8
5/13/79	19094	469	53.5	75.1
5/20/79	14066	449	58.1	82.4
5/27/79	10709	565	62.3	72.0
6/3/79	8543	599	65.0	82.2
6/10/79	7098	612	67.9	86.0
6/17/79	8579	623	66.5	82.6
6/24/79	11699	626	68.8	85.3

Table 1.1-2 (Continued)

Week of	River Discharge (cfs)	Plant Intake (cfs)	Ambient River Temp (°F)	Discharge Canal Temp (°F)
7/1/79	11787	620	72.5	86.4
*7/8/79	10382	619	73.5	89.4
*7/15/79	*	*	*	*
*7/22/79	6920	620	75.4	89.0
7/29/79	5880	619	74.5	89.9
8/5/79	5294	545	74.3	86.5
8/12/79	4750	578	68.3	85.7
8/19/79	4207	566	67.8	85.9
8/26/79	4422	572	68.6	88.2
9/2/79	4665	578	69.7	83.6
9/9/79	4170	564	64.0	89.8
9/16/79	3878	591	62.9	91.2
9/23/79	3067	614	61.9	91.1
9/30/79	2981	623	57.3	86.7
10/7/79	2707	602	48.6	78.2
10/14/79	2693	588	49.1	79.7
10/21/79	3165	574	45.7	77.4
10/28/79	4926	548	44.6	76.7
11/4/79	8560	489	37.5	73.3
11/11/79	6187	422	33.8	75.9
11/18/79	6463	564	36.0	67.3
11/25/79	5242	495	32.4	68.6
12/2/79	4275	486	32.1	66.8
12/9/79	4143	516	32.1	65.9
12/16/79	4273	517	32.1	66.1
12/23/79	4265	525	32.1	65.1
12/30/79	4258	555	32.2	65.6

*Computer outage from 7/14 to 7/22/79. No data available

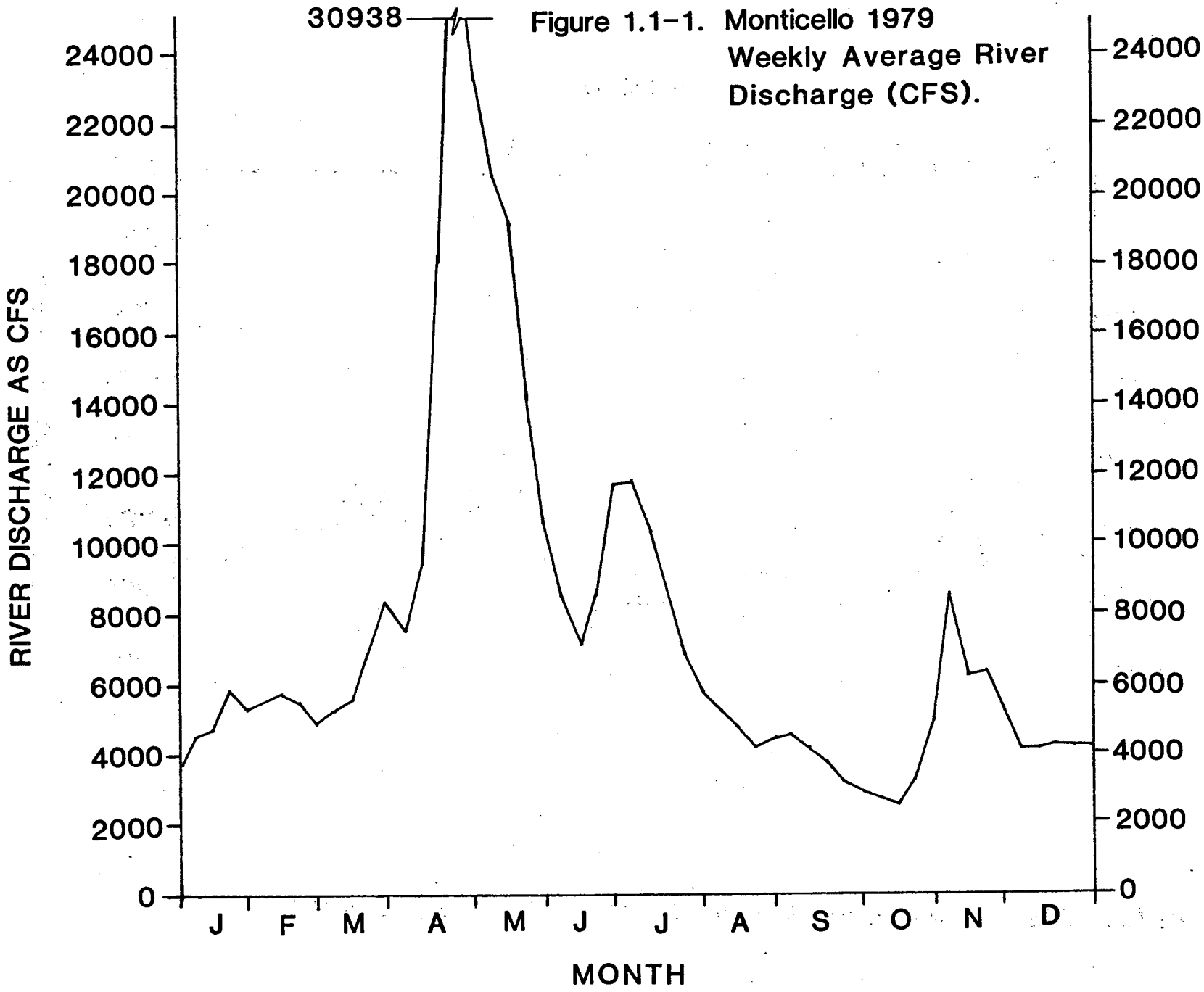


Figure 1.1-1. Monticello 1979 Weekly Average River Discharge (CFS).

Figure 1.1-2. Monticello 1979 Weekly Average Plant Intake Withdrawal Rate (CFS)

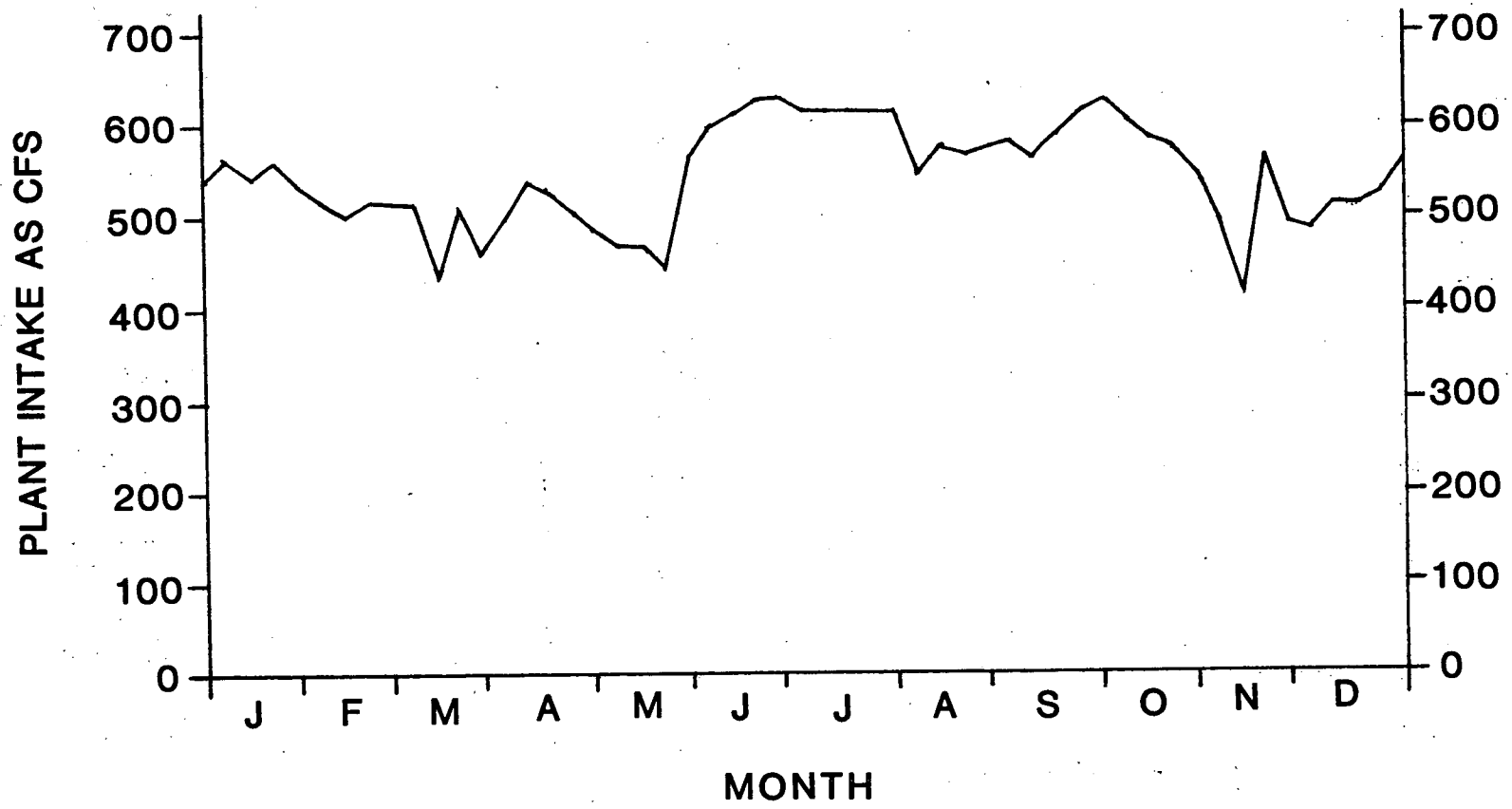


Figure 1.1-3. Monticello Weekly Average River Temperature (°F).

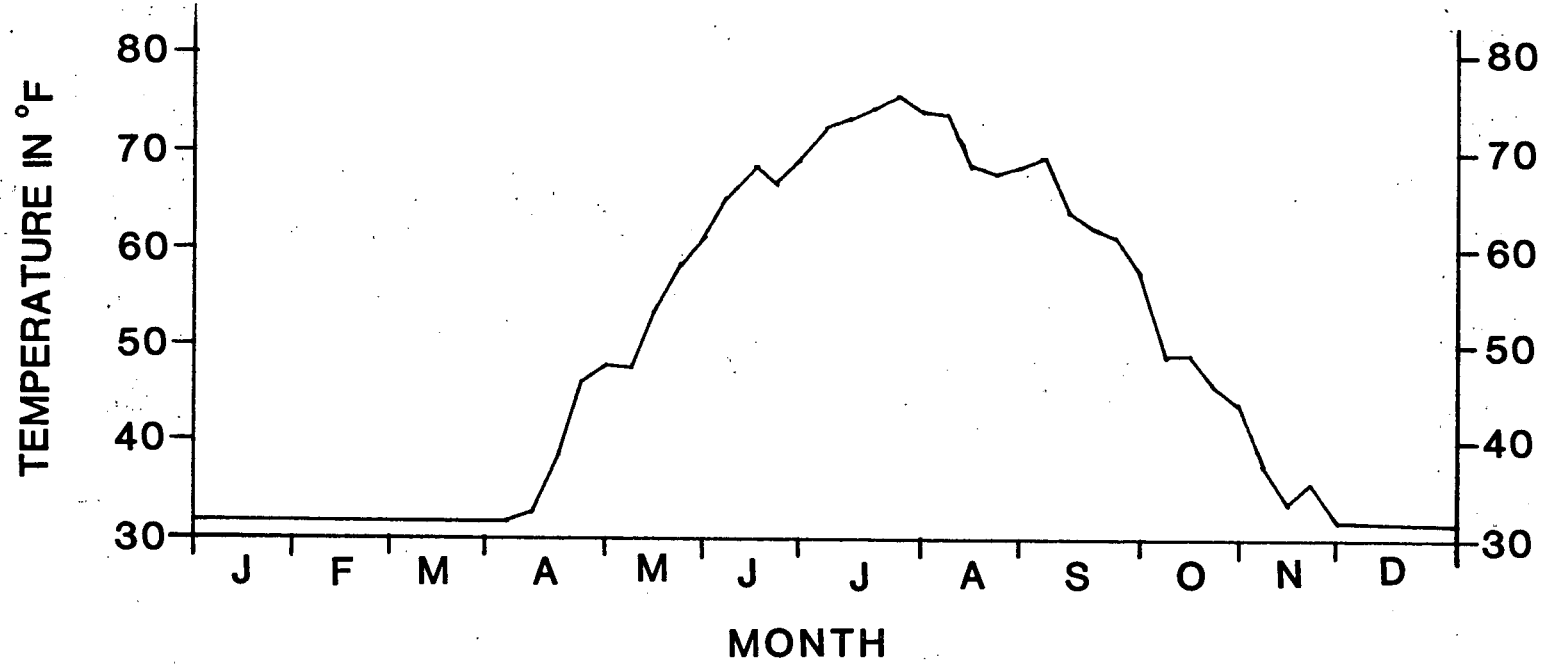
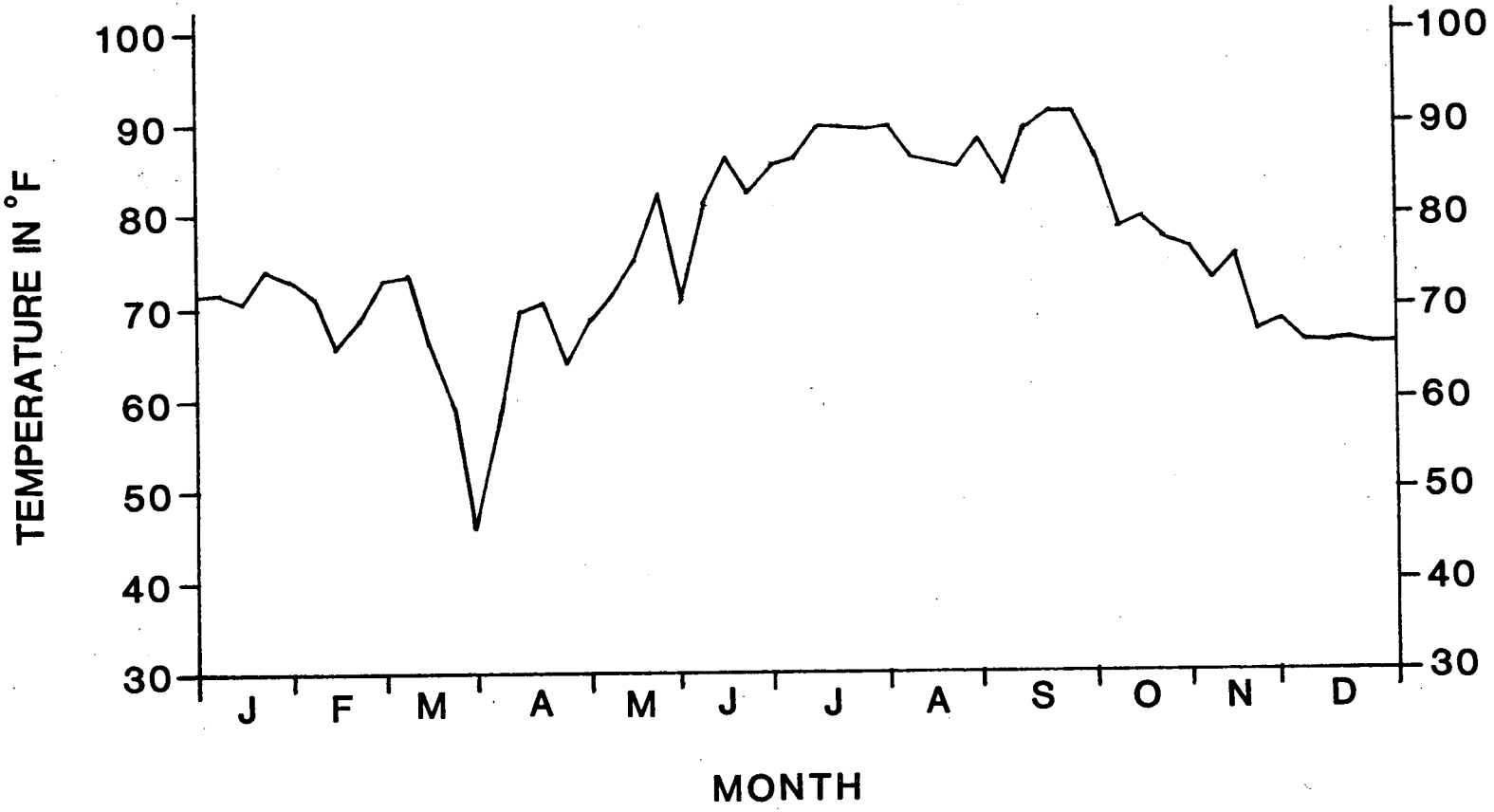


Figure 1.1-4. Monticello 1979 Weekly Average Discharge Canal Water Temperature (°F).



MONTICELLO NUCLEAR GENERATING PLANT
ENVIRONMENTAL MONITORING PROGRAM
1979 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

The 1979 Mississippi River water monitoring program was identical to the programs of 1972 through 1978. Three sampling sites were used in the acquisition of the water quality data used in assessing the impact of the discharge from the Monticello Plant on the river.

The three sampling sites used were the discharge outfall, 1,000 feet upstream of the outfall, and 1,000 feet downstream of the outfall. Samples were taken during the last week of the month from January through December. Sample collection and analyses were done by NSP personnel. The NSP Chestnut Street Testing Laboratory was used for the analyses. Procedures for the collection and analyses were as outlined in the US EPA Manual of Methods for Chemical Analyses of Water and Wastes and the APHA-AWWA-WPCF Standard Methods for the Examination of Water and Wastewater (14 Editions 1975).

Results of the analyses are presented in Table 1.2-1. A comparison of the discharge outfall and downstream transect statistical values with the corresponding upstream transect values showed a significant difference only in the temperature values. The discharge outfall temperature readings were significantly higher than the upstream temperature values. This variation was apparent both on a monthly and an annual average comparison. The most significant variation for an extended portion of the year occurred during the months of September through January. Differences in temperature during this period ranged from 12.8°C in September to 20°C in January.

The upstream and downstream temperature values showed no significant variation except in December. The downstream sample was 16.7°C greater than the upstream and just 0.5°C less than the discharge outfall. As in the past years of monitoring, the impact exerted by the plant effluent discharge is observed in the significant elevation of the physical water quality temperature. This impact is, as expected, most evident at the discharge outfall. However, any attempt to extrapolate concern for the river system, based on the impact seen at the outfall, should dissipate when consideration is given to the impact at the downstream transect, which is 1,000 feet from the discharge outfall.

Table 1.2-1.

MONTICELLO - ENVIRONMENTAL MONITORING

Mississippi River Water

	Temp °C			Dissolved Oxygen mg/l O_2			Specific Conductance µmhos/cm 25°C			pH			Total Dissolved Solids mg/l			Sulfate mg/l SO_4			P-Alkalinity mg/l $CACO_3$		
	U	D	Disc	U	D	Disc	U	D	Disc	U	D	Disc	U	D	Disc	U	D	Disc	U	D	Disc
January	0.0	0.0	20.0	15.6	15.8	9.4	340	350	330	8.8	7.7	7.7	210	200	190	9	9	8	0	0	0
February	5.0	10.0	15.0	12.0	10.2	10.2	360	350	360	7.6	7.8	7.9	230	220	240	10	11	10	0	0	0
March	2.0	7.0	11.0	10.5	10.8	10.2	360	380	360	7.7	7.5	7.7	200	200	200	13	11	11	0	0	0
April	11.0	12.0	24.0	8.6	9.0	8.2	197	197	199	8.0	8.4	8.0	130	130	140	9	11	11	0	0	0
May	17.0	21.0	28.0	8.8	8.2	8.2	248	241	246	8.1	8.6	8.0	150	160	170	10	10	10	0	0	0
June	19.0	22.0	29.0	9.4	8.9	8.6	300	302	304	8.1	8.0	8.0	190	190	190	8	9	8	0	0	0
July	23.9	23.3	29.4	8.1	8.2	8.4	300	300	320	8.0	8.0	8.1	200	370	260	7	8	7	0	0	0
August	18.9	21.1	26.7	8.7	8.5	7.2	320	320	300	7.9	8.2	8.0	180	190	190	5	12	8	0	0	0
September	15.6	15.6	28.4	8.6	8.3	8.3	280	280	280	8.5	8.5	8.3	200	220	240	9	18	8	0	0	0
October	7.8	9.4	23.9	11.4	10.1	10.4	340	350	350	8.2	7.9	8.0	200	200	160	12	13	13	0	0	0
November	3.3	10.0	20.0	12.8	11.6	10.8	-	-	-	7.9	8.7	7.9	170	170	180	11	10	10	0	0	0
December	0.0	16.7	17.2	13.4	11.8	12.2	320	320	320	8.4	8.3	8.3	170	180	180	7	7	8	0	0	0
Average	10.0	14.0	23.0	11.0	10.0	9.0	306	301	306	8.0	8.0	8.0	186	202	195	9	11	9.0	0	0	0

	M-Alkalinity mg/l $CACO_3$			Ammonia Nitrogen mg/l N			Nitrate Nitrogen mg/l N			Nitrite Nitrogen mg/l N			Total Dissolved Phosphorous mg/l P			Biochemical Oxygen Demand mg/l O_2			Chloride		
	U	D	Disc	U	D	Disc	U	D	Disc	U	D	Disc	U	D	Disc	U	D	Disc	U	D	Disc
January	129	133	132	0.27	0.11	0.20	0.41	0.40	0.39	.008	.010	.015	.076	.066	.064	-	-	-	6	8	7
February	164	166	168	0.16	0.28	0.14	0.44	0.43	0.46	.007	.008	.012	.042	.035	.037	1.3	1.2	0.9	12	10	9
March	160	160	159	0.25	0.26	0.29	0.97	0.54	0.55	.008	.009	.012	.062	.059	.054	2.2	2.1	3.0	8	10	8
April	86	84	84	<0.01	<0.01	<0.01	0.15	0.14	0.15	.006	.005	.006	.030	.031	.029	-	-	-	4	4	4
May	124	122	118	0.06	0.01	<0.01	0.09	0.11	0.12	.004	.005	.005	.02	.02	.02	2.1	2.0	2.0	5	5	6
June	140	144	145	0.01	0.01	0.01	0.17	0.18	0.17	.008	.008	.008	.04	.04	.04	1.8	1.6	1.8	4	6	7
July	138	136	134	<0.01	0.12	<0.01	0.25	0.26	0.31	.011	.011	.011	.04	.04	.04	1.3	1.2	1.2	7	8	8
August	151	153	151	0.06	<0.05	0.10	0.16	0.22	0.21	.006	.009	.006	.06	.04	.05	0.2	<0.1	0.1	8	9	9
September	151	152	151	<0.01	0.10	0.13	0.09	0.12	0.14	.004	.005	.004	.07	.03	.15	1.5	1.5	1.5	8	9	8
October	167	168	165	0.02	0.03	0.03	0.11	0.11	0.16	.007	.006	.008	.01	.04	.04	2.7	1.3	1.6	12	11	11
November	139	142	139	0.01	0.01	0.02	1.5	0.32	0.32	.010	.007	.007	.02	.02	.02	1.5	1.4	1.3	7	7	8
December	167	167	166	<.01	<0.01	0.06	0.33	0.34	0.36	.011	.010	.010	.02	.01	.02	2.0	1.7	1.8	9	9	9
Average	143	144	143	<.07	<0.08	<0.08	0.40	0.30	0.30	.007	.008	.009	.04	.03	.05	1.7	<1.4	1.5	7	8	8

Note:
U - Means upstream
D - Means downstream
Disc - Means discharge canal

MONTICELLO NUCLEAR GENERATING PLANT
ENVIRONMENTAL MONITORING PROGRAM
1979 ANNUAL REPORT

A SUMMARY OF THE 1979 MONTICELLO-SHERCO CREEL SURVEY

(2.1)

Prepared for

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Minneapolis, Minnesota

by

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2.1 A SUMMARY OF THE 1979 MONTICELLO-SHERCO CREEL SURVEY

2.1.1 INTRODUCTION

Angler usage of the Mississippi River near the Monticello Nuclear Generating Plant (MNGP) was surveyed in 1979 for the eighth consecutive year. An estimated 19,942 man-hours of angling pressure was tabulated during this survey. The sampling began on May 19 and terminated on October 14, 1979. This 149-day period encompassed a majority of the annual fishing pressure on the river in the MNGP area. During this period ninety days were sampled.

Six creel survey stations were used to collect data. These sampling locations have remained the same since 1974 (Figure 2.1-1).

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 Saturday and Sunday during this study period; two weekdays were also randomly sampled each week. The survey clerk was positioned at one station for a complete day. While at the site, the clerk 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, 1,434 fishermen were counted, and an estimated 19,942 man-hours were spent fishing.

Table 2.1-2 presents overall catch rates for species of fish caught by sampling site. A total of 1,038 fish were caught at a rate of 0.776 fish per man-hour.

Catch rates for species sought by site are presented in Table 2.1-3. The overall rate of success for species sought was 0.387 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 1979 total harvest estimate was 8,259 fish and 2,644 kg.

2.1.4 DISCUSSION

The total 1979 fishing pressure estimate was 19,942 man-hours. This was a 230 percent increase in angling pressure over 1978 and a 170 percent rise over 1977, which previously had the highest estimate (Table 2.1-4). Unlike other years, the MNGP discharge canal site constituted a majority of the fishing pressure. This location contributed 56.7 percent to the total man-hour estimate. This anomaly was created primarily by MNGP personnel that went fishing during "break periods". Angling pressure distribution for the remaining five sites was similar: River Terrace 11.6, Big Oaks Park 9.3, Tarzan Elms 8.2, Nelson's Landing 7.5, and Montissippi

Park 6.7 percent of the total man-hour estimate. Good roads, parking areas, picnic tables, and restroom facilities at Montissippi Park, Big Oaks Park, and River Terrace Park were believed to be the primary reasons these locations received substantial utilization in previous studies. However, in 1979 boat fishing in the form of float trips, negated the convenience aspect of these sampling locations, and has become the dominant form of angling on the river.

The species sought distribution was as follows: 52 percent of the fishing pressure was for smallmouth bass, 4 percent for walleye, 4 percent for northern pike, 1 percent for black crappie, and 38 percent for anything. As in earlier studies, the major fishing pressure is exerted toward the most catchable species. Traditionally, this has been the smallmouth bass. Black crappie have also been given considerable attention by anglers during years (1975 and 1978) when they were abundant. This species was not present in large numbers during 1979, and, therefore, received negligible fishing pressure.

Catch rates for all species combined was 0.776 fish per man-hour in 1979. Smallmouth bass had the highest catch rate of 0.469 fish per hour. The remaining catch rates were as follows: carp 0.067, black crappie 0.066, rock bass 0.047, black bullhead 0.040, walleye 0.037, shorthead redhorse 0.018, silver redhorse 0.016, northern pike 0.013, white sucker 0.002, bigmouth buffalo 0.001, and muskellunge 0.001 fish per hour. Muskellunge and bigmouth buffalo had not been documented in creel survey investigations prior to 1979. The Minnesota Department of Natural Resources has designated the Mississippi River in the MNGP area as muskellunge waters. Local resident catches, newspaper articles, and MNGP electrofishing studies confirm the presence of this species. However, it is not considered abundant. Another rather uncommon fish, the bigmouth buffalo, has also been collected during MNGP electrofishing studies.

Tarzan Elms had the highest rate of success: 1.764 fish were caught per hour of angling. Big Oaks Park was least productive, with an overall catch rate of 0.430 fish per hour.

The influence of a strong 1976 year class of smallmouth bass began to be realized in the angling fishery in 1977, with a catch rate of 1.233 fish per hour. The average weight of smallmouth bass caught in 1979 was 0.24 kg, or about one half pound. Catch rate for this species is down from the 1977 data due to natural attrition and less than good fishing conditions,such as high water levels and turbidity.

As indicated earlier, a majority of the angling was conducted from boats during float trips. Seventy-five percent of the fishing pressure was in August and September during the period of lowest river discharge. Forty-five percent of the anglers used natural bait, 26 percent used artificial lures,and 29 percent used a combination of artificial and natural bait. Forty-seven percent of these fishermen were from the Twin Cities area, 32 percent were from the local area, and 21 percent were vacationers from more than 50 miles away. Daily fishing pressure had the following percent distribution: Sunday 24, Monday 13, Tuesday 6, Wednesday 9, Thursday 5, Friday 16, and Saturday 28 percent.

The total harvest estimate for the six census sites was 8,259 fish and 2,644 kg. The MNGP discharge canal had the largest harvest estimate with 4,637 fish and 1,501 kg. Tarzan Elms was second with 1,255 fish and 345 kg. The remaining sites were progressively lower in this order: River Terrace Park 1,228 fish and 430 kg, Nelson's Landing 571 fish and 173 kg, Montissippi Park 378 fish and 108 kg, and Big Oaks Park 190 fish and 86 kg.

2.1.5 SUMMARY

1. The 1979 angler creel survey was conducted on 90 days during a 149-day period between May 19 and October 14, 1979.

2. Total fishing pressure for all sites was estimated at 19,942 man-hours, which is a 230 percent increase over 1978.

3. The overall catch rate for all species combined was 0.776 fish per hour.

4. The total harvest estimate was 8,259 fish and 2,644 kg.

5. Smallmouth bass is the major sport fish near MNGP. Black crappie, walleye, northern pike, muskellunge, black bullhead, rock bass, and sunfish are sport fish of less importance in this area.

6. Aging of smallmouth bass, by scale samples collected during the 1979 creel survey, indicates that a majority of fish were three years old (1976 year class).

7. Black crappie, which had major fishery importance in 1975 and 1978, was not present in large numbers during the 1979 creel survey.

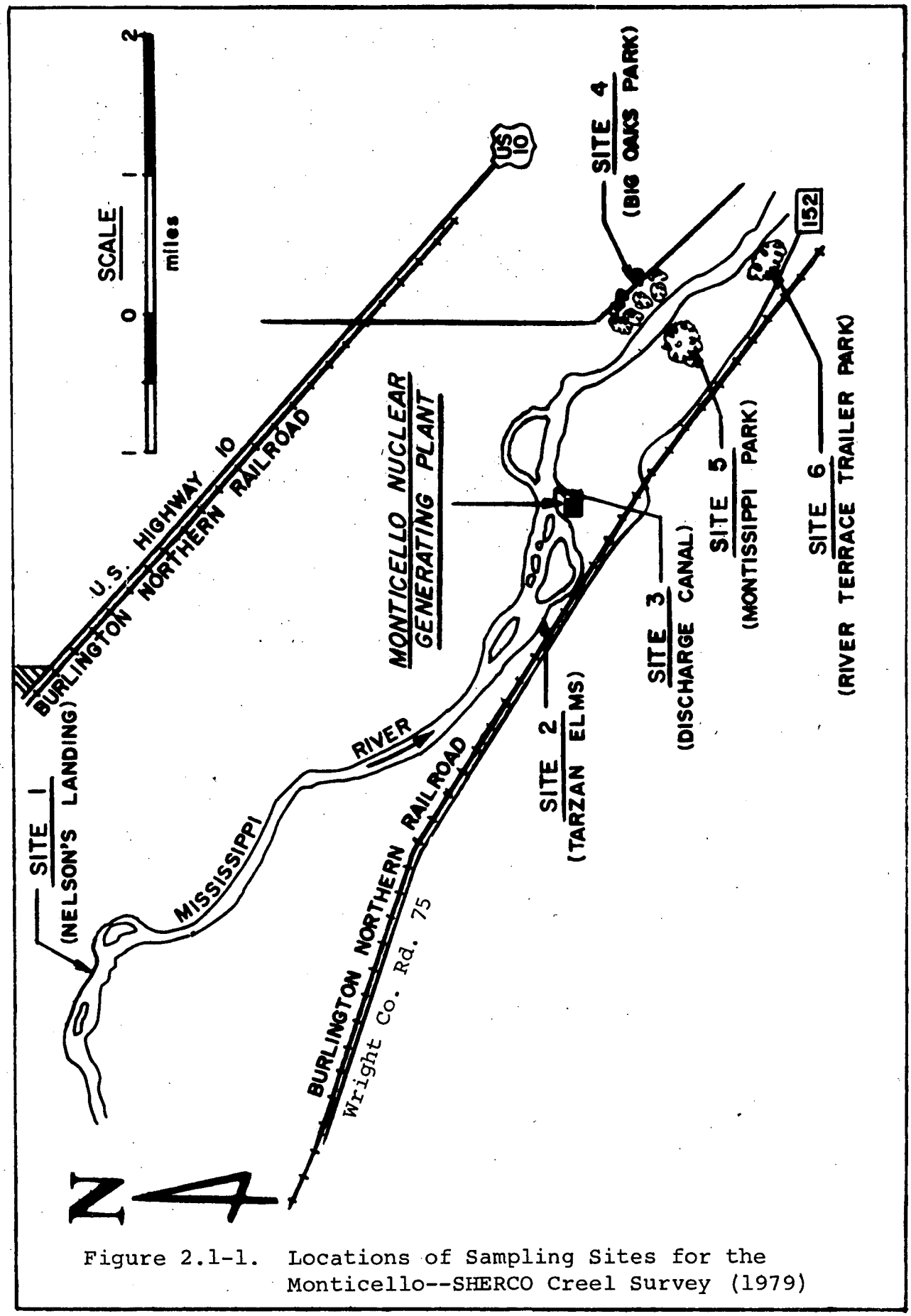

Figure 2.1-1. Locations of Sampling Sites for the Monticello--SHERCO Creel Survey (1979)

Table 2.1-1. Miscellaneous statistics

	Nelson's Landing	Tarzan Elms	Monticello Discharge Canal	Big Oaks Park	Montissippi Park	River Terrace Park	
SECTOR	1	2	3	4	5	6	Total
No. fishermen counted	108	117	813	133	96	167	1434
No. instantaneous counts	150	150	150	150	150	150	900
Mean no. fishermen/count	0.7200	0.7800	5.4200	0.8867	0.6400	1.1133	9.5600
Estimated fisherman-hours	1501.92	1627.08	11306.12	1849.59	1335.04	2322.41	19942.16

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

Species	Sect 1		Sect 2		Sect 3		Sect 4		Sect 5		Sect 6		Total	
	Caught	/MHR	Caught	/MHR	Caught	/MHR	Caught	/MHR	Caught	/MHR	Caught	/MHR	Caught	/MHR
Walleye	3	0.026	19	0.299	13	0.038	1	0.010	10	0.018	3	0.019	49	0.037
Smallmouth bass	61	0.527	44	0.693	246	0.716	23	0.236	209	0.376	44	0.274	627	0.469
Northern pike	2	0.017	1	0.016	1	0.003	2	0.020	7	0.013	5	0.031	18	0.013
W. sucker	0	0.0	0	0.0	0	0.0	0	0.0	2	0.004	1	0.006	3	0.002
Crappie	0	0.0	15	0.236	9	0.026	0	0.0	30	0.054	34	0.212	88	0.066
Carp	0	0.0	5	0.079	19	0.055	6	0.061	50	0.090	9	0.056	89	0.067
Rock bass	3	0.026	20	0.315	32	0.093	1	0.010	6	0.011	1	0.006	63	0.047
Buffalofish	0	0.0	0	0.0	0	0.0	0	0.0	1	0.002	0	0.0	1	0.001
Muskellunge	0	0.0	0	0.0	0	0.0	0	0.0	1	0.002	0	0.0	1	0.001
Black bullhead	1	0.009	4	0.063	19	0.055	0	0.0	10	0.018	20	0.125	54	0.040
Shorthead redhorse	0	0.0	4	0.063	5	0.015	9	0.092	5	0.009	1	0.006	24	0.018
Silver redhorse	0	0.0	0	0.0	1	0.003	0	0.0	3	0.005	17	0.106	21	0.016
TOTAL	70	0.605	112	1.764	345	1.003	42	0.430	334	0.600	135	0.841	1038	0.776

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

Species	Sect 1		Sect 2		Sect 3		Sect 4		Sect 5		Sect 6		Total	
	Caught	/Hr	Caught	/Hr	Caught	/Hr	Caught	/Hr	Caught	/Hr	Caught	/Hr	Caught	/Hr
Walleye	0	0.0	0	0.0	3	0.125	1	0.500	2	0.076	0	0.0	6	0.108
Smallmouth bass	53	0.648	33	0.805	206	0.985	12	0.420	135	0.424	5	1.111	449	0.649
Northern pike	0	0.0	0	0.0	1	0.133	0	0.0	3	0.115	3	0.162	7	0.135
Crappie	0	0.0	2	0.286	0	0.0	0	0.0	11	9.167	33	3.402	46	2.570
Silver redhorse	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	10	20.000	10	20.000
TOTAL	58	0.501	35	0.551	210	0.611	13	0.133	151	0.271	51	0.318	518	0.387

Table 2.1-4. Monticello-SHERCO angling pressure and catch/rate (fish/hour) for 1972 through 1979

Species	1972	1973	1974	1975	1976	1977	1978	1979
Walleye	0.005	0.031	0.083	0.010	0.010	0.029	0.029	0.037
Smallmouth bass	0.081	0.078	0.050	0.185	0.078	1.233	0.345	0.469
Northern pike	0.006	0.150	0.023	0.008	0.006	0.005	0.008	0.013
White sucker	0.006	0.0018	0.003	0	0	0.024	0.002	0.002
Black crappie	0.014	0.101	0.104	0.280	0.010	0.013	0.251	0.066
Carp	0.202	0.078	0.087	0.103	0.049	0.082	0.002	0.007
Rock bass	0.005	0	0.003	0.003	0	0	0.020	0.047
Black bullhead	0.062	0.053	0.200	0.026	0	0	0.027	0.040
Shorthead redhorse	0	0	0.003	0.021	0.003	0.010	0.031	0.018
Silver redhorse	0	0	0	0.008	0	0.002	0.010	0.016
Largemouth buffalofish	0	0	0	0	0	0	0	0.001
Muskellunge	0	0	0	0	0	0	0	0.001
TOTAL CATCH RATE	0.381	0.508	0.568	0.643	0.155	1.398	0.726	0.776
TOTAL FISHING PRESSURE	2570	2435	3700	4929	5772	11674	8668	19942

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

Species	Sect 1		Sect 2		Sect 3		Sect 4		Sect 5		Sect 6		Total	
	Caught	Kg	Caught	Kg	Caught	Kg	Caught	Kg	Caught	Kg	Caught	Kg	Caught	Kg
Walleye	13	7.255	205	114.403	263	146.771	0	0.0	19	10.603	14	7.813	514	286.845
Smallmouth bass	532	128.134	666	160.409	3716	895.014	133	32.034	300	72.256	159	38.296	5506	1326.143
Northern pike	26	37.700	0	0.0	33	47.850	0	0.0	7	10.150	29	42.050	95	137.750
W.sucker	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	14	11.200	14	11.200
Crappie	0	0.0	179	26.724	230	34.338	0	0.0	43	6.420	405	60.465	857	127.946
Carp	0	0.0	0	0.0	296	342.044	19	21.956	2	2.311	101	116.711	418	483.021
Rock bass	0	0.0	179	22.162	66	8.171	0	0.0	5	0.619	14	1.733	264	32.686
Muskellunge	0	0.0	0	0.0	0	0.0	0	0.0	2	5.400	0	0.0	2	5.400
Black bullhead	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	232	53.650	232	53.650
Shorthead redhorse	0	0.0	26	21.667	33	27.500	38	31.667	0	0.0	14	11.667	111	92.500
Silver redhorse	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	246	86.823	246	86.823
TOTAL	571	173.089	1255	345.364	4637	1501.688	190	85.656	378	107.759	1228	430.407	8259	2643.964

MONTICELLO NUCLEAR GENERATING PLANT

ENVIRONMENTAL MONITORING PROGRAM

1979 ANNUAL REPORT

A SUMMARY OF THE 1979 MONTICELLO ELECTROFISHING SURVEY

(2.2)

Prepared for

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Minneapolis, Minnesota

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2.2 A SUMMARY OF THE 1979 MONTICELLO ELECTROFISHING SURVEY

2.2.1 INTRODUCTION

Electrofishing studies were conducted in 1979 to assess relative abundance and seasonal distribution of fish in response to the Monticello Nuclear Generating Plant's (MNGP) thermal plume. Study areas (Figure 2.2-1) were sampled eight times between April 10 and October 23. 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. The thermal plume covered less than one-half the area of Sector B throughout most of the sampling season.

In contrast with low river discharges in 1976 and 1977, both 1978 and 1979 had higher river levels throughout the electrofishing period.

Percentage composition, catch per unit effort, condition factors, and length-weight relationships were determined for predominant species in each sector. Comparisons with 1968-1978 data were also made.

2.2.2 MATERIALS AND METHODS

Equipment, sampling frequency, technique, and data computation were the same as the 1976-1978 studies. Sampling was conducted with pulsed direct-current electrofishing equipment (Figure 2.2-2). A 16-foot, flat bottom boat equipped with a railing, one anode, and ten cathodes was utilized. 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 fish were captured with one-inch mesh landing nets equipped with eight-foot insulated 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.

Fish 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.

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 fish collected per area by the elapsed shocking time for that area.

Fish 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:

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

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 2,889 fish was collected in the 1979 survey, 1,404 from Sector A and 1,485 from Sector B. Most of the 18 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 1979 (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 are presented in Figures 2.2-3 through 2.2-7. 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.

2.2.4 DISCUSSION

In contrast to the 1975-1977 drought, drainage systems in 1978 and 1979 were sufficiently charged to maintain high river discharges throughout the year. Some scouring

occurred during the spring ice-out and run-off periods. As a result, much of the rooted aquatic vegetation that had become established was dislodged. High water levels and increased turbidity in 1978 and 1979 prohibited re-establishment of these plants.

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

Lake cisco, which is rare in this river section, was collected for the first time in 1979. This species is indigenous to some larger lakes in the drainage system, and its presence was probably transient in nature. Burbot and bigmouth buffalo were also collected in 1979; these species are believed to be commmon but not abundant residents of the fish population. Black crappie (major constituent of miscellaneous category), which during some years is quite abundant, was not present in substantial numbers in 1979 (Table 2.2-5).

Carp

Carp constituted 15.2 percent of the total catch by number in Sector A and 9.4 percent in Sector B. Mean annual abundance for carp was 49.3 fish/hr. in Sector A and 43.0 fish/hr. in Sector B (Table 2.2-5). These averages are the lowest recorded during the four-year study period. Figure 2.2-3 illustrates that carp were attracted to the heated area of Sector B only during May. A preference for ambient temperatures occurred in June, August, September, and October.

Mean condition factors for Sectors A and B fish were very similar at 1.27 and 1.28, respectively. This species had a mean condition factor of 1.35 during 1976 through 1978, indicating that 1979 fish weighed approximately five percent less for any given length.

The length-weight relationship for carp was:

$$\log W = -4.474 + 2.843 \log L.$$

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 43.4 percent of the catch by number in Sector A and 49.7 percent in Sector B. This species was more abundant in 1979 than in previous studies (Table 2.2-5). Mean annual abundance for shorthead redhorse was 140.9 fish/hr. for Sector A and 226.8 fish/hr. for Sector B. The strong 1976 year class, which contributed to the high cpe's in 1977 and 1978, was the major component in the 1979 catch. Fish from this year class had a length range of 325 to 350 mm. This cohort exhibited considerable growth since 1978 when their average length was 200 to 330 mm.

Shorthead redhorse was more abundant in the thermally influenced area during all months except October (Figure 2.2-4). Reduced sampling success for this species in July and August was probably a result of fish seeking deeper

water during the warmest period of the year. These deep water areas are not efficiently sampled by the electro-fishing equipment utilized in this study.

Average condition factors for shorthead redhorse were 0.99 for Sector A and 0.97 for Sector B. These means are lower than those computed for 1976 and 1977, but similar to 1978 data. Increased abundance and reduced food-producing areas (because of high water) in 1978 and 1979 has resulted in increased competition for food, and may have accounted for a reduction in the mean condition.

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

$$\log W = -5.219 + 3.082 \log L.$$

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 29.5 percent of the catch by number in Sector A and 26.9 percent in Sector B. These figures are similar to 1978 data and are several times greater than previous studies (Table 2.2-2).

Fish were collected at the rate of 95.8 fish/hr. in Sector A and 122.6 fish/hr. in Sector B. Figure 2.2-5 reveals that catch rates in Sector B were substantially higher than those in Sector A during May and June. It is apparent that this species did avoid the warm water area during August, when

cpe in Sector A doubled that of Sector B. Increased cpe's during 1978 and 1979 are attributed to the 1976 year class, which comprised a majority of the silver redhorse catch.

Condition factors for Sector A and Sector B fish compared well. The mean condition factor for Sector A fish was 1.04 and 1.05 for Sector B. These means are lower than those computed in 1976 and 1977, and indicate that 1979 fish are about 12 percent 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:

$$\log W = -5.222 + 3.095 \log L.$$

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 5.5 percent of the catch by number in Sector A and 4.0 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 was collected at the rate of 17.9 fish/hr. in Sector A and 18.3 fish per hour in Sector B. Elevated cpe's during 1979 were again attributable to a strong 1976 year class. This cohort comprised a majority of the white sucker catch. Figure 2.2-6 indicates that white sucker had a preference for warm water in April and July, but avoided this area in August and September.

Mean condition factors for Sector A and Sector B were 1.12 and 1.19, respectively. These indicies are five percent lower than those computed in 1976 and 1977. They do, however, show some increase over 1978 data. As with other catostomid members, white sucker 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:

$$\log W = -4.202 + 2.707 \log L.$$

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

Smallmouth bass composed 4.3 percent of the total catch by number in Sector A and 5.3 percent in Sector B (Table 2.2-2). Annual cpe data (Table 2.2-5) indicate a substantial decrease in abundance. Fish were collected at a rate of 13.9 fish/hr. in Sector A and 24.3 fish/hr. in Sector B. Natural attrition and increased avoidance to the electrofishing equipment (due to age) by the strong 1976 year class fish are believed to be responsible for the abundance decline of this species.

Seasonal abundance, illustrated in Figure 2.2-7, reveals a preference for the warm water of Sector B in April, May, June, July, and October. During the remainder of the study period, Sector A had higher cpe's.

The mean condition factor for smallmouth bass was 1.39 for Sector A and 1.29 for Sector B. Average condition of these fish were similar to those of 1978. However, these indicies reveal that 1978 and 1979 fish were about 11 percent leaner for a given length than those collected during 1976 and 1977. Reduced condition factors are a result of increased intraspecific and interspecific competition for food.

The length-weight relationship for smallmouth bass was:

$$\log W = -4.862 + 2.999 \log L.$$

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 1979 catch. Their percentage contribution by number was 0.2 percent in Sector A and 0.3 percent in Sector B.

Catch per unit effort for walleye was 0.5 fish/hr. in Sector A and 1.3 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. Walleye was generally more common in Sector B and infrequently collected in Sector A. Insufficient numbers of walleye were collected in 1979 to warrant computation of condition factors or length-weight regressions.

Miscellaneous Species

Miscellaneous species comprised 2.1 percent of the total catch in Sector A and 4.5 percent in Sector B (Table 2.2-2). Their mean annual catch rate was 6.7 fish/hr. in Sector A and 20.3 fish/hr. in Sector B (Table 2.2-5). The numerical dominance raking for the miscellaneous catch in Sector A was: black crappie, greater redhorse, rock bass, northern pike, black bullhead, bigmouth buffalo, northern hogsucker, lake cisco, burbot, and largemouth bass. Sector B had the following dominance ranking: rock bass, black crappie, greater redhorse, bluegill, black bullhead, northern pike, northern hogsucker, and largemouth bass. As in earlier studies, the warm water of Sector B attracted uncommon species, especially centrachids and ictalurids.

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 2,889 fish were collected from 18 species and 8 families.

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

4. Catch per unit effort was lower than 1978. Abundance for all of the major species declined, except shorthead redhorse. These reductions are primarily a result of the natural attrition of the exceptionally strong 1976 year classes.

5. Catch rates (cpe) were generally higher for the dominant species in Sector B. This condition also occurred in 1976 through 1978, 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:

   a. In general, 1979 fish in both sectors have the same weight for a given length.

   b. All species had reduced physical condition over 1976 and 1977 studies. It is theorized that intra-specific and interspecific competition, generated by large numbers of 1976 year class fish, 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).

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, 421 pp. The Iowa State University Press, Ames, Iowa.

Figure 2.2-1. 1979 Monticello Electrofishing Areas.

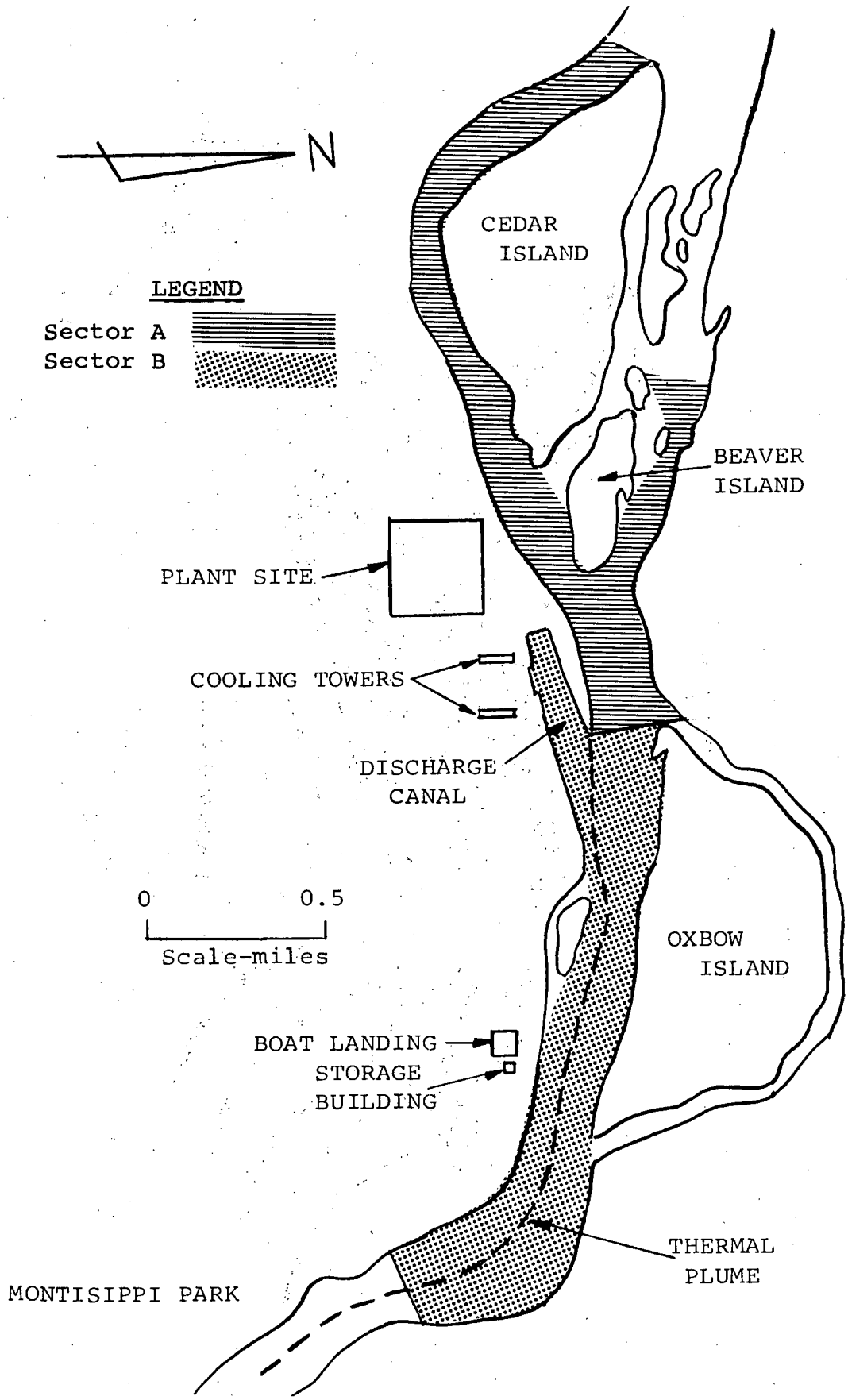

Figure 2.2-2

ELECTROFISHING BOAT (16 FT.)

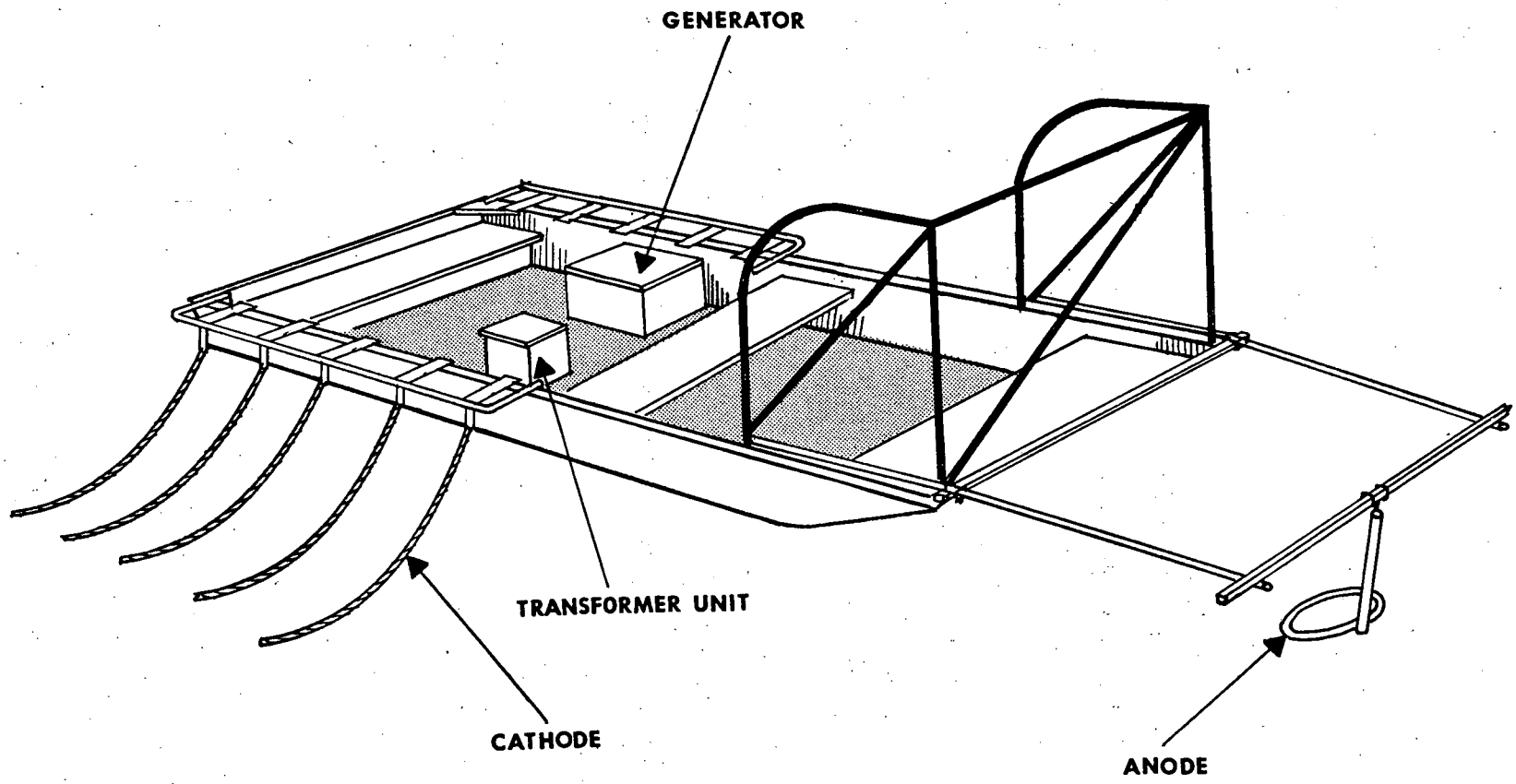

Figure 2.2-3. 1979 Monticello Electrofishing Carp Catch per Unit Effort.

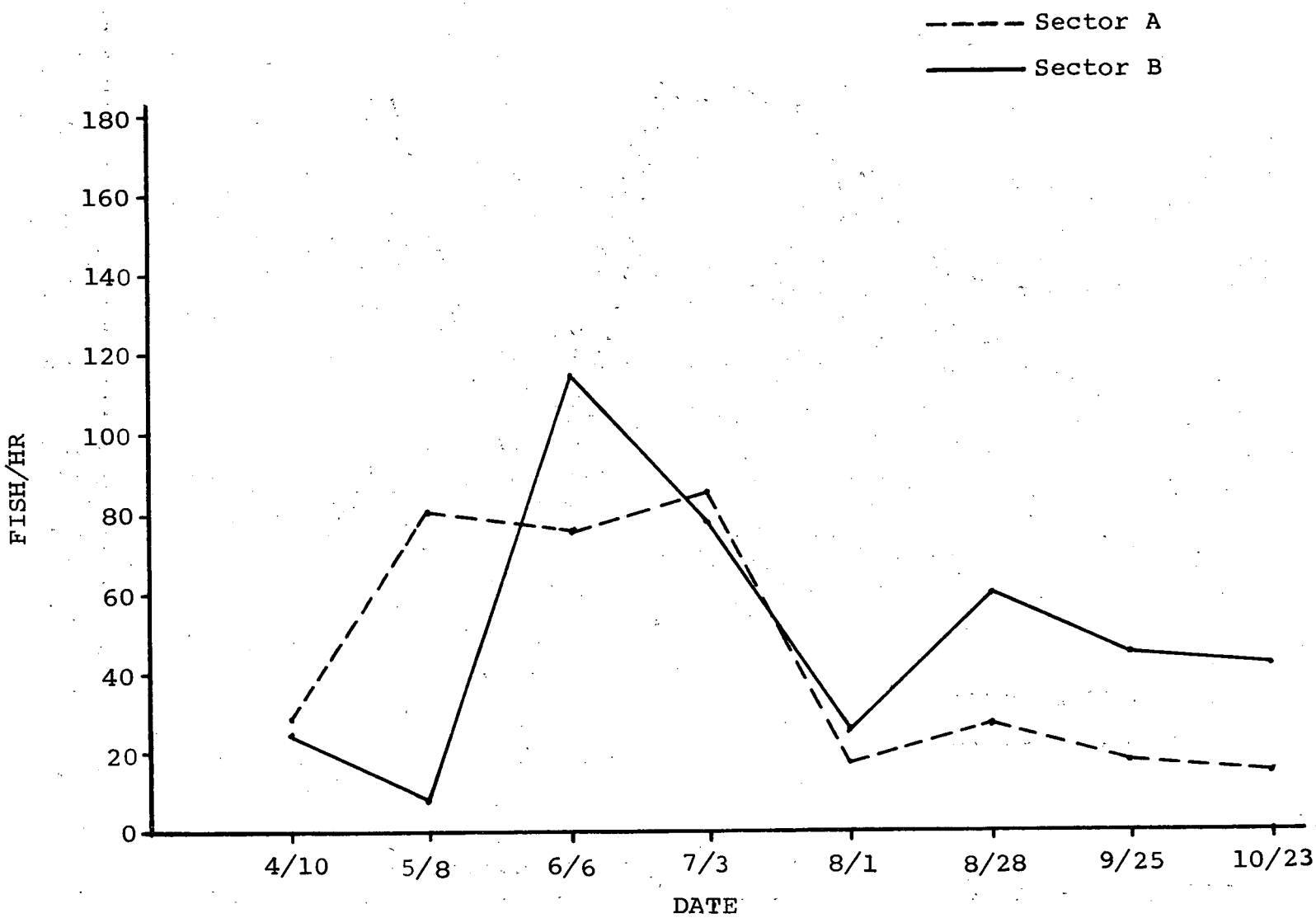

Figure 2.2-4. 1979 Monticello Electrofishing Shorthead Redhorse Catch per Unit Effort.

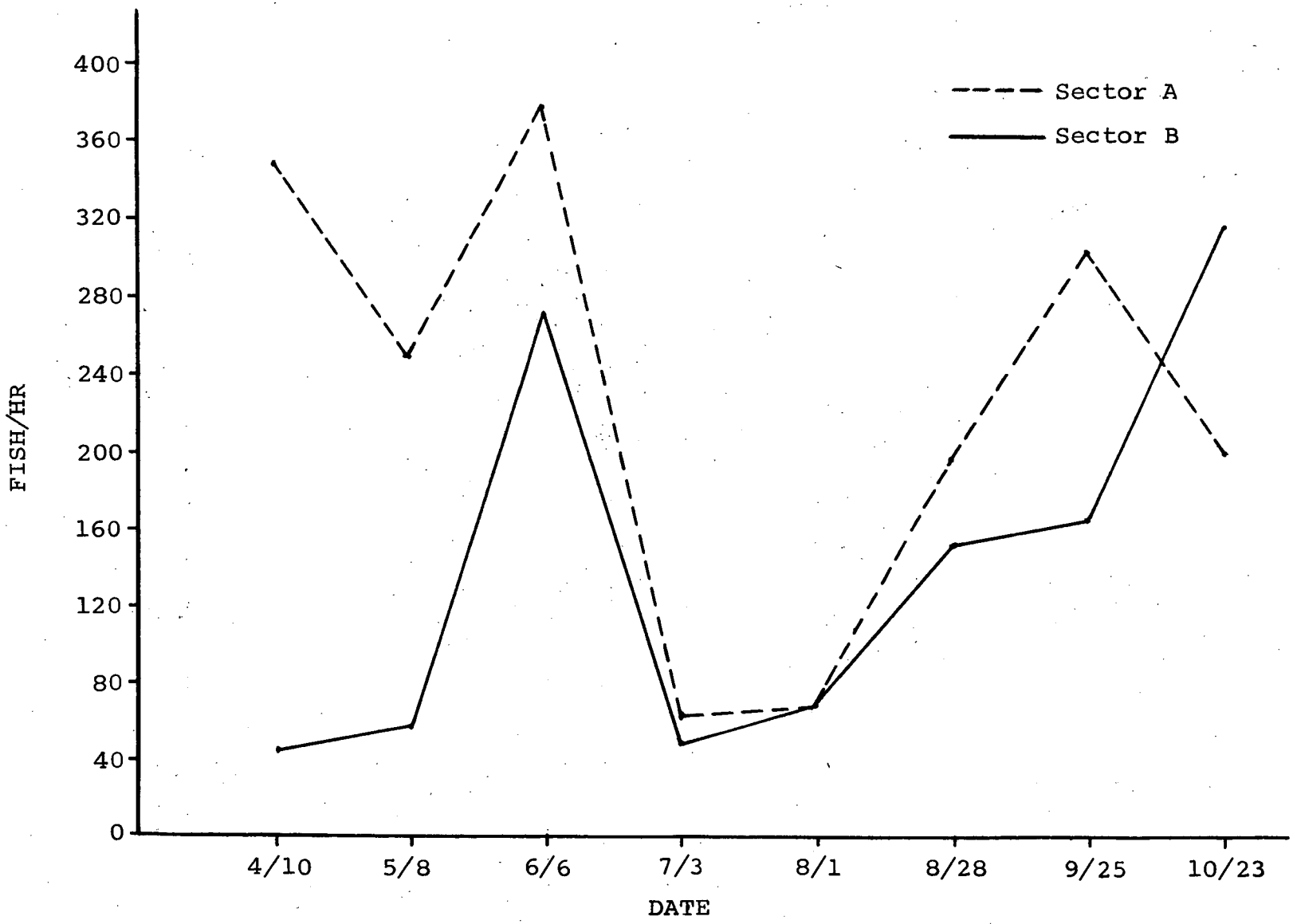

Figure 2.2-5. 1979 Monticello Electrofishing Silver Redhorse Catch per Unit Effort.

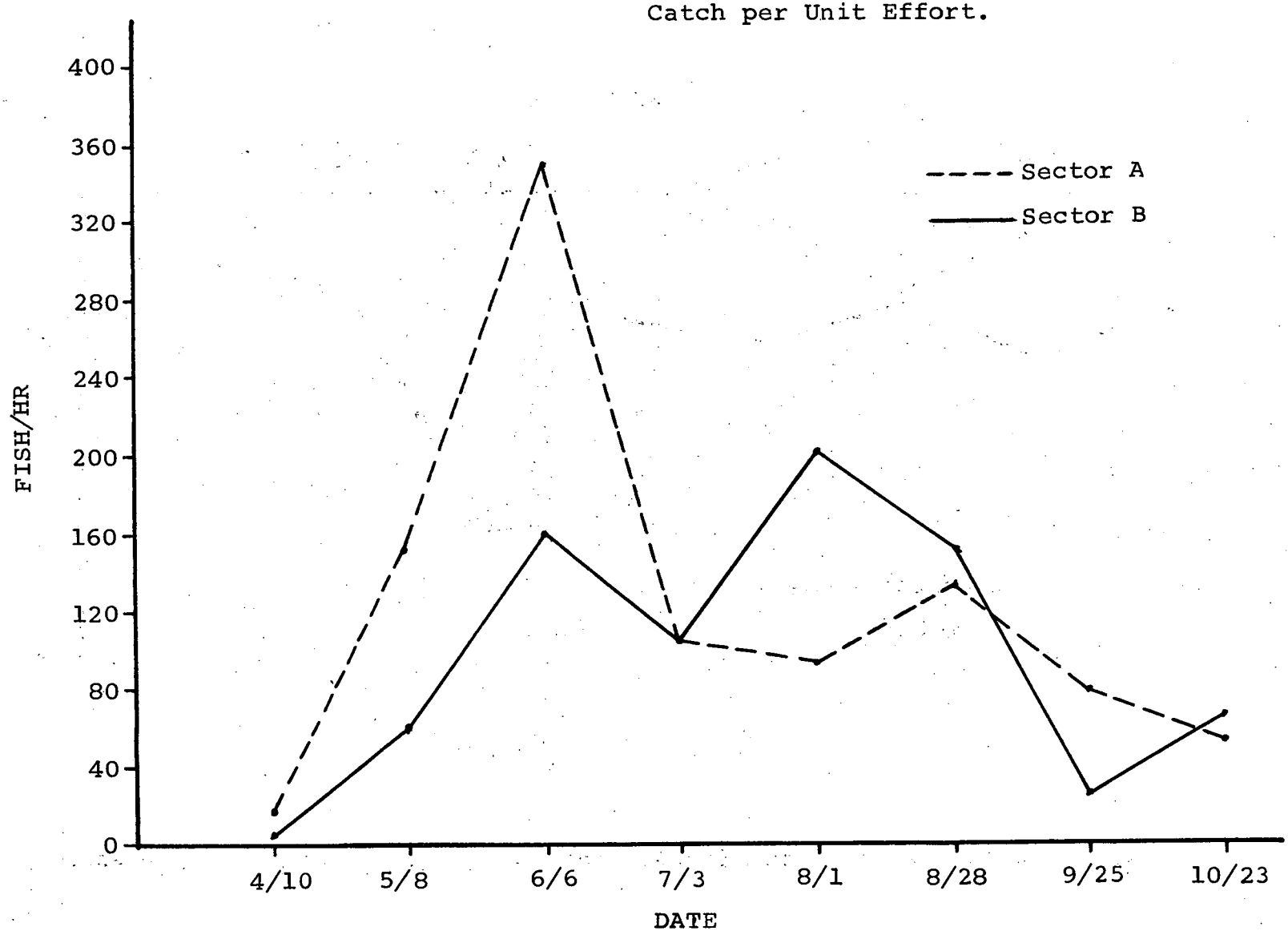

Figure 2.2-6. 1979 Monticello Electrofishing White Sucker Catch per Unit Effort.

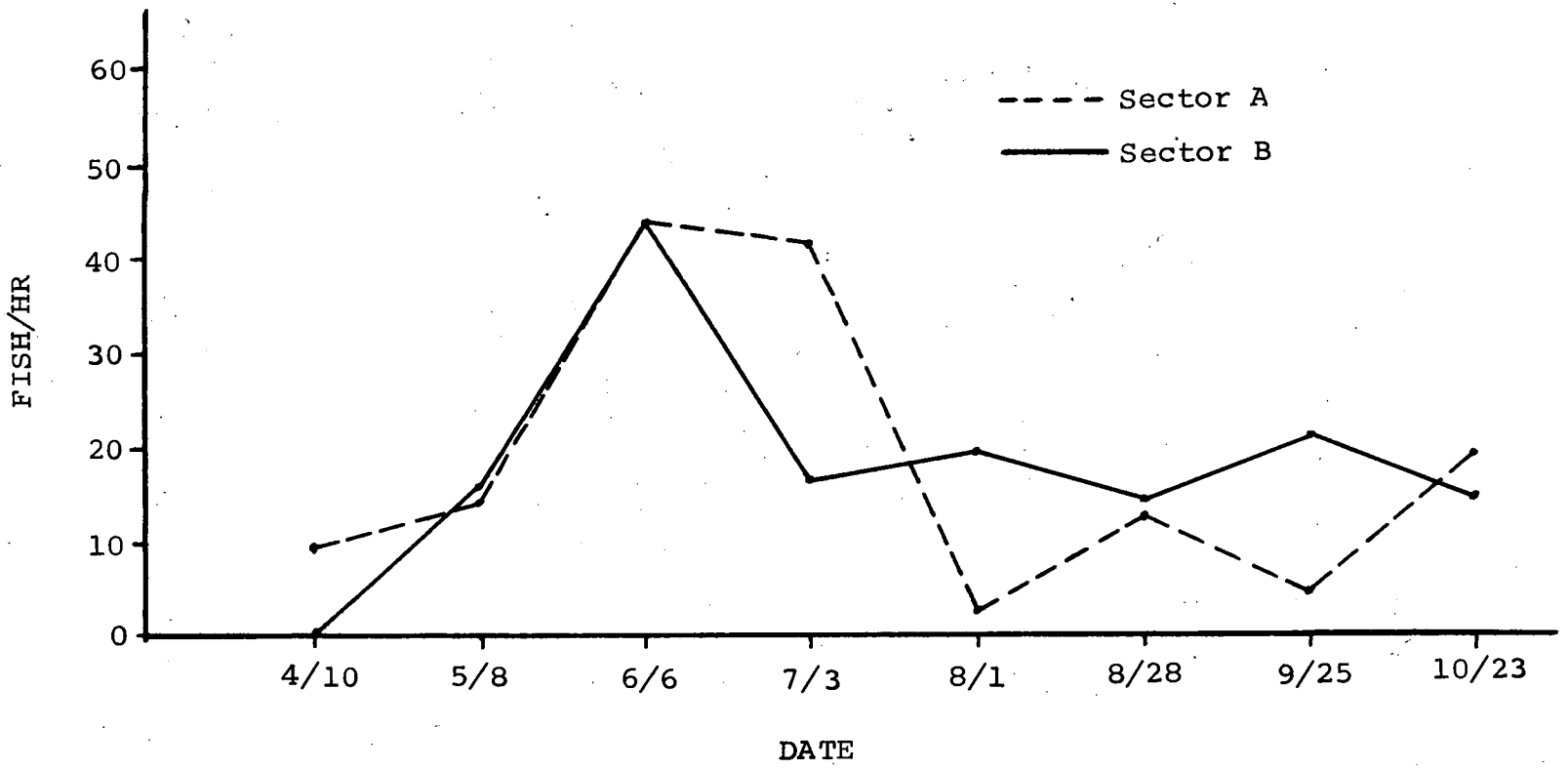

Figure 2.2-7. 1979 Monticello Electrofishing Smallmouth Bass Catch per Unit Effort.

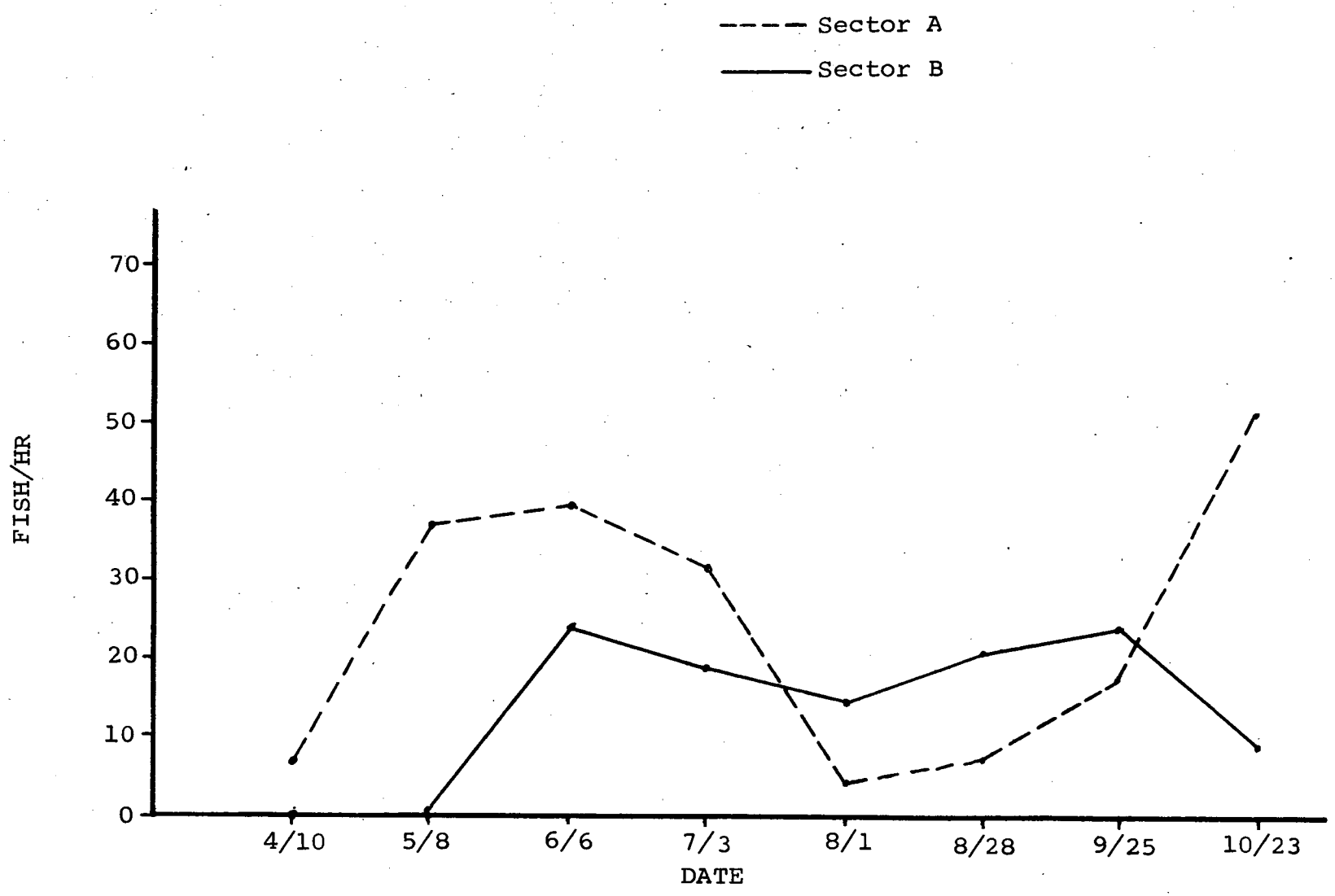

Table 2.2-1. Monticello Electrofishing Species List.

Species	1976	1977	1978	1979
Cisco *(Coregonus artedi)*				x
Northern pike *(Esox lucius)*	x	x	x	x
Muskellunge *(Esox masquinongy)*	x			
Shorthead redhorse *(Moxostoma macrolepidotum)*	x	x	x	x
Silver redhorse *(Moxostoma anisurum)*	x	x	x	x
Greater redhorse *(Moxostoma valenciennesi)*			x	x
White sucker *(Catostomus commersoni)*	x	x	x	x
Bigmouth buffalo *(Ictiobus cyprinellus)*	x			x
Northern hogsucker *(Hypentelium nigricans)*	x	x	x	x
Carp *(Cyprinus carpio)*	x	x	x	x
Black bullhead *(Ictalurus melas)*	x	x	x	x
Yellow bullhead *(Ictalurus natalis)*	x	x	x	x
Brown bullhead *(Ictalurus nebulosus)*			x	
Burbot *(Lota lota)*				x
Smallmouth bass *(Micropterus dolomieui)*	x	x	x	x
Largemouth bass *(Micropterus salmoides)*		x		x
Rock bass *(Ambloplites rupestris)*	x	x	x	x
Bluegill *(Lepomis macrochirus)*		x	x	x
Black crappie *(Pomoxis nigromaculatus)*	x	x	x	x
White crappie *(Pomoxis annularis)*			x	
Walleye *(Stizostedium vitreum)*	x	x	x	x
Yellow perch *(Perca flavescens)*			x	

Table 2.2-2. 1968-1979 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
1979	15.2	43.4	29.5	5.5	4.3	0.2	2.1
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	47.0	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
1979	9.4	49.7	26.9	4.0	5.3	0.3	4.5

Table 2.2-3. 1979 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									
4/10	23.7	47.3	3.6	0	0	0	0	1.8	76.4
5/8	8.8	57.4	59.6	15.4	0	0	0	4.4	145.6
6/6	113.3	271.7	158.3	43.2	23.4	0	0	5.4	615.3
7/3	78.0	51.3	104.7	16.4	18.5	2.1	0	6.2	277.2
8/1	25.8	66.3	200.7	18.4	14.7	0	0	5.4	331.3
8/28	59.8	155.6	151.6	14.0	21.9	0	10.0	4.0	416.9
9/25	44.7	162.4	24.3	20.5	24.3	1.9	1.9	9.4	289.4
10/23	40.5	315.1	63.9	14.9	8.5	0	0	4.2	447.1
Mean	49.3	140.9	95.8	17.9	13.9	0.5	1.5	5.1	324.9
Sector B									
4/10	27.7	350.9	18.5	9.2	6.9	0	0	4.6	417.8
5/8	79.6	247.7	147.4	14.7	35.4	0	0	2.9	527.7
6/6	75.4	379.1	351.8	43.9	39.8	2.1	4.2	23.1	919.4
7/3	84.9	67.0	105.0	40.2	31.3	0	6.7	6.7	341.8
8/1	17.9	65.2	92.2	2.2	4.5	0	0	2.2	184.2
8/28	27.8	199.4	136.3	12.6	7.6	2.5	2.5	10.2	398.9
9/25	17.2	305.6	77.5	4.3	17.2	0	4.3	6.5	432.6
10/23	13.6	199.2	51.9	19.1	51.9	5.5	19.1	68.3	428.6
Mean	43.0	226.8	122.6	18.3	24.3	1.3	4.6	15.6	456.5

Table 2.2-4. 1979 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									
4/10	39.5	44.6	6.5	0	0	0	0	4.8	95.4
5/8	13.1	60.2	100.8	6.6	0	0	0	12.7	193.4
6/6	138.8	155.3	80.0	20.1	4.1	0	0	1.0	399.3
7/3	108.1	31.2	54.3	7.2	3.9	3.2	0	3.7	211.6
8/1	36.0	37.9	54.6	8.4	2.9	0	0	7.9	147.7
8/28	68.5	105.0	66.1	5.3	5.1	0	0.9	7.4	258.3
9/25	67.1	102.6	19.9	8.9	7.3	0.3	0.2	2.4	208.7
10/23	58.9	197.5	74.9	7.9	2.6	0	0	3.1	344.9
Mean	66.3	91.8	57.1	8.1	3.2	0.4	0.1	5.4	232.4
Sector B									
4/10	36.9	191.5	20.1	3.8	1.5	0	0	7.2	261.0
5/8	125.3	131.1	179.4	6.1	15.9	0	0	7.8	465.6
6/6	91.3	178.7	132.9	15.6	6.7	3.1	0.5	12.2	441.0
7/3	87.1	45.8	37.0	17.4	4.8	0	0.5	5.3	197.9
8/1	17.0	37.3	33.2	1.0	0.7	0	0	0.3	89.5
8/28	27.5	109.6	47.2	4.8	2.0	0.4	0.5	4.1	196.1
9/25	20.4	169.2	52.4	2.9	2.7	0	0.8	0.4	248.8
10/23	19.5	300.8	55.9	11.6	14.0	1.2	2.2	14.1	419.3
Mean	53.1	145.5	69.8	7.9	6.0	0.6	0.6	6.4	289.9

Table 2.2-5. 1976-1979 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
1979	49.3	140.9	95.8	17.9	13.9	0.5	6.7	325.0
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
1979	43.0	226.8	122.6	18.3	24.3	1.3	20.3	456.6
*4 yr. $\bar{x}$	62.1	132.8	80.2	13.0	45.7	2.4	14.6	349.9

*For both sectors combined.

Table 2.2-6. 1976-1979 Monticello Electrofishing 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
1979	66.3	91.8	57.1	8.1	3.2	0.4	5.6	232.5
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
1979	53.1	145.5	69.8	7.9	6.0	0.6	7.6	290.5
*4 yr. $\bar{x}$	82.0	93.0	52.3	6.7	8.8	1.1	4.2	249.4

*For both sectors combined.

Table 2.2-7. 1979 Condition Factors for Sector A and B Fish Collected via Monticello Electrofishing.

Length	Carp		Shorthead redhorse		Silver redhorse		White Sucker		Smallmouth bass	
	A	B	A	B	A	B	A	B	A	B
100										1.68
120										0.98
140									1.75	0.70
160					0.81	0.73			1.27	1.40
180					-	-			1.61	1.48
200				0.74	0.90	1.14			1.35	1.15
220			0.93	0.90	1.04	1.06	1.05	1.72	1.24	1.27
240			1.05	0.94	1.05	1.04	1.17	1.19	1.32	1.23
260			1.05	0.98	1.09	1.06	1.29	1.10	1.33	1.27
280		1.23	0.99	1.00	1.06	1.06	1.09	1.18	1.33	1.20
300	1.46	1.43	0.97	0.96	1.15	1.06	1.21	1.13	1.34	1.20
320	-	1.53	0.99	1.01	1.10	1.01	1.21	1.11	1.44	1.30
340	-	1.40	1.04	1.02	1.10	1.12	1.12	1.12	1.34	-
360	-	1.33	1.06	1.05	-	-	1.19	1.18		1.39
380	1.37	1.30	1.09	1.09	-	-	1.13	1.21		-
400	1.34	1.28	1.05	0.96	-	-	1.16	1.21		-
420	1.23	1.28	1.01	1.00	1.12	1.04	1.00	1.10		1.47
440	1.25	1.26	0.96	0.97	1.00	1.21	1.04	-		-
460	1.26	1.26	0.98	0.94	1.05	1.04	0.91	0.99		1.67
480	1.23	1.22	0.93	0.97	1.04	1.04				
500	1.20	1.21	0.94	0.96	1.05	1.07				
520	1.25	1.23	0.86	1.00	1.06	1.06				
540	1.17	1.11			1.06	1.05				
560	1.32	1.38			1.07	1.09				
580	1.34	1.19			1.05	0.98				
600	1.10	1.18				1.11				
620	1.26									
640										
660										
Mean	1.27	1.28	0.99	0.97	1.04	1.05	1.12	1.19	1.39	1.29

Table 2.2-8. 1979 Length-Weight Relationships For Fish Collected Via Monticello Electrofishing (Length in Millimeters and Weight in Grams).

Species	log Formula	Arithmetic Formula	Length Range (mm)
Carp	$\log W = -4.474 + 2.843 \log L$	$W = (3.36 \times 10^{-5})L^{2.843}$	280-620
Shorthead redhorse	$\log W = -5.219 + 3.082 \log L$	$W = (6.04 \times 10^{-6})L^{3.082}$	200-520
Silver redhorse	$\log W = -5.222 + 3.095 \log L$	$W = (6.0 \times 10^{-6})L^{3.095}$	160-600
White sucker	$\log W = -4.202 + 2.707 \log L$	$W = (6.28 \times 10^{-5})L^{2.707}$	220-460
Smallmouth bass	$\log W = -4.862 + 2.999 \log L$	$W = (1.37 \times 10^{-5})L^{2.999}$	100-460

MONTICELLO NUCLEAR GENERATING PLANT

ENVIRONMENTAL MONITORING PROGRAM

1979 ANNUAL REPORT

SEINING STUDY

(2.3)

Prepared for

Northern States Power Company

Minneapolis, Minnesota

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2.3 MONTICELLO SEINING STUDY 1979

2.3.1 INTRODUCTION

The sixth seining study was conducted in 1979 at Monticello Nuclear Generating Plant (MNGP). Study objectives were to determine species composition and relative abundance of small fishes in the Mississippi River near the plant site and their response to thermal discharges of MNGP.

Seining was conducted once every two weeks between June 13, and September 27, 1979. The study area included 1.6 km of river extending 0.8 km upstream and 0.8 km downstream from the MNGP discharge canal. Two upstream stations and two downstream stations were utilized (Figure 2.3-1); their locations were the same as those used in 1977 and 1978.

2.3.2 MATERIALS AND METHODS

A 15-foot seine with 1/8" mesh was used for sampling. Hauls were directed downstream with the current. The distance of each seining haul was determined and recorded. Captured fish were immediately placed in a water-filled basin, 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 fish captured per area seined to the number of fish 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 1,543 specimens were collected. Of these, 22 species from 5 families were identified (Table 2.3-4). Sixteen species were collected in the upstream sector and 19 were collected in the downstream sector. River shiner, trout perch, and largemouth bass were collected in the upstream sector exclusively. Fathead minnow, shorthead redhorse, northern hogsucker, black crappie, bluegill, and yellow perch were found only in the downstream area (Table 2.3-2).

Abundance indices (Table 2.3-3) in fish per hectare, for each station revealed that sand shiner, bigmouth shiner, and spotfin shiner were common components in both sectors. In addition to these species, smallmouth bass were common in the downstream catch.

2.3.4 DISCUSSION

Twenty-two species were collected and identified during the 1979 seining study (Table 2.3-1). Sixteen were collected in the upstream sector and 19 were collected in the downstream area (Table 2.3-2). Three species found only in the upstream sector were river shiner, trout perch, and largemouth bass. Species found only in the downstream area were fathead minnow, shorthead redhorse, northern hogsucker, black crappie, bluegill, and yellow perch.

Dominant species found in the upstream sector were sand shiner, bigmouth shiner, spotfin shiner, bluntnose minnow, and white sucker. Common components of the downstream community were spotfin shiner, sand shiner, bigmouth shiner, bluntnose minnow, and smallmouth bass (Table 2.3-2).

Since 1970, 34 species representing seven families have been collected in MNGP seining investigations (Table 2.3-1). In 1979 two new species, walleye and northern hogsucker, were collected. Creek chub, brassy minnow, golden shiner, mimic shiner, carp, blacknose dace, northern redbelly dace, black bullhead, brook silverside, white crappie, rock bass, and logperch were collected in earlier studies but not in 1979.

Variations in river discharge have influenced the type of habitat available to small fish and the availability of suitable sampling locations. This parameter more than any other has greatly influenced fish community structure and sampling selectivity, and has resulted in differences in annual catch statistics.

Relative abundance of smallmouth bass, white sucker, and Moxostoma spp. (redhorse) have been reviewed over the study period to evaluate reproductive success of these major constituents of the "large fish" population (Table 2.3-5). Smallmouth bass were collected in relatively large numbers in downstream areas, while few were collected upstream, demonstrating this species attraction to warm water. Young-of-the-year white sucker and redhorse (shorthead redhorse and silver redhorse) numbers were relatively low when compared with earlier studies, indicating poor 1979 year class survival. Unpublished seining studies conducted in 1976 and electrofishing data from 1976 to 1979 indicate that catostomids and smallmouth bass had an abundant year class in 1976. Subsequent year classes have been relatively weak.

2.3.5 SUMMARY

1. Twenty-two species were collected in 1979. Sixteen species were collected in the upstream sector, and 19 were found in the downstream sector.

2. The dominance order for major upstream species was: sand shiner - bigmouth shiner (combined), spotfin shiner, bluntnose minnow, and white sucker. Dominance ranking for downstream fish was: spotfin shiner, sand shiner-bigmouth shiner (combined), bluntnose minnow, Moxostoma spp., and smallmouth bass.

3. Northern hogsucker and walleye were collected in 1979, but not during previous studies.

4. Young-of-the-year smallmouth bass were relatively abundant in the downstream sector only, demonstrating a preference for warm water.

5. Abundance of young-of-the-year redhorse (shorthead redhorse and silver redhorse) was relatively low, suggesting poor reproductive success for these species in 1979.

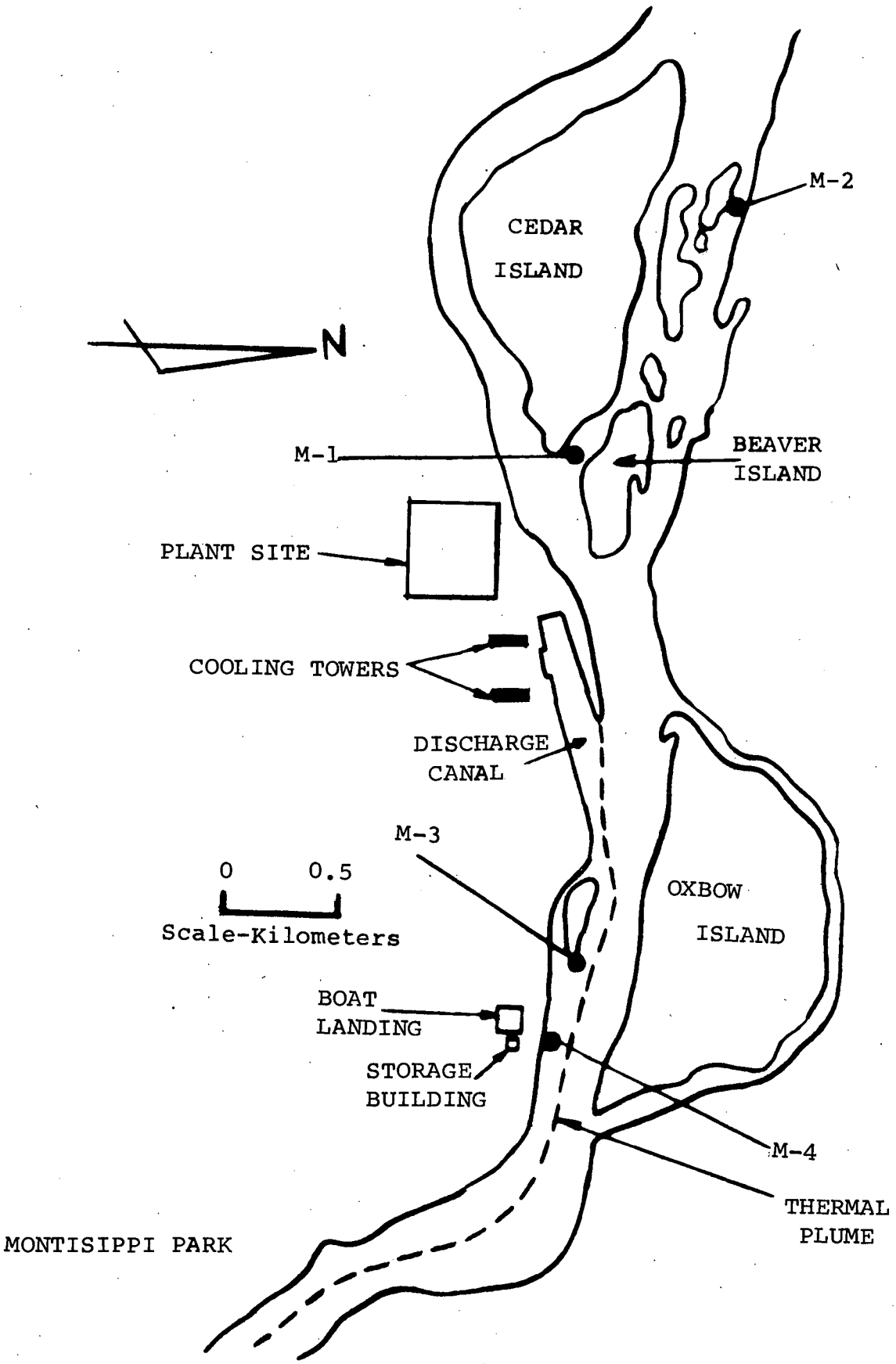

Figure 2.3-1. 1979 Monticello Seining Station Locations.

Table 2.3-1 1979 Monticello Seining Study
Species Lists for 1970, 1973, 1976, 1977, 1978, and 1979.

Species	1970	1973	1976	1977	1978	1979
Hornyhead chub	X	X	X	X	X	X
Creek chub	X	X		X		
Fathead minnow		X	X	X	X	X
Bluntnose minnow	X	X	X	X	X	X
Brassy minnow		X				
Spotfin shiner	X	X	X	X	X	X
Bigmouth shiner	X	X	X	X	X	X
Sand shiner	X	X	X	X	X	X
River shiner				X		X
Spottail shiner	X	X		X	X	X
Common shiner	X	X	X	X	X	X
Golden shiner	X					
Mimic shiner			X			
Carp			X	X		
Longnose dace	X	X	X	X		X
Blacknose dace	X	X	X	X	X	
Northern redbelly dace		X				
Silver redhorse	X	X	X	X	X	X
Shorthead redhorse	X	X	X	X	X	X
White sucker	X	X	X	X	X	X
Northern hogsucker						X
Black bullhead	X					
Trout perch		X		X	X	X
Brook silverside				X	X	
Smallmouth bass	X	X	X	X	X	X
Largemouth bass		X				X
Black crappie	X				X	X
White crappie					X	
Rock bass	X			X		
Bluegill			X	X	X	X
Logperch		X	X	X	X	
Johnny darter	X	X	X	X	X	X
Walleye						X
Yellow perch					X	X

X - Denotes presence

Table 2.3-2 1979 Monticello Seining Study
Species percentage contribution to total
catch by number for upstream and downstream areas

Upstream		Downstream	
Sand shiner & Bigmouth shiner	76.7%	Spotfin shiner	31.1%
Spotfin shiner	5.7	Sand shiner & Bigmouth shiner	18.8
Bluntnose minnow	4.2	Bluntnose minnow	12.1
White sucker	4.0	Moxostoma species	11.2
Longnose dace	2.7	Smallmouth bass	10.4
Moxostoma species	2.2	White sucker	5.3
Johnny darter	1.3	Hornyhead chub	2.3
Spottail shiner	0.9	Longnose dace	2.2
Shiner species	0.9	Johnny darter	1.8
River shiner	0.7	Spottail shiner	1.2
Hornyhead chub	0.3	Bluegill	0.9
Common shiner	0.1	Walleye	0.9
Silver redhorse	0.1	Northern hogsucker	0.9
Trout perch	0.1	Common shiner	0.6
Smallmouth bass	0.1	Shorthead redhorse	0.6
Largemouth bass	0.1	Silver redhorse	0.2
Walleye	0.1	Black crappie	0.2
		Yellow perch	0.2
		Fathead minnow	0.2

Table 2.3-3 Fish per hectare for sampling stations upstream and downstream of the Monticello Plant discharge in 1979

	Upstream		Downstream	
	Station 1	Station 2	Station 3	Station 4
Hornyhead chub	51		36	171
Fathead minnow				13
Bluntnose minnow	637	135	48	1042
Spotfin shiner	446	607	1253	1541
Sand shiner & Bigmouth shiner	8607	5534	296	1396
River shiner		126		
Spottail shiner	90	72		108
Common shiner		15	54	
Longnose dace	494			197
Shorthead redhorse			54	
Silver redhorse		18	18	
White sucker	139	589	45	426
Northern hogsucker			63	
Trout perch	18			
Smallmouth bass		18	323	606
Largemouth bass		18		
Black crappie				18
Bluegill				78
Johnny darter	198	36		157
Walleye	18		15	
Yellow perch			18	
Shiner species		162		
Moxostoma species		395	1002	

Table 2.3-4 1979 Monticello Seining Study
Species list of fish discussed in this text

Common Name	Scientific Name
Hornyhead chub	Nocomis biguttus
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 cataractae
Blacknose dace	Rhinichthys atratulus
Northern redbelly dace	Chrosomus eos
Silver redhorse	Moxostoma anisurum
Shorthead redhorse	Moxostoma macrolepidotum
White sucker	Catostomus commersoni
Northern hogsucker	Hypentelium nigricans
Black bullhead	Ictalurus melas
Trout perch	Percopsis omincomaycus
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
Walleye	Stizostedion vitreum

Table 2.3-5 1979 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, 1978, and 1979

Smallmouth bass

	Upstream	Downstream
	Fish/ha	Fish/ha
1973	256	92
1974	380	152
1977	101	12
1978	101	167
1979	9	465

White sucker

	Upstream	Downstream
	Fish/ha	Fish/ha
1973	1881	1416
1974	250	78
1977	2401	157
1978	240	65
1979	364	236

Moxostoma species

	Upstream	Downstream
	Fish/ha	Fish/ha
1973	989	1140
1974	841	797
1977	405	494
1978	201	125
1979	103	179