ENVIRONMENTAL MONITORING AND ECOLOGICAL STUDIES PROGRAM

1978 ANNUAL REPORT

VOLUME 1

PRAIRIE ISLAND NUCLEAR GENERATING PLANT

NEAR RED WING, MINNESOTA

NSP

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INTRODUCTION

Results of Northern States Power Company's (NSP) ninth consecutive reporting of environmental monitoring studies for the calendar year 1978 are contained in this publication. The 1978 calendar year represents the fourth full year of two-unit operation for the Prairie Island Nuclear Generating Plant (PINGP).

The 1978 annual report represents the final year of reporting for the following studies: Terrestrial Vegetation Study (Section 2.6), Small Mammal Study (Section 2.7), and Birds Killed Striking Transmission Lines (Section 3.1). The terrestrial vegetation study indicates that other than construction activities the only power plant effects detectable are those associated with ice formation on trees adjacent to the plant cooling towers. Other changes in the vegetation community structure are associated with natural succession. The small mammal study has defined the magnitude of natural changes in the small mammal populations in the vicinity of PINGP and indicates no abnormal population or community structure alterations. The magnitude and species composition of birds killed by striking transmission lines have been adequately defined, and the results indicate that those lines perpendicular to bird migration routes have the highest proportion of bird kills.

Although not conducted in 1978, a fish creel survey will be conducted in 1979 by the Minnesota Department of Natural Resources (MDNR). Results of this study will be incorporated into the 1979 annual report.

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

PRAIRIE ISLAND NUCLEAR GENERATING PLANT
ENVIRONMENTAL MONITORING PROGRAM
1978 ANNUAL REPORT

WATER CHEMICAL ANALYSES
(1.1)

Prepared for

Northern States Power Company
Minneapolis, Minnesota

by

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Environmental and Regulatory Activities Department
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1.1 WATER CHEMICAL ANALYSES

1.1.1 INTRODUCTION

Sampling was conducted by Environmental and Regulatory Activities Department personnel at Prairie Island. Parameters sampled included: phenolphthalein (p) and total (m) alkalinity, dissolved orthophosphates, total dissolved phosphorus, filterable and nonfilterable residue, ammonia, nitrite and nitrate nitrogen, pH, conductivity, dissolved oxygen, turbidity, and temperature. Schmidt (1976) described each of the parameters and indicated its significance in water chemical analyses.

1.1.2 MATERIALS AND METHODS

Samples were collected monthly at four stations (Figure 1.1-1). Station B-1 represents upstream main channel river conditions, X-1 reflects the quality of intake cooling water, Y-2 indicates water quality following plant usage prior to mixing, and Station C-4 represents downstream main channel river conditions, after mixing with plant effluent.

Samples were collected from top and bottom of the water column with a 6.2 liter Van Dorn water bottle and placed in new plastic gallon jugs. Dissolved oxygen, pH, conductivity, turbidity, and temperature were analyzed at the Prairie Island Environmental Lab. The remaining parameters were determined according to Standard Methods (1975) by the NSP Chestnut Lab within 24-hours of collection. Instrumentation was similar to that used in previous years.

Chemical data were analyzed with a full factorial analysis of variance (ANOVA) to determine seasonal, depth, and plant effects by combining data from Stations B-1 and X-1 (upstream) and comparing with data from Stations Y-2 and C-4 (downstream). Missing values, caused by unsafe ice conditions at some stations during winter, were estimated according to Li (1964).

1.1.3 RESULTS AND DISCUSSION

The 1978 Mississippi River water quality data and ANOVA are presented in Tables 1.1-1 and 1.1-2, respectively. The letters "T" and "B" appearing after the site locations refer to top and bottom samples, respectively. For each sample collected, annual mean, median, standard deviation, and range are also listed in Table 1.1-1.

Analysis of variance assumes that variability in chemical concentration is caused by seasonal variation, depth, and whether the sample was collected above or below the plant. Some variation may also be caused by interaction between any two of these factors; the factors are not independent and together are contributing to changes in the parameters sampled.

Highly significant differences ($P \leq .01$) between upstream and downstream stations were observed for all properties except nitrite nitrogen, with regard to time (month of the year). Nitrite nitrogen showed a significant difference ($P \leq .05$). Temperature showed a highly significant difference with regard to plant effect. Ammonia showed a significant difference also attributable to plant effect.

In 1976 and 1977 there were significant differences ($P \leq .05$) between upstream and downstream conductivity values. The 1977 difference was attributed to the fact that conductivity values had not been corrected for differences in sample temperature. The 1976 figures were also not adjusted for the temperature differences. The 1978 figures were corrected for the sample temperature differences using the equation:

$$G = \frac{1{,}000{,}000\ C}{R\ \ 1 + 0.0200\ (t - 25)} \quad ,$$

where R = resistance of sample, ohms; C = cell constant; t = temperature degree C. No significant difference between upstream and downstream values was seen.

No other property analyzed showed any significant difference.

1.1.4 LITERATURE CITED

Eberley, L W, 1977 Water Chemistry. In Environmental Monitoring and Ecological Studies Program. 1977 Annual Report for Prairie Island Nuclear Generating Plant near Red Wing, Minnesota, Volume 1. Northern States Power Company, Minneapolis, Minnesota.

Standard Method : for the Examination of Water and Waste Water , 14th edition, 1975, APHA-AWWA-WPCF, American Public Health Association, Washington, D. C.

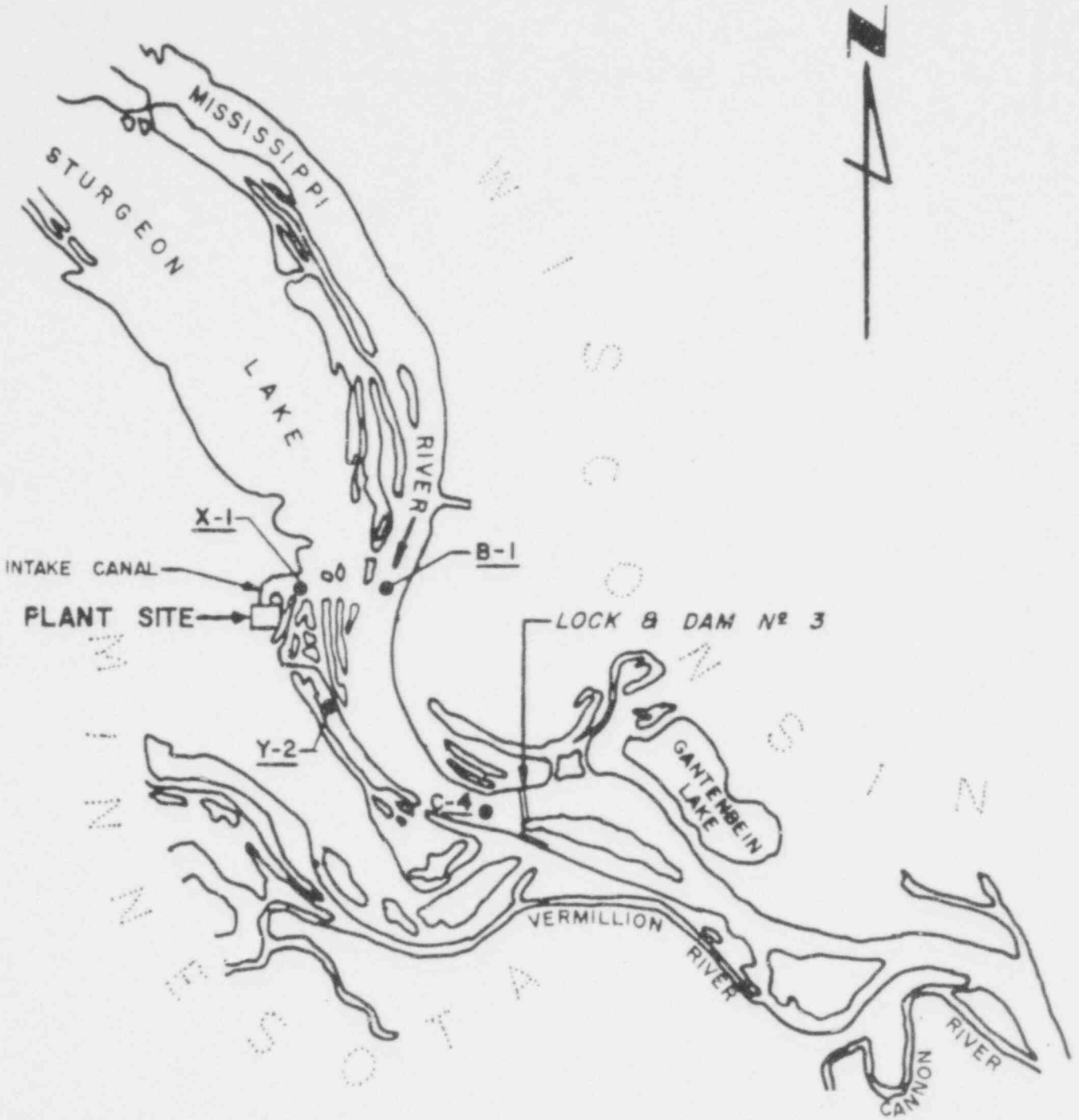

Figure 1.1-1. WATER CHEMISTRY SAMPLING LOCATIONS

Table 1.1-1

SITE B-1B

1978 PAGE 1

	P-ALKALINITY MG/L AS CACO3	M-ALKALINITY MG/L AS CACO3	DISSOLVED ORTHOPHOSPHATE PHOSPHORUS MG/L P	TOTAL DISSOLVED PHOSPHORUS MG/L P	FILTERABLE RESIDUE MG/L	NONFILTERABLE RESIDUE MG/L
JAN	0.0	176.000	0.140	-1.000	300.000	22.600
FEB	0.0	192.000	0.100	0.140	350.000	7.800
MAR	0.0	167.000	0.100	-1.000	260.000	2.200
APR	0.0	94.000	0.040	0.070	200.000	36.000
MAY	0.0	122.000	0.009	0.026	310.000	28.000
JUNE	0.0	120.000	0.090	0.100	310.000	54.000
JULY	0.0	101.000	0.090	0.120	210.000	49.000
AUG	0.0	152.000	0.070	0.120	260.000	60.000
SEP	0.0	115.000	0.100	0.130	220.000	240.000
OCT	0.0	135.000	0.020	0.070	220.000	30.000
NOV	0.0	130.000	0.080	-1.000	210.000	20.000
DEC	0.0	142.000	0.100	0.110	240.000	4.000
MEAN	0.0	137.167	0.078	0.098	257.500	46.133
S. D.	0.0	29.987	0.038	0.036	49.383	63.925
MEDIAN	0.0	135.000	0.090	0.110	260.000	30.000
LOWEST	0.0	94.000	0.009	0.026	200.000	2.200
HIGHEST	0.0	192.000	0.140	0.140	350.000	240.000

	AMMONIA NITROGEN MG/L N	NITRITE NITROGEN MG/L N	NITRATE NITROGEN MG/L N	PH	CONDUCTIVITY UMHOS/CM	DISSOLVED OXYGEN MG/L	TURBIDITY JTU	TEMPERATURE DEGREES C
JAN	0.740	0.014	1.010	7.600	461.000	9.900	5.000	0.400
FEB	0.550	0.120	0.320	7.600	500.000	11.100	3.000	0.0
MAR	0.700	0.018	0.920	7.500	482.000	11.400	3.000	0.500
APR	0.260	0.020	0.640	7.900	300.000	12.100	15.000	7.500
MAY	0.160	0.022	0.310	8.300	537.000	10.800	10.000	17.000
JUNE	0.330	0.050	1.090	8.100	430.000	7.900	22.000	22.000
JULY	0.190	0.042	0.550	7.900	325.000	6.000	5.600	20.500
AUG	0.460	0.076	0.780	8.000	489.000	6.600	20.000	24.500
SEP	0.350	0.043	0.380	7.700	394.000	7.700	40.000	21.000
OCT	0.380	0.022	0.310	8.000	421.000	9.000	10.000	11.000
NOV	0.400	0.021	0.320	8.300	422.000	11.300	7.000	4.500
DEC	0.640	0.010	0.570	8.000	500.000	11.700	2.500	0.0
MEAN	0.463	0.038	0.600	7.908	438.417	9.625	11.925	10.742
S. D.	0.243	0.032	0.289	0.264	71.929	2.119	11.005	9.760
MEDIAN	0.400	0.022	0.570	8.000	461.000	10.800	10.000	11.000
LOWEST	0.160	0.010	0.310	7.500	300.000	6.000	2.500	0.0
HIGHEST	0.950	0.120	1.090	8.300	537.000	12.100	40.000	24.500

NOTE: -1.000'S ARE MISSING VALUES

1.1-9

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Table 1.1-1 (Continued)

SITE F-1T 1978 PAGE 2

	P-ALKALINITY MG/L AS CACO3	M-ALKALINITY MG/L AS CACO3	DISSOLVED ORTHOPHOSPHATE PHOSPHORUS MG/L P	TOTAL DISSOLVED PHOSPHORUS MG/L P	FILTERABLE RESIDUE MG/L	NONFILTERABLE RESIDUE MG/L
JAN	0.0	181.000	0.140	0.200	320.000	4.200
FEB	0.0	182.000	0.110	0.150	350.000	6.000
MAR	0.0	166.000	0.100	0.120	270.000	2.400
APR	0.0	90.000	0.050	0.070	190.000	34.000
MAY	0.0	123.000	0.013	0.028	330.000	26.000
JUNE	0.0	118.000	0.080	0.090	310.000	45.000
JULY	0.0	100.000	0.050	0.120	210.000	39.000
AUG	0.0	151.000	0.070	0.140	250.000	42.000
SEP	0.0	112.000	0.100	0.130	230.000	99.000
OCT	0.0	135.000	0.030	0.080	210.000	18.000
NOV	0.0	131.000	0.080	-1.000	210.000	18.000
DEC	0.0	143.000	0.080	0.120	250.000	3.000
MEAN	0.0	136.000	0.079	0.113	260.833	28.050
S. D.	0.0	29.882	0.035	0.046	54.516	27.353
MEDIAN	0.0	135.000	0.080	0.120	250.000	26.000
LOWEST	0.0	90.000	0.013	0.028	190.000	2.400
HIGHEST	0.0	182.000	0.140	0.200	350.000	99.000

	AMMONIA NITROGEN MG/L N	NITRITE NITROGEN MG/L N	NITRATE NITROGEN MG/L N	PH	CONDUCTIVITY UMHOS/CM	DISSOLVED OXYGEN MG/L	TURBIDITY JTU	TEMPERATURE DEGREES C
JAN	0.810	0.020	1.080	7.600	395.000	11.700	3.000	0.0
FEB	0.950	0.013	0.390	7.600	468.000	11.100	3.000	0.0
MAR	0.670	0.019	0.280	7.500	464.000	11.200	3.000	1.000
APR	0.240	0.019	0.680	7.800	286.000	12.100	10.000	7.000
MAY	0.180	0.022	1.330	8.300	500.000	10.800	10.000	17.000
JUNE	0.300	0.040	1.160	8.000	420.000	8.100	20.000	22.000
JULY	0.160	0.040	0.690	7.800	320.000	6.200	6.400	20.700
AUG	0.440	0.070	0.750	8.300	469.000	6.600	15.000	24.500
SEP	0.340	0.040	0.360	7.700	383.000	7.700	25.000	21.000
OCT	0.330	0.022	0.310	8.000	419.000	8.900	8.000	11.000
NOV	0.460	0.021	0.320	8.300	422.000	11.300	6.500	5.000
DEC	0.680	0.010	0.540	8.000	518.000	11.900	2.500	0.0
MEAN	0.463	0.028	0.657	7.908	423.667	9.800	9.367	10.767
S. D.	0.257	0.017	0.362	0.287	70.581	2.164	7.247	9.759
MEDIAN	0.440	0.022	0.680	8.000	422.000	11.100	8.000	11.000
LOWEST	0.160	0.010	0.280	7.500	286.000	6.200	2.500	0.0
HIGHEST	0.950	0.070	1.330	8.300	518.000	12.100	25.000	24.500

NOTE: -1.000'S ARE MISSING VALUES

	P-ALKALINITY MG/L AS CACO3	M-ALKALINITY MG/L AS CACO3	DISSOLVED ORTHOPHOSPHATE PHOSPHORUS MG/L P	TOTAL DISSOLVED PHOSPHORUS MG/L P	FILTERABLE RESIDUE MG/L	NONFILTERABLE RESIDUE MG/L
JAN	0.0	166.000	0.130	-1.000	300.000	3.200
FEB	0.0	173.000	0.100	0.140	300.000	5.800
MAR	0.0	165.000	0.080	-1.000	240.000	1.600
APR	0.0	108.000	0.050	0.060	230.000	23.000
MAY	0.0	124.000	0.005	0.022	300.000	24.000
JUNE	0.0	122.000	0.090	0.090	320.000	32.000
JULY	0.0	103.000	0.090	0.140	190.000	42.000
AUG	0.0	140.000	0.070	0.120	240.000	26.000
SEP	0.0	103.000	0.070	0.130	220.000	65.000
OCT	0.0	139.000	0.030	0.070	220.000	21.000
NOV	0.0	130.000	0.070	-1.000	210.000	16.000
DEC	0.0	139.000	0.080	0.120	240.000	4.000
MEAN	0.0	134.333	0.072	0.096	250.833	21.983
S. D.	0.0	24.212	0.033	0.041	42.738	18.476
MEDIAN	0.0	139.000	0.080	0.120	240.000	23.000
LOWEST	0.0	103.000	0.005	0.022	190.000	1.600
HIGHEST	0.0	173.000	0.130	0.140	320.000	65.000

	AMMONIA NITROGEN MG/L N	NITRITE NITROGEN MG/L N	NITRATE NITROGEN MG/L N	PH	CONDUCTIVITY UMHOS/CM	DISSOLVED OXYGEN MG/L	TURBIDITY JTU	TEMPERATURE DEGREES C
JAN	0.680	0.024	1.120	7.700	426.000	11.500	3.000	0.400
FEB	0.880	0.013	0.390	7.200	469.000	11.200	3.000	0.0
MAR	0.680	0.023	0.250	7.400	468.000	11.300	3.000	0.500
APR	0.170	0.026	0.620	7.900	350.000	12.500	10.000	7.500
MAY	0.100	0.022	0.150	8.400	550.000	11.600	5.000	17.000
JUNE	0.300	0.060	1.090	8.100	430.000	7.400	15.000	22.000
JULY	0.160	0.042	0.480	7.800	320.000	7.600	82.000	20.500
AUG	0.400	0.068	0.790	8.100	500.000	6.300	10.000	24.000
SEP	0.280	0.038	0.360	7.800	372.000	7.800	20.000	21.000
OCT	0.240	0.021	0.330	8.200	408.000	9.500	10.000	11.000
NOV	0.440	0.021	0.300	8.300	439.000	11.300	6.500	5.000
DEC	0.740	0.011	0.560	8.000	500.000	11.800	2.500	0.0
MEAN	0.422	0.031	0.540	7.906	436.000	9.983	14.167	10.742
S. D.	0.261	0.018	0.314	0.355	66.863	2.141	22.035	9.669
MEDIAN	0.400	0.024	0.480	8.000	439.000	11.300	10.000	11.000
LOWEST	0.100	0.011	0.150	7.200	320.000	6.300	2.500	0.0
HIGHEST	0.880	0.068	1.120	8.400	550.000	12.500	82.000	24.000

NOTE: -1.000'S ARE MISSING VALUES

Table 1.1-1 (Continued) SITE C-48 1978 PAGE 3

	P-ALKALINITY MG/L AS CACO3	M-ALKALINITY MG/L AS CACO3	DISSOLVED ORTHOPHOSPHATE PHOSPHORUS MG/L P	TOTAL DISSOLVED PHOSPHORUS MG/L P	FILTERABLE RESIDUE MG/L	NONFILTRABLE RESIDUE MG/L
JAN	0.0	170.000	0.150	0.180	290.000	2.600
FEB	0.0	170.000	0.100	0.140	300.000	6.600
MAR	0.0	165.000	0.070	-1.000	260.000	2.000
APR	0.0	106.000	0.050	0.070	240.000	25.000
MAY	0.0	125.000	0.006	0.024	300.000	33.000
JUNE	0.0	120.000	0.090	0.090	330.000	49.000
JULY	0.0	111.000	0.100	0.140	230.000	44.000
AUG	0.0	146.000	0.070	0.120	250.000	31.000
SEP	0.0	105.000	0.090	0.120	220.000	90.000
OCT	0.0	135.000	0.020	0.070	220.000	22.000
NOV	0.0	133.000	0.060	-1.000	220.000	17.000
DEC	0.0	140.000	0.090	0.110	240.000	3.000
MEAN	0.0	135.500	0.075	0.106	258.333	27.117
S. D.	0.0	23.624	0.038	0.044	37.618	25.454
MEDIAN	0.0	135.000	0.090	0.120	250.000	25.000
LOWEST	0.0	105.000	0.006	0.024	220.000	2.000
HIGHEST	0.0	170.000	0.150	0.180	330.000	90.000

	AMMONIA NITROGEN MG/L N	NITRITE NITROGEN MG/L N	NITRATE NITROGEN MG/L	PH	CONDUCTIVITY UMHOS/CM	DISSOLVED OXYGEN MG/L	TURBIDITY JTU	TEMPERATURE DEGREES C
JAN	0.700	0.024	1.160	7.700	409.000	10.900	3.000	0.800
FEB	0.840	0.013	0.410	7.500	484.000	11.200	3.000	0.0
MAR	0.680	0.015	0.320	7.500	468.000	11.400	3.000	1.000
APR	0.180	0.026	0.620	8.000	343.000	12.800	10.000	6.000
MAY	0.120	0.022	0.360	8.400	536.000	11.800	10.000	17.000
JUNE	0.320	0.050	1.060	8.100	430.000	7.400	15.000	22.000
JULY	0.160	0.052	0.520	7.900	355.000	6.600	9.300	20.300
AUG	0.400	0.068	0.800	8.200	490.000	6.300	15.000	24.500
SEP	0.310	0.038	0.380	8.800	372.000	7.800	30.000	20.000
OCT	0.230	0.022	0.330	8.100	419.000	9.100	10.000	11.000
NOV	0.350	0.022	0.370	8.300	441.000	11.500	5.000	5.000
DEC	0.660	0.011	0.560	8.000	481.000	11.800	2.500	0.0
MEAN	0.412	0.030	0.574	7.958	435.667	9.883	9.817	10.600
S. D.	0.245	0.018	0.288	0.291	59.278	2.302	7.760	9.522
MEDIAN	0.350	0.024	0.520	8.000	441.000	11.200	10.000	11.000
LOWEST	0.120	0.011	0.320	7.500	343.000	6.300	2.500	0.0
HIGHEST	0.840	0.068	1.160	8.400	536.000	12.800	30.000	24.500

NOTE: -1.000'S ARE MISSING VALUES

1.1-11

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Table 1.1-1 (Continued)

	P-ALKALINITY MG/L AS CACO3	M-ALKALINITY MG/L AS CACO3	DISSOLVED ORTHOPHOSPHATE PHOSPHORUS MG/L P	TOTAL DISSOLVED PHOSPHORUS MG/L P	FILTERABLE RESIDUE MG/L	NONFILTERABLE RESIDUE MG/L
JAN	0.0	165.000	0.120	0.130	280.000	3.600
FEB	0.0	173.000	0.090	0.110	300.000	6.400
MAR	0.0	167.000	0.110	0.120	270.000	3.600
APR	0.0	117.000	0.040	0.080	250.000	13.000
MAY	9.000	126.000	0.001	0.019	310.000	24.000
JUNE	0.0	121.000	0.070	0.080	320.000	39.000
JULY	0.0	120.000	0.140	0.170	240.000	25.000
AUG	0.0	139.000	0.091	0.100	240.000	32.000
SEP	0.0	99.000	0.070	0.110	190.000	91.000
OCT	0.0	119.000	0.010	0.060	220.000	24.000
NOV	2.000	128.000	0.030	-1.000	210.000	16.000
DEC	0.0	142.000	0.080	0.100	220.000	4.000
MEAN	0.917	134.917	0.071	0.098	254.167	23.467
S. D.	2.610	22.992	0.043	0.039	41.878	24.314
MEDIAN	0.0	129.000	0.080	0.100	250.000	24.000
LOWEST	0.0	99.000	0.001	0.019	190.000	3.600
HIGHEST	9.000	173.000	0.140	0.170	320.000	91.000

	AMMONIA NITROGEN MG/L N	NITRITE NITROGEN MG/L N	NITRATE NITROGEN MG/L N	PH	CONDUCTIVITY UMHOS/CM	DISSOLVED OXYGEN MG/L	TURBIDITY JTU	TEMPERATURE DEGREES C
JAN	0.600	0.011	0.920	7.700	600.000	10.400	3.000	0.0
FEB	0.840	0.013	0.470	7.400	500.000	10.000	3.000	0.0
MAR	0.780	0.016	0.390	7.400	478.000	11.000	4.000	1.000
APR	0.140	0.032	0.890	8.000	386.000	12.300	5.000	8.500
MAY	0.040	0.024	0.260	8.700	549.000	11.900	5.000	17.000
JUNE	0.290	0.070	1.070	8.200	450.000	8.300	16.000	21.500
JULY	0.140	0.059	0.630	7.900	315.000	7.300	6.900	20.200
AUG	0.230	0.072	0.820	8.300	479.000	7.200	10.000	23.500
SEP	0.260	0.029	0.350	7.700	333.000	6.500	25.000	15.500
OCT	0.280	0.020	0.320	8.300	405.000	11.300	10.000	11.000
NOV	0.180	0.019	0.360	8.700	422.000	12.200	6.500	3.500
DEC	0.670	0.010	0.560	8.000	500.000	11.200	2.500	0.0
MEAN	0.371	0.031	0.587	8.025	456.417	9.967	8.075	10.475
S. D.	0.275	0.023	0.275	0.437	76.664	2.095	6.596	9.446
MEDIAN	0.280	0.024	0.560	8.000	478.000	11.000	6.500	11.000
LOWEST	0.040	10	0.260	7.400	333.000	6.500	2.500	0.0
HIGHEST	0.840	72	1.070	8.700	600.000	12.300	25.000	23.500

NOTE: -1.000'S ARE MISSING VALUES

Table 1.1-1 (Continued)

	P-ALKALINITY MG/L AS CACO3	M-ALKALINITY MG/L AS CACO3	DISSOLVED ORTHOPHOSPHATE PHOSPHORUS MG/L P	TOTAL DISSOLVED PHOSPHORUS MG/L P	FILTERABLE RESIDUE MG/L	NONFILTERABLE RESIDUE MG/L
JAN	0.0	162.000	0.140	0.160	280.000	2.400
FEB	0.0	170.000	0.080	0.140	330.000	12.000
MAR	0.0	162.000	0.070	0.120	250.000	2.800
APR	0.0	119.000	0.060	0.080	250.000	12.000
MAY	2.000	131.000	0.009	0.024	210.000	59.000
JUNE	0.0	124.000	0.070	0.080	330.000	49.000
JULY	0.0	122.000	0.140	0.150	240.000	24.000
AUG	0.0	112.000	0.090	0.100	250.000	35.000
SEP	0.0	99.000	0.070	0.110	200.000	34.000
OCT	0.0	134.000	0.020	0.060	210.000	48.000
NOV	0.0	119.000	0.060	-1.000	230.000	16.000
DEC	0.0	142.000	0.060	0.100	240.000	4.000
MEAN	0.167	133.000	0.072	0.106	260.000	24.850
S. D.	0.577	22.008	0.039	0.046	43.485	19.786
MEDIAN	0.0	131.000	0.070	0.100	250.000	24.000
LOWEST	0.0	99.000	0.009	0.024	200.000	2.400
HIGHEST	2.000	170.000	0.140	0.190	330.000	59.000

	AMMONIA NITROGEN MG/L N	NITRITE NITROGEN MG/L N	NITRATE NITROGEN MG/L N	PH	CONDUCTIVITY UMHOS/CM	DISSOLVED OXYGEN MG/L	TURBIDITY JTU	TEMPERATURE DEGREES C
JAN	0.720	0.021	1.040	7.600	580.000	10.400	3.000	0.0
FEB	0.780	0.013	0.380	7.400	480.000	10.200	4.000	0.0
MAR	0.680	0.016	0.310	7.400	478.000	11.200	3.000	2.000
APR	0.180	0.033	0.730	8.500	386.000	12.500	10.000	8.500
MAY	0.060	0.024	0.390	8.500	549.000	11.900	15.000	17.000
JUNE	0.280	0.060	1.020	8.000	430.000	7.700	21.000	21.000
JULY	0.140	0.620	0.600	7.900	385.000	6.600	6.500	20.000
AUG	0.290	0.740	0.820	8.200	479.000	6.600	15.000	23.500
SEP	0.270	0.030	0.380	7.600	430.000	6.500	30.000	19.500
OCT	0.320	0.020	0.420	8.200	405.000	10.600	20.000	10.000
NOV	0.360	0.021	0.320	8.500	422.000	12.200	8.500	3.000
DEC	0.700	0.009	0.570	8.000	500.000	11.200	3.000	0.0
MEAN	0.400	0.134	0.582	7.983	460.333	9.800	11.583	10.375
S. D.	0.252	0.257	0.264	0.413	62.066	2.303	8.730	9.323
MEDIAN	0.320	0.024	0.570	8.000	478.000	10.600	10.000	10.000
LOWEST	0.060	0.009	0.310	7.400	385.000	6.500	3.000	0.0
HIGHEST	0.780	0.740	1.040	8.500	580.000	12.500	30.000	23.500

NOTE: -1.000'S ARE MISSING VALUES

Table 1.1-1 (Continued)

	P-ALKALINITY MG/L AS CACO3	M-ALKALINITY MG/L AS CACO3	DISSOLVED ORTHOPHOSPHATE PHOSPHORUS MG/L P	TOTAL DISSOLVED PHOSPHORUS MG/L P	FILTERABLE RESIDUE MG/L	NONFILTERABLE RESIDUE MG/L
JAN	0.0	164.000	0.150	-1.000	280.000	1.800
FEB	0.0	171.000	0.100	0.130	340.000	5.200
MAR	0.0	167.000	0.100	0.110	260.000	2.400
APR	0.0	114.000	0.060	0.080	250.000	20.000
MAY	5.000	134.000	0.005	0.021	320.000	29.000
JUNE	0.0	124.000	0.090	0.110	320.000	36.000
JULY	0.0	121.000	0.140	0.160	240.000	25.000
AUG	0.0	153.000	0.080	0.120	270.000	33.000
SEP	0.0	95.000	0.070	0.100	190.000	44.000
OCT	0.0	131.000	0.020	0.080	220.000	27.000
NOV	0.0	136.000	0.060	-1.000	230.000	18.000
DEC	0.0	142.000	0.070	0.110	250.000	3.000
MEAN	0.417	137.667	0.079	0.102	264.167	20.367
S. D.	1.443	23.011	0.042	0.037	44.611	14.483
MEDIAN	0.0	136.000	0.080	0.110	260.000	25.000
LOWEST	0.0	95.000	0.005	0.021	190.000	1.800
HIGHEST	5.000	171.000	0.150	0.160	340.000	44.000

	AMMONIA NITROGEN MG/L N	NITRITE NITROGEN MG/L N	NITRATE NITROGEN MG/L N	PH	CONDUCTIVITY UMHOS/CM	DISSOLVED OXYGEN MG/L	TURBIDITY JTU	TEMPERATURE DEGREES C
JAN	0.660	0.021	1.010	7.800	558.000	10.300	2.000	0.100
FEB	0.840	0.013	0.410	7.600	444.000	9.400	2.000	1.000
MAR	0.600	0.024	0.300	7.600	471.000	11.000	3.000	4.000
APR	0.330	0.030	0.770	8.000	364.000	9.500	10.000	6.500
MAY	0.040	0.022	1.370	8.600	548.000	12.200	10.000	21.000
JUNE	0.240	0.060	1.260	8.300	430.000	7.800	16.000	25.500
JULY	0.160	0.057	0.620	8.000	375.000	7.800	7.200	22.000
AUG	0.230	0.060	0.980	8.400	500.000	7.200	15.000	27.500
SEP	0.160	0.025	0.400	8.100	423.000	7.100	20.000	25.000
OCT	0.130	0.020	0.400	8.400	434.000	9.000	10.000	16.000
NOV	0.220	0.024	0.520	8.500	434.000	10.400	8.500	13.000
DEC	0.590	0.023	0.640	8.000	484.000	11.200	3.000	3.000
MEAN	0.342	0.032	0.723	8.108	447.083	9.408	8.892	13.717
S. D.	0.258	0.017	0.357	0.337	70.942	1.675	5.896	10.430
MEDIAN	0.230	0.024	0.640	8.100	444.000	9.500	10.000	16.000
LOWEST	0.040	0.013	0.300	7.600	323.000	7.100	2.000	0.100
HIGHEST	0.840	0.060	1.370	8.600	558.000	12.200	20.000	27.500

NOTE: -1.000'S ARE MISSING VALUES

Table 1.1-1 (Continued)

SITE Y-2E

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	P-ALKALINITY MG/L AS CACO3	M-ALKALINITY MG/L AS CACO3	DISSOLVED ORTHOPHOSPHATE PHOSPHORUS MG/L P	TOTAL DISSOLVED PHOSPHORUS MG/L P	FILTERABLE RESIDUE MG/L	NONFILTERABLE RESIDUE MG/L
JAN	0.0	165.000	0.110	0.150	280.000	3.800
FEB	0.0	175.000	0.100	0.140	300.000	6.600
MAR	0.0	169.000	0.090	-1.000	260.000	2.200
APR	0.0	115.000	0.050	0.060	250.000	21.000
MAY	0.0	132.000	0.004	0.018	340.000	40.000
JUNE	3.000	124.000	0.080	0.090	320.000	49.000
JULY	0.0	118.000	0.110	0.150	230.000	35.000
AUG	0.0	144.000	0.100	0.110	200.000	39.000
SEP	0.0	96.000	0.070	0.100	190.000	57.000
OCT	0.0	124.000	0.020	0.600	220.000	35.000
NOV	0.0	139.000	0.060	-1.000	220.000	20.000
DEC	0.0	139.000	0.080	0.100	250.000	8.000
MEAN	0.250	136.667	0.073	0.152	255.000	26.383
S. D.	0.866	23.735	0.034	0.163	47.194	18.674
MEDIAN	0.0	139.000	0.080	0.110	250.000	35.000
LOWEST	0.0	96.000	0.004	0.018	190.000	2.200
HIGHEST	3.000	175.000	0.110	0.600	340.000	57.000

	AMMONIA NITROGEN MG/L N	NITRITE NITROGEN MG/L N	NITRATE NITROGEN MG/L N	PH	CONDUCTIVITY UMHOS/CM	DISSOLVED OXYGEN MG/L	TURBIDITY JTU	TEMPERATURE DEGREES C
JAN	0.610	0.024	1.090	7.700	553.000	10.300	3.000	3.000
FEB	0.650	0.020	0.380	7.600	465.000	9.800	3.000	3.000
MAR	0.640	0.024	0.320	7.600	468.000	11.300	3.000	4.000
APR	0.210	0.028	0.660	8.000	364.000	9.500	10.000	5.500
MAY	0.040	0.024	0.380	8.500	561.000	12.300	10.000	17.000
JUNE	0.035	0.060	1.090	8.100	440.000	7.600	20.000	21.500
JULY	0.180	0.055	0.690	8.000	375.000	6.700	7.500	20.200
AUG	0.300	0.071	0.870	8.200	490.000	6.900	15.000	24.000
SEP	0.190	0.028	0.390	8.000	330.000	7.000	25.000	20.000
OCT	0.160	0.021	0.340	8.200	405.000	10.000	15.000	11.000
NOV	0.770	0.021	0.350	8.500	435.000	11.800	10.000	5.000
DEC	0.560	0.022	0.620	8.000	500.000	10.800	3.000	4.000
MEAN	0.362	0.033	0.598	8.033	449.167	9.500	10.375	11.517
S. D.	0.264	0.018	0.288	0.299	72.135	1.989	7.234	8.366
MEDIAN	0.300	0.024	0.620	8.000	465.000	10.000	10.000	11.000
LOWEST	0.035	0.020	0.320	7.600	330.000	6.700	3.000	3.000
HIGHEST	0.770	0.071	1.090	8.500	561.000	12.300	25.000	24.000

NOTE: -1.000'S ARE MISSING VALUES

Table 1.1-2 (Continued)

FULL FACTORIAL ANALYSIS OF VARIANCE
(0 MISSING VALUES HAVE BEEN ESTIMATED)

M-ALKALINITY MG/L AS CACO3

PLANT EFFECT

	ABOVE STATIONS X-1 AND B-1 DEPTH EFFECT		BELOW STATIONS Y-2 AND C-4 DEPTH EFFECT	
	BOTTOM	TOP	BOTTOM	TOP
JAN	162.000 X-1	165.000 X-1	165.000 Y-2	164.000 Y-2
	176.000 B-1	181.000 B-1	170.000 C-4	166.000 C-4
FEB	170.000 X-1	173.000 X-1	175.000 Y-2	171.000 Y-2
	192.000 B-1	182.000 B-1	170.000 C-4	173.000 C-4
MAR	162.000 X-1	167.000 X-1	169.000 Y-2	167.000 Y-2
	167.000 B-1	166.000 B-1	165.000 C-4	165.000 C-4
APR	119.000 X-1	117.000 X-1	115.000 Y-2	114.000 Y-2
	94.000 B-1	90.000 B-1	106.000 C-4	108.000 C-4
MAY	131.000 X-1	129.000 X-1	132.000 Y-2	134.000 Y-2
	122.000 B-1	123.000 B-1	125.000 C-4	124.000 C-4
JUN	124.000 X-1	121.000 X-1	124.000 Y-2	124.000 Y-2
	120.000 B-1	118.000 B-1	120.000 C-4	122.000 C-4
JUL	122.000 X-1	120.000 X-1	118.000 Y-2	121.000 Y-2
	101.000 B-1	100.000 B-1	111.000 C-4	113.000 C-4
AUG	112.000 X-1	139.000 X-1	144.000 Y-2	153.000 Y-2
	152.000 B-1	151.000 B-1	146.000 C-4	140.000 C-4
SEP	99.000 X-1	99.000 X-1	96.000 Y-2	95.000 Y-2
	115.000 B-1	112.000 B-1	105.000 C-4	103.000 C-4
OCT	134.000 X-1	119.000 X-1	124.000 Y-2	131.000 Y-2
	135.000 B-1	135.000 B-1	135.000 C-4	139.000 C-4
NOV	119.000 X-1	128.000 X-1	139.000 Y-2	136.000 Y-2
	130.000 B-1	131.000 B-1	133.000 C-4	130.000 C-4
DEC	142.000 X-1	142.000 X-1	139.000 Y-2	142.000 Y-2
	142.000 B-1	143.000 B-1	140.000 C-4	139.000 C-4
PLANT TOTAL	6493.000		6530.000	
AVERAGE	135.271		136.042	

		BOTTOM	TOP
DEPTH	TOTAL	6508.000	6515.000
	AVERAGE	135.583	135.729

ANOVA

SOURCE	D F	SUM OF SQUARES	MEAN SQUARE	F-STAT
MONTH	11.	51116.2813	4646.9347	71.1321**
PLANT	1.	14.2604	14.2604	0.2183
MONTH X PLANT	11.	544.8646	49.5331	0.7582
DEPTH	1.	0.5104	0.5104	0.0078
MONTH X DEPTH	11.	136.1146	12.3741	0.1894
PLANT X DEPTH	1.	1.2604	1.2604	0.0193
ERROR	59.	3854.3646	65.3282	
TOTAL	95.	55667.6563		

* SIGNIFICANT (95 % CONFIDENCE LEVEL)
** HIGHLY SIGNIFICANT (99 % CONFIDENCE LEVEL)

Table 1.1-2

FULL FACTORIAL ANALYSIS OF VARIANCE
(0 MISSING VALUES HAVE BEEN ESTIMATED)

P-ALKALINITY MG/L AS CACO3

PLANT EFFECT

	ABOVE STATIONS X-1 AND B-1 DEPTH EFFECT				BELOW STATIONS Y-2 AND C-4 DEPTH EFFECT			
	BOTTOM		TOP		BOTTOM		TOP	
JAN	0.0	X-1	0.0	X-1	0.0	Y-2	0.0	Y-2
	0.0	B-1	0.0	B-1	0.0	C-4	0.0	C-4
FEB	0.0	X-1	0.0	X-1	0.0	Y-2	0.0	Y-2
	0.0	B-1	0.0	B-1	0.0	C-4	0.0	C-4
MAR	0.0	X-1	0.0	X-1	0.0	Y-2	0.0	Y-2
	0.0	B-1	0.0	B-1	0.0	C-4	0.0	C-4
APR	0.0	X-1	0.0	X-1	0.0	Y-2	0.0	Y-2
	0.0	B-1	0.0	B-1	0.0	C-4	0.0	C-4
MAY	2.000	X-1	9.000	X-1	0.0	Y-2	5.000	Y-2
	0.0	B-1	0.0	B-1	0.0	C-4	0.0	C-4
JUN	0.0	X-1	0.0	X-1	3.000	Y-2	0.0	Y-2
	0.0	B-1	0.0	B-1	0.0	C-4	0.0	C-4
JUL	0.0	X-1	0.0	X-1	0.0	Y-2	0.0	Y-2
	0.0	B-1	0.0	B-1	0.0	C-4	0.0	C-4
AUG	0.0	X-1	0.0	X-1	0.0	Y-2	0.0	Y-2
	0.0	B-1	0.0	B-1	0.0	C-4	0.0	C-4
SEP	0.0	X-1	0.0	X-1	0.0	Y-2	0.0	Y-2
	0.0	B-1	0.0	B-1	0.0	C-4	0.0	C-4
OCT	0.0	X-1	0.0	X-1	0.0	Y-2	0.0	Y-2
	0.0	B-1	0.0	B-1	0.0	C-4	0.0	C-4
NOV	0.0	X-1	2.000	X-1	0.0	Y-2	0.0	Y-2
	0.0	B-1	0.0	B-1	0.0	C-4	0.0	C-4
DEC	0.0	X-1	0.0	X-1	0.0	Y-2	0.0	Y-2
	0.0	B-1	0.0	B-1	0.0	C-4	0.0	C-4
PLANT TOTAL	13.000				8.000			
AVERAGE	0.271				0.167			

		BOTTOM	TOP
DEPTH	TOTAL	5.000	16.000
	AVERAGE	0.104	0.333

ANOVA

SOURCE	D F	SUM OF SQUARES	MEAN SQUARE	F-STAT
MONTH	11.	29.0313	2.6392	2.4671*
PLANT	1.	0.2604	0.2604	0.2434
MONTH X PLANT	11.	5.8646	0.5331	0.4984
DEPTH	1.	1.2604	1.2604	1.1782
MONTH X DEPTH	11.	18.3646	1.6695	1.5607
PLANT X DEPTH	1.	0.5104	0.5104	0.4771
ERROR	59.	63.1146	1.0697	
TOTAL	95.	118.4063		

* SIGNIFICANT (95 % CONFIDENCE LEVEL)
** HIGHLY SIGNIFICANT (99 % CONFIDENCE LEVEL)

Table 1.1-2 (Continued)

FULL FACTORIAL ANALYSIS OF VARIANCE
(15 MISSING VALUES HAVE BEEN ESTIMATED)

TOTAL DISSOLVED PHOSPHORUS MG/L P

PLANT EFFECT

	ABOVE STATIONS X-1 AND B-1 DEPTH EFFECT		BELOW STATIONS Y-2 AND C-4 DEPTH EFFECT	
	BOTTOM	TOP	BOTTOM	TOP
JAN	0.160 X-1	0.130 X-1	0.150 Y-2	0.155 Y-2
	0.154 B-1	0.200 B-1	0.180 C-4	0.154 C-4
FEB	0.140 X-1	0.110 X-1	0.140 Y-2	0.130 Y-2
	0.140 B-1	0.150 B-1	0.140 C-4	0.140 C-4
MAR	0.120 X-1	0.120 X-1	0.164 Y-2	0.110 Y-2
	0.117 B-1	0.120 B-1	0.119 C-4	0.117 C-4
APR	0.080 X-1	0.080 X-1	0.080 Y-2	0.080 Y-2
	0.070 B-1	0.070 B-1	0.070 C-4	0.060 C-4
MAY	0.024 X-1	0.019 X-1	0.016 Y-2	0.021 Y-2
	0.026 B-1	0.028 B-1	0.024 C-4	0.022 C-4
JUN	0.080 X-1	0.080 X-1	0.090 Y-2	0.110 Y-2
	0.100 B-1	0.090 B-1	0.090 C-4	0.090 C-4
JUL	0.190 X-1	0.170 X-1	0.150 Y-2	0.160 Y-2
	0.120 B-1	0.120 B-1	0.140 C-4	0.140 C-4
AUG	0.100 X-1	0.100 X-1	0.110 Y-2	0.120 Y-2
	0.120 B-1	0.140 B-1	0.120 C-4	0.120 C-4
SEP	0.110 X-1	0.110 X-1	0.100 Y-2	0.100 Y-2
	0.130 B-1	0.130 B-1	0.120 C-4	0.130 C-4
OCT	0.060 X-1	0.060 X-1	0.060 Y-2	0.080 Y-2
	0.070 B-1	0.080 B-1	0.070 C-4	0.070 C-4
NOV	0.101 X-1	0.093 X-1	0.148 Y-2	0.102 Y-2
	0.100 B-1	0.108 B-1	0.102 C-4	0.101 C-4
DEC	0.100 X-1	0.100 X-1	0.100 Y-2	0.110 Y-2
	0.110 B-1	0.120 B-1	0.110 C-4	0.120 C-4
PLANT TOTAL	5.049		5.658	
PLANT AVERAGE	0.105		0.118	

		BOTTOM	TOP
DEPTH	TOTAL	5.637	5.071
	AVERAGE	0.117	0.106

ANOVA

SOURCE	D F	SUM OF SQUARES	MEAN SQUARE	F-STAT
MONTH	11.	0.1210	0.0110	2.5910*
PLANT	1.	0.0039	0.0039	0.9094
MONTH X PLANT	11.	0.0348	0.0032	0.7458
DEPTH	1.	0.0033	0.0033	0.7854
MONTH X DEPTH	11.	0.0302	0.0027	0.6466
PLANT X DEPTH	1.	0.0035	0.0035	0.8281
ERROR	44.	0.1868	0.0042	
TOTAL	80.	0.3835		

* SIGNIFICANT (95 % CONFIDENCE LEVEL)
** HIGHLY SIGNIFICANT (99 % CONFIDENCE LEVEL)

Table 1.1-2 (Continued)

FULL FACTORIAL ANALYSIS OF VARIANCE
(0 MISSING VALUES HAVE BEEN ESTIMATED)

DISSOLVED ORTHOPHOSPHATE PHOSPHORUS MG/L P

PLANT EFFECT

	ABOVE STATIONS X-1 AND B-1 DEPTH EFFECT		BELOW STATIONS Y-2 AND C-4 DEPTH EFFECT	
	BOTTOM	TOP	BOTTOM	TOP
JAN	0.140 X-1	0.120 X-1	0.110 Y-2	0.150 Y-2
	0.140 B-1	0.140 B-1	0.150 C-4	0.130 C-4
FEB	0.080 X-1	0.090 X-1	0.100 Y-2	0.100 Y-2
	0.100 B-1	0.110 B-1	0.100 C-4	0.100 C-4
MAR	0.070 X-1	0.110 X-1	0.090 Y-2	0.100 Y-2
	0.100 B-1	0.100 B-1	0.070 C-4	0.080 C-4
APR	0.060 X-1	0.040 X-1	0.050 Y-2	0.060 Y-2
	0.040 B-1	0.050 B-1	0.050 C-4	0.050 C-4
MAY	0.009 X-1	0.001 X-1	0.004 Y-2	0.005 Y-2
	0.009 B-1	0.013 B-1	0.006 C-4	0.005 C-4
JUN	0.070 X-1	0.070 X-1	0.080 Y-2	0.090 Y-2
	0.090 B-1	0.080 B-1	0.090 C-4	0.090 C-4
JUL	0.140 X-1	0.140 X-1	0.110 Y-2	0.140 Y-2
	0.090 B-1	0.090 B-1	0.100 C-4	0.090 C-4
AUG	0.090 X-1	0.090 X-1	0.100 Y-2	0.080 Y-2
	0.070 B-1	0.070 B-1	0.070 C-4	0.070 C-4
SEP	0.070 X-1	0.070 X-1	0.070 Y-2	0.070 Y-2
	0.100 B-1	0.100 B-1	0.090 C-4	0.070 C-4
OCT	0.020 X-1	0.010 X-1	0.020 Y-2	0.020 Y-2
	0.020 B-1	0.030 B-1	0.020 C-4	0.030 C-4
NOV	0.060 X-1	0.030 X-1	0.060 Y-2	0.060 Y-2
	0.080 B-1	0.080 B-1	0.060 C-4	0.070 C-4
DEC	0.060 X-1	0.080 X-1	0.080 Y-2	0.070 Y-2
	0.100 B-1	0.080 B-1	0.090 C-4	0.080 C-4
PLANT TOTAL	3.602		3.580	
PLANT AVERAGE	0.075		0.075	

		BOTTOM	TOP
DEPTH	TOTAL	3.578	3.604
	AVERAGE	0.075	0.075

ANOVA

SOURCE	D F	SUM OF SQUARES	MEAN SQUARE	F-STAT
MONTH	11.	0.1138	0.0103	49.2125**
PLANT	1.	0.0000	0.0000	0.0240
MONTH X PLANT	11.	0.0008	0.0001	0.3352
DEPTH	1.	0.0000	0.0000	0.0335
MONTH X DEPTH	11.	0.0008	0.0001	0.3274
PLANT X DEPTH	1.	0.0000	0.0000	0.1444
ERROR	59.	0.0124	0.0002	
TOTAL	95.	0.1278		

* SIGNIFICANT (95 % CONFIDENCE LEVEL)
** HIGHLY SIGNIFICANT (99 % CONFIDENCE LEVEL)

FULL FACTORIAL ANALYSIS OF VARIANCE
(0 MISSING VALUES HAVE BEEN ESTIMATED)

Table 1.1-2 (Continued)

NONFILTERABLE RESIDUE MG/L

PLANT EFFECT

	ABOVE STATIONS X-1 AND B-1 DEPTH EFFECT		BELOW STATIONS Y-2 AND C-4 DEPTH EFFECT	
	BOTTOM	TOP	BOTTOM	TOP
JAN	2.400 X-1	3.600 X-1	3.800 Y-2	1.800 Y-2
	22.600 B-1	4.200 B-1	2.600 C-4	3.200 C-4
FEB	12.000 X-1	6.400 X-1	6.600 Y-2	5.200 Y-2
	7.800 B-1	6.000 B-1	6.800 C-4	5.800 C-4
MAR	2.800 X-1	3.600 X-1	2.200 Y-2	2.400 Y-2
	2.200 B-1	2.400 B-1	2.000 C-4	1.800 C-4
APR	12.000 X-1	13.000 X-1	21.000 Y-2	20.000 Y-2
	36.000 B-1	34.000 B-1	25.000 C-4	23.000 C-4
MAY	59.000 X-1	24.000 X-1	40.000 Y-2	29.000 Y-2
	28.000 B-1	26.000 B-1	33.000 C-4	24.000 C-4
JUN	49.000 X-1	39.000 X-1	49.000 Y-2	36.000 Y-2
	54.000 B-1	45.000 B-1	49.000 C-4	32.000 C-4
JUL	24.000 X-1	25.000 X-1	35.000 Y-2	25.000 Y-2
	45.000 B-1	39.000 B-1	44.000 C-4	42.000 C-4
AUG	35.000 X-1	32.000 X-1	39.000 Y-2	33.000 Y-2
	60.000 B-1	42.000 B-1	31.000 C-4	26.000 C-4
SEP	34.000 X-1	91.000 X-1	57.000 Y-2	44.000 Y-2
	240.000 B-1	59.000 B-1	90.000 C-4	65.000 C-4
OCT	48.000 X-1	24.000 X-1	35.000 Y-2	27.000 Y-2
	30.000 B-1	18.000 B-1	22.000 C-4	21.000 C-4
NOV	16.000 X-1	16.000 X-1	20.000 Y-2	18.000 Y-2
	20.000 B-1	18.000 B-1	17.000 C-4	16.000 C-4
DEC	4.000 X-1	4.000 X-1	8.000 Y-2	3.000 Y-2
	4.000 B-1	3.000 B-1	3.000 C-4	4.000 C-4
PLANT TOTAL	1470.000		1150.200	
AVERAGE	30.625		23.963	

		BOTTOM	TOP
DEPTH	TOTAL	1493.800	1126.400
	AVERAGE	31.121	23.467

ANOVA

SOURCE	D F	SUM OF SQUARES	MEAN SQUARE	F-STAT
MONTH	11.	52491.8612	4771.9874	11.2664**
PLANT	1.	1065.3338	1065.3338	2.5152
MONTH X PLANT	11.	4722.6112	429.3283	1.0136
DEPTH	1.	1406.0704	1406.0704	3.3196
MONTH X DEPTH	11.	1660.6546	150.9595	0.3564
PLANT X DEPTH	1.	103.7504	103.7504	0.2449
ERROR	59.	24990.0546	423.5602	
TOTAL	95.	86440.2362		

* SIGNIFICANT (95 % CONFIDENCE LEVEL)
** HIGHLY SIGNIFICANT (99 % CONFIDENCE LEVEL)

Table 1.1-2 (Continued)

FULL FACTORIAL ANALYSIS OF VARIANCE
(0 MISSING VALUES HAVE BEEN ESTIMATED)

FILTERABLE RESIDUE MG/L

PLANT EFFECT

	ABOVE STATIONS X-1 AND B-1 DEPTH EFFECT		BELOW STATIONS Y-2 AND C-4 DEPTH EFFECT	
	BOTTOM	TOP	BOTTOM	TOP
JAN	280.000 X-1	280.000 X-1	280.000 Y-2	280.000 Y-2
	300.000 B-1	320.000 B-1	290.000 C-4	300.000 C-4
FEB	330.000 X-1	300.000 X-1	300.000 Y-2	340.000 Y-2
	350.000 B-1	350.000 B-1	300.000 C-4	300.000 C-4
MAR	250.000 X-1	270.000 X-1	260.000 Y-2	260.000 Y-2
	260.000 B-1	270.000 B-1	260.000 C-4	240.000 C-4
APR	250.000 X-1	250.000 X-1	250.000 Y-2	250.000 Y-2
	200.000 B-1	190.000 B-1	240.000 C-4	230.000 C-4
MAY	310.000 X-1	310.000 X-1	340.000 Y-2	320.000 Y-2
	310.000 B-1	330.000 B-1	300.000 C-4	300.000 C-4
JUN	330.000 X-1	320.000 X-1	320.000 Y-2	320.000 Y-2
	310.000 B-1	310.000 B-1	330.000 C-4	320.000 C-4
JUL	240.000 X-1	240.000 X-1	230.000 Y-2	240.000 Y-2
	210.000 B-1	210.000 B-1	230.000 C-4	190.000 C-4
AUG	250.000 X-1	240.000 X-1	200.000 Y-2	270.000 Y-2
	260.000 B-1	250.000 B-1	250.000 C-4	240.000 C-4
SEP	200.000 X-1	190.000 X-1	190.000 Y-2	190.000 Y-2
	220.000 B-1	230.000 B-1	220.000 C-4	220.000 C-4
OCT	210.000 X-1	220.000 X-1	220.000 Y-2	220.000 Y-2
	220.000 B-1	210.000 B-1	220.000 C-4	220.000 C-4
NOV	230.000 X-1	210.000 X-1	220.000 Y-2	230.000 Y-2
	210.000 B-1	210.000 B-1	220.000 C-4	210.000 C-4
DEC	240.000 X-1	220.000 X-1	250.000 Y-2	250.000 Y-2
	240.000 B-1	250.000 B-1	240.000 C-4	240.000 C-4
PLANT TOTAL	12390.000		12340.000	
AVERAGE	258.125		257.083	

		BOTTOM	TOP
DEPTH	TOTAL	12370.000	12360.000
	AVERAGE	257.708	257.500

ANOVA

SOURCE	D F	SUM OF SQUARES	MEAN SQUARE	F-STAT
MONTH	11.	162411.4583	14764.6780	49.6746**
PLANT	1.	26.0417	26.0417	0.0876
MONTH X PLANT	11.	2536.4583	230.5871	0.7758
DEPTH	1.	1.0417	1.0417	0.0035
MONTH X DEPTH	11.	611.4583	55.5871	0.1870
PLANT X DEPTH	1.	26.0417	26.0417	0.0876
ERROR	59.	17536.4583	297.2281	
TOTAL	95.	183148.9583		

* SIGNIFICANT (95 % CONFIDENCE LEVEL)
** HIGHLY SIGNIFICANT (99 % CONFIDENCE LEVEL)

FULL FACTORIAL ANALYSIS OF VARIANCE
(0 MISSING VALUES HAVE BEEN ESTIMATED)

Table 1.1-2 (Continued)

NITRITE NITROGEN MG/L N

PLANT EFFECT

	ABOVE STATIONS X-1 AND B-1 DEPTH EFFECT		BELOW STATIONS Y-2 AND C-4 DEPTH EFFECT	
	BOTTOM	TOP	BOTTOM	TOP
JAN	0.021 X-1	0.011 X-1	0.024 Y-2	0.021 Y-2
	0.014 B-1	0.020 B-1	0.024 C-4	0.024 C-4
FEB	0.013 X-1	0.013 X-1	0.020 Y-2	0.013 Y-2
	0.120 B-1	0.013 B-1	0.013 C-4	0.013 C-4
MAR	0.016 X-1	0.016 X-1	0.024 Y-2	0.024 Y-2
	0.018 B-1	0.019 B-1	0.018 C-4	0.023 C-4
APR	0.033 X-1	0.032 X-1	0.026 Y-2	0.030 Y-2
	0.020 B-1	0.019 B-1	0.026 C-4	0.026 C-4
MAY	0.024 X-1	0.024 X-1	0.024 Y-2	0.022 Y-2
	0.022 B-1	0.022 B-1	0.022 C-4	0.022 C-4
JUN	0.060 X-1	0.070 X-1	0.060 Y-2	0.060 Y-2
	0.050 B-1	0.040 B-1	0.050 C-4	0.060 C-4
JUL	0.620 X-1	0.059 X-1	0.055 Y-2	0.057 Y-2
	0.042 B-1	0.040 B-1	0.052 C-4	0.042 C-4
AUG	0.740 X-1	0.072 X-1	0.071 Y-2	0.060 Y-2
	0.076 B-1	0.070 B-1	0.068 C-4	0.068 C-4
SEP	0.030 X-1	0.029 X-1	0.028 Y-2	0.025 Y-2
	0.043 B-1	0.040 B-1	0.038 C-4	0.038 C-4
OCT	0.020 X-1	0.020 X-1	0.021 Y-2	0.020 Y-2
	0.022 B-1	0.022 B-1	0.022 C-4	0.021 C-4
NOV	0.021 X-1	0.019 X-1	0.021 Y-2	0.024 Y-2
	0.021 B-1	0.021 B-1	0.022 C-4	0.021 C-4
DEC	0.009 X-1	0.010 X-1	0.022 Y-2	0.023 Y-2
	0.010 B-1	0.010 B-1	0.011 C-4	0.011 C-4
PLANT TOTAL	2.776		1.512	
AVERAGE	0.058		0.031	

		BOTTOM	TOP
DEPTH	TOTAL	2.829	1.459
	AVERAGE	0.059	0.030

ANOVA

SOURCE	D F	SUM OF SQUARES	MEAN SQUARE	F-STAT
MONTH	11.	0.1781	0.0162	2.0281*
PLANT	1.	0.0166	0.0166	2.0852
MONTH X PLANT	11.	0.0831	0.0076	0.9463
DEPTH	1.	0.0196	0.0196	2.4496
MONTH X DEPTH	11.	0.0815	0.0074	0.9284
PLANT X DEPTH	1.	0.0186	0.0186	2.3365
ERROR	59.	0.4709	0.0080	
TOTAL	95.	0.8684		

* SIGNIFICANT (95 % CONFIDENCE LEVEL)
** HIGHLY SIGNIFICANT (99 % CONFIDENCE LEVEL)

Table 1 1-2 (Continued)

FULL FACTORIAL ANALYSIS OF VARIANCE
(0 MISSING VALUES HAVE BEEN ESTIMATED)

AMMONIA NITROGEN MG/L N

PLANT EFFECT

	ABOVE STATIONS X-1 AND B-1 DEPTH EFFECT		BELOW STATIONS Y-2 AND C-4 DEPTH EFFECT	
	BOTTOM	TOP	BOTTOM	TOP
JAN	0.720 X-1	0.600 X-1	0.610 Y-2	0.660 Y-2
	0.740 B-1	0.810 B-1	0.700 C-4	0.680 C-4
FEB	0.780 X-1	0.840 X-1	0.650 Y-2	0.840 Y-2
	0.950 B-1	0.950 B-1	0.840 C-4	0.880 C-4
MAR	0.680 X-1	0.780 X-1	0.640 Y-2	0.600 Y-2
	0.700 B-1	0.670 B-1	0.680 C-4	0.680 C-4
APR	0.180 X-1	0.140 X-1	0.210 Y-2	0.230 Y-2
	0.260 B-1	0.240 B-1	0.180 C-4	0.170 C-4
MAY	0.060 X-1	0.040 X-1	0.040 [illegible]	0.040 Y-2
	0.160 B-1	0.180 B-1	0.12[illegible] [illegible]-4	0.100 C-4
JUN	0.280 X-1	0.290 X-1	0.03[illegible] Y-[illegible]	0.240 Y-2
	0.330 B-1	0.300 B-1	0.320 C-4	0.300 C-4
JUL	0.140 X-1	0.140 X-1	0.180 Y-2	0.160 Y-2
	0.190 B-1	0.160 B-1	0.160 C-4	0.160 C-4
AUG	0.290 X-1	0.230 X-1	0.300 Y-2	0.230 Y-2
	0.460 B-1	0.440 B-1	0.400 C-4	0.400 C-4
SEP	0.270 X-1	0.260 X-1	0.190 Y-2	0.160 Y-2
	0.350 B-1	0.340 B-1	0.310 C-4	0.280 C-4
OCT	0.320 X-1	0.280 X-1	0.160 Y-2	0.130 Y-2
	0.380 B-1	0.330 B-1	0.230 C-4	0.240 C-4
NOV	0.380 X-1	0.180 X-1	0.770 Y-2	0.220 Y-2
	0.400 B-1	0.460 B-1	0.350 C-4	0.440 C-4
DEC	0.700 X-1	0.670 X-1	0.560 Y-2	0.550 Y-2
	0.640 B-1	0.680 B-1	0.660 C-4	0.740 C-4
PLANT TOTAL	20.370		18.465	
AVERAGE	0.424		0.385	

		BOTTOM	TOP
DEPTH	TOTAL	19.655	19.180
	AVERAGE	0.409	0.400

ANOVA

SOURCE	D F	SUM OF SQUARES	MEAN SQUARE	F-STAT
MONTH	11.	5.3715	0.4883	66.0624**
PLANT	1.	0.0378	0.0378	5.1141*
MONTH X PLANT	11.	0.0685	0.0062	0.8419
DEPTH	1.	0.0024	0.0024	0.3180
MONTH X DEPTH	11.	0.0643	0.0058	0.7912
PLANT X DEPTH	1.	0.0005	0.0005	0.0713
ERROR	59.	0.4361	0.0074	
TOTAL	95.	5.9811		

* SIGNIFICANT (95 % CONFIDENCE LEVEL)
** HIGHLY SIGNIFICANT (99 % CONFIDENCE LEVEL)

FULL FACTORIAL ANALYSIS OF VARIANCE
(0 MISSING VALUES HAVE BEEN ESTIMATED)

Table 1.1-2 (Continued)

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PLANT EFFECT

	ABOVE STATIONS X-1 AND B-1 DEPTH EFFECT		BELOW STATIONS Y-2 AND C-4 DEPTH EFFECT	
	BOTTOM	TOP	BOTTOM	TOP
JAN	7.600 X-1	7.700 X-1	7.700 Y-2	7.800 Y-2
	7.600 B-1	7.600 B-1	7.700 C-4	7.700 C-4
FEB	7.400 X-1	7.400 X-1	7.600 Y-2	7.600 Y-2
	7.600 B-1	7.600 B-1	7.500 C-4	7.200 C-4
MAR	7.400 X-1	7.400 X-1	7.600 Y-2	7.600 Y-2
	7.500 B-1	7.500 B-1	7.500 C-4	7.400 C-4
APR	8.500 X-1	8.000 X-1	8.000 Y-2	8.000 Y-2
	7.900 B-1	7.800 B-1	8.000 C-4	7.900 C-4
MAY	8.500 X-1	8.700 X-1	8.500 Y-2	8.600 Y-2
	8.300 B-1	8.300 B-1	8.400 C-4	8.400 C-4
JUN	8.000 X-1	8.200 X-1	8.100 Y-2	8.300 Y-2
	8.100 B-1	8.000 B-1	8.100 C-4	8.100 C-4
JUL	7.900 X-1	7.900 X-1	8.000 Y-2	8.000 Y-2
	7.900 B-1	7.800 B-1	7.900 C-4	7.800 C-4
AUG	8.200 X-1	8.300 X-1	8.200 Y-2	8.400 Y-2
	8.000 B-1	8.300 B-1	8.200 C-4	8.100 C-4
SEP	7.600 X-1	7.700 X-1	8.000 Y-2	8.100 Y-2
	7.700 B-1	7.700 B-1	7.800 C-4	7.800 C-4
OCT	8.200 X-1	8.300 X-1	8.200 Y-2	8.400 Y-2
	8.000 B-1	8.000 B-1	8.100 C-4	8.200 C-4
NOV	8.500 X-1	8.700 X-1	8.500 Y-2	8.500 Y-2
	8.300 B-1	8.300 B-1	8.300 C-4	8.300 C-4
DEC	8.000 X-1	8.000 X-1	8.000 Y-2	8.000 Y-2
	8.000 B-1	8.000 B-1	8.000 C-4	8.000 C-4
PLANT TOTAL	381.900		384.100	
AVERAGE	7.956		8.002	

		BOTTOM	TOP
DEPTH	TOTAL	382.600	383.400
	AVERAGE	7.971	7.987

ANOVA

SOURCE	D F	SUM OF SQUARES	MEAN SQUARE	F-STAT
MONTH	11.	9.2708	0.8428	49.2756**
PLANT	1.	0.0504	0.0504	2.9537
MONTH X PLANT	11.	0.1621	0.0147	0.8632
DEPTH	1.	0.0067	0.0067	0.3906
MONTH X DEPTH	11.	0.1608	0.0146	0.8566
PLANT X DEPTH	1.	0.0004	0.0004	0.0244
ERROR	59.	1.0071	0.0171	
TOTAL	95.	10.6583		

* SIGNIFICANT (95 % CONFIDENCE LEVEL)
** HIGHLY SIGNIFICANT (99 % CONFIDENCE LEVEL)

Table 1.1-2 (Continued)

FULL FACTORIAL ANALYSIS OF VARIANCE
(0 MISSING VALUES HAVE BEEN ESTIMATED)

NITRATE NITROGEN MG/L N

PLANT EFFECT

	ABOVE STATIONS X-1 AND B-1 DEPTH EFFECT		BELOW STATIONS Y-2 AND C-4 DEPTH EFFECT	
	BOTTOM	TOP	BOTTOM	TOP
JAN	1.040 X-1	0.520 X-1	1.090 Y-2	1.010 Y-2
	1.010 B-1	1.080 B-1	1.160 C-4	1.120 C-4
FEB	0.380 X-1	0.470 X-1	0.380 Y-2	0.410 Y-2
	0.320 B-1	0.390 B-1	0.410 C-4	0.390 C-4
MAR	0.310 X-1	0.390 X-1	0.320 Y-2	0.300 Y-2
	0.920 B-1	0.280 B-1	0.320 C-4	0.290 C-4
APR	0.730 X-1	0.890 X-1	0.660 Y-2	0.770 Y-2
	0.640 B-1	0.680 B-1	0.620 C-4	0.620 C-4
MAY	0.390 X-1	0.260 X-1	0.380 Y-2	1.370 Y-2
	0.310 B-1	1.330 B-1	0.360 C-4	0.150 C-4
JUN	1.020 X-1	1.070 X-1	1.090 Y-2	1.260 Y-2
	1.090 B-1	1.160 B-1	1.060 C-4	1.090 C-4
JUL	0.600 X-1	0.630 X-1	0.690 Y-2	0.620 Y-2
	0.550 B-1	0.690 B-1	0.520 C-4	0.480 C-4
AUG	0.820 X-1	0.820 X-1	0.870 Y-2	0.980 Y-2
	0.780 B-1	0.750 B-1	0.800 C-4	0.790 C-4
SEP	0.380 X-1	0.350 X-1	0.390 Y-2	0.400 Y-2
	0.380 B-1	0.360 B-1	0.380 C-4	0.360 C-4
OCT	0.420 X-1	0.320 X-1	0.340 Y-2	0.400 Y-2
	0.310 B-1	0.310 B-1	0.330 C-4	0.330 C-4
NOV	0.320 X-1	0.360 X-1	0.350 Y-2	0.520 Y-2
	0.320 B-1	0.320 B-1	0.370 C-4	0.300 C-4
DEC	0.570 X-1	0.560 X-1	0.620 Y-2	0.640 Y-2
	0.570 B-1	0.540 B-1	0.560 C-4	0.560 C-4
PLANT TOTAL	29.110		29.230	
PLANT AVERAGE	0.606		0.609	

DEPTH	BOTTOM	TOP
TOTAL	28.250	30.090
AVERAGE	0.[illegible]	0.627

ANOVA

SOURCE	D F	SUM OF SQUARES	MEAN SQUARE	F-STAT
MONTH	11.	6.2696	0.5700	19.2780**
PLANT	1.	0.0001	0.0001	0.0051
MONTH X PLANT	11.	0.1036	0.0094	0.3185
DEPTH	1.	0.0353	0.0353	1.1928
MONTH X DEPTH	11.	0.3961	0.0360	1.2180
PLANT X DEPTH	1.	0.0012	0.0012	0.0407
ERROR	59.	1.7444	0.0296	
TOTAL	95.	8.5503		

* SIGNIFICANT (95 % CONFIDENCE LEVEL)
** HIGHLY SIGNIFICANT (99 % CONFIDENCE LEVEL)

Table 1.1-2 (Continued)

FULL FACTORIAL ANALYSIS OF VARIANCE
(0 MISSING VALUES HAVE BEEN ESTIMATED)

DISSOLVED OXYGEN MG/L

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PLANT EFFECT

	ABOVE STATIONS X-1 AND B-1 DEPTH EFFECT		BELOW STATIONS Y-2 AND C-4 DEPTH EFFECT	
	BOTTOM	TOP	BOTTOM	TOP
JAN	10.400 X-1	10.400 X-1	10.300 Y-2	10.300 Y-2
	9.900 B-1	11.700 B-1	10.900 C-4	11.500 C-4
FEB	10.200 X-1	10.000 X-1	9.800 Y-2	9.400 Y-2
	11.100 B-1	11.100 B-1	11.200 C-4	11.200 C-4
MAR	11.200 X-1	11.000 X-1	11.300 Y-2	11.000 Y-2
	11.400 B-1	11.200 B-1	11.400 C-4	11.300 C-4
APR	12.500 X-1	12.300 X-1	9.500 Y-2	9.500 Y-2
	12.100 B-1	12.100 B-1	12.800 C-4	12.500 C-4
MAY	11.900 X-1	11.900 X-1	12.300 Y-2	12.200 Y-2
	10.800 B-1	10.800 B-1	11.800 C-4	11.600 C-4
JUN	7.700 X-1	8.300 X-1	7.600 Y-2	7.800 Y-2
	7.900 B-1	8.100 B-1	7.400 C-4	7.400 C-4
JUL	6.600 X-1	7.300 X-1	6.700 Y-2	7.800 Y-2
	7.00 B-1	6.200 B-1	6.600 C-4	7.600 C-4
AUG	6.600 X-1	7.200 X-1	6.900 Y-2	7.200 Y-2
	6.600 B-1	6.600 B-1	6.300 C-4	6.300 C-4
SEP	6.500 X-1	6.500 X-1	7.000 Y-2	7.100 Y-2
	7.700 B-1	7.700 B-1	7.800 C-4	7.800 C-4
OCT	10.600 X-1	11.300 X-1	10.000 Y-2	9.000 Y-2
	9.000 B-1	8.900 B-1	9.100 C-4	9.500 C-4
NOV	12.200 X-1	12.200 X-1	11.800 Y-2	10.400 Y-2
	11.300 B-1	11.300 B-1	11.500 C-4	11.300 C-4
DEC	11.200 X-1	11.200 X-1	10.800 Y-2	11.200 Y-2
	11.700 B-1	11.900 B-1	11.800 C-4	11.800 C-4
PLANT TOTAL	470.300		465.300	
AVERAGE	9.798		9.694	

		BOTTOM	TOP
DEPTH	TOTAL	465.700	469.900
	AVERAGE	9.702	9.790

ANOVA

SOURCE	D F	SUM OF SQUARES	MEAN SQUARE	F-STAT
MONTH	11.	356.7233	32.4302	66.8471**
PLANT	1.	0.2604	0.2604	0.5368
MONTH X PLANT	11.	6.0096	0.5463	1.1261
DEPTH	1.	0.1838	0.1838	0.3788
MONTH X DEPTH	11.	2.4212	0.2201	0.4537
PLANT X DEPTH	1.	0.1667	0.1667	0.3435
ERROR	59.	28.6233	0.4851	
TOTAL	95.	394.3983		

* SIGNIFICANT (95 % CONFIDENCE LEVEL)
** HIGHLY SIGNIFICANT (99 % CONFIDENCE LEVEL)

Table 1.1-2 (Continued)

FULL FACTORIAL ANALYSIS OF VARIANCE
(0 MISSING VALUES HAVE BEEN ESTIMATED)

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PLANT EFFECT

	ABOVE STATIONS X-1 AND B-1 DEPTH EFFECT		BELOW STATIONS Y-2 AND C-4 DEPTH EFFECT	
	BOTTOM	TOP	BOTTOM	TOP
JAN	580.000 X-1	600.000 X-1	553.000 Y-2	558.000 Y-2
	461.000 B-1	395.000 B-1	409.000 C-4	426.000 C-4
FEB	480.000 X-1	500.000 X-1	465.000 Y-2	444.000 Y-2
	500.000 B-1	468.000 B-1	484.000 C-4	469.000 C-4
MAR	478.000 X-1	478.000 X-1	468.000 Y-2	471.000 Y-2
	482.000 B-1	464.000 B-1	458.000 C-4	468.000 C-4
APR	386.000 X-1	386.000 X-1	364.000 Y-2	364.000 Y-2
	300.000 B-1	286.000 B-1	343.000 C-4	350.000 C-4
MAY	549.000 X-1	549.000 X-1	561.000 Y-2	548.000 Y-2
	537.000 B-1	500.000 B-1	536.000 C-4	550.000 C-4
JUN	430.000 X-1	450.000 X-1	440.000 Y-2	430.000 Y-2
	430.000 B-1	420.000 B-1	430.000 C-4	430.000 C-4
JUL	385.000 X-1	375.000 X-1	375.000 Y-2	375.000 Y-2
	325.000 B-1	320.000 B-1	355.000 C-4	320.000 C-4
AUG	479.000 X-1	479.000 X-1	490.000 Y-2	500.000 Y-2
	489.000 B-1	489.000 B-1	490.000 C-4	500.000 C-4
SEP	430.000 X-1	333.000 X-1	330.000 Y-2	323.000 Y-2
	394.000 B-1	383.000 B-1	372.000 C-4	372.000 C-4
OCT	405.000 X-1	405.000 X-1	405.000 Y-2	394.000 Y-2
	421.000 B-1	419.000 B-1	419.000 C-4	403.000 C-4
NOV	422.000 X-1	422.000 X-1	439.000 Y-2	434.000 Y-2
	422.000 B-1	422.000 B-1	441.000 C-4	439.000 C-4
DEC	500.000 X-1	500.000 X-1	500.000 Y-2	484.000 Y-2
	500.000 B-1	518.000 B-1	481.000 C-4	500.000 C-4
PLANT TOTAL	21346.000		21215.000	
AVERAGE	444.708		441.979	

DEPTH		BOTTOM	TOP
	TOTAL	21403.000	21158.000
	AVERAGE	445.896	440.792

ANOVA

SOURCE	D F	SUM OF SQUARES	MEAN SQUARE	F-STAT
MONTH	11.	349832.2813	31804.7528	26.1111**
PLANT	1.	178.7604	178.7604	0.1468
MONTH X PLANT	11.	6554.8646	595.8968	0.4892
DEPTH	1.	625.2604	625.2604	0.5133
MONTH X DEPTH	11.	2039.8646	185.4422	0.1522
PLANT X DEPTH	1.	429.2604	429.2604	0.3524
ERROR	59.	71865.3646	1218.0570	
TOTAL	95.	431545.6562		

* SIGNIFICANT (95 % CONFIDENCE LEVEL)
** HIGHLY SIGNIFICANT (99 % CONFIDENCE LEVEL)

FULL FACTORIAL ANALYSIS OF VARIANCE
(0 MISSING VALUES HAVE BEEN ESTIMATED)

Table 1.1-2 (Continued)

WATER TEMPERATURE DEGREES CELSIUS

PLANT EFFECT

	ABOVE STATIONS X-1 AND B-1 DEPTH EFFECT				BELOW STATIONS Y-2 AND C-4 DEPTH EFFECT			
	BOTTOM		TOP		BOTTOM		TOP	
JAN	0.0	X-1	0.0	X-1	3.000	Y-2	0.100	Y-2
	0.400	B-1	0.0	B-1	0.800	C-4	0.400	C-4
FEB	0.0	X-1	0.0	X-1	3.000	Y-2	1.000	Y-2
	0.0	B-1	0.0	B-1	0.0	C-4	0.0	C-4
MAR	2.000	X-1	1.000	X-1	4.000	Y-2	4.000	Y-2
	0.500	B-1	1.000	B-1	1.000	C-4	0.500	C-4
APR	8.500	X-1	8.500	X-1	5.500	Y-2	6.500	Y-2
	7.500	B-1	7.000	B-1	8.000	C-4	7.500	C-4
MAY	17.000	X-1	17.000	X-1	17.000	Y-2	21.000	Y-2
	17.000	B-1	17.000	B-1	17.000	C-4	17.000	C-4
JUN	21.000	X-1	21.500	X-1	21.500	Y-2	25.500	Y-2
	22.000	B-1	22.000	B-1	22.000	C-4	22.000	C-4
JUL	20.000	X-1	20.200	X-1	20.200	Y-2	22.000	Y-2
	20.500	B-1	20.700	B-1	20.300	C-4	20.500	C-4
AUG	23.500	X-1	23.500	X-1	24.000	Y-2	27.500	Y-2
	24.500	B-1	24.500	B-1	24.500	C-4	24.000	C-4
SEP	19.500	X-1	19.500	X-1	20.000	Y-2	25.000	Y-2
	21.000	B-1	21.000	B-1	20.000	C-4	21.000	C-4
OCT	10.000	X-1	11.000	X-1	11.000	Y-2	16.000	Y-2
	11.000	B-1	11.000	B-1	11.000	C-4	11.000	C-4
NOV	3.000	X-1	3.500	X-1	5.000	Y-2	13.000	Y-2
	4.500	B-1	5.000	B-1	5.000	C-4	5.000	C-4
DEC	0.0	X-1	0.0	X-1	4.000	Y-2	3.000	Y-2
	0.0	B-1	0.0	B-1	0.0	C-4	0.0	C-4

PLANT	TOTAL	508.300	561.300
	AVERAGE	10.590	11.694

		BOTTOM	TOP
DEPTH	TOTAL	521.200	548.400
	AVERAGE	10.858	11.425

ANOVA

SOURCE	D F	SUM OF SQUARES	MEAN SQUARE	F-STAT
MONTH	11.	7908.2108	718.9283	322.9242**
PLANT	1.	29.2604	29.2604	13.1430**
MONTH X PLANT	11.	18.3671	1.6697	0.7500
DEPTH	1.	7.7067	7.7067	3.4616
MONTH X DEPTH	11.	20.2558	1.8414	0.8271
PLANT X DEPTH	1.	6.1004	6.1004	2.7402
ERROR	59.	131.2521	2.2263	
TOTAL	95.	8121.2533		

* SIGNIFICANT (95 % CONFIDENCE LEVEL)
** HIGHLY SIGNIFICANT (99 % CONFIDENCE LEVEL)

Table 1.1-2 (Continued)

FULL FACTORIAL ANALYSIS OF VARIANCE
(0 MISSING VALUES HAVE BEEN ESTIMATED)

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PLANT EFFECT

	ABOVE STATIONS X-1 AND B-1 DEPTH EFFECT		BELOW STATIONS Y-2 AND C-4 DEPTH EFFECT	
	BOTTOM	TOP	BOTTOM	TOP
JAN	3.000 X-1	3.000 X-1	3.000 Y-2	2.000 Y-2
	5.000 B-1	3.000 B-1	3.000 C-4	3.000 C-4
FEB	4.000 X-1	3.000 X-1	3.000 Y-2	2.000 Y-2
	3.000 B-1	3.000 B-1	3.000 C-4	3.000 C-4
MAR	3.000 X-1	4.000 X-1	3.000 Y-2	3.000 Y-2
	3.000 B-1	3.000 B-1	3.000 C-4	3.000 C-4
APR	10.000 X-1	5.000 X-1	10.000 Y-2	10.000 Y-2
	15.000 B-1	10.000 B-1	10.000 C-4	10.000 C-4
MAY	15.000 X-1	5.000 X-1	10.000 Y-2	10.000 Y-2
	10.000 B-1	10.000 B-1	10.000 C-4	5.000 C-4
JUN	21.000 X-1	16.000 X-1	20.000 Y-2	16.000 Y-2
	22.000 B-1	20.000 B-1	15.000 C-4	15.000 C-4
JUL	6.500 X-1	6.900 X-1	7.500 Y-2	7.200 Y-2
	5.600 B-1	6.400 B-1	9.300 C-4	82.000 C-4
AUG	15.000 X-1	10.000 X-1	15.000 Y-2	15.000 Y-2
	20.000 B-1	15.000 B-1	15.000 C-4	10.000 C-4
SEP	30.000 X-1	25.000 X-1	25.000 Y-2	20.000 Y-2
	40.000 B-1	25.000 B-1	30.000 C-4	20.000 C-4
OCT	20.000 X-1	10.000 X-1	15.000 Y-2	10.000 Y-2
	10.000 B-1	8.000 B-1	10.000 C-4	10.000 C-4
NOV	8.500 X-1	6.500 X-1	10.000 Y-2	8.500 Y-2
	7.000 B-1	6.500 B-1	7.000 C-4	6.500 C-4
DEC	3.000 X-1	2.500 X-1	3.000 Y-2	3.000 Y-2
	2.500 B-1	2.500 B-1	2.500 C-4	2.500 C-4

PLANT	TOTAL	491.400	519.000
	AVERAGE	10.238	10.813

		BOTTOM	TOP
DEPTH	TOTAL	524.400	486.000
	AVERAGE	10.925	10.125

ANOVA

SOURCE	D F	SUM OF SQUARES	MEAN SQUARE	F-STAT
MONTH	11.	4910.9725	446.4520	7.3096**
PLANT	1.	7.9350	7.9350	0.1299
MONTH X PLANT	11.	914.0475	83.0952	1.3605
DEPTH	1.	15.3600	15.3600	0.2515
MONTH X DEPTH	11.	939.1975	85.3816	1.3979
PLANT X DEPTH	1.	119.7067	119.7067	1.9595
ERROR	59.	3603.5808	61.0776	
TOTAL	95.	10510.8000		

* SIGNIFICANT (95 % CONFIDENCE LEVEL)
** HIGHLY SIGNIFICANT (99 % CONFIDENCE LEVEL)

PRAIRIE ISLAND NUCLEAR GENERATING PLANT
ENVIRONMENTAL MONITORING PROGRAM
1978 ANNUAL REPORT

WATER TEMPERATURE AND FLOW
(1.2)

Prepared for
Northern States Power Company
Minneapolis, Minnesota

by
L. W. Eberley
Environmental and Regulatory Activities Department
Northern States Power Company

1.2 WATER TEMPERATURE AND FLOW

1.2.1 INTRODUCTION AND METHODS

This report presents daily maximum, minimum, and average water temperatures recorded by Resistance Temperature Devices (RTD's) in the vicinity of the Prairie Island Nuclear Generating Plant (PINGP). River inlet temperature is recorded at RTD1 and site discharge temperature at RTD2 (Figure 1.2-1). The RTD temperature sensors are spaced vertically at two-foot (0.6 m) intervals, with readings averaged by the PINGP computer and recorded hourly.

In addition, daily average site discharge flow (blowdown), measured by PINGP personnel, and daily Mississippi River flow, measured at U. S. Lock and Dam 3 are presented. Daily average blowdown includes additional water appropriated to compensate for cooling tower evaporation loss (approximately 38 cfs when all cooling towers and fans are operating).

1.2.2 RESULTS AND DISCUSSION

Daily maximum, minimum, and average river inlet and site discharge temperature data are presented in Table 1.2-1 by month. Daily average river inlet temperatures ranged from 32.3°F (0.2°C) to 81.4°F (27.5°C) during January and August, respectively. Daily average site discharge temperatures ranged from 34.6°F (1.4°C) during January to 85.5°F (29.7°C) in August. Generally, daily average site discharge temperature exceeded daily average river inlet temperature by three to five degrees Fahrenheit. Eberley (1977), however, indicated that under certain conditions, daily average river inlet temperature may equal or exceed daily average site discharge temperature due to recirculation of some of the heated water discharge.

Table 1.2-2 indicates mean daily and monthly site discharge flow (blowdown) recorded at PINGP during 1978. Daily mean blowdown ranged from 156 to 1,023 cfs. Mean monthly blowdown ranged from 185 to 634 cfs. Daily Mississippi River discharge flow rates (Table 1.2-3) were somewhat atypical in 1978 due to heavy rains in late June and early July. One result of these heavy rains and the resultant cooler river temperatures was reduced plant intake flows. PINGP withdrew an annual average of approximately two percent of the Mississippi River flow (Table 1.2-4). Monthly withdrawal flows ranged from 0.5 to 3.7 percent in April and August, respectively.

1.2.3 LITERATURE CITED

Eberley, L. W. 1977. Water Temperature and Flow In: Northern States Power Company Prairie Island Environmental Monitoring and Ecological Studies Program, 1977 Annual Report, Volume I, Minneapolis, MN.

Figure 1.2-1. RTD (Resistance Temperature Device) Locations at Prairie Island Nuclear Generating Plant.

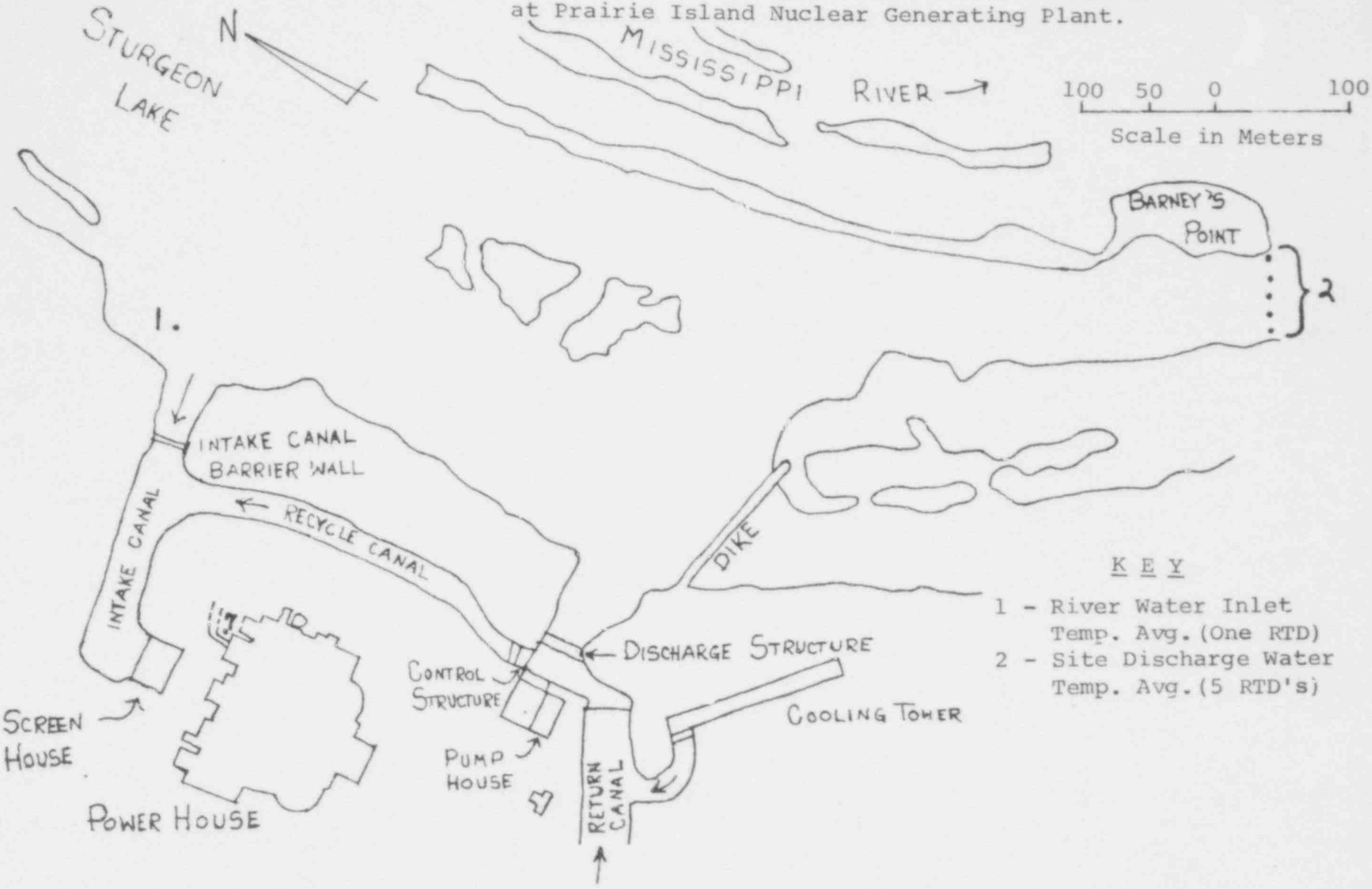

Table 1.2-1. Maximum, Minimum, and Mean Daily River Inlet and Site Discharge Temperatures at the Prairie Island Plant during January 1978.

DATE	OPERATING HOURS	River WATER INLET TEMP.			Site DISCHARGE TEMP.		
		MIN	MAX	AVG FOR OP HRS	MIN	MAX	AVG FOR OP HRS
1	24	32.3	32.6	32.5	33.3	36.0	34.6
2	24	32.3	32.5	32.4	33.9	36.8	35.0
3	24	32.3	32.4	32.3	34.0	36.8	35.1
4	24	32.3	32.4	32.4	35.0	36.4	35.5
5	24	32.3	32.6	32.4	34.0	36.5	35.9
6	24	32.5	32.7	32.6	35.5	38.2	36.7
7	24	32.7	32.7	32.7	35.2	37.2	36.0
8	24	32.1	32.7	32.4	34.9	36.6	36.0
9	24	31.9	33.0	32.3	34.7	36.5	35.5
10	24	32.9	33.0	32.9	33.2	36.5	34.9
11	24	32.8	33.0	32.9	34.4	37.7	36.0
12	24	32.8	32.9	32.9	35.6	37.5	36.3
13	24	32.8	33.0	32.9	35.8	37.1	36.5
14	24	32.8	33.0	32.9	36.1	36.9	36.5
15	24	32.9	33.0	32.9	36.0	37.5	36.5
16	24	32.8	33.0	32.9	35.7	37.6	36.6
17	24	32.8	33.0	32.9	35.4	36.7	36.1
18	24	32.9	33.0	32.9	36.0	37.9	36.6
19	24	32.9	33.0	32.9	35.9	37.2	36.3
20	24	32.9	33.0	32.9	35.6	36.8	36.2
21	24	32.9	33.0	32.9	35.8	38.1	36.5
22	24	32.8	32.9	32.9	36.1	37.8	36.8
23	24	32.8	32.9	32.9	35.5	38.0	36.6
24	24	32.8	32.9	32.9	35.1	42.4	37.6
25	24	32.9	32.9	32.9	34.9	37.4	36.3
26	24	32.8	33.0	32.9	34.6	36.6	35.8
27	24	32.8	32.9	32.9	35.4	37.6	36.5
28	24	32.9	33.0	32.9	36.4	39.5	37.7
29	24	32.8	33.0	32.9	36.3	38.3	37.2
30	24	32.9	33.0	32.9	36.8	39.1	38.0
31	24	32.8	33.0	32.9	36.2	38.9	37.8

Table 1.2-1 (Continued). Maximum, Minimum, and Mean Daily River Inlet and Site Discharge Temperatures at the Prairie Island Plant during February 1978.

DATE	OPERATING HOURS	RIVER WATER INLET TEMP.			SITE DISCHARGE TEMP.		
		MIN	MAX	AVG FOR OP HRS	MIN	MAX	AVG FOR OP HRS
1	24	32.8	33.1	32.9	36.5	38.7	37.8
2	24	32.9	33.1	33.0	36.3	37.6	37.0
3	24	33.0	33.1	33.0	36.1	38.3	37.0
4	24	33.0	33.1	33.1	35.7	39.3	37.3
5	24	33.0	33.1	33.1	36.1	37.9	36.7
6	24	33.1	33.1	33.1	35.4	38.8	37.1
7	24	33.0	33.2	33.1	35.3	37.1	36.2
8	24	33.1	33.2	33.1	35.9	38.5	37.0
9	24	33.1	33.2	33.1	36.3	38.5	37.2
10	24	33.1	33.2	33.1	36.1	38.0	37.0
11	24	33.1	33.2	33.2	36.1	38.1	37.0
12	24	33.1	33.2	33.1	35.9	37.7	36.6
13	24	33.1	33.2	33.2	35.7	38.6	37.3
14	24	33.1	33.2	33.1	36.2	38.2	37.1
15	24	33.1	33.2	33.1	35.9	38.6	36.8
16	24	33.1	33.2	33.1	36.0	38.0	36.7
17	24	33.1	33.2	33.1	36.1	39.3	37.3
18	24	33.1	33.2	33.1	36.4	38.3	37.3
19	24	33.1	33.5	33.2	36.3	38.5	37.4
20	24	33.4	33.5	33.5	36.6	39.3	37.6
21	24	33.3	33.5	33.4	36.3	38.0	37.2
22	24	33.4	33.5	33.4	36.4	38.5	37.2
23	24	33.3	33.5	33.4	36.1	38.3	37.0
24	24	33.3	33.4	33.4	35.7	37.8	36.9
25	24	33.3	33.4	33.4	35.3	37.7	36.3
26	24	33.3	33.4	33.3	35.1	37.3	36.1
27	24	33.3	33.4	33.3	35.7	38.2	36.5
28	24	33.2	33.4	33.3	35.6	37.3	36.4
29							
30							
31							

Table 1.2-1 (Continued). Maximum, Minimum, and Mean Daily River Inlet and Site Discharge Temperatures at the Prairie Island Plant during March 1978.

DATE	OPERATING HOURS	RIVER WATER INLET TEMP.			SITE WATER DISCHARGE TEMP.		
		MIN	MAX	AVG FOR OP HRS	MIN	MAX	AVG FOR OP HRS
1	24	33.2	33.3	33.2	35.4	37.7	36.3
2	24	33.2	33.3	33.2	35.9	37.0	36.5
3	24	33.2	33.3	33.2	35.5	37.5	36.2
4	24	33.2	33.4	33.3	35.3	37.9	36.4
5	24	33.3	33.4	33.4	35.6	37.5	36.5
6	24	33.2	33.4	33.3	35.8	37.2	36.4
7	24	33.3	33.4	33.4	35.7	37.9	36.6
8	24	33.2	33.3	33.3	35.7	36.8	36.3
9	24	33.2	33.3	33.3	36.0	39.4	37.3
10	24	33.2	33.5	33.4	36.3	38.3	37.5
11	24	33.3	33.4	33.4	37.0	38.9	38.2
12	24	33.4	33.5	33.4	37.5	39.6	38.7
13	24	33.4	33.5	33.4	38.4	40.9	39.6
14	24	33.4	33.5	33.4	38.7	39.7	39.2
15	24	33.4	33.5	33.5	38.4	40.3	39.4
16	24	33.5	33.8	33.7	38.6	42.4	39.7
17	24	33.7	34.1	33.9	38.2	40.4	39.6
18	24	33.8	34.2	34.0	38.2	43.1	39.8
19	24	34.1	34.4	34.3	38.7	39.9	39.4
20	24	34.3	34.7	34.5	38.2	41.5	38.9
21	24	34.2	34.4	34.3	37.7	39.5	38.4
22	24	34.2	34.6	34.4	35.8	39.9	37.7
23	24	34.5	35.0	34.8	35.4	37.8	36.4
24	24	34.6	35.0	34.8	35.2	37.7	36.6
25	24	34.5	35.0	34.7	34.9	38.0	36.2
26	24	34.6	36.5	35.0	35.4	38.9	37.0
27	24	35.5	37.4	36.1	34.7	39.5	37.5
28	24	37.3	37.9	37.5	36.5	41.5	38.8
29	24	37.3	37.3	37.3	37.0	42.3	39.5
30	24	37.3	37.3	37.3	39.1	44.5	41.6
31	24	37.3	46.3	40.2	41.2	46.3	43.6

Table 1.2-1 (Continued). Maximum, Minimum, and Mean Daily River Inlet and Site Discharge Temperatures at the Prairie Island Plant during April 1978.

DATE	OPERATING HOURS	RIVER WATER INLET TEMP.			SITE WATER DISCHARGE TEMP.		
		MIN	MAX	AVG FOR OP HRS	MIN	MAX	AVG FOR OP HRS
1	24	41.6	45.7	43.2	41.1	44.7	43.1
2	24	38.7	43.5	40.4	38.4	42.7	39.9
3	24	38.7	41.4	39.6	38.6	42.3	40.1
4	24	40.7	43.3	41.8	40.2	43.8	41.8
5	24	40.8	43.1	41.7	40.6	42.8	41.7
6	24	40.8	45.7	43.2	41.4	46.0	43.5
7	24	44.6	45.9	45.2	42.9	45.6	44.1
8	24	43.5	45.1	44.1	41.8	43.9	42.9
9	24	43.2	44.1	43.5	41.3	43.2	42.3
10	24	43.3	44.9	44.0	41.2	44.5	42.5
11	24	44.1	44.5	42.3	42.0	44.3	42.8
12	24	44.1	45.3	44.8	42.4	46.6	43.9
13	24	43.2	44.6	43.9	41.6	43.5	42.5
14	24	44.1	45.9	45.0	42.4	44.5	43.5
15	24	45.9	47.5	46.6	44.2	46.6	45.3
16	24	46.7	48.5	47.6	44.9	47.8	46.3
17	24	47.9	48.8	48.2	46.0	47.7	47.0
18	24	46.4	48.0	47.1	44.5	47.3	45.6
19	24	45.4	46.4	45.9	44.3	45.9	44.9
20	24	44.9	45.4	45.1	43.7	45.6	44.7
21	24	44.6	48.1	46.1	43.4	48.2	45.9
22	24	46.8	49.7	48.2	45.5	50.5	47.7
23	24	48.1	49.1	48.5	46.7	48.4	47.5
24	24	47.9	48.6	48.1	46.7	49.6	48.1
25	24	47.2	52.2	49.1	46.5	53.9	50.0
26	24	50.1	55.0	52.2	49.9	55.8	52.1
27	24	52.0	56.2	54.0	51.1	57.7	52.7
28	24	53.5	57.0	55.3	53.1	58.3	55.7
29	24	55.2	57.0	56.1	54.5	57.3	55.8
30	23	54.0	57.6	55.8	52.6	58.0	55.0
31							

Table 1.2-1 (Continued). Maximum, Minimum, and Mean Daily River Inlet and Site Discharge Temperatures at the Prairie Island Plant during May 1978.

DATE	OPERATING HOURS	RIVERWATER INLET TEMP.			SITE DISCHARGE TEMP.		
		MIN	MAX	AVG FOR OP HRS	MIN	MAX	AVG FOR OP HRS
1	24	52.9	57.7	55.4	51.7	58.1	54.7
2	24	54.9	59.3	56.9	52.9	59.7	56.2
3	24	56.6	61.5	58.8	54.7	62.3	58.4
4	24	58.0	61.0	59.3	57.4	60.7	59.2
5	24	56.6	60.4	58.6	55.8	62.3	56.7
6	24	57.4	60.4	59.1	56.0	61.3	58.8
7	24	56.4	60.4	58.3	56.9	60.3	57.9
8	24	55.0	56.7	56.0	55.2	58.8	56.7
9	24	54.8	56.7	55.6	54.1	57.6	55.5
10	24	54.8	60.1	56.5	54.7	62.5	57.8
11	24	59.1	63.4	60.8	59.9	65.1	62.2
12	24	60.7	63.1	62.0	61.0	64.0	62.5
13	24	57.8	62.0	59.4	57.2	61.3	59.3
14	24	58.5	61.0	59.8	57.4	62.9	60.2
15	24	59.7	62.2	60.8	60.6	63.9	62.3
16	24	60.7	65.1	60.3	60.6	66.4	63.6
17	24	62.8	67.8	64.9	63.1	69.2	64.1
18	24	65.7	68.9	62.5	65.0	72.2	69.4
19	24	66.7	69.4	67.9	68.2	73.3	70.7
20	24	65.8	69.4	67.0	67.5	73.9	69.7
21	24	64.3	67.8	65.9	64.8	70.8	68.1
22	24	66.3	68.4	67.5	66.3	70.8	68.7
23	24	67.4	69.6	68.3	67.8	73.4	70.6
24	24	68.5	70.7	69.6	70.5	73.8	72.3
25	24	69.4	72.3	70.7	73.2	76.7	74.7
26	24	71.3	73.7	72.3	75.5	77.4	76.6
27	24	73.1	74.9	73.8	76.3	78.6	77.4
28	24	71.9	74.5	73.3	76.1	78.3	77.2
29	24	73.1	75.3	74.3	76.9	78.8	78.0
30	24	71.1	75.2	72.8	74.3	78.8	75.8
31	24	70.1	71.4	70.8	72.5	74.5	73.7

Table 1.2-1 (Continued). Maximum, Minimum, and Mean Daily River Inlet and Site Discharge Temperatures at the Prairie Island Plant during June 1978.

DATE	OPERATING HOURS	River WATER INLET TEMP.			Site DISCHARGE TEMP.		
		MIN	MAX	AVG FOR OP HRS	MIN	MAX	AVG FOR OP HRS
1	24	68.9	71.1	70.1	69.6	73.4	71.8
2	24	66.7	69.0	67.9	66.2	70.3	68.3
3	24	67.7	71.1	69.3	66.4	72.2	69.3
4	24	68.3	70.7	69.5	67.2	72.0	69.5
5	24	68.6	72.2	70.2	67.0	73.2	70.2
6	24	69.0	72.7	70.8	68.6	74.9	71.7
7	24	68.2	72.7	70.3	67.4	80.0	70.8
8	24	66.3	70.7	68.3	66.0	71.4	68.7
9	24	68.3	71.7	70.0	68.8	73.8	71.1
10	24	69.6	71.6	70.7	70.5	75.2	73.0
11	24	70.2	71.4	70.7	72.7	74.5	73.7
12	24	69.2	71.3	70.3	69.4	73.4	71.3
13	24	70.1	72.6	71.2	70.9	75.7	73.4
14	24	70.2	72.5	71.1	70.7	75.3	72.6
15	24	69.9	71.0	70.5	69.7	74.4	72.7
16	24	70.2	72.5	71.0	70.9	75.9	74.0
17	24	70.7	71.8	71.3	74.3	76.1	75.2
18	24	70.1	72.6	71.3	69.7	76.6	73.4
19	24	70.8	73.4	72.0	70.8	78.1	74.9
20	24	70.3	73.4	71.8	71.7	77.6	73.9
21	24	69.2	72.7	70.7	68.2	75.0	71.7
22	24	70.9	72.9	71.9	70.6	77.1	73.8
23	24	70.4	72.9	71.4	71.7	75.9	73.4
24	24	70.2	72.4	71.0	70.2	76.2	73.1
25	24	71.7	73.3	72.3	75.0	78.0	76.2
26	24	72.8	76.7	74.3	76.1	80.8	78.2
27	24	73.6	76.6	75.2	76.0	80.0	78.3
28	24	74.0	76.8	75.2	76.9	81.7	79.3
29	24	75.7	79.2	77.0	79.9	83.9	81.4
30	24	77.2	79.1	78.1	80.8	83.9	82.2
31							

Table 1.2-1 (Continued). Maximum, Minimum, and Mean Daily River Inlet and Site Discharge Temperatures at the Prairie Island Plant during July 1978.

DATE	OPERATING HOURS	RIVER WATER INLET TEMP.			SITE DISCHARGE TEMP.		
		MIN	MAX	AVG FOR OP HRS	MIN	MAX	AVG FOR OP HRS
1	24	75.6	77.5	76.2	77.8	81.7	79.4
2	24	74.7	76.5	75.7	77.1	79.7	78.3
3	24	73.9	75.5	74.6	74.3	78.4	76.5
4	24	73.4	75.3	74.5	74.9	78.8	76.9
5	24	73.8	77.3	75.9	75.9	81.2	78.3
6	24	75.1	78.2	76.4	76.3	82.7	79.4
7	24	75.9	77.6	76.5	77.8	81.7	78.9
8	24	74.7	76.8	75.9	74.8	79.9	77.4
9	24	74.7	76.3	75.1	74.8	78.0	76.0
10	24	72.2	74.8	73.8	71.7	77.9	75.0
11	24	72.7	74.5	73.5	72.7	77.0	74.6
12	24	72.5	74.1	73.1	72.1	75.3	73.5
13	24	71.6	74.9	72.8	73.5	76.7	74.1
14	24	72.9	76.0	74.2	72.9	78.3	75.3
15	24	74.6	77.9	76.0	73.5	79.3	76.6
16	24	75.6	79.2	77.2	74.9	80.9	77.7
17	24	76.5	79.5	78.0	76.7	81.0	78.7
18	24	78.2	79.6	78.8	77.7	80.9	79.3
19	24	78.1	79.9	76.2	77.4	81.7	79.8
20	24	77.0	79.8	77.7	76.5	80.5	77.6
21	24	75.9	78.7	76.4	76.0	78.7	77.1
22	24	72.6	76.4	74.0	74.3	77.0	75.2
23	24	72.0	75.2	73.4	71.8	77.3	74.3
24	24	74.2	76.3	75.0	73.4	79.0	76.3
25	24	74.1	77.7	75.4	74.9	82.4	78.5
26	24	75.7	77.5	76.6	78.6	80.8	79.7
27	24	74.9	77.0	76.0	75.0	80.1	78.1
28	24	74.6	76.5	75.3	75.0	80.9	78.3
29	24	74.1	75.5	74.7	75.5	80.4	77.6
30	24	72.4	74.2	73.3	72.1	78.0	75.0
31	24	72.9	75.1	73.8	73.5	86.0	78.7

Table 1.2-1 (Continued). Maximum, Minimum, and Mean Daily River Inlet and Site Discharge Temperatures at the Prairie Island Plant during August 1978.

DATE	OPERATING HOURS	River WATER INLET TEMP.			Site WATER DISCHARGE TEMP.		
		MIN	MAX	AVG FOR OP HRS	MIN	MAX	AVG FOR OP HRS
1	24	73.4	76.1	74.5	73.5	80.4	77.6
2	24	74.5	76.0	75.2	74.7	80.2	77.4
3	24	73.4	74.9	73.9	72.3	76.8	74.8
4	24	72.7	74.2	73.4	71.0	77.0	74.5
5	24	73.6	75.0	74.2	72.5	77.2	74.8
6	24	74.8	76.4	75.5	74.5	79.9	77.0
7	24	75.6	77.6	76.5	77.6	82.4	79.8
8	24	76.7	78.1	77.5	80.5	82.9	81.8
9	24	76.0	77.4	76.8	76.9	81.8	79.9
10	24	75.9	77.1	76.5	76.5	80.9	79.3
11	24	76.4	78.0	77.2	76.6	83.7	80.0
12	24	76.8	78.9	77.7	77.3	83.6	80.8
13	24	77.9	81.4	79.2	81.8	86.0	83.3
14	24	80.7	82.2	81.4	84.3	87.8	85.5
15	24	78.3	82.2	80.4	82.0	87.2	84.9
16	24	75.5	78.2	76.4	77.3	81.8	79.6
17	24	75.8	79.8	77.4	77.4	84.0	81.0
18	24	76.9	79.5	78.7	80.6	83.3	82.3
19	24	75.3	76.9	75.9	77.6	80.8	79.1
20	24	74.4	75.8	75.0	74.7	79.7	77.4
21	24	74.5	78.0	75.8	75.7	80.9	78.2
22	24	75.7	77.1	76.1	76.5	81.0	79.3
23	24	76.3	77.8	77.2	79.9	81.6	80.6
24	24	76.6	77.5	77.0	80.6	83.7	81.8
25	24	75.6	76.9	76.1	80.0	81.2	80.5
26	24	75.5	76.4	75.9	79.3	80.8	80.8
27	24	74.4	75.6	74.9	77.4	79.3	78.4
28	24	73.4	75.6	73.9	73.5	83.6	76.4
29	24	71.9	73.7	73.0	72.4	77.7	75.1
30	24	72.1	74.0	73.3	73.2	77.3	75.4
31	24	72.9	74.7	73.8	71.9	76.3	74.6

Table 1.2-1 (Continued). Maximum, Minimum, and Mean Daily River Inlet and Site Discharge Temperatures at the Prairie Island Plant during September 1978.

DATE	OPERATING HOURS	River WATER INLET TEMP			Site DISCHARGE TEMP		
		MIN	MAX	AVG FOR OP HRS	MIN	MAX	AVG FOR OP HRS
1	24	72.8	74.4	73.6	71.8	76.1	74.4
2	24	72.9	76.1	74.2	73.8	79.0	76.1
3	24	74.2	76.6	75.4	74.7	78.6	76.9
4	24	74.5	76.9	75.7	75.4	79.4	77.6
5	24	74.8	76.9	75.8	76.2	79.8	77.9
6	24	75.3	77.6	76.1	77.2	81.3	79.1
7	24	75.5	78.0	76.9	79.3	82.5	80.9
8	24	76.9	78.1	77.5	80.0	82.5	81.5
9	24	76.9	77.9	77.4	80.6	82.4	81.5
10	24	77.2	78.8	78.0	81.0	83.3	82.2
11	24	77.7	79.2	78.7	81.8	84.3	83.1
12	24	70.9	79.1	75.6	73.8	83.9	79.8
13	24	67.5	70.9	68.4	72.0	74.0	72.7
14	24	66.3	69.5	68.1	71.7	73.6	72.5
15	24	68.1	69.7	69.0	70.9	73.3	72.3
16	24	68.5	69.6	68.9	69.9	73.0	71.1
17	24	66.8	68.5	67.2	68.8	71.7	67.8
18	24	65.5	67.5	66.3	68.6	71.3	69.4
19	24	65.9	68.8	67.3	69.4	71.9	70.7
20	24	65.3	68.6	66.4	65.9	70.3	67.3
21	24	64.8	65.7	65.2	64.3	66.6	65.6
22	24	64.7	65.7	65.2	63.9	67.8	65.8
23	24	63.5	65.6	64.4	65.1	68.0	66.6
24	24	64.3	65.1	64.8	65.3	68.1	66.9
25	24	63.0	65.0	63.7	64.1	67.0	65.6
26	24	62.8	63.6	63.2	64.4	67.8	66.3
27	24	63.4	64.2	63.7	64.7	67.6	66.0
28	24	62.6	63.4	62.9	63.2	66.2	64.7
29	24	62.0	62.9	62.5	63.9	67.7	65.6
30	24	61.6	62.6	61.9	63.8	66.0	64.8
31							

Table 1.2-1 (Continued). Maximum, Minimum, and Mean Daily River Inlet and Site Discharge Temperatures at the Prairie Island Plant during October 1978.

DATE	OPERATING HOURS	RIVER WATER INLET TEMP			SITE DISCHARGE TEMP		
		MIN	MAX	AVG FOR OP HRS	MIN	MAX	AVG FOR OP HRS
1	24	60.7	62.5	61.6	62.4	67.0	64.5
2	24	61.8	62.6	62.2	65.3	68.2	66.4
3	24	61.1	62.4	61.7	63.9	65.6	64.6
4	24	59.8	61.1	60.5	63.6	65.5	64.8
5	24	56.6	59.9	58.1	60.3	64.0	62.8
6	24	54.7	56.6	55.2	58.3	60.4	59.6
7	24	54.0	54.7	54.2	57.0	58.5	57.4
8	24	53.6	55.4	54.4	56.5	59.3	57.6
9	24	54.8	56.2	55.4	58.4	61.6	60.3
10	24	55.8	58.8	57.4	60.0	63.4	62.0
11	24	58.4	62.6	59.8	61.5	65.4	63.5
12	24	56.0	58.4	57.1	58.9	62.0	60.8
13	24	53.9	55.9	54.7	56.8	58.8	57.9
14	24	53.1	54.0	53.5	56.0	57.3	56.7
15	24	53.5	53.5	53.5	55.7	57.6	56.9
16	24	50.6	53.7	52.4	54.6	57.1	55.7
17	24	51.6	57.8	53.9	55.0	59.0	56.3
18	24	50.7	53.4	51.3	53.7	56.8	54.8
19	24	50.2	51.5	50.9	53.1	55.3	54.2
20	24	51.4	54.6	52.6	55.0	57.9	56.1
21	24	53.9	54.9	54.3	57.5	58.6	58.1
22	24	52.3	54.5	53.8	55.0	58.2	56.7
23	24	50.1	52.3	50.7	52.7	54.7	53.6
24	24	49.8	55.6	52.3	52.0	56.7	54.0
25	24	49.9	55.0	51.5	53.9	56.8	55.3
26	24	48.9	49.9	49.3	52.2	54.1	53.4
27	24	48.5	49.3	48.9	51.8	53.0	52.6
28	24	48.4	49.4	48.9	52.0	53.3	52.6
29	25	48.7	55.1	51.8	50.5	54.2	52.3
30	24	49.6	54.9	51.9	52.1	54.9	53.7
31	24	48.9	50.1	49.5	52.8	54.1	53.6

Table 1.2-1 (Continued). Maximum, Minimum, and Mean Daily River Inlet and Site Discharge Temperatures at the Prairie Island Plant during November 1978.

DATE	OPERATING HOURS	River WATER INLET TEMP.			Site DISCHARGE TEMP.		
		MIN	MAX	AVG FOR OP HRS	MIN	MAX	AVG FOR OP HRS
1	24	48.7	50.6	49.6	51.9	53.9	52.8
2	24	48.6	50.1	49.3	52.6	54.1	53.5
3	24	49.7	52.6	50.6	53.6	56.1	54.6
4	24	50.6	53.7	51.3	54.3	56.6	55.4
5	24	50.6	56.1	52.0	53.6	57.4	55.3
6	24	47.9	50.6	49.1	51.9	53.7	52.9
7	24	46.7	50.2	48.3	50.1	52.5	51.4
8	24	46.7	49.0	47.5	50.5	52.4	51.6
9	24	46.7	48.4	47.5	50.8	53.9	52.1
10	24	47.8	48.3	48.1	51.4	53.7	52.6
11	24	44.5	47.9	46.0	48.9	51.6	50.0
12	24	42.3	44.5	43.3	46.4	49.2	47.8
13	24	40.9	44.2	42.4	45.4	50.8	48.1
14	24	39.0	41.4	40.0	43.4	46.4	45.0
15	24	37.9	39.0	38.4	42.7	45.5	43.7
16	24	36.7	38.0	37.3	42.4	46.1	44.0
17	24	36.3	37.2	36.8	41.6	43.9	42.9
18	24	36.6	37.0	36.8	41.1	43.3	41.7
19	24	34.7	36.9	35.5	38.5	41.2	39.7
20	24	33.6	34.8	34.3	37.2	40.7	39.4
21	24	33.5	34.5	34.0	39.0	43.7	41.5
22	24	34.3	34.5	34.4	41.6	44.7	43.6
23	24	34.5	34.9	34.7	43.9	46.7	45.0
24	24	34.3	34.8	34.6	42.4	44.5	43.8
25	24	34.3	34.6	34.5	42.6	44.2	43.3
26	24	34.3	34.6	34.5	40.6	44.6	42.6
27	24	34.2	34.4	34.3	39.7	42.0	40.8
28	24	33.7	34.3	34.2	35.8	40.7	37.2
29	24	33.4	33.8	33.6	36.3	39.2	37.5
30	24	33.1	33.4	33.3	36.1	39.6	36.6
31							

Table 1.2-1 (Continued). Maximum, Minimum, and Mean Daily River Inlet and Site Discharge Temperatures at the Prairie Island Plant during December 1978.

DATE	OPERATING HOURS	RIVER WATER INLET TEMP.			SITE DISCHARGE TEMP.		
		MIN	MAX	AVG FOR OP HRS	MIN	MAX	AVG FOR OP HRS
1	24	33.0	33.2	33.1	37.5	39.8	38.9
2	24	33.1	33.2	33.1	37.1	42.2	39.1
3	24	32.9	33.1	33.0	39.1	40.9	39.9
4	24	32.9	33.0	32.9	37.6	41.8	40.0
5	24	32.9	33.2	33.0	38.4	40.7	39.8
6	24	33.2	33.3	33.3	36.9	39.9	38.4
7	24	33.0	33.2	33.1	36.5	38.5	37.8
8	24	32.9	33.1	33.0	36.0	39.7	37.8
9	13	32.9	35.2	33.9	33.5	39.3	35.1
10	24	32.7	32.9	32.8	37.4	40.0	38.9
11	24	32.6	32.7	32.7	37.9	40.0	39.3
12	24	32.7	32.7	32.7	37.8	40.2	39.3
13	24	32.	32.9	32.8	36.7	39.8	38.4
14	24	32.8	32.8	32.8	37.1	40.3	39.0
15	24	32.8	32.8	32.8	39.2	41.8	40.3
16	24	32.8	32.9	32.8	36.9	42.4	40.4
17	24	32.8	32.9	32.8	37.2	39.6	38.7
18	24	32.7	32.8	32.8	37.5	40.7	39.0
19	24	32.7	33.2	32.8	37.4	41.8	39.0
20	24	32.6	32.8	32.7	38.3	40.6	39.3
21	24	32.6	32.7	32.7	37.5	40.1	38.7
22	24	32.6	32.7	32.6	37.9	39.8	39.0
23	24	32.6	32.7	32.6	38.4	41.9	39.8
24	24	32.6	32.7	32.6	36.9	39.2	38.4
25	24	32.6	32.7	32.6	36.7	39.3	38.1
26	24	32.6	32.6	32.6	37.0	39.5	38.2
27	24	32.5	32.7	32.6	36.6	39.1	38.9
28	24	3	34.3	33.2	37.2	40.4	38.9
29	24	32	34.2	32.9	37.9	43.5	39.8
30	24	32.4	32.5	32.4	37.5	39.8	38.7
31	24	32.4	32.5	32.5	37.5	40.7	38.9

Table 1.2-2 Mean Daily Site Discharge Flow (blowdown)* at the Prairie Island Plant During 1978 (cfs)

Day	Jan	Feb	Mar	Apr	May	Jun
1	185	185	185	185	212	482
2	185	185	185	185	211	264
3	185	186	185	185	256	273
4	185	185	185	185	277	297
5	185	185	185	185	252	306
6	185	185	185	185	191	456
7	185	185	185	185	195	770
8	185	185	185	185	212	490
9	185	185	185	185	149	478
10	156	185	185	185	216	554
11	178	185	185	185	282	611
12	185	185	185	217	268	438
13	185	185	185	188	214	487
14	185	185	185	185	227	386
15	185	185	185	185	378	478
16	185	185	185	185	307	544
17	185	185	185	213	317	554
18	185	185	185	188	364	350
19	185	185	185	185	490	460
20	185	185	185	221	737	578
21	185	185	185	209	722	396
22	185	185	185	183	244	437
23	185	185	185	185	387	463
24	272	185	185	279	412	497
25	185	185	185	368	595	712
26	185	185	185	353	692	813
27	185	185	185	411	678	923
28	185	185	185	410	689	884
29	185	-	185	304	665	865
30	185	-	185	208	692	899
31	185	-	185	-	577	-
Average	188	185	185	224	391	538

*Including 38 cfs for cooling tower evaporation

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Table 1.2-2 (Continued) Mean Daily Site Discharge Flow (blowdown)* at the Prairie Island Plant During 1978 (cfs)

Day	Jul	Aug	Sep	Oct	Nov	Dec
1	881	558	552	229	185	185
2	923	491	660	327	185	185
3	596	403	540	231	185	185
4	614	395	600	340	313	185
5	746	257	599	279	327	185
6	777	413	680	237	185	185
7	805	703	817	196	185	185
8	699	828	828	185	181	185
9	596	525	850	268	178	185
10	430	608	868	305	203	185
11	506	617	889	333	185	185
12	550	712	821	261	185	185
13	579	743	848	227	184	185
14	703	688	722	185	185	185
15	913	620	531	185	185	185
16	474	619	417	202	185	185
17	680	868	461	236	185	185
18	759	1,023	369	192	185	185
19	733	628	484	185	185	185
20	564	488	279	185	185	185
21	611	677	188	185	185	185
22	482	654	244	185	185	185
23	253	777	295	185	185	185
24	506	722	323	185	185	185
25	794	713	283	185	185	185
26	901	742	348	185	185	185
27	467	739	274	185	185	185
28	642	687	229	185	144	185
29	558	611	291	185	144	185
30	389	618	259	185	147	185
31	429	533	-	185	-	185
Average	631	634	518	220	190	185

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Table 1.2-3 Daily 1978 Mississippi River Discharge Flow Rate (cfs) at Lock and Dam 3

Day	Jan	Feb	Mar	Apr	May	Jun
1	13,898	7,800	7,251	34,350	37,800	21,300
2	13,699	7,800	6,940	33,345	33,495	24,875
3	13,183	7,750	6,740	38,000	33,000	28,288
4	11,002	7,750	6,940	40,000	33,864	30,492
5	11,340	7,750	6,769	41,500	32,592	30,615
6	10,740	7,700	7,061	43,000	31,548	29,830
7	10,700	7,700	7,022	43,200	29,250	29,637
8	10,830	7,700	7,001	44,200	28,182	28,840
9	10,350	7,700	7,000	50,200	28,710	27,951
10	10,605	7,700	7,250	52,000	26,506	25,368
11	10,610	7,700	7,426	56,500	25,920	25,488
12	9,320	7,550	7,282	59,400	27,272	25,506
13	9,130	7,562	7,196	60,000	27,664	23,717
14	8,560	7,700	7,310	64,000	27,272	21,231
15	8,560	7,489	7,190	64,000	27,076	19,710
16	8,680	7,400	6,680	59,000	26,432	19,329
17	8,980	7,340	6,960	57,800	26,109	23,966
18	9,390	6,791	6,960	56,200	24,700	24,175
19	9,400	6,703	7,620	53,000	24,034	24,154
20	9,370	6,750	8,250	52,000	23,625	26,535
21	9,080	6,800	9,690	49,000	21,684	27,328
22	8,760	6,730	11,549	45,500	20,106	27,100
23	8,605	6,800	15,626	45,000	20,340	26,300
24	8,550	7,214	19,115	44,000	19,329	26,250
25	8,580	7,401	21,200	42,800	17,654	25,955
26	8,580	7,290	23,377	42,000	16,965	28,560
27	8,560	7,290	26,926	41,000	16,011	28,084
28	8,560	7,283	28,396	40,000	18,925	26,656
29	8,280	-	29,172	39,200	18,727	24,165
30	8,125	-	30,742	38,700	20,664	22,310
31	7,676	-	32,252	-	30,360	-
Average	9,732	7,398	12,609	47,630	25,349	25,791

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Table 1.2-3 (Continued) Daily 1978 Mississippi River Discharge Flow Rate (cfs) at Lock and Dam 3

Day	Jul	Aug	Sep	Oct	Nov	Dec
1	29,664	21,701	27,755	16,385	9,926	8,720
2	30,050	20,874	28,008	13,992	10,010	6,985
3	30,300	20,220	25,170	14,412	9,975	6,500
4	30,850	18,900	24,556	13,695	9,961	6,520
5	31,217	18,612	22,488	12,790	10,199	6,700
6	31,528	18,054	20,520	13,000	9,989	7,380
7	36,800	15,218	19,798	12,850	10,031	8,123
8	37,000	13,288	16,618	12,790	10,045	8,600
9	40,000	14,212	17,400	12,720	10,115	8,170
10	44,000	13,320	18,615	12,295	9,975	7,800
11	44,500	13,520	16,618	12,340	10,010	7,500
12	44,300	12,429	13,948	12,740	9,800	7,872
13	45,000	12,411	21,185	13,200	9,695	8,410
14	44,750	11,136	21,620	12,426	10,785	8,170
15	44,300	11,456	21,736	9,513	11,280	8,375
16	41,000	13,720	21,428	9,347	10,896	8,620
17	42,000	12,330	23,790	9,379	11,096	8,670
18	39,700	11,120	24,566	10,875	11,577	8,753
19	37,400	12,708	24,556	14,122	11,577	8,502
20	33,208	14,685	24,192	10,968	11,407	8,710
21	30,720	12,348	23,608	10,440	10,630	8,620
22	31,200	12,663	23,100	11,192	7,940	8,620
23	30,800	13,700	22,172	11,144	6,340	8,360
24	28,800	16,032	22,540	10,944	5,880	8,360
25	37,454	16,288	21,450	10,052	6,820	8,360
26	26,622	16,458	20,083	10,241	7,390	8,060
27	26,235	26,616	19,296	11,344	9,520	7,560
28	25,575	28,112	17,392	11,240	9,860	7,260
29	25,085	28,148	16,425	10,928	9,930	6,660
30	23,760	27,522	17,055	9,695	9,800	6,620
31	22,850	28,315	-	10,024	-	6,620
Average	34,086	16,972	21,256	11,841	9,749	7,977

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Table 1.2-4 Percentage of Mean Monthly Mississippi River Flow Entering the Prairie Island Plant Intake Canal During 1978

Month	Mean Intake Flow (cfs)	Mean Monthly River Flow (cfs)	Percentage of Mean Monthly River Flow Entering Intake Canal
Jan	188	9,732	1.9
Feb	185	7,398	2.5
Mar	185	12,609	1.5
Apr	224	47,630	0.5
May	391	25,349	1.5
Jun	538	25,791	2.1
Jul	631	34,086	1.9
Aug	634	16,972	3.7
Sep	518	21,256	2.4
Oct	220	11,841	1.9
Nov	190	9,749	2.0
Dec	185	7,877	2.4

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PRAIRIE ISLAND NUCLEAR GENERATING PLANT
ENVIRONMENTAL MONITORING PROGRAM
1978 ANNUAL REPORT
ECOLOGICAL STUDIES

1978
ATTACHED ALGAE STUDIES
IN THE MISSISSIPPI RIVER NEAR THE
PRAIRIE ISLAND NUCLEAR GENERATING PLANT
(2.1)

Prepared for
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Minneapolis, Minnesota

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2.1 1978 ATTACHED ALGAE STUDIES IN THE MISSISSIPPI RIVER NEAR THE PRAIRIE ISLAND NUCLEAR GENERATING PLANT

2.1.1 INTRODUCTION

Periphytic algae of freshwater streams and rivers attach to a variety of substrata usually located on or near the shore. Factors influencing species composition and diversity include substrate, temperature, light, current, and water chemistry.

Bacillariophyta (diatoms), Chlorophyta (green algae), Cyanophyta (blue-green algae), and Chrysophyta (yellow-green algae) make up the major groups of freshwater algae, with each group containing many species. Attached algae studies at the Prairie Island Nuclear Generating Plant concentrate on diatoms, since they constitute the largest portion of the periphyton community within the study area.

Under natural conditions, one of the main factors in seasonal succession of species is the different temperature optimums of species; and, as a result, as the temperature increases or decreases, replacement takes place (Patrick 1969). When natural conditions are altered and temperatures increase above ambient, there may be a shift in normal seasonal succession. Severe thermal increases may cause the exclusion of certain species and other temperature tolerant forms may dominate.

Past studies of attached algae in the study area have indicated that temperature is the major factor affecting algal succession and community trends (Baker 1976). Data gathered during the 1978, the seventh year of the program, were analyzed, as in previous years, determining if any significant adverse impact occurred.

2.1.2 FIELD METHODS

Field methods were the same as in previous years. Four glass microscope slides installed in an acrylic plastic sampler were allowed to colonize for 14 days. Three samplers were placed at each of seven stations throughout the study area (Figure 2.1-1). Following each colonization period, all slides from each sampler were graded according to algal density; the densest slide, to be used in pigment analyses, being placed in a bottle containing 90 percent aqueous acetone solution saturated with magnesium carbonate. The three remaining slides were placed in a slide box and returned to the laboratory for quantitative analyses. Thus, three slides were used for pigment analvses and three for quantitative analyses at each station. Extra slides from each sampler were discarded after analyses. New slides were placed in the samplers and colonized for the next sampling period.

Winter sampling allows only heated stations to be collected, since ice conditions negates maintaining samplers in the main channel, intake area, and Sturgeon Lake.

2.1.3 LABORATORY PROCEDURES

2.1.3.1 Pigment Analysis

Pigment analysis procedures remained consistent with previous years; samples were scraped, macerated, diluted to a known volume (25-200 ml), and centrifuged for ten minutes. The pigment extract was decanted into a four-centimeter cuvette and analyzed at 665 nm and 750 nm before and after acidification using a Beckman DB-GT spectrophotometer. Chlorophyll *a* concentrations and phaeophytin *a*, the primary degradation product of chlorophyll *a*, were determined by computer program utilizing the Lorenzen (1967) equation:

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$$\text{Chlorophyl } \underline{a}\ \mu g/cm^2 = \frac{26.7\ [(665-750)^u - (665-750)a]\ V}{(32.5\ cm^2)\ (4\ cm\ light\ path)}$$

$$\text{Phaeophytin } \underline{a}\ \mu g/cm^2 = \frac{26.7\ [1.7(665-750)^a - (665-750)^u]\ V}{(32.5\ cm^2)\ \ (4\ cm\ light\ path)}\ ,$$

where: u = unacidified
a = acidified
665 = chlorophyll a absorbance
750 = turbidity check absorbance
V = acetone and chlorophyll a extraction volume (ml).

Results of the above computer analysis were expressed as micrograms chlorophyll a and phaeophytin a per square centimeter per 14 days. Percent chlorophyll a values were tabulated as follows:

Percent chlorophyll a = (chlorophyll a/chlorophyll a + phaeophytin a)100

2.1.3.2 Taxonomic Identification and Enumeration

Miscroscopic analyses remained the same as 1977 methods; slides were scraped and the biofilm removed of all organic material by using nitric acid-potassium dichromate. Cleaned frustules were placed in a vial and diluted to 10 ml with distilled water. A thoroughly mixed sample provided a known aliquot to be pipetted onto a 22 mm^2 No. 1 coverglass. The coverglass was mounted on a microscope slide using Hyrax, labelled, and cataloged for microscopic analysis.

Slide mounts were observed at 1000 x oil immersion using an American Optical Phase Star phase contrast microscope. Selected taxonomic keys were used to identify and enumerate species observed in 30 to 60 fields or until 100 of the most

dominant species were tallied. Raw data were then extrapolated to express cell density as the number of cells per square centimeter.

2.1.4 RESULTS

2.1.4.1 Phytopigment Analyses

2.1.4.1.1 Chlorophyll a

Chlorophyll a concentrations at ambient stations during 1978 ranged from 0.00 $\mu g/cm^2$ at Station 6 on July 26 to 13.37 $\mu g/cm^2$ at Station 5 on May 17 (Table 2.1-1). Main channel stations exhibited chlorophyll a ranges from 1.12 $\mu g/cm^2$ at Station 1 on November 15 to 11.60 $\mu g/cm^2$ at Station 1 on September 6. Mean chlorophyll a concentration for main channel stations was 4.84 $\mu g/cm^2$, while ambient Stations 5 and 6 exhibited a mean of 3.35 μg/Chlorophyll a/cm^2.

Heated Stations 3, 4, and 7 showed chlorophyll a concentration ranges from 0.04 $\mu g/cm^2$ at Station 4 on December 28 to 9.21 $\mu g/cm^2$ at Station 4 on October 4 (Table 2.1-1). Mean chlorophyll a concentrations were 2.85, 2.18, and 1.62 $\mu g/cm^2$ at Stations 3, 4, and 7, respectively.

As in previous years, ambient stations had higher mean chlorophyll a concentrations than heated stations, 4.09 $\mu g/cm^2$ at ambient stations versus 2.22 $\mu g/cm^2$ at heated stations. Seasonal chlorophyll a biomass maxima occurred during early March at heated Station 3, while main channel peak chlorophyll a accumulation occurred in early September (Figure 2.1-2). This six-month separation in peak chlorophyll a concentration represents the point at which river water temperature reached optimum conditions for periphyton growth. Optimal temperature regimes at both locations ranged from 20 - 23°C, occurring in early March at Station 3 and early September in the main channel.

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Low chlorophyll a concentrations at Stations 5 and 6 during late July and early August are not indicative of normal periphyton growth. Extremely high river flow in 1978 (Figure 2.1-3) apparently uprooted a large portion of the aquatic macrophytes found in Sturgeon Lake. The uprooted plants became entangled on periphyton samplers, forming a mat allowing insufficient illumination for periphyton colonization.

2.1.4.1.2 Phaeophytin a

Phaeophytin a concentrations ranged from 0.02 $\mu g/cm^2$ to 6.85 $\mu g/cm^2$ during 1978 (Table 2.1-2). Ambient stations (1, 2, 5, and 6) had peak phaeophytin a concentrations during August, depicting the linear relationship between increased temperature and chlorophyll a degradation. Heated Station 3 showed peak phaeophytin a concentration during the May 17 sampling period, but high phaeophytin a to chlorophyll a ratios during August indicate this to be the peak period of chlorophyll a degradation.

2.1.4.1.3 Percent Chlorophyll a

Percent chlorophyll a values during 1978 ranged from 0 to 99 percent (Table 2.1-3). Main channel stations averaged 90 percent chlorophyll a, ambient Stations 5 and 6 (Sturgeon Lake and Intake) averaged 73.5 percent, while heated stations averaged 67 percent. The 16.5 percent difference between main channel Station and 2 and the other ambient stations can be attributed to increased flow and physiological richness of the main channel. The 23 percent reduction in percent chlorophyll a between main channel stations and heated stations indicates thermal stress within the immediate plant area. Heated Stations 4 and 7 had mean percent chlorophyll a values of 70 and 63 percent, respectively. This seven percent increase from Station 7

(immediate discharge) to Station 4 (Barney's Point) indicates partial recovery of community health within even a short distance.

Extremely low percent chlorophyll a values at Stations 5 and 6 during July are probably related to the shading effect caused by aquatic macrophytes entangled in the samplers. Visual observation of the samplers showed little or no algal growth due to shading and abrasion by aquatic macrophytes.

2.1.4.2 Microscope Analyses

Attached diatom cell density during 1978 varied from less than 8,000 cells per square centimeter to more than two million. Cell density at all stations for all sampling periods is shown in Table 2.1-4. Minimal cell densities occurred during winter months at Station 4 (Barney's Point), while maximum densities occurred at differing times, depending on station. Main channel station maxima occurred during September, with a secondary peak during May. Heated stations peaked during March with a secondary peak in May. Ambient Stations 5 and 6 had a May peak with a smaller peak during September. Maximum cell densities are regulated by temperature; optimal temperatures giving rise to peak cell densities of each seasonal community.

Table 2.1-5 lists all diatom species identified since the initiation of the PINGP attached algae program. The list now includes 220 species from 34 genera. Diatom analysis for 1978 presents species representing two orders, Centrales and Pennales. Each order has certain genera that are present at all stations. These include Cyclotella, Melosira, and Stephanodiscus from the Order Centrales; and Diatoma, Fragilaria, Gomphonema, Navicula, Nitzschia, and Synedra from the Order Pennales.

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Seasonal succession of the attached algal community is divided into four groups; winter, spring, summer, and late summer (Baker 1976). Each of these groups has certain dominant species indicative of the thermal conditions of the season. The winter community was dominated by Fragilaria intermedia, Diatoma vulgare var. producta, and Nitzschia acicularis at heated stations. Ambient stations are not accessible during winter months, giving no taxonomic profile of these stations.

The spring diatom community was dominated by Synedra (S. acus) and Gomphonema (G. parvalum and G. olivaceum) genera. Peak concentrations occurred during March in the recirculation canal and May at ambient stations. Certain species of Gomphonema occurred at various times throughout the year, but no significant peaks were reached.

Summer diatoms were characterized by Navicula (N. cincta) and the centric genus Cyclotella. These species tolerated high temperatures in the main channel, but the even higher temperature within the recirculation canal caused a dip in cell density.

Late summer forms included Navicula cincta, Nitzschia acuta, and Nitzschia tryblionella. These species were encountered during September in the main channel, but densities within the recirculation canal at the same time were much lower.

All diatoms comprising the seasonal community of attached algae operate within a temperature regime indicative of that species. A shift in temperature from optimum to a point outside the regime will cause one species to subside, whereas another form will dominate if the temperature is conducive to its growth and reproduction.

2.1.5 DISCUSSION

Community structure and seasonal trends exhibited by the attached diatom community during 1978 reflect the response of algal species to optimum temperature conditions. Other factors that may influence algal growth include light, nutrients, and substrate. As in previous years, heated stations had peak chlorophyll *a* and cell density during January through March. Ambient main channel stations had peak chlorophyll *a* and cell density during September. Optimum temperature range for both areas was 20 - 23°C.

Chlorophyll *a* and cell density were low during June and July, especially evident at Sturgeon Lake and intake stations (5 and 6). River flow during 1978 was much higher than 1977, causing an over abundance of aquatic macrophytes to be uprooted and carried downstream. This vegetation became entangled in the periphyton samplers, causing abrasion of the substrate and shading of the entire sampler. Comparison of field notes and laboratory results indicates the vegetation was probably responsible for low periphyton growth.

Periphyton growth generally followed normal seasonal profiles indicative of the Mississippi River near PINGP. Data gathered over the last years have given a detailed account of species composition and chlorophyll pigments as they react to ambient river conditions and heated effluent from PINGP. Thermal effects have always been most evident in the recirculation canal, close-in discharge, and to a lesser extent at Barney's Point. The most evident effect seems to be a shift in peak cell density, community structure, and phytopigment concentrations. Rapid mixing of the effluent below Barney's Point, especially that of U. S. Lock and Dam 3, indicates a return of the community to normal ambient structure immediately downstream of the plant.

2.1.6 LITERATURE CITED

Lorenzen, C. J. 1967. Determination of Chlorophyll and Pheopigments: Spectrophotometric Equations. Limnol. Oceanogr. 12(3): 343-346.

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Figure 2.1-1. Periphyton sampling locations.

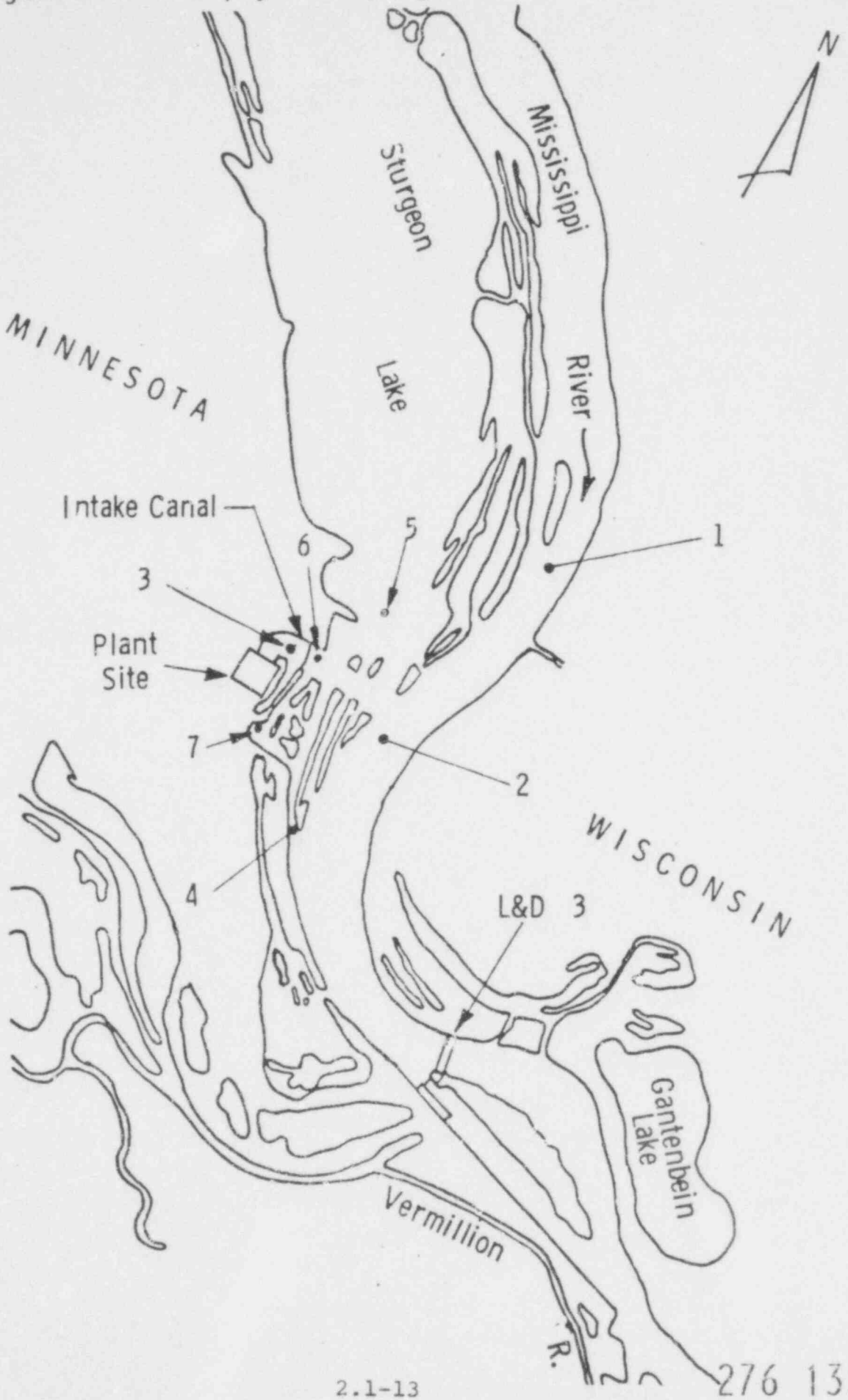

Figure 2.1-2. 1979 Chlorophyll a Concentrations at Station 3 and Main Channel Stations 1 and 2 (Mean).

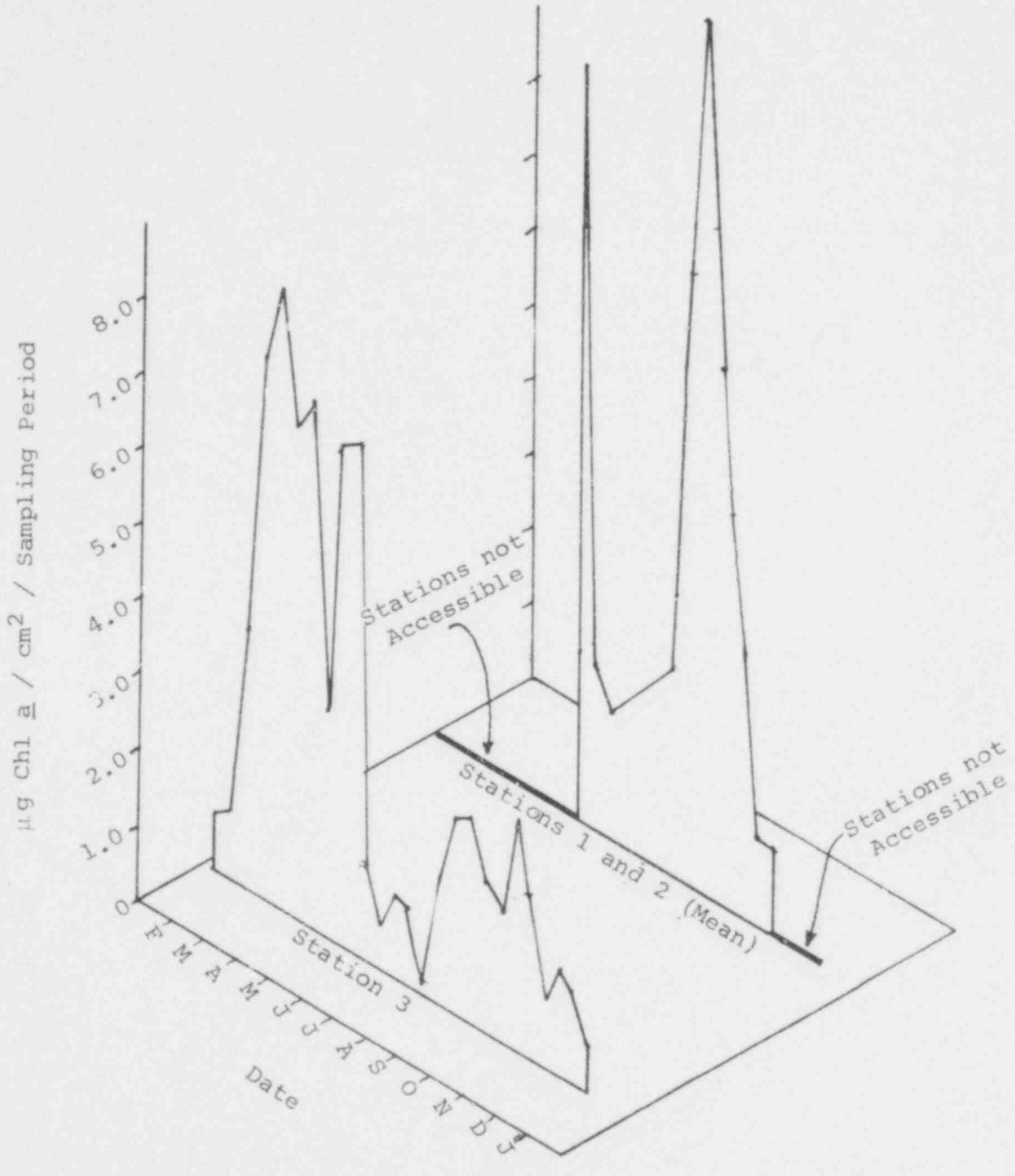

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Figure 2.1-3. Comparison of 1978 and 1977 River Flow Data. Figures Based on Data from U.S. Lock and Dam 3.

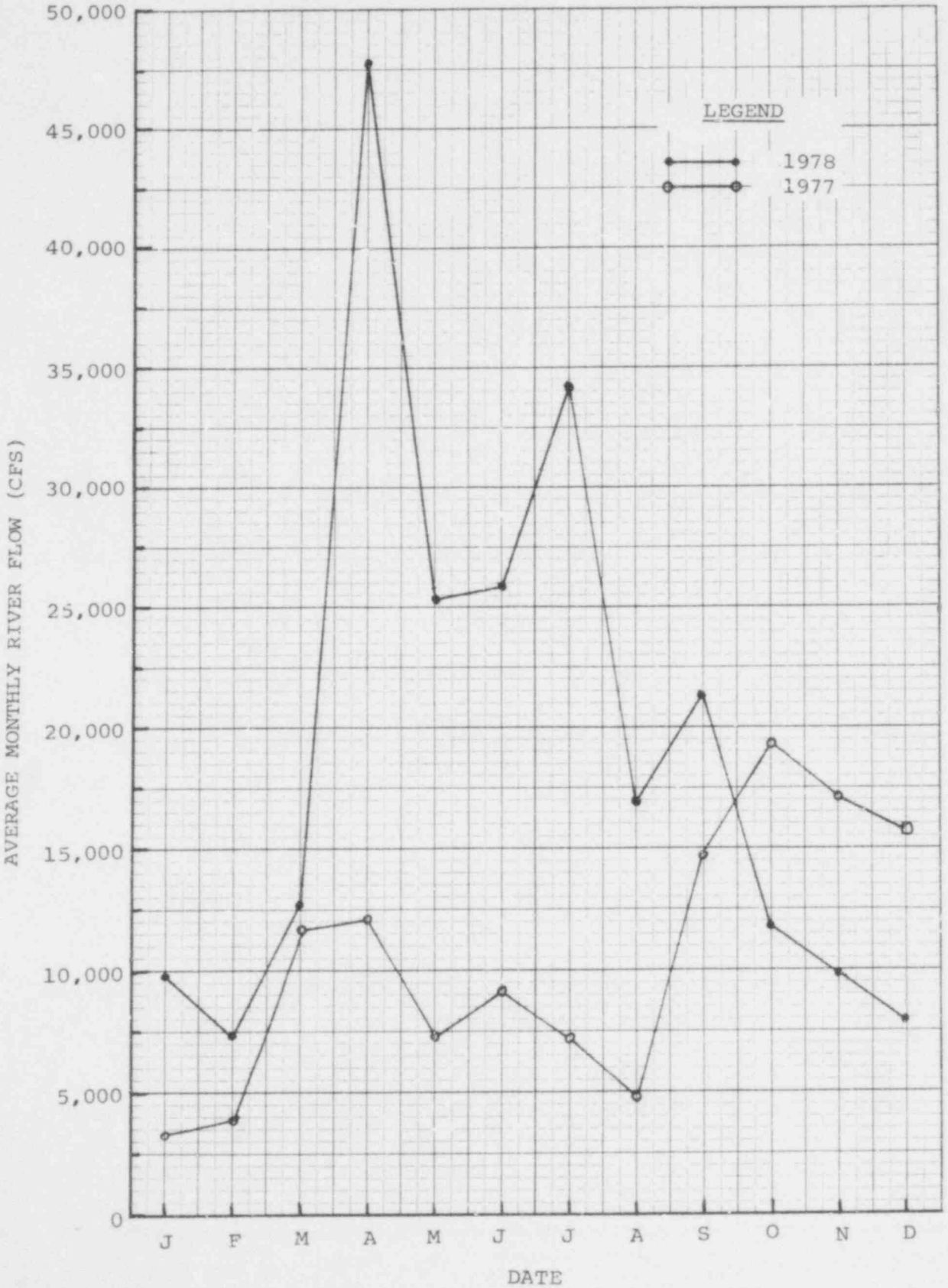

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Table 2.1-1 1978 Chlorophyll a concentrations at each station expressed as $\mu g/cm^2$/sampling period.

Collection Date	Station 1	2	3	4	5	6	7
1/11	ICE	ICE	0.73	ICE	ICE	ICE	0.07
1/25			0.83				0.21
2/8			3.41				0.57
2/22			7.21				2.82
3/8			8.17				7.01
3/22			6.50				6.74
4/5			6.93				3.82
4/19			2.96				4.67
5/4			6.54				3.98
5/17	9.29	10.75	6.73	4.70	13.37	9.05	2.06
6/1	2.95	1.44	1.24	1.21	3.57	2.33	0.81
6/15	*	1.68	0.58	0.17	2.40	0.59	0.25
6/28	*	*	1.10	1.07	1.10	0.57	0.21
7/12	*	*	1.05	0.97	1.49	0.83	0.62
7/26	*	*	0.16	0.21	0.10	0.00	0.12
8/9	2.77	*	1.69	0.95	0.31	2.07	0.35
8/24	8.15	*	2.58	3.24	9.57	4.19	1.04
9/6	11.60	*	2.61	2.43	9.69	4.32	1.27
9/20	*	7.07	1.97	2.14	7.05	3.93	1.09
10/4	7.37	3.71	1.70	9.21	5.13	5.29	0.49
10/18	4.48	2.59	3.01	3.11	0.79	1.12	0.34
11/1	*	1.22	2.21	4.94	0.38	2.84	1.38
11/15	1.12	1.25	0.94	2.19	0.19	1.33	0.58
11/29	ICE	ICE	1.43	0.33	ICE	ICE	0.57
12/12			1.20	0.11			0.87
12/28			0.69	0.04			0.21
Mean	5.97	3.71	2.85	2.18	3.94	2.75	1.62

*Sampler missing - vandalism or destroyed by barge traffic.

Table 2.1-2 1978 Phaeophytin a concentrations at each station expressed as g/cm^2/sampling period.

Collection Date	Station 1	2	3	4	5	6	7
1/11			0.06				0.05
1/25			0.12				0.14
2/8			0.12				0.15
2/22			0.49				0.05
3/8			1.94				0.33
3/22	ICE	ICE	1.52	ICE	ICE	ICE	0.64
4/5			3.48				0.68
4/19			2.27				0.67
5/4			3.92				1.45
5/17	0.13	0.66	6.85	0.42	0.51	0.41	0.55
6/1	0.28	0.26	0.72	0.82	0.75	0.41	0.70
6/15	-	0.53	0.76	0.08	0.94	0.28	0.28
6/28	-	-	0.51	0.56	0.27	0.33	1.22
7/12	-	-	1.38	0.70	0.99	0.59	0.60
7/26	-	-	0.58	0.10	0.35	0.38	0.42
8/9	1.65	-	1.31	1.08	0.36	2.11	0.42
8/24	1.24	-	0.95	2.12	0.81	2.12	0.88
9/6	1.30	-	0.80	0.39	1.22	0.79	0.34
9/20	-	0.71	1.26	0.29	1.01	0.60	0.95
10/4	0.50	0.20	1.02	1.71	0.19	0.70	0.46
10/18	0.19	0.24	1.04	0.50	0.21	0.30	0.38
11/1	-	0.02	0.75	0.61	0.06	0.16	0.38
11/15	0.07	0.05	0.44	0.35	0.10	0.14	0.39
11/29			0.42	0.08			0.28
12/12	ICE	ICE	0.42	0.17	ICE	ICE	1.11
12/28			0.13	0.04			0.17
Mean	0.67	0.33	1.28	0.59	0.56	0.67	0.53

Table 2.1-3 1978 Percent chlorophyll a values for each station.
Percent chlorophyll a = (Chla + Phaco a) x 100.

Collection Date	Station						
	1	2	3	4	5	6	7
1/11	ICE	ICE	92	ICE	ICE	ICE	58
1/25			87				60
2/8			97				79
2/22			94				98
3/8			81				96
3/22			81				91
4/5			67				85
4/19			57				87
5/4			63				73
5/17	99	94	50	92	96	96	79
6/1	91	85	63	60	83	85	54
6/15	-	76	43	68	72	68	47
6/28	-	-	68	66	80	63	15
7/12	-	-	43	58	60	58	51
7/26	-	-	22	68	22	0	22
8/9	63	-	56	47	46	50	45
8/24	87	-	73	60	92	58	54
9/6	90	-	77	86	89	85	79
9/20	-	91	61	88	87	87	53
10/4	94	95	63	84	96	88	51
10/18	96	92	74	86	79	79	47
11/1	-	98	75	89	86	95	78
11/15	94	96	68	86	66	90	60
11/29	ICE	ICE	77	80	ICE	ICE	67
12/12			74	30			67
12/28			74	39			43
Mean	89	91	68	70	75	72	63

Table 2.1-5. Attached Diatoms of the Mississippi River near Prairie Island
Numbers Expressed as Cells per Square Centimeter
January 11, 1978

Species	Station		
	2	4	7
-----CENTRALES-----			
Cyclotella kutzingiana	2844		2844
Cyclotella Meneghiniana	2844		5689
Melosira granulata	2844		5689
Stephanodiscus astraea	11379		8534
-----PENNALES-----			
Amphora ovalis	11379		5689
Cymbella ventricosa	2844		8534
Diatoma vulgare	8534		2844
Fragilaria brevistriata	5689		2844
Gomphonema olivaceum	14224		19915
Gomphonema parvulum	19915	NO DATA (ICE)	17068
Gyrosigma acuminatum	2844		5689
Navicula bacillum v. capitata	11379		44172
Navicula cincta	51205		34769
Navicula hungarica	17068		14224
Nitzschia acicularis	8534		54050
Nitzschia acuta	45516		39826
Nitzschia dissipata	2844		48360
Nitzschia palea	5689		0
Surirella ovata	2844		2844
Surirella ovata v. pinnata	2844		5689
Synedra acus	0		2844
Synedra ulna v. oxyrhynchus fo. constricta	0		21335
Unidentified (girdle view, etc.)	5689		8534

Table 2.1-4 Attached Diatom Species Identified Since Initiation Of Prairie Island Nuclear Generating Plant Attached Algae Program

COSCINODISCUS LACUSTRIS
COSCINODISCUS CF. ROTHII V. SUBSALSA
COSCINODISCUS SP.
CYCLOTELLA COMTA
CYCLOTELLA KUTZINGIANA
CYCLOTELLA MENEGHINIANA
MELOSIRA AMBIGUA
MELOSIRA DISTANS V. PFAFFIANA
MELOSIRA GRANULATA
MELOSIRA GRANULATA V. ANGUSTISSIMA
MELOSIRA ISLANDICA
MELOSIRA ITALICA
MELOSIRA VARIANS
MELOSIRA SP.
STEPHANODISCUS ASTRAEA
STEPHANODISCUS ASTRAEA VAR. MINUTULA
STEPHANODISCUS DUBIUS
STEPHANODISCUS NIAGARAE
STEPHANODISCUS SP.
ACHNANTHES CONSPICUA
ACHNANTHES EXIGUA
ACHNANTHES EXIGUA V. HETEROVALVATA
ACHNANTHES HUNGARICA
ACHNANTHES KOLBII
ACHNANTHES LANCEOLATA
ACHNANTHES LANCEOLATA V. ELLIPTICA
ACHNANTHES LANCEOLATA V. ROSTRATA
ACHNANTHES MINUTISSIMA
ACHNANTHES SP.(BENT, GIRDLE VIEW)
ACTINELLA PUNCTATA
AMPHORA OVALIS
AMPHORA OVALIS V. PEDICULUS
AMPHORA PERPUSILLA
AMPHORA SP.
ANOMOEONEIS SPHAEROPHORA
ASTERIONELLA FORMOSA
BACILLARIA PARADOXA
CALONEIS BACILLUM
CALONEIS CLEVEI
CALONEIS LEWISII
CALONEIS SILICULA
COCCONEIS DIMINUTA
COCCONEIS DISCULUS
COCCONEIS PEDICULUS
COCCONEIS PLACENTULA
COCCONEIS PLACENTULA V. EUGLYPTA
COCCONEIS PLACENTULA V. LINEATA
COCCONEIS SCUTELLUM
CYMATOPLEURA SOLEA
CYMATOPLEURA SOLEA V. REGULA
CYMBELLA AMPHICEPHALA
CYMBELLA HUSTEDTII
CYMBELLA PUSILLA
CYMBELLA TUMIDA
CYMBELLA TURGIDA
CYMBELLA VENTRICOSA
CYMBELLA SP.
CYMBELLA SP.1
CYMBELLA SP. 2
DENTICULA ELEGANS
DIATOMA ELONGATUM
DIATOMA HIEMALE
DIATOMA VULGARE
DIATOMA VULGARE V. GRANDIS
DIATOMA VULGARE V. PRODUCTA
DIATOMA VULGARE V. UNKNOWN
EPITHEMIA TURGIDA
EUNOTIA VALIDA
FRAGILARIA BREVISTRIATA
FRAGILARIA BREVISTRIATA V. INFLATA
FRAGILARIA CAPUCINA
FRAGILARIA CONSTRUENS
FRAGILARIA CONSTRUENS V. SUBSALINA
FRAGILARIA CONSTRUENS V. VENTER
FRAGILARIA CROTONENSIS
FRAGILARIA GRACILLIMA
FRAGILARIA HARRISSONII
FRAGILARIA HARRISSONII V. RHOMBOIDES
FRAGILARIA INFLATA
FRAGILARIA INTERMEDIA
FRAGILARIA PINNATA
FRAGILARIA VIRESCENS
FRAGILARIA VIRESCENS V. MESOLEPTA
FRAGILARIA SP. (GIRDLE, FILAMENT)
GOMPHONEMA ACUMINATUM
GOMPHONEMA GRACILE
GOMPHONEMA LANCEOLATUM
GOMPHONEMA LONGICEPS V. GRACILIS
GOMPHONEMA LONGICEPS V. SUBCLAVATA
GOMPHONEMA OLIVACEUM
GOMPHONEMA OLIVACEUM V. MINUTISSIMA
GOMPHONEMA PARVULUM
GOMPHONEMA PARVULUM V. MICROPUS
GOMPHONEMA SPHAEROPHORUM
GOMPHONEMA VENTRICOSUM
GOMPHONEMA SP. 1
GYROSIGMA ACUMINATUM
HANTZSCHIA SP.
MERIDION CIRCULARE
MERIDION CIRCULARE V. CONSTRICTA
NAVICULA BACILLIFORMIS
NAVICULA BACILLUM
NAVICULA BACILLUM V. CAPITATA
NAVICULA CAPITATUM
NAVICULA CINCTA
NAVICULA CITRUS
NAVICULA COLIOPLEUROIDES
NAVICULA COSTULATA
NAVICULA CRYPTOCEPHALA
NAVICULA CRYPTOCEPHALA V. VENETA
NAVICULA CUSPIDATA
NAVICULA CUSPIDATA V. AMBIGUA
NAVICULA DICEPHALA
NAVICULA DICEPHALA V. NEGLECTANS
NAVICULA ELEGANS
NAVICULA EXIGUA
NAVICULA GASTRUM
NAVICULA HUNGARICA
NAVICULA HUNGARICA V. CAPITATA
NAVICULA HUSTEDTII
NAVICULA INTEGRA
NAVICULA MINIMA
NAVICULA NOTICA
NAVICULA PEREGRINA
NAVICULA PLACENTULA
NAVICULA PLACENTULA FO. LANCEOLATA
NAVICULA PROTRACTA
NAVICULA PUPULA
NAVICULA CF. PUSILLA
NAVICULA REINHARDTII
NAVICULA RHYNCOCEPHALA
NAVICULA CF. SALINARUM
NAVICULA SCHONFELDII
NAVICULA SCOLIOPLEUROIDES
NAVICULA SCUTELOIDES
NAVICULA TUSCULA
NAVICULA SP./GIRDLE VIEW
NEIDIUM AFFINE
NEIDIUM DUBIUM
NEIDIUM DUBIUM FO. CONSTRICTA
NITZSCHIA ACICULARIS
NITZSCHIA ACUTA
NITZSCHIA AMPHIBIA
NITZSCHIA CAPITELLATA
NITZSCHIA CLOSTERIUM
NITZSCHIA COMMUTATA
NITZSCHIA DISSIPATA
NITZSCHIA DUBIA
NITZSCHIA FILIFORMIS
NITZSCHIA FONTICOLA
NITZSCHIA FRUSTULUM
NITZSCHIA FRUSTULUM V. SUBSALINA
NITZSCHIA GRACILIS
NITZSCHIA HANTZSCHIANA
NITZSCHIA HEUFLERIANA
NITZSCHIA HOLSATICA
NITZSCHIA KUTZINGIANA
NITZSCHIA MICROCEPHALA
NITZSCHIA OBTUSA
NITZSCHIA OVALIS
NITZSCHIA PALEA
NITZSCHIA PALACEA
NITZSCHIA RECTA
NITZSCHIA ROMANA
NITZSCHIA STAGNORUM/THERMAL
NITZSCHIA SUBLINEARIS
NITZSCHIA SUBTILIS
NITZSCHIA TRYBLIONELLA
NITZSHIA TRYBIONELLA V. VICTORIAE
NITZSCHIA SP.(NO STR.,LGE KL PUNCTAE)
OPEPHORA MARTYI
PINNULARIA ACROSPHAERIA
PINNULARIA BRAUNII V. AMPHICEPHALA
PINNULARIA GIBBA
PINNULARIA MICROSTAURON V. BREBISSONII
PINNULARIA MOLARIS
PINNULARIA POLYONCA
PINNULARIA SP.
PLEUROSIGMA ANGULATUM
PLEUROSIGMA ELONGATUM
RHOICOSPHENIA CURVATA
STAURONEIS ANCEPS
STAUROMEIS SP.1
SURIRELLA ANGUSTATA
SURIRELLA BISERATA V. CONSTRICTA
SURIRELLA DIDYMA
SURIRELLA GRACILIS
SURIRELLA LINEARIS V. HELVETICA
SURIRELLA OVALIS
SURIRELLA OVATA
SURIRELLA OVATA V. CRUMENA
SURIRELLA OVATA V. PINNATA
SURIRELLA OVATA V. SALINA
SYNEDRA ACTINASTROIDES
SYNEDRA ACUS
SYNEDRA ACUS V. RADIANS
SYNEDRA AFFINIS
SYNEDRA RUMPENS
SYNEDRA RUMPENS V. FAMILIARIS
SYNEDRA ULNA
SYNEDRA ULNA V. DANICA
SYNEDRA ULNA V. IMPRESSA
SYNEDRA ULNA V. OXYRHYNCHUS
SYNEDRA ULNA V. OXYRHYNCHUS FO.CONTRACTA
SYNEDRA VAUCHERIAE
UNIDENTIFIED (GIRDLE VIEW, ETC.)

ADDITIONAL SPECIES IDENTIFIED DURING 1977 AND 1978

COSCINODISCUS ROTHII
CYCLOTELLA STELLIGRA
STEPHANODISCUS TENUIS
ACHNANTHES LANCEOLATA VAR. OMISSA
ACHNANTHES MINUTISSIMA VAR. CRYPTOCEPHALA
CAPARTOGRAMMA CRUCICULA VAR. CRUCICULA
CYMBELLA PROSTRATA VAR. AUERSWAL
EPITHEMIA SOREX
FRAGILARIA LEPTOSTAURON
FRUSTULIA RHOMBOIDES
GOMPHONEMA SIMUS
GYROSIGMA SCALPROIDES
NAVICULA CF. DECUSSIS
NAVICULA PYGMAEA
NAVICULA SALINARUM VAR. INTERMEDIA

Table 2.1-5. Attached Diatoms of the Mississippi River near Prairie Island
Numbers Expressed as Cells per Square Centimeter
January 25, 1978

Species	Station		
	3	4	7
-----CENTRALES-----	7518		3568
Cyclotella kutzinghiana	0		3568
Stephanodiscus astraea			
-----PENNALES-----	15306		
Achnanthes lanceolata v. omissa	22554		3568
Diatoma elongatum	15036		0
Fragilaria brevistriata	90216		21406
Fragilaria construens v. subsalina	22554		3568
Gomphonema longiceps v. gracilis	150367		10703
Gomphonema olivaceum	285685		7135
Gomphonema parvulum	22554		14271
Navicula bacillum v. capitata	67662		3568
Navicula cincta	97734	NO DATA (ICE)	10703
Navicula cryptocephala	52626		10703
Navicula dicephala v. neglecta	60144		0
Navicula hungarica	142843		14271
Navicula rhyncocephala	150360		10703
Navicula schonfeldii	7518		17838
Nitzschia acicularis	22554		7135
Nitzschia acuta	267108		17838
Nitzschia amphibia	751803		10703
Nitzschia dissipata	90216		117744
Surirella ovata	240577		3568
Synedra ulna	195468		7135
Synedra ulna v. oxyrhynchus fo. constricta	60144		7135
Unidentified (girdle view, etc.)	7518		10703

Table 2.1-5. Attached Diatoms of the Mississippi River near Prairie Island
Numbers Expressed as Cells per Square Centimeter
February 8, 1978

Species	Station		
	3	4	7
-----CENTRALES-----	5216		3674
Cyclotella kutzingiana	5216		3674
Stephanodiscus niagarae	15647		0
-----PENNALES-----			
Achnanthes exigua	5216		3674
Amphora ovalis	0		0
Diatoma vulgare	0		3674
Diatoma vulgare v. producta	5216		0
Fragilaria brevistriata	20863		3674
Fragilaria capucina	5216		22047
Fragilaria construens v. subsalina	31296	[ICE]	7349
Gomphonema olivaceum	41726		18372
Gomphonema parvulum	406829		51442
Navicula bacillum v. capitata	15647		0
Navicula cincta	62589	NO DATA	7349
Navicula dicephala	2[illegible]435		14698
Nitzschia acicularis	31294		11023
Nitzschia acuta	198199		7349
Nitzschia dissipata	307730		44093
Nitzschia palea	5216		3674
Surirella ovata v. pinnata	20863		7349
Synedra ulna	62589		3674
Synedra ulna v. oxyrhynchus fo. constricta	146041		7349
Unidentified	67805		7349

Table 2.1-5. Attached Diatoms of the Mississippi River near Prairie Island
Numbers Expressed as Cells per Square Centimeter
February 22, 1978

Species	Station		
	3	4	7
-----CENTRALES-----			
Cyclotella kutzinghiana	17395		0
Melosira granulata	0		9693
Melosira varians	5798		4847
Stephanodiscus niagarae	11597		9693
-----PENNALES-----			
Cymatopleura solea	11597		4847
Cymbella ventricosa	23193		9693
Cymbella sp.	5798		14539
Diatoma vulgare	0	NO DATA (ICE)	29079
Fragilaria capucina	11597		9693
Fragilaria intermedia	40588		4847
Gomphonema olivaceum	34790		63005
Gomphonema parvulum	75378		43619
Navicula cincta	23193		87238
Navicula cryptocephala	34790		14539
Navicula dicephala	17395		9693
Navicula dicephala v. neglecta	278320		33925
Nitzschia acicularis	23193		24232
Nitzschia acuta	432278		111470
Nitzschia amphibia	17395		19386
Nitzschia dissipata	11596		58158
Synedra ulna	23193		9693
Synedra ulna v. oxyrhynchus	214538		19386
Synedra ulna v. oxyrhynchus fo. constricta	185547		38772
Unidentified	34790		9693

Table 2.1-5. Attached Diatoms of the Mississippi River near Prairie Island
Numbers Expressed as Cells per Square Centimeter
March 8, 1978

Species	Station		
	3	4	7
-----CENTRALES-----			
Cyclotella Meneghiniana	8133		7428
Stephanodiscus niagarae	4066		3743
-----PENNALES-----			
Diatoma elongatum	12199		11231
Diatoma vulgare	28465		26205
Diatoma vulgare v. producta	24399		22462
Fragilaria intermedia	32473		29949
Gomphonema olivaceum	12199		11231
Gomphonema parvulum	48798		44924
Navicula cincta	56931	NO DATA (ICE)	52411
Navicula dicephala	20332		18718
Navicula hungarica v. capitata	16266		14974
Navicula pygmaea	4066		3743
Navicula rhyncocephala	8133		7487
Nitzschia acicularis	8133		14974
Nitzschia acuta	65064		78617
Nitzschia amphibia	8133		7487
Nitzschia dissipata	24399		18718
Pinnularia gibba	16626		3743
Surirella ovata	8133		3748
Surirella ovata v. pinnata	24399		11231
Synedra ulna	12199		26205
Synedra ulna v. oxyrhynchus	36598		3748
Unidentified (girdle view, etc.)	12199		7487

Table 2.1-5. Attached Diatoms of the Mississippi River near Prairie Island
Numbers Expressed as Cells per Square Centimeter

March 22, 1978

Species	Station		
	3	4	7
-----CENTRALES-----			
Melosira granulata	15804		0
Melosira varians	23706		0
-----PENNALES-----			
Fragilaria intermedia	3951		15804
Gomphonema olivaceum	7902		27657
Gomphonema parvulum	7902		23706
Navicula cincta	27657		11853
Navicula cryptocephala	7902		7902
Navicula dicephala	0	NO DATA (ICE)	3951
Navicula hungarica v. capitata	7902		0
Navicula rhyncocephala	7902		3951
Navicula schonfeldii	11853		19755
Navicula sp.	7902		11853
Nitzschia acicularis	15804		2951
Nitzschia acuta	51363		0
Nitzschia dissipata	3951		0
Nitzschia dubia	3951		3951
Pinnularia gibba	3951		0
Surirella ovata	3951		7902
Synedra rumpens	23706		11853
Synedra ulna	3951		11853
Synedra ulna v. oxyrhynchus	11853		19755
Unidentified (girdle view, etc.)	7902		0

Table 2.1-5. Attached Diatoms of the Mississippi River near Prairie Island
Numbers Expressed as Cells per Square Centimeter
April 5, 1978

Species	Station		
	3	4	7
-----CENTRALES-----			
Melosira granulata	55314		67167
Melosira varians	19755		47412
Stephanodiscus astraea	15804		35559
-----PENNALES-----			
Amphora ovalis	7902		11853
Diatoma elongatum	3951		7902
Diatoma vulgare	3951		3951
Fragilaria crotonensis	15804		11853
Fragilaria intermedia	7902		19735
Gyrosigma acuminatum	71118		3951
Navicula cincta	15804		51363
Navicula hungarica	11853		7902
Navicula Reinhardtii	15804		3951
Navicula schonfeldii	11853		11853
Navicula sp.	15804		7902
Nitzschia acicularis	7902		0
Nitzschia amphibia	11853		27657
Nitzschia stagnorum/thermalis	35559		23706
Surirella ovata	27657		19755
Surirella ovata v. pinnata	25657		7902
Synedra ulna	15804		0
Synedra ulna v. oxyrhynchus	0		0
Synedra vaucheriae	7902		0
Unidentified (girdle view, etc.)	7902		7902

(HIGH WATER)
NO DATA

Table 2.1-5. Attached Diatoms of the Mississippi River near Prairie Island
Numbers Expressed as Cells per Square Centimeter
April 19, 1978

Species	Station 3	Station 4	Station 7
-----CENTRALES-----			
Cyclotella Meneghiniana	7902		11853
Melosira varians	11853		11853
-----PENNALES-----			15804
Cocconeis pediculus	11853		
Cocconeis placentula v. euglypta	7902		0
Cymbella prostrata v. auerswaldii	7902		0
Diatoma elongatum	3951		11853
Gomphonema olivaceum	11853		31608
Gomphonema parvulum	23706		3951
Gyrosigma acuminatum	7902		86922
Navicula cincta	15804		7902
Navicula hungarica	3951		3951
Navicula peregrina	0		11853
Navicula schonfeldii	7902		23706
Navicula sp.	3951		11853
Nitzschia acicularis	3951		7902
Nitzschia acuta	31608		102726
Nitzschia amphibia	7902		11853
Nitzschia dissipata	7902		7902
Synedra rumpens	3951		19755
Synedra ulna	11853		23706
Synedra ulna v. oxyrhynchus	7902		0
Unidentified (girdle view, etc.)	7902		15804

NO DATA (ICE)

Table 2.1-5 Attached Diatoms of the Mississippi River near Prairie Island
Numbers Expressed as Cells per Square Centimeter

June 15, 1978

Species	Station						
	1	2	3	4	5	6	7
-----CENTRALES-----							
Melosira distans v. pfaffiana		3951	7902	15804	0	3951	23706
Melosira granulata		3951	0	0	0	0	15804
Melosira islandica		11853	11853	11853	3951	0	7902
Melosira varians		7902	7902	11853	7902	7902	3951
-----PENNALES-----							
Achnanthes lanceolata		7902	0	0	7902	0	7902
Cocconeis placentula var. euglypta		3951	0	0	0	0	3951
Cymbella turgida		0	3951	3951	0	7902	15804
Cymbella ventricosa		15804	3951	7902	0	0	3951
Diatoma elongatum		67167	0	7902	23706	7902	7902
Diatoma vulgare var. producta		23706	0	15804	27657	7902	0
Fragilaria capucina		7902	7902	11853	11853	0	0
Fragilaria crotonensis		11853	3951	11853	0	0	0
Fragilaria intermedia		27657	0	27657	0	0	63216
Gomphonema olivaceum		71118	3951	15804	0	15804	23706
Gomphonema parvulum		134334	0	11853	0	7902	3951
Navicula cincta		19755	0	39510	0	0	11853
Navicula cryptocephala		3951	3951	0	15804	23706	7902
Navicula rhyncocephala		0	0	51363	47412	3951	82971
Navicula schonfeldii		11853	7902	47412	3951	0	0
Nitzschia acicularis		15804	49412	3951	0	0	3951
Nitzschia acuta		347688	7902	106677	15804	17384	23706
Nitzschia dissipata		3951	11853	0	0	3951	7902
Nitzschia stagnorum/thermalis		0	7902	7902	0	0	0
Synedra ulna		106677	0	0	0	0	0
Synedra ulna var. oxyrhynchus		7902	0	0	0	0	0
Unidentified (girdle view, etc.)		7902	7902	7902	3951	7902	3951

Sampler Missing

Table 2.1-5. Attached Diatoms of the Mississippi River near Prairie Island
Numbers Expressed as Cells per Square Centimeter
June 28, 1978

Species	Station						
	1	2	3	4	5	6	7
-----CENTRALES-----				3951			
Cyclotella Meneghiniana			11853	47412	0	0	3951
Melosira distans var. pfaffina			3951	0	0	0	67167
Melosira granulata			0	11853	3951	0	11853
Melosira varians			15804		0	7902	7902
-----PENNALES-----							
Achnanthes exigua			3951	3951	0	0	3951
Achnanthes exigua var. heterovalvata			3951	0	0	0	0
Cymbella ventricosa			7902	0	0	7902	7902
Diatoma elongatum			0	0	7902	0	0
Diatoma vulgare var. producta			3951	3951	0	0	0
Fragilaria brevistriata			3951	0	0	0	0
Fragilaria intermedia			0	23706	11853	0	0
Gomphonema olivaceum			7902	27657	7902	0	0
Gomphonema parvulum			7902	3951	0	0	0
Gyrosigma acuminatum			0	3951	0	0	3951
Navicula cincta			3951	0	0	23706	3951
Navicula dicephala			[illegible]	11853	0	0	3951
Navicula hungarica			0	3951	0	27657	0
Navicula peregrina			1185[illegible]	0	3951	0	7902
Navicula pygmaea			0	0	0	0	7902
Navicula Reinhardtii			3951	0	0	3951	0
Navicula schonfeldii			3951	7902	0	0	11853
Nitzschia acicularis			7902	63216	39510	11853	7902
Nitzschia acuta			47412	0	3951	0	23706
Nitzschia dissipata			3951	3951	11853	11853	3951
Nitzschia palea			0	0	0	0	0
Synedra ulna			3951	0	0	0	3951
Synedra ulna var. oxyrhynchus			0	3954	0	0	0
Unidentified (girdle view, etc)			7902	7902	0	0	0

Sampler Missing

Sampler Missing

Table 2.1-5. Attached Diatoms of the Mississippi River near Prairie Island
Numbers Expressed as Cells per Square Centimeter
July 12, 1978

Species	Station						
	1	2	3	4	5	6	7
-----CENTRALES-----							
Cyclotella Meneghenianą			173844	205452	34373	63492	71988
Melosira granulata			114579	75069	33188	41247	71988
Melosira italica			3951	15804	0	0	7902
Melosira varians			7902	0	0	0	0
-----PENNALES-----							
Cymbella prostrata var. auerswaldii			0	3951	0	0	0
Cymbella ventricosa			7902	0	0	0	3951
Diatoma vulgare var. producta			7902	3951	0	0	3951
Gomphonema olivaceum			0	0	3951	0	3951
Gomphonema parvulum			39510	0	31608	37062	0
Navicula cincta			7902	15804	0	0	0
Navicula cryptocephala			3951	3951	0	0	0
Navicula cryptocephala var. veneta			0	0	0	0	3951
Navicula rhyncocephala			0	0	0	0	3951
Neidium dubium			3951	0	0	0	7902
Nitzachia acicularis			0	11853	0	0	7902
Nitzschia acuta			67167	0	18569	41427	23706
Nitzschia dissipata			7902	0	0	0	0
Rhoicosphenia curvata			0	3951	0	0	0
Surirella ovata			7902	7902	0	0	3951
Synedra ulna			7902	0	0	0	0
Unidentified (girdle view, etc.)			7902	11853	7902	0	0

Sampler Missing

Sampler Missing

Table 2.1-5. Attached Diatoms of the Mississippi River near Prairie Island
Numbers Expressed as Cells per Square Centimeter

July 26, 1978

Species	Station						
	1	2	3	4	5	6	7
-----CENTRALES-							
Cyclotella kutzi[illegible]iana			0	0	580	3951	31608
Cyclotella Meneghiniana			165492	3951	580	0	39510
Melosira granulata			114579	67167	580	0	47412
Melosira varians			3951	39510	0	0	7902
-----PENNALES-----							
Achnanthes exigua var. heterovalvata			0	3951	0	0	7902
Achnanthes lanceolata			0	3951	0	0	7902
Gomphonema olivaceum			0	7902	0	3951	3951
Gomphonema parvulum			7902	27657	0	0	0
Gyrosigma scalproides			3951	0	0	0	0
Navicula cincta	Sampler Missing	Sampler Missing	0	31608	0	7902	0
Navicula cryptocephala			0	3951	580	0	7902
Navicula hungrica			3951	0	1160	11853	3951
Navicula rhyncocephala			0	0	580	0	0
Navicula schonfeldii			0	0	1160	11853	0
Navicula sp.			0	7902	0	0	0
Nitzschia acicularis			11853	0	0	0	3951
Nitzschia acuta			75069	86922	3480	3951	51363
Nitzschia palea			0	3951	0	0	3951
Nitzschia recta			0	3951	0	0	0
Surirella ovata			3951	0	580	3951	0
Synedra ulna			7902	0	0	0	3951
Unidentified (girdle view, etc)			7902	3951	1160	7902	7902

Table 2.1-5. Attached Diatoms of the Mississippi River near Prairie Island
Numbers Expressed as Cells per Square Centimeter

August 9, 1978

Species	Station						
	1	2	3	4	5	6	7
-----CENTRALES-----							
Cyclotella kutzinghiana	11853		7902	23706	0	0	7902
Cyclotella Meneghiniana	154089		67167	47412	3951	0	47412
Melosira granulata	19755		114579	39510	0	3951	67167
Melosira italica	7902		7902	3951	7902	0	0
-----PENNALES-----							
Achnanthes exigua v. heterovalvata	3951		0	0	0	0	0
Amphora ovalis	0		0	3951	0	0	0
Gophonema parvulum	126432		47412	39510	11853	15804	15804
Gyrosigma acuminatum	0		3951	11853	0	0	3951
Gyrosigma scalproides	3951		3951	7902	0	0	0
Navicula cincta	63216	Sampler Missing	0	98715	11853	11853	0
Navicula cryptocephala	0		0	0	0	0	0
Navicula dicephala	7902		0	3951	0	0	0
Navicula hungarica	0		3951	3951	0	3951	7902
Navicula mutica	11853		0	7902	0	0	0
Navicula sp. (girdle view, etc.)	3951		11853	0	0	0	3951
Nitzschia acicularis	7902		0	11853	3951	0	3951
Nitzschia acuta	27261		0	3951	0	0	0
Nitzschia dissipata	47412		67167	154089	11853	15804	59215
Nitzschia palea	0		3951	0	3951	0	11853
Nitzschia recta	0		3951	0	0	0	0
Pinnularia gibba	3951		7902	3951	0	0	0
Synedra ulna	3951		3951	3951	7902	3951	0
Unidentified (girdle view, etc.)	3951		0	3951	0	7902	3951

Table 2.1-5. Attached Diatoms of the Mississippi River near Prairie Island
Numbers Expressed as Cells per Square Centimeter
August 24, 1978

Species	Station						
	1	2	3	4	5	6	7
-----CENTRALES-----							
Cyclotella kutzingiana	3951	15804	0	19755	7902	3951	3951
Cyclotella Meneghiniana	23706	15804	79020	86922	11853	7902	11853
Cyclotella stelligra	15804	7902	3951	15804	0	11583	23706
Melosira distans v. pfaffina	15804	0	11853	23706	11853	15804	47412
Melosira granulata	19755	7902	15804	27657	3951	23706	11583
Melosira islandica	7902	154089	15804	0	0	3951	7902
Melosira varians	229158	23706	94824	3951	0	0	7902
-----PENNALES-----							
Gomphonema olivaceum	7902	3951	7902	0	0	3951	0
Gomphonema parvulum	173844	7902	11583	0	3951	0	0
Navicula bacillum v. capitata	3197	2951	0	3951	0	15804	3951
Navicula cincta	173844	47412	15804	154089	0	0	0
Navicula cryptocephala	0	3951	0	15804	264717	304227	0
Navicula cryptocephala v. venesta	3951	0	0	0	3951	0	7902
Navicula sp. (girdle view, etc.)	7902	0	3951	0	7902	0	0
Nitzschia acicularis	0	3951	0	0	0	0	3951
Nitzschia acuta	7902	23706	0	0	0	0	0
Nitzschia dissipata	39510	94824	27657	47412	55314	3951	7902
Nitzschia recta	0	3951	15804	15804	23706	71118	7902
Nitzschia stagnorum/thermalis	0	0	0	0	0	7902	0
Surirella ovata	0		7902	3951	0	0	3951
Synedra ulna	11853	02	0	3951	3951	3951	0
Synedra ulna v. oxyrhynchus	47412	15804	0	0	0	0	0
Unidentified (girdle view, etc.)	7902	3951	3951	0	7902	0	7902

Table 2.1-5. Attached Diatoms of the Mississippi River near Prairie Island
Numbers Expressed as Cells per Square Centimeter
September 6, 1978

Species	Station						
	1	2	3	4	5	6	7
-----CENTRACES-----							
Cyclotella kutzingiana	11853		3951	15804	3951	3951	15804
Cyclotella Meneghiniana	15804		71118	82917	0	15804	0
Melosira distans v. pfaffina	19755		15804	11853	15804	11853	0
Melosira islandica	0		3951	7902	7902	11853	0
Melosira varians	150138		51363	0	7902	0	7902
-----PENNALES-----							
Fragilaria intermedia	3951		7902	3951	0	0	3951
Gomphonema olivaceum	23706		7902	0	0	0	0
Gomphonema parvulum	114579		0	63216	11853	15804	0
Gyrosigma acuminatum	7902		0	0	0	0	7902
Navicula cincta	979848		0	158040	387198	391149	15804
Navicula salinarum v. veneta	0		3951	0	7902	7902	3951
Navicula sp. (girdle view, etc)	0		7902	3951	3951	0	3951
Nitzschia dissipata	63216		51363	67167	86922	47412	67167
Nitzschia palea	3951		0	0	0	0	0
Nitzschia recta	15804		3951	15804	0	15804	3951
Synedra ulna	0		0	0	0	3951	0
Synedra ulna v. oxyrhynchus	0		0	7902	7902	0	0
Unidentified (girdle view, etc.)	3951		0	3951	0	3951	7902

Sampler Missing

Table 2.1-5. Attached Diatoms of the Mississippi River near Prairie Island
Numbers Expressed as Cells per Square Centimeter
September 20, 1978

Species	Station						
	1	2	3	4	5	6	7
-----CENTRALES-----							
Cyclotella kutzinghiana		3951	15804	3951	15804	7902	15804
Cyclotella Meneghiniana		15804	19755	15804	3951	3951	11853
Melosira distans v. pfaffina		11853	15804	0	7902	15804	0
Melosira granulata		15804	0	3951	3951	11853	0
Melosira varians		79020	1.853	47412	260766	347688	27657
Stephanodiscus niagarae		23706	7902	7902	3951	0	23706
-----PENNALES-----							
Cocconeis placentula v. euglypta		7902	0	0	15804	11853	0
Cymbella ventricosa		7902	0	0	11853	15804	27657
Gomphonema olivaceum		11853	3951	0	15804	15804	0
Gomphonema parvulum		82971	0	47412	15804	7902	31608
Gomphonema cf. ventricosum		15804	0	7902	0	0	0
Navicula cincta		359541	0	410904	343737	391149	225207
Navicula cryptocephala		7902	3951	7902	0	7202	3951
Navicula hungarica		7902	3951	0	0	11853	0
Navicula mutica		15804	0	0	0	3951	0
Nitzschia acicularis		15804	3951	3951	3951	7902	7902
Nitzschia acuta		126432	0	11853	15804	0	0
Nitzschia dissipata		15804	79020	19755	47412	67167	79020
Nitzschia recta		3951	0	0	0	0	3951
Nitzschia tryblionella		11853	0	0	11853	0	0
Synedra ulna		15804	7902	0	0	3951	0
Synedra ulna v. oxyrhynchus fo. constricta		0	0	3951	7902	23706	7902
Unidentified (girdle view, etc.)		0	7902	3951	0	7902	0

Sampler Missing

Table 2.1-5. Attached Diatoms of the Mississippi River near Prairie Island
Numbers Expressed as Cells per Square Centimeter

October 4, 1978

Species	Station						
	1	2	3	4	5	6	7
-----CENTRALES------							
Coscinodiscus Rothii	0	0	3951	0	0	0	3951
Cyclotella Kutzingiana	3951	7902	7902	0	3951	11853	7902
Cyclotella Meneghiniana	3951	3951	3951	3951	11853	7902	3951
Melosira granulata	0	15804	11853	7902	3951	0	15804
Melosira varians	284472	161991	27657	31608	86922	94824	63216
Stephanodiscus niagarae	7902	0	15804	0	7902	0	0
-----PENNALES-----							
Amphora ovalis	0	0	3951	3951	0	0	0
Cocconeis placentula v. euglypta	3951	3951	0	0	3951	7902	11852
Cymbella ventricosa	3951	7902	0	0	3951	7902	0
Diatoma vulgare v. producta	15804	11853	0	7902	0	0	0
Fragilaria intermedia	0	0	7902	3951	11853	0	0
Gomphonema olivaceum	27657	23706	3951	0	7902	19755	0
Gomphonema parvulum	31608	47412	63216	0	3951	98775	55314
Navicula cincta	474120	355590	79020	244962	213354	316080	71118
Navicula cryptocephala	7902	7902	0	3951	3951	3951	3951
Navicula hungarica	3951	15804	0	0	0	7902	0
Navicula rhyncocephala	3951	11853	3951	3951	3951	0	0
Navicula sp. (girdle view, etc.)	7902	3951	3951	3951	7902	0	3951
Nitzschia acicularis	0	3951	0	0	11853	11853	7902
Nitzschia acuta	7902	7902	0	7902	3951	0	0
Nitzschia dissipata	82971	94824	47412	63216	114579	126432	82971
Nitzschia palea	3951	3951	3951	0	0	7902	3951
Nitzschia recta	7902	0	7902	0	27657	23706	0
Nitzschia tryblionella var. victoriae	3951	0	3951	3951	7902	3951	0
Synedra ulna	3951	7902	3951	3951	11853	19755	11853
Synedra ulna var. oxyrhynchus	86922	51363	7902	15804	15804	31608	15804
Synedra ulna var. oxyrhynchus fo. constricta	11953	3951	0	0	3591	11853	3951
Unidentified (girdle view, etc.)	11853	7902	0	0	15804	15804	7902

Table 2.1-5. Attached Diatoms of the [illegible] Numbers Expressed as Cells per Square Centimeter

October 18, 1978

Species	Station						
	1	2	3	4	5	6	7
-----CENTRALES-----							
Coscinodiscus Rothii	0	0	3951	0	0	0	7902
Cyclotella kutzingiana	3951	3951	0	3951	0	11853	0
Cyclotella Meneghiniana	3951	0	0	3951	15804	19755	0
Melosira granulata	0	15804	3951	7902	31608	3951	3951
Melosira italica	0	0	3951	3951	11853	15804	7902
Melosira varians	347688	241011	0	15804	67167	86922	23706
Stephanodiscus niagarae	7902	0	11853	11853	0	0	15804
-----PENNALES-----							
Amphora ovalis	0	0	3951	0	0	0	7902
Cocconeis pediculus	7902	3951	0	3951	7902	7902	3951
Cocconeis placentula v. euglypta	7902	3951	0	3951	3951	0	0
Cymbella turgida	3951	0	0	0	0	3951	7902
Cymbella ventricosa	11853	7902	3951	3951	0	0	11853
Diatoma vulgare	3951	3951	7902	3951	7902	11853	0
Diatoma vulgare v. producta	23706	11853	3951	0	11853	15804	0
Fragilaria intermedia	11853	11853	0	7902	3951	3951	3951
Gomphonema olivaceum	19755	3951	0	3951	7902	11853	27657
Gomphonema parvulum	114579	79020	0	31608	27657	35554	47412
Gomphonema cf. simus	3951	0	0	3951	0	0	3951
Navicula bacillum v. capitata	3951	0	3951	0	3951	3951	0
Navicula cincta	106677	71118	23706	189648	114579	280521	241011
Navicula cryptocephala	3951	0	7902	3951	0	11853	7902
Navicula hungarica	0	0	3951	7902	7902	0	3951
Navicula rhyncocephala	0	3951	0	3951	7902	3951	3951
Navicula salinarum var. intermedia	7902	11853	0	0	0	3951	0
Navicula sp. (girdle view, etc.)	3951	3951	3951	0	3951	0	0
Nitzschia acicularis	0	0	3951	3951	3951	0	3951
Nitzschia acuta	7902	7902	0	3951	3951	0	0
Nitzschia dissipata	205452	233109	11853	67167	134344	177795	0
Nitzschia recta	47412	39510	3951	11853	37657	23706	3951
Nitzschia tryblionella	11853	15804	0	0	11853	19755	3951
Synedra ulna	11853	3951	0	3951	0	3951	3951
Synedra ulna var. oxyrhynchus	3951	0	0	3951	7902	11853	0
Synedra ulna var. oxyrhynchus fo.	7902	3951	7902	7902	7902	11853	3951
Unidentified (girdle view, etc.)							

Table 2.1-5. Attached Diatoms of the Mississippi River near Prairie Island
Numbers Expressed as Cells per Square Centimeter
November 1, 1978

Species	Station						
	1	2	3	4	5	6	7
-----CENTRALES-----							
Coscinodiscus Rothii		0	3951	3951	0	0	3951
Cyclotella Meneghiniana		7902	7902	7902	0	0	7902
Cylotella stelligra		0	3951	3951	3951	7902	11853
Melosira distans var. pfaffina		11853	15804	23706	3951	0	11853
Melosira granulata		7902	11853	15804	0	0	3951
Melosira varians		47412	7902	67167	55314	43461	51363
Stephanodiscus niagarae		7902	27657	15804	3951	0	47412
-----PENNALES-----							
Cocconeis placentula v. euglypta		3951	0	0	3951	3951	0
Cymbella pusilla		0	0	3951	3951	0	3951
Cymbella ventricosa		7902	0	3951	0	0	3951
Diatoma elongatum		7902	0	0	0	7902	0
Epithemia sp.		0	0	7902	3951	11853	0
Fragilaria intermedia		7902	0	0	7902	3951	0
Gomphonema olivaceum		7902	0	3951	3951	0	7902
Gomphonema parvulum		71118	11853	23706	0	0	15804
Navicula cincta		90873	23706	106677	35559	43461	284472
Navicula cryptocephala		0	0	3951	7902	11853	3951
Navicula hungarica		3951	0	39510	3951	3951	3951
Navicula rhyncocephala		11853	7902	43461	11853	7902	47412
Navicula sp. (girdle view, etc.)		3951	0	0	0	0	11853
Nitzschia acicularis		19755	3951	47412	3951	3951	3951
Nitzschia acuta		0	3951	0	7902	3951	0
Nitzschia dissipata		59265	19755	110628	43461	55314	86922
Nitzschia palea		3951	0	0	3951	7902	7902
Nitzschia recta		3951	0	27657	11853	15804	3951
Nitzschia tryblionella		0	0	0	3951	0	0
Nitzschia tryblionella var.victoriae		0	0	3951	0	0	0
Synedra acus		3951	0	3951	0	0	3951
Synedra ulna		15804	3951	0	0	3951	3951
Synedra ulna var. oxyrhynchus		7902	0	0	3951	7902	0
Synedra ulna var. oxyrhynchus fo. constricta		7902	0	0	3951	3951	7902
Unidentified (girdle view, etc.)		7902	11853	15804	3951	3951	0

Sample Missing

Table 2.1-5. Attached Diatoms of the Mississippi River near Prairie Island
Numbers Expressed as Cells per Square Centimeter

November 15, 1978

Species	Station						
	1	2	3	4	5	6	7
-----CENTRALES-----		0	7902	0	0	0	3951
Coscinodiscus Rothii		3951	3951	7902	35559	7902	11853
Cyclotella kutzingiana		3951	3951	3951	3951	3951	3951
Cyclotella Meneghiniana		7902	11853	19751	3951	3951	0
Melosira granulata		15804	3951	11853	0	7902	3951
Melosira varians		55314	7902	19755	71118	94824	11853
Stephanodiscus niagarae		23706	3951	27657	7902	11853	19755
-----PENNALES-----							
Amphora ovalis		0	3951	3951	0	0	11853
Cocconeis placentula var. euglypta		7902	3951	0	3951	0	3951
Cymbella turgida		3951	7902	3951	7902	3951	0
Cymbella ventricosa		39510	11853	3951	0	0	15804
Diatoma vulgare var. producta		205452	3951	7902	63216	51363	0
Fragilaria intermedia		63216	15804	3951	39510	31608	11853
Gomphonema olivaceum		0	7902	0	23706	27657	0
Gomphonema parvulum	NO DATA	79020	63216	71118	75069	63216	35559
Navicula cincta		71118	82971	114579	201501	158040	63216
Navicula cryptocephala		47412	3951	0	51363	39510	7903
Navicula rhyncocephala		23706	11853	19755	27657	15804	15804
Navicula sp.		3951	0	3951	0	7902	3951
Nitzschia acicularis		19755	3951	3951	19755	11853	3951
Nitzschia acuta		0	3951	0	15804	3951	0
Nitzschia dissipata		71118	27657	35559	82971	63216	11853
Nitzschia recta		0	7902	23706	0	3951	3951
Nitzschia tryblionella		3951	3951	11853	3951	0	0
Rhocosphenia curvata		0	0	7902	3951	0	0
Synedra ulna		59265	0	0	31608	23706	0
Synedra ulna var. oxyrhynchus		0	3951	0	0	0	0
Synedra ulna var. oxyrhynchus fo. constricta		3951	0	0	3951	0	0
Unidentified (girdle view, etc.)		7902	3951	7902	3951	3951	7902
		821808	316080	406953	782298	640062	252864

Table 2.1-5. Attached Diatoms of the Mississippi River near Prairie Island
Numbers Fxpressed as Cells per Square Centimeter
November 29, 1978

Species	Station		
	3	4	7
-----CENTRALES-----			
Cyclotella kutzingiana	807[illegible]	4037	12113
Melosira granulata	121[illegible]	4037	4037
Melosira varians	4037	12113	0
Stephanodiscus niagarae	4037	20189	0
-----PENNALES-----			
Cymbella ventricosa	4037	4037	0
Diatoma vulgare var. producta	12113	8075	4037
Gomphonema parvulum	48455	80758	32303
Navicula cincta	72682	125175	60568
Navicula cryptocephala	0	8075	12113
Navicula hungarica	0	4037	12113
Navicula rhyncocephala	0	0	8075
Nitzschia acicularis	8075	4037	4037
Nitzschia acuta	4037	8075	12113
Nitschia dissipata	32303	24227	12113
Nitzschia recta	0	21089	0
Nitzschia tryblionella	0	12113	0
Pinnularia molaris	4037	4037	0
Rhoicosphenia curvata	4037	0	4037
Synedra ulna	4037	0	0
Unidentified (girdle view, etc.)	4037	12113	8075

Table 2.1-5. Attached Diatoms of the Mississippi River near Prairie Island
Numbers Expressed as Cells per Square Centimeter
December 12, 1978

Species	Station		
	3	4	7
-----CENTRALES-----			
Cyclotella Meneghiniana	11853	0	0
Melosira granulata	0	3951	3951
Melosira varians	15804	7902	0
Stephanodiscus niagarae	23706	3951	15804
-----PENNALES-----			
Cymbella ventricosa	3951	11853	19755
Diatoma vulgare var. producta	0	3951	11853
Fragilaria intermedia	0	15804	15804
Gomphonema olivaceum	3951	0	27657
Gomphonema parvulum	19755	35559	82971
Navicula cryptocephala	3951	0	23706
Navicula hungarica	0	3951	19755
Navicula rhyncocephala	7902	7902	31608
Navicula sp. (girdle view, etc.)	11853	3951	7902
Nitzschia acicularis	0	11853	11853
Nitzschia dissipata	26657	7902	114579
Nitzschia tryblionella	3951	15804	0
Synedra ulna	0	11853	47412
Unidentified (girdle view, etc.)	3951	0	3951

Table 2.1-5. Attached Diatoms of the Mississippi River near Prairie Island
Numbers Expressed as Cells per Square Centimeter
December 28, 1978

Species	Station		
	3	4	7
-----CENTRALES-----			
Cyclotella kutzingiana	3014	0	0
Cyclotella Meneghiniana	0	0	3014
Stephanodiscus astraea	6029	3014	3014
-----PENNALES-----			
Amphora ovalis	9043	3014	3014
Fragilaria capucina	3014	9043	3014
Gomphonema olivaceum	18087	0	9043
Gomphonema parvulum	15072	18087	15072
Navicula bacillum v. capitata	3014	0	0
Navicula cincta	9043	0	6029
Navicula salinarum v. intermedia	9043	0	15072
Navicula hungarica	3014	0	0
Navicula rhyncocephala	6029	3104	6029
Navicula schonfeldii	3014	6029	3014
Nitzschia acicularis	6029	0	0
Nitzschia acuta	6029	0	3014
Nitzschia dissipata	15072	9043	15072
Synedra acus	0	0	3014
Synedra ulna	3014	0	0
Synedra ulna v. oxyrhynchus	6029	3014	3014
Unidentified	18087	6029	12596
TOTALS			

PRAIRIE ISLAND NUCLEAR GENERATING PLANT
ENVIRONMENTAL MONITORING PROGRAM
1978 ANNUAL REPORT
ECOLOGICAL STUDIES

BENTHIC MACROINVERTEBRATE STUDY
(2.2)

Prepared for
Northern States Power Company
Minneapolis, Minnesota

by
Texas Instruments Incorporated
Ecological Services
P.O. Box 225621
Dallas, Texas 75265

April 1979

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2.2 BENTHIC MACROINVERTEBRATES

2.2.1 INTRODUCTION

This report of the benthic macroinvertebrates of the Mississippi River at Prairie Island is the ninth in a continuing monitoring program for Northern States Power Company's (NSP) Prairie Island Nuclear Generating Plant (PINGP) near Red Wing, Minnesota. This annual report presents analysis and interpretation of 402 benthic samples collected during the fifth year of plant operation, spanning the period January through December 1978.

The primary objective of the study is characterization of the benthic community in the vicinity of PINGP, with respect to any effects which may be attributable to operation of the generating facility. To meet this objective, a study program was designed in which any major alterations in community integrity directly attributable to plant operations could be segregated from natural community fluctuations.

2.2.2 MATERIALS AND METHODS

2.2.2.1 Field Sampling

Regularly scheduled benthic macroinvertebrate samples were collected by Northern States Power personnel during 1978. Two types of samples were collected:

1. Petersen dredge samples (every 6 weeks from February through November)

2. Artificial substrate (Hester-Dendy) samples (every 6 weeks from January through December)

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The Petersen dredge was used to collect sedentary substrate dwelling organisms. Petersen dredge samples were collected at Stations B-1, SL, X-1, X-3, Y-1, Y-2, C-1, and C-4 (Figure 2.2-1). The Hester-Dendy multiplate sampler (artificial substrate) was used to sample benthic organisms which prefer a rigid substrate. Artificial substrate samples were collected at Stations B-1, SL, X-1, X-2, X-3, Y-1, and Y-2 (Figure 2.2-1).

Petersen dredge sampling consisted of three replicate grabs at each station using a dredge sampling 1.0 ft^2. Samples were washed in the field using a No. 60 mesh sieve and preserved in 37 percent formalin.

Artificial substrate samples were collected using a Hester-Dendy multiplate sampler consisting of eight tempered hardboard plates with a surface area of 1.0 ft^2 (Hester and Dendy 1962). The samplers were anchored with concrete blocks suspended from surface floats and incubated for approximately six weeks. At each station, four samplers were installed in two sets at two and four feet below the surface, respectively. After the six-week incubation period, samplers were removed and organisms sieved and preserved in the same manner as Petersen samples.

All samples were then shipped to the Dallas sample processing facility of Texas Instruments. Data were analyzed by Texas Instruments personnel and subsequently computer processed to final form.

2.2.2.2 Laboratory Analysis

Before analysis, samples were washed through a No. 60 mesh screen, which removed most of the remaining sediment and preservative. The contents of each sample were then sorted according to general morphological characteristics to

facilitate efficient processing of bulk samples. Samples were placed in a sorting tray or petri dish, depending on sample size, and systematically scanned under 10X magnification. Organisms displaying similar morphological features were placed in vials containing 70 percent ethanol for later identification and enumeration.

For extremely dense artificial substrate samples, a TI-modified Folsom plankton splitter (Scarola and Novotny 1968; Lewis and Garriott 1970) was utilized to obtain statistically representative subsamples. During 1978, 86 multiplate samples were split. This procedure was designed to yield a subsample of workable density while maintaining a high level of precision. Appendix A2.2.1 presents the rationale and justification for this subsampling procedure. In addition to those samples listed in Appendix A2.2.1, 14 additional samples were checked to verify splitting precision. Sorting procedures are the same for subsamples as those listed above for entire samples.

Sorted samples were placed in divided petri dishes, where all taxa were enumerated and identified using a stereozoom dissecting microscope equipped with an ocular micrometer. When necessary, a compound microscope supplemented the dissecting microscope. Only those organisms whose dimensions exceeded the mesh size of the screens were quantified. Organisms were identified to the lowest practical identification level (LPIL), usually genus, but higher levels of identification were made for certain minor taxa that required extremely difficult taxonomic delineation. Oligochaetes and chironomids were mounted on slides with Hoyers mounting media (Roback 1957; Knudsen 1966) for identification purposes.

Enumeration involved only individuals living at the time of collection (indicated by the presence of fleshy tissue). In

instances when organisms (such as oligochaetes) fragmented due to preservation and handling, only anterior portions were enumerated.

Principal taxonomic keys used in the identification of benthic macroinvertebrate taxa were: Ward and Whipple (1959), Pennak (1963), and Usinger (1971). These were supplemented by monographs specific to the systematics of locally occurring organisms and/or specific groups of taxa (see asterisked references in Literature Cited, subsection 2.2.6).

2.2.2.3 Data Analysis

Data obtained from the benthic portion of this study were used to generate a presence/absence list of benthic macrovertebrates for each month studied.

Numerical abundance data were calculated as total number of organisms per collection (No./ft^2), extrapolated, and expressed as a mean number (by species and total) per square meter. Standard errors for each set of replicate samples were also computed for each station. Relative abundance (percent) data were expressed as the percent that a particular taxon comprised of a total sample. Evaluation of these data provided information on species and number per unit area, relative composition during each sampling period, and normal seasonal population fluctuations.

Using the Shannon-W[illegible]ormational measure of diversity (H') (Shannon a[illegible]1949), a diversity value was calculated for e[illegible] sample collected. This value was compared (as a ratio) to the maximum theoretical diversity of the sample to obtain a measure of "evenness" (J') of distribution of individuals among the various taxa (Pielou 1969).

2.2.2.4 Statistical Analysis

In order to accurately characterize phenomena observed in the data, a series of statistical analyses was performed. These analyses were designed to determine significant trends and patterns that existed in the data, primarily significant variances in the data that may be attributable to plant operation.

Sampling with the Hester-Dendy multiplate sampler was not consistent throughout the year due to icing conditions in the winter months and very high flow conditions during spring months. However, there were subsets of months and stations that formed consistent blocks of data. Three such "blocks" were used to compare stations as shown in the following table:

Station-Month Combination

Month	Stations* Sampled	Station 1-7	Station 2-7	Station 3-7
1	2-7		x	x
2	2-7		x	x
4	2,4-6			
5	1-7	x	x	x
7	1-7	x	x	x
8	1-7	x	x	x
9	2-7		x	x
11	1-7	x	x	x
12	2-7		x	x

*1 = B-1; 2 = SL; 3 - X-1; 4 = X-2; 5 = X-3; 6 = Y-1; 7 = Y-2.

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Petersen dredge sampling was consistent throughout the year with three subsets of months necessary to compare stations. These data "blocks" are shown in the following table:

Station-Month Combinations

Month	Stations* Sampled	Station 1-8	Station 3-6	Station 1,3-8
2	2-6		x	
3	1-8	x	x	x
5	1-8	x	x	x
6	1-8	x	x	x
7	1,3-8		x	x
9	1-8	x	x	x
10	1-8	x	x	x
11	1-8	x	x	x

*1 - B-1; 2 - SL; 3 - X-1; 4 = X-3; 5 = Y-1; 6 - Y-2; 7 = C-1; 8 - C-4

The Newman-Keuls multiple range test (Winer 1971) compared mean densities against background sampling variation to determine which station(s) were statistically distinguishable. Since there were no occurrences of zero densities in Petersen dredge samples, the $\log_{10}(X)$ data transformation could be used without further modification for this gear. The occurrences of zero densities at Stations X-1 and Y-2 for artificial substrate samples in January necessitated use of a $\log_{10}(X+1)$ data transformation to obtain meaningful comparison data for this gear type. Logarithmically-transformed data yielded a comparison of relative orders of magnitude rather than absolute densities, and tended to stabilize variance. Newman-Keuls multiple range tests were performed for the monthly means for each ANOVA.

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2.2.3 RESULTS

2.2.3.1 Petersen Dredge Sampling

Taxa Inventory/Seasonal Occurrence

Benthic macroinvertebrate collections (Petersen dredge) yielded 78 taxa, with chironomid (midge) larvae comprising the major portion (Table 2.2-1). Organisms appearing most ubiquitously throughout the study period were Nematoda, Tubificidae (Oligochaeta), and the chironomids Chironomus, Cryptochironomous, and Procladius. The prevalence of these organisms in 1978 collections is consistent with the last two years' findings (Texas Instruments 1977 and 1978) in which these organisms were well distributed both spatially and temporally throughout the study area.

As in previous years of study in this area, a broad assemblage of pollution-tolerant (i.e., Chironomus, Cryptochironomus, and Tubificidae [Oligochaeta]), facultative (i.e., Caenis, Plumatella repens, and Polypedilum), and intolerant (i.e., Ablabesmyia, Psectrocladius, and Hexagenia) macroinvertebrate taxa (Weber 1973) were collected. Taxa occurring in the area are generally characteristic of benthic assemblages in moderate current, soft-substrate riverine environments (Hynes 1970).

Numerical Abundance

The temporal density pattern was not consistent for all stations during 1978 (Figure 2.2-2). The upriver control station (B-1) and downriver control stations (C-1 and C-4) exhibited similar seasonal density patterns in which peak densities occurred in the March sampling period. Due to high river flows (Figure 2.2-6), which scoured the main channel bottom substrates, Stations B-1, C-1, and C-4

exhibited markedly reduced organism densities for the May through November sampling periods. Densities at the recirculation canal station (X-3) were consistently low throughout the year. Stations located at Sturgeon Lake (SL) and the p'ant intake (X-1) displayed similar trends in density with numbers increasing from February through June, declining in July (no samples were analyzed for SL in July) and September, increasing significantly in October and, finally, declining again in November. Peak values for Station SL were reached in June and October, whereas Station X-1 reached its maximum values in May and June. Station Y-1, discharge canal, registered an annual peak in February, then remained fairly constant at a lower level from March through June before declining to an annual low in July. Densities remained low at Y-1 in September before reaching a secondary peak in October, then declined in November. Station Y-2, also in the discharge canal, exhibited an annual low in February with densities thereafter increasing each sampling period to a maximum in July. Density values for Station Y-2 then declined through October before increasing in the November sampling period.

As in 1976 and 1977, the intake station (X-1) compared favorably with the upriver control station (SL). Also, as in the two previous years, the recirculation canal station (X-3) displayed sustained low values over the course of the year. The discharge canal stations, Y-1 and Y-2, reflected generally increasing densities relative to the recirculation canal, with Station Y-2 exhibiting the highest density values of all stations sampled during the year (12,759.2/m^2 in June and 12,960.1/m^2 in July). Stations B-1, C-1, and C-4 displayed similar trends in density during the year. Densities for these stations were the highest of all sampled stations in March (Table 2.2-2), but thereafter, were generally lower than all stations except the recirculation canal (X-3). Total density values ranged from 10.8/m^2 at

Station C-1 in September to a maximum of 12,960.1/m^2 at Station Y-2 in July (Table 2.2-2). These values can be compared with ranges of 0-10,079/m^2 and 75.3-17,947.6/m^2 observed during 1976 and 1977, respectively (Texas Instruments 1977, 1978).

Percent Composition

As in the previous two years of study (Texas Instruments 1977, 1978), tubificid oligochaetes and dipterans, primarily Chironomidae (midge larvae), dominated the Petersen dredge collections in the study area during 1978 (Table 2.2-3; Figure 2.2-2). Tubificids represented 69.0 percent of all organisms collected, while dipterans constituted 24.8 percent of the total. Collectively, these two taxa contributed 93.8 percent to the total number of organisms in 1978.

Tubificid worms were abundant at all sampled stations except the recirculation canal (X-3) during the February and March sampling periods. Tubificid abundance at X-3 remained low throughout the year, reflecting the unstable substrate and turbulent water flow conditions that characterize this station. Beginning in May and extending throughout November, the upstream control (SL), intake (X-1), and discharge (Y-1, Y-2) stations exhibited similar tubificid abundance patterns. The upriver control (B-1) and downriver control (C-1, C-4) stations also exhibited similar patterns of tubificid abundance, in that numbers were generally reduced from 1976 and 1977 levels in response to unusually high river discharge (Figure 2.2-6). The scoured conditions at these stations and in the recirculation canal indicate that substrate stability and river discharge are two major factors controlling tubificid abundance and distribution in this area. The fact that the upstream control station (SL) is comparable with the intake (X-1) and discharge (Y-1, Y-2)

stations would suggest, as in past years, that plant operation is not a major factor influencing tubificid abundance and distribution.

Procladius, Cryptochironomus, Chironomus, and Polypedilum were the dominant chironomid (midge) larvae collected during 1978. This compares favorably with 1976 and 1977 data (Texas Instruments 1977, 197B). As with tubificid worms, densities of chironomid larvae were markedly reduced at the recirculation canal station (X-3) further emphasizing the lack of suitable habitat at this location for the most abundant organism groups in the study area. The comparability in terms of abundance and density of chironomids of upstream control station (SL) with intake (X-1) and discharge (Y-1, Y-2) stations suggests that plant impact is localized in the recirculation canal, and that normal population structure is maintained at other stations in the study area.

Community Diversity

Seasonal variations in community diversity (H') and eveness (J'), are affected by density, the number of taxa collected, and the distribution of densities within the various taxonomic groups. The H' index has a range of 3.31 $\log_2 N$ (N = number of taxa), with an effective range of 0 to 4 in most freshwater situations. The J' index has a range of 0 to 1, with a value of 1 being a completely evenly distributed (i.e., equal numbers of individuals in all taxa sampled) population.

Community diversity values (H') (Figure 2.2-3) generally exhibited the lowest values of the year during months of extremely high tubificid percentage composition (i.e., February, March, and May), and had the highest values where chironomid percentage composition was high (i.e., September,

October, November). Values of H' ranged from 0 at Station X-3 in May, when only one taxon was encountered, to 3.08 at Station C-1 in November, when 19 taxa were collected. This range in diversity values is greater than that observed in 1977 and 1976, when maxima of 1.17 and 2.53, respectively, were recorded (Texas Instruments 1977, 1978). Evenness (J') values ranged from 0 to 0.90 (on a scale of 0 to 1) corresponding to H' minima and maxima, respectively. Relative to 1977, the increase in benthic community diversity measured in 1978 can largely be attributed to decreased densities of tubificid worms from the very numerous levels during 1977 and to the occurrence of midge larvae in the samples over a longer time than in the previous year.

Statistical Analysis

The data were analyzed in three subsets, because in certain months, all stations were not sampled. The Newman-Keuls multiple range test was applied to station means. Logarithmically transformed data were used to stabilize variances and provide for order-of-magnitude comparisons among stations. Results of statistical analyses for 1978 data are presented in Table 2.2-4.

Comparisons among intake (X-1), recirculation (X-3), and discharge (Y-1 and Y-2) stations for all sampling periods reveal that X-3 differs significantly ($\alpha = 0.05$) from the other three stations, with much lower densities. Stations X-1, Y-1, and Y-2 were not distinguishable from each other for the data set including these stations and all sampled months for both transformed and untransformed data.

Using the transformed data set for all stations and the months March, May, June, September, October, and November, a comparison across all stations indicates that upstream control stations (B-1 and SL) were indistinguishable, in

terms of total density, between each other and from the intake (X-1) and discharge stations (Y-2 and Y-2). Differences in total density among the upstream control (B-1), discharge (Y-1), and downstream control (C-4) stations were not distinguishable. The corresponding untransformed data show no significant differences in total density among upstream control station (B-1), recirculation canal station (X-3), and downstream control stations (C-1 and C-4). Untransformed data for all months except February and July and all stations except SL (Table 2.2-4), depict only discharge Station Y-2 as significantly different from other stations in the study area. Transformed data for the same months and stations show no differences between the recirculation canal station (X-3) and downstream control station (C-1), but significant differences exist between these two stations and all other stations in this subset.

In summary, the statistical analyses indicate that variations in infaunal density patterns may be introduced by plant-related activities in the immediate vicinity of the plant, particularly at recirculation canal Station X-3, where consistently low densities were observed. The data also indicate, however, that these variations are within the natural variation introduced by river discharge and substrate characteristic fluctuations in the upstream and downstream control areas of the river during 1978.

2.2.3.2 Artificial Substrate Sampling - Taxa Inventory/ Seasonal Occurrence

Artificial substrate sampling yielded 108 invertebrate taxa, of which chironomid larvae comprised the greatest portion (Table 2.2-5). The most ubiquitous organisms were nematodes, Naididae (Oligochaeta), and the midge larvae, Glyptotendipes sp., Cricotopus sp., and Tanytarsus sp.. Beginning with the May sampling period and extending to the end

of the year, mayfly nymphs (Stenonema sp. and Caenis sp.) and caddisfly larvae (Hydropsyche orris, Hydropsyche sp., Cheumatopsyche sp., Potamyia sp., and Neureclipsis sp.) were also widespread in the study area.

Artificial substrate sampling yielded 56 taxa that were not collected by grab sampling. This number can be compared with 23 and 39 taxa, which were found exclusive to multiplate samplers in 1977 and 1978, respectively. The majority of organisms exclusive to the multiplate samplers were immature insect forms representing the orders Ephemeroptera (mayflies), Trichoptera (caddisflies), and Diptera (flies, midges).

Numerical Abundance

Seasonal density distribtuion data (Figure 2.2-4 and Table 2.2-6) reflected similar numerical trends to those observed in 1976 and 1977 for multiplate sampling in the study area. Peak densities for all stations were recorded during the May to November time frame. Recirculation canal (X-3), intake (X-2), and discharge canal (Y-1) stations displayed the highest densities during 1978 -- a fact consistent with prior years of data (Texas Instruments 1977, 1978; Haynes 1976). Overall, densities ranged from zero values recorded at X-1 and Y-2 in January to 108,921 organisms/m^2 at X-3 in May (Table 2.2-7). High density values were also recorded at X-2 in May (approximately 76,000/m^2), X-3 in August (67,352/m^2), and Y-1 in September (62,626/m^2). B-1, SL, X-1, and Y-2 generally exhibited higher densities in 1978 than were observed in 1977; this was particularly true in the May and September sampling periods.

Percent Composition

The relative abundance of major taxa in the study area is displayed in Figure 2.2-4. January, February, April, and

May samples were generally dominated by aquatic oligochaetes (Naididae). Nemerteans (proboscis worms) and nematodes were also present in appreciable numbers during this time period at X-2, X-3, and Y-1. Chironomid larvae began to appear in large numbers in the May sampling period, and was a prevalent group in the July through November collections. Glyptotendipes sp. was the dominant chironomid encountered with densities reaching maximums of 49,462/m^2 at X-3 in August and 52,379/m^2 at Y-1 in September. These values represented 73.4 percent and 83.6 percent, respectively, of the organisms collected at the station during the specified sampling periods. Cricotopus sp., Parachironomus sp., Psectrocladius sp., Polypedilum sp., Dicrotendipes sp., and Tanytarsus sp. were other chironomids that were commonly encountered and sometimes numerous in the study area from May through November. Trichoptera larvae and/or pupae of the families Hydropsychidae and Polycentropodidae were also commonly encountered, and were periodically numerous in the July to November collections. Hydropsyche orris, Hydropsyche sp., Cheumatopsyche sp., Potamyia sp., Hydropsychidae (LPIL), Cyrnellus sp., Neureclipsis sp., and Polycentropodidae (LPIL), collectively, constituted 10.2 percent, 35.0 percent, 36.6 percent, and 27.8 percent of the total organisms collected in the study area during the July, August, September, and November sampling periods, respectively. Naididae (Oligochaeta) were again the most dominant organisms in the area in the November and December collection periods, with densities representing 46.8 percent and 84.8 percent of the organisms collected during these months, respectively. Naidids were especially numerous at X-3 in November, where they comprised 87.2 percent of the total, a figure equivalent to approximately 52,800 organisms/m^2.

As in prior years, Naididae, Chironomidae (particularly Glyptotendipes sp. and Tanytarsus sp.), and Hydropsychidae were the predominant organisms collected during 1978.

Naididae dominated the January, February, April, and May collections. Chironomids began to increase as a proportion of the total in May and, along with net-spinning caddisflies (Hydropsychidae and Polycentropodidae), constituted the majority of organisms collected during the warm summer and fall months. While a greater number of taxa were collected during 1978 than in the three previous years, the taxa comprising the dominants for multiplate samplers were very similar for all four years, indicating little or no alteration in the compositional characteristics of the community during 1978.

Community Diversity

Table 2.2-6 summarizes density, H', J', and number of taxa collected. Figure 2.2-5 shows the changes in diversity (H') occurring through the year for artificial substrate samples. Seasonal variations in diversity (H') were characterized by generally higher values during the warmer months of May through November, consistent with the greater numbers of taxa collected during this period. Diversity (H') values ranged from 0 (Station SL, January and February; Station X-1, February) to 3.46 Station X-1, November). These values can be compared against the ranges observed in 1977 (0 to 2.78), 1976 (0 to 2.83), and 1975 (0 to 2.78). Generally, higher community diversity measures were recorded during 1978 due to the influx of a number of taxa of drift-type organisms in the artificial substrate collections, a condition brought about by high stream and river discharge rates in the study area. Stations X-2, X-3, and Y-1 generally displayed the lowest diversity (H') measures in 1978.

Evenness (J') ranged from 0 to 0.91 with a mean J' of 0.45 and a standard deviation of 0.25. The low J' values observed during 1978 reflect the dominance of certain taxa (i.e., Naididae, Glyptotendipes sp., and Hydropsyche orris) in the study area.

Statistical Analysis

Sampling with the Hester-Dendy Multiplate Sampler was not consistent across the year. There were, however, subsets of months and stations that formed consistent blocks of data. Three such blocks were used to compare stations (Table 2.2-8).

The Newman-Keuls multiple range test compared the mean densities against the background sampling variation to determine which station(s) was statistically distinguishable. Logarithmically transformed data yielded a test which compared relative orders of magnitude rather than absolute density differences. This transformation also tended to stabilize variance in the analysis.

Data from January, February, April, May, July, August, September, November, and December, and Stations X-1, X-2, X-3, Y-1, and Y-2 show that X-1, Y-2, Y-1, and X-2 had statistically similar densities. This was also true with samples from intake forebay (X-2), recirculation canal (X-3), and discharge (Y-1). Transformed data showed that X-1 and Y-2 had similar densities, and that these two stations were significantly different from X-2, X-3, and Y-1.

Adding Sturgeon Lake (SL) to the analyses showed that SL sample density was most similar to Station X-1, the nearest other test station, and to Y-2. Transformed data showed that SL density was statistically identical to X-1 and Y-2 density measurements.

Data for all stations for May, July, August, and November showed the recirculation canal (X-3) to have significantly higher densities than all other tested stations. The remaining stations were not distinguishable from each other

on the basis of total density. Logarithmically transformed data indicated that X-3 and X-2 were similar and that these stations were significantly different from SL, B-1, and X-1. Stations Y-1 and Y-2 were statistically similar to one another and both were similar to X-2, X-3, and B-1. Station Y-2 was signficantly different from X-3.

In summary, in 1978 as in 1977, stations near the plant were readily distinguishable from the more distant stations. The upstream and downstream control stations, Sturgeon Lake, and intake station (X-1) were also similar to one another, particularly SL, B-1, and X-1. Data indicate that effects of power plant operation on benthic organism densities (as reflected on Hester-Dendy multiplate samplers) is limited to the immediate vicinity of the Prairie Island Nuclear Generating Plant, particularly with respect to the recirculation and/or discharge of heated water.

2.2.4 DISCUSSION

In order to assess the influence of operations of the Prairie Island generating facility on the benthic macroinvertebrate community, it is first necessary to describe natural community dynamics and their pertinent control factors in the study area. During 1978, high river discharge with its attendant effects of biota/substrate scour and rapid -- sometimes turbulent -- current, played a major role in influencing community dynamics. These effects were noticeable both in the infaunal and artificial substrate sample results. Infaunal effects were most readily observed in the upstream control (B-1) and downstream control (C-1 and C-4) stations, where densities of benthic organisms were markedly reduced from March through November when compared with levels reached at these stations during 1976 and 1977 (Texas Instruments 1977, 1978). The scouring effects of unusually high discharge rates on infaunal

community dynamics, as experienced in the study area during the first three quarters of 1978, are well documented (Hynes 1970; Hoopes 1974; Anderson and Lehmkuhl 1967). The resiliency of the infaunal community at the control stations was observed in the gradual upward trend in densities during October and November after flow rates had subsided. High flow rates had several positive effects on epifaunal (drift) organisms colonizing the Hester-Dendy multiplate samplers. First, swift currents provided favorable conditions for the establishment of large populations of case-building, net-spinning midge (i.e., Tanytarsus sp.) and caddisfly larvae (i.e., Hydropsyche orris) that rely on water flow to satisfy their filter-feeding requirements. Second, the heavy rainfall that led to high discharge rates in the June to September period undoubtedly caused dislodging and drift of organisms from the tributary streams and littoral areas of the river. The enrichment of the taxa list for artificial substrate samplers, 31 additional taxa, when compared with 1977, is indicative of the magnitude of this effect. It can also be noted that community diversity levels, as measured by H', are generally observed to be higher in 1978 than in 1977 due largely to the influx of new taxa in the drift.

Just as Station B-1 was impacted unfavorably by the scouring effects on the infauna, it generally reflected the largest increases in epifaunal densities, relative to 1977, with increased flow rates. These natural variations in benthic community dynamics observed during 1978 can be consolidated with community structure information that has remained similar from 1976 through 1978 to serve as background against which plant operation effects can be evaluated.

As in 1976 and 1977, tubificids and chironomids dominated the infaunal collections, and naidids, chironomids, hydropsychids, and polycentropodids dominated the epifaunal (drift) collections. Also, as in prior years, seasonal

temperature variations were important determinants on community structure in that immature insect forms, especially midge and caddisfly larvae, displayed greatest abundance in the epifaunal drift community during the warmer months of the year. Generally, the gross community structure characteristics described in the 1976 and 1977 studies are supported, by, and similar to, 1978 data. The high flow rates observed in the river during 1978 significantly altered substrate stability at the upstream control (B-1) and downstream control (C-1 and C-4) stations and prevented benthic organisms from becoming established. This natural situation is similar to the man-induced conditions at X-3 in the recirculation canal. Moderate to swift discharge currents leading to substrate instability and thermal enrichment at X-3 combine to create an unfavorable environment for benthic invertebrates. Statistical analysis of the infaunal results confirms that X-3, B-1, C-1, and C-4 were similar ($\alpha = 0.05$) in 1978. The fact that Y-2 at the end of the discharge canal, and SL, the upstream control are similar may suggest that plant effects are confined to the immediate vicinity of the plant for infaunal populations, and that recovery is evident by the outlet of the discharge canal at Station Y-2. The data also suggest that the variation introduced by a significant natural event, such as unusually high discharge rates in the main river channel, produces effects that are similar to the conditions observed in the stations most heavily influenced by plant operation (X-2, X-3, Y-1) for both infaunal and epifaunal community components.

As in past years, it appears that the current study design is adequate to segregate and characterize natural population fluctuations and plant effects, both temporally and spatially, within the study area. The large impact of high stream flows on the upstream and downstream control stations during 1978 makes it difficult to determine if plant-induced effects are sustained in the downstream infaunal benthic

community. Percentage composition data similar to 1977 for C-1 and C-4 and the similarity of the discharge station (Y-2) to upstream control station (SL) seem to indicate that plant-induced effects are not sustained downstream. Epifaunal results indicate that similar effects on community dynamics are introduced by high discharge rates in the river and by plant operational effects, although epifaunal densities were generally significantly ($\alpha = 0.05$) higher in the immediate vicinity (i.e., Stations X-2, X-3, Y-1) of the plant.

2.2.5 SUMMARY

1. Dominant taxa observed during 1978 in the vicinity of the Prairie Island Nuclear Generating Plant were Tubificidae (Oligochaeta) and Chironomidae (Diptera) in the infaunal collections and Naididae (Oligochaeta), Chironomidae, Hydropsychidae, and Polycentropodidae (Trichoptera) in the epifaunal collections.

2. Unusually high spring and summer discharge rates in the main river channel had major impacts on the abundance of infaunal organisms and the abundance and composition of epifaunal organisms. These effects were most noticeable at B-1, C-1, and C-4, where high flow rates scoured the infaunal populations but contributed to increased colonization of the rigid Hester-Dendy substrates by filter-feeding taxa and drift organisms.

3. As in the time period 1975-1977, data suggest that stations closest to the plant, and particularly in the intake forebays (X-2) and recirculation canal (X-3), were different from other stations. The outstanding exception to this generalization is observed in the infaunal comparisons where X-3 is statistically similar to the main river stations (B-2, C-1, C-4) that had been

subjected to the natural scouring effects of high river discharge.

4. Although the denuding of downstream control stations (C-1 and C-4) makes it difficult to assess the impact of plant operational effects on downstream community characteristics, it appears that the relative stability of infaunal collections at Y-2 from year to year for infaunal and epifaunal community components and their similarity to upstream control (SL) during 1978 are indicative of localization of plant effects to the immediate vicinity of the facility.

5. Gross community characteristics (i.e., total densities and relative abundance of dominant taxa) described in this report are generally similar to those presented in the 1975-1977 annual reports, indicating little overall change in the main constituents of the benthic macroinvertebrate community from year to year.

2.2.6 LITERATURE CITED

Anderson, H.H., and D.M. Lehmkuhl. 1967. Catastrophic drift of of insects in a woodland stream. Ecology 49:198-206.

*Beck, E.C, and W.M. Beck, Jr. 1969. Chironomidae (Diptera) of Florida: III. The Harnischia complex (Chironominae). Florida State Mus. Bull. 13:277-313.

*Beck, W.M., Jr., and E.C. Beck. 1966. Chironomidae (Diptera) of Florida: I. Pentaneurini (Tanypodinae). Florida State Mus. Bull. 10:305-379.

*Beck, W.M. Jr., and E.C. Beck. 1970. The immature stages of some Chironomini (Chironomidae). Q.J. Fla. Acad. Sci. 33(1).

*Berner, Lewis. 1950. The mayflies of Florida. Univ. of Fla. Press.

*Bousfield, E.L. 1967. Fresh-water amphipod crustaceans of Glaciated North America. Canadian Field-Naturalist 72:55-77.

*Brinkhurst, R.O. 1964. Studies on the North American Aquatic Oligochaeta I: Naididae and Opistocystidae. Proc. Acad. Nat. Sci. Phila. 116:195-230.

*Brinkhurst, R.O. 1965. Studies on the North American Aquatic Oligochaeta II: Tubificidae. Proc. Acad. Nat. Sci. Phila. 117(4):117-172

*Brinkhurst, R.O., and B.G.M. Jamieson. 1971. Aquatic Oligochaeta of the world. Univ. of Toronto Press.

*Bryce, D. and A. Hobart. The biology and identification of the larvae of the Chironomidae (Diptera). Entomol. Gazette. 23.

*Burch, J.B. 1972. Freshwater sphaeriacean clams (Mollusca: Pelecypoda) of North America. Biota of Freshwater Ecosystems. ID Manual 3, EPA.

*Burks, B.D. 1975. The mayflies, or Ephemeroptera, of Illinois. Illinois Nat. Hist. Surv. Div. Bull. 26(1). [First published in 1953).

*Claassen, P.W. 1931. Plecoptera nymphs of America (North of Mexico). Springfield, IL.

*Claassen, P.W. 1940. A catalogue of the Plecoptera of the world. Cornell Univ. Pub.

*Crocker, D.W. 1957. The crayfishes of New York State (Decapods, Astacidae). NY St. Mus. and Sci. Serv. Bull. 355.

*Edmunds, G.F. Jr., S.L. Jensen, and L. Berner. 1976. The mayflies of North and Central America. Univ. of Minnesota Press.

*Hamilton, A.L., and O.A. Saether. 1969. A classification of the Nearctic Chironomidae. Fish. Res. Bd. Can. Tech. Rpt. 124.

*Hardin, P.H., and C.E. Mickel. 1952. The stoneflies of Minnesota. Univ. Minn. Exp. Sta. Tech. Bull. 201.

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*Harmon, W.N., and C.O. Berg. 1971. The freshwater snails of central New York with illustrated keys to the genera and species. Search Agriculture 1(4).

Haynes, C.M. 1976. Macroinvertebrate Study. In. Prairie Island Nuclear Generating Plant Environmental Monitoring Program. 1975. Annual report prepared for Northern States Power Company, Minneapolis, MN..

Hester, F.E., and J.S. Dendy. 1962. A multiplate sampler for aquatic macroinvertebrates. Trans. Amer. Fish. Soc. 91(4): 420-421.

*Hilsenhoff, W.L. 1975. Aquatic insects of Wisconsin. Wisconsin Dept. Nat. Resor. Tech. Bull. 89.

*Hiltunen, J.K. 1973. Keys to the tubificid and naidid Oligochaeta of the Great Lakes Region. (unpublished manuscript).

*Hobbs, H.H., Jr. 1942. The crayfishes of Florida. Univ. Fla. Pub. 3(2).

*Hobbs, H.H., Jr. 1972. Crayfishes (Astacidae) of North and Middle America. Biota of Freshwater Ecosystems. ID Manual 9. EPA.

*Holsinger, J.R. 1972. The freshwater amphipod crustaceans (Gammaridae) of North America. Biota of Freshwater Ecosystems. ID Manual 5. EPA.

Hoopes, R.L. 1974. Flooding, as a result of Hurricane Agnes, and its effect on a macrobenthic community in an infertile headwater stream in central Pennsylvania. Limnol. & Oceanogr. 19(5):853-857.

Hynes, H.B.N. 1970. The ecology of running waters. Univ. Toronto Press, Toronto.

*Jackson, G.A. 1977. Nearctic and Palaearctic Paracladopelma Harnisch and Saetheria N. gen. (Diptera: Chironomidae) Journ. Fish. Res. Bd. Can. 34(9):1321-1359.

*Johannsen, O.A. 1934-1937. Aquatic Diptera - eggs, larvae, and pupae of aquatic flies. Entomol. Reprints. spec. Los Angeles, DA.

*Jorgensen, S.E., and R.W. Sharp. 1971. Rare and endangered mollusks (Naiads) of the U.S. Bur. of Sport Fish. and Wildlife, Region 3.

*Kenk, R. 1972. Freshwater Planarians (Tubellaria) of North America; Biota of Freshwater Ecosystems. ID Manual 1. EPA.

*Klemm, Donald J. 1972. Freshwater leeches (Annelida: Hirudinea) of North America. Biota of Freshwater Ecosystems. ID Manual 8.

Knudsen, J.W. 1966. Biological techniques - collecting, preserving and illustrating plants and animals. Harper and Row, New York. 525p.

276 188

Lewis, S.A., and D.D. Garriott. 1970. A modified Folsom plankton splitter for analysis of meter net samples. In Proceedings of the 24th Annual Conference of the Southeastern Association of Game and Fish Commissioners. 332-337.

*Mason, William T., Jr. 1973. An introduction to the identification of Chironomid larvae. EPA.

*Merritt, R.W., D.H. Ross, and B.V. Petersen. 1978. Larval ecology of some lower Michigan Black flies (Diptera: Simuliidae) with keys to the immature stages. Great Lakes Entomo.

*Pennak, R.W. 1953. Fresh-water invertebrates of the United States. The Ronald Press Co., NY.

*Peterson, A. 1960. Larvae of insects (Coleoptera, Diptera, Neuroptera, Siphonaptera, Mecoptera, Trichoptera), Part II. Edwards Brothers, Inc., Ann Arbor, MI.

*Peterson, A. 1962. Larvae of insects (Lepidoptera and Hymenoptera), Part I. Edwards Brothers, Inc. Ann Arbor, MI.

*Petersen, B.V. 1970. The Prosimulium of Canada and Alaska (Diptera: Simuliidae) Mem. Entomo. Soc. Can. 69.

Pielou, E.L. 1969. An introduction to mathematical ecology. John Wiley and Sons. New York.

*Roback, S.S. 1957. The immature tendipedids of the Philadelphia area. Mono. Acad. Nat. Sci. Phil. No.9.

*Roback, S.S. 1976. The immature Chironomids of the eastern United States: I. Introduction and Tanypodinae-Coelotanypodini. Proc. Acad. Nat. Sciences of Philadelphia. 127(14):147-201.

*Ross, H.H. 1944. The caddis flies, or Trichoptera, of Illinois. Ill. Nat. Hist. Surv. Div. Bull. 23(1).

Scarola, J.F, and A.J. Novotny. 1968. Folsom plankton splitter modified for enumeration of entomastraca. Limnol. and Oceanog. 13(1):195-196.

Shannon, C.E., and W. Weaver. 1949. The mathematical theory of communication. University of Illinois Press. Urbana.

*Stewart, P., and J.S. Loch. 1973. A guide for the identification of two subfamilies of larval Chironomidae: the Chironominae and Tanypodinae found in benthic studies in the Winnipeg River in the vicinity of Pine Falls, Manitoba in 1971 and 1972. Dept. Env. Fish. and Mar. Ser. Cent. Reg. Tech. Rpt. No. CEN/T-73-12.

*Teskey, H.J. 1969. Larvae and pupae of some eastern North American Tabanidae (Diptera). Mem. Entomo. Soc. Can. 63.

Texas Instruments Incorporated. 1977. Benthic macroinvertebrate study. In Prairie Island Nuclear Generating Plant Environmental Monitoring Program. 1976 annual report prepared for Northern States Power Company, Minneapolis, MN.

Texas Instruments Incorporated. 1978. Benthic macroinvertebrate study. In Prairie Island Nuclear Generating Plant Environmental Monitoring Program. 1977 annual report prepared for Northern States Power Company, Minneapolis, MN.

*Usinger, R.L. 1956. Aquatic insects of California. University of California Press, Berkeley, CA.

*Walter, H.J., and J.B. Burch. 1957. Key to the genera of freshwater Gastropods (snails and limpets) occurring in Michigan. Mus. Zool. Univ. Mich. Cir. 3.

Ward, H.B., and G.C. Whipple. 1959. Freshwater biology, 2nd ed. John Wiley and Sons, Inc. NY.

Weber, C.I. 1973. Biological field and laboratory methods for measuring the quality of surface waters and effluents. National Environmental Research Center, Office of Research and Development, U.S.E.P.A., Cincinnati, OH.

*Wiggins, G.B. 1977. Larvae of the North American caddisfly genera (Trichoptera). Univ. Toronto Press.

Winer, B.J. 1971. Statistical principles in experimental design. McGraw-Hill Co., NY. 191 p.

Zo, Z. 1978. Zooplankton spin splitter. Deep-Sea Research, 25:571-576.

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Figure 2.2-1. Macroinvertebrate Sampling Locations (Quantitative)

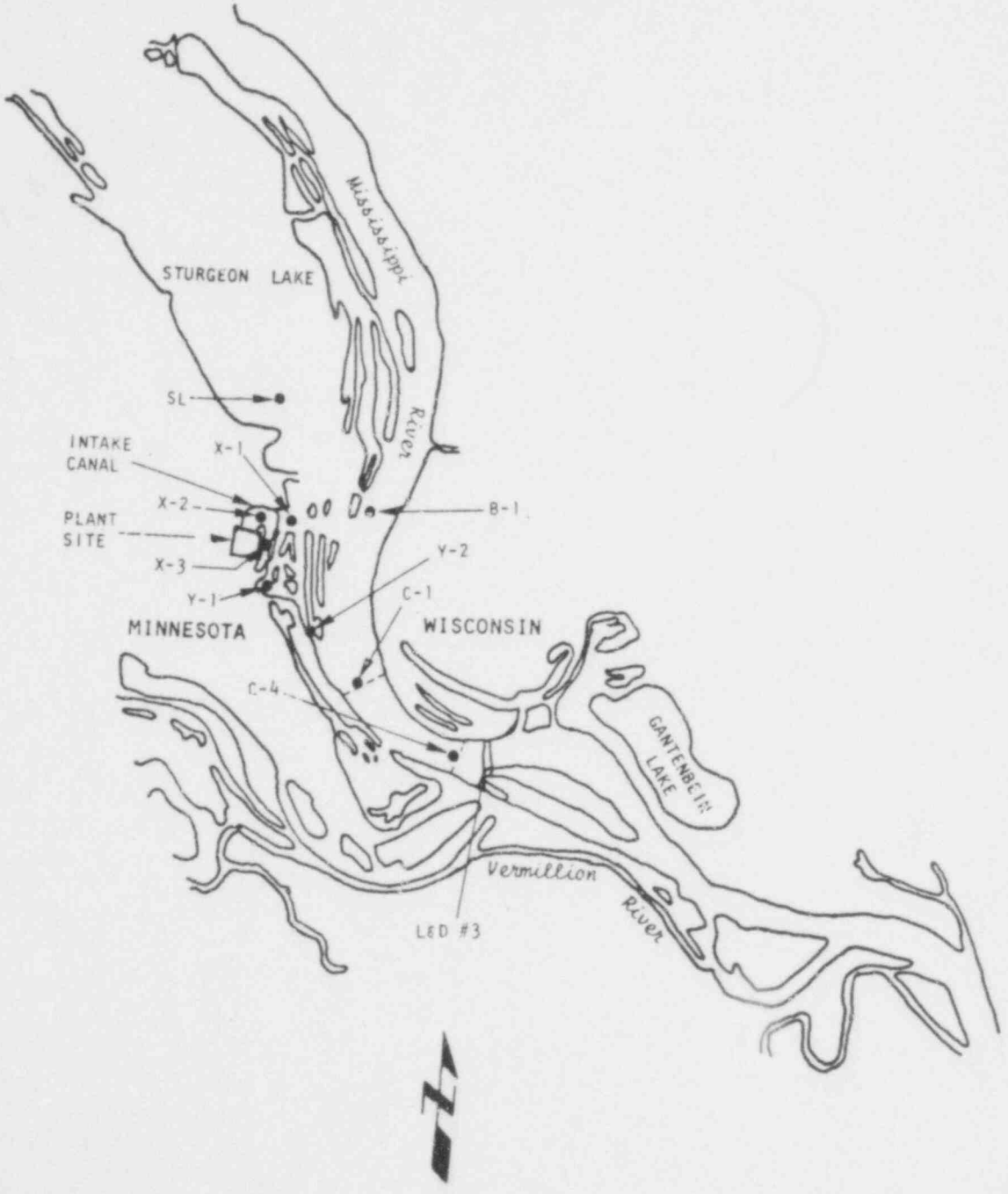

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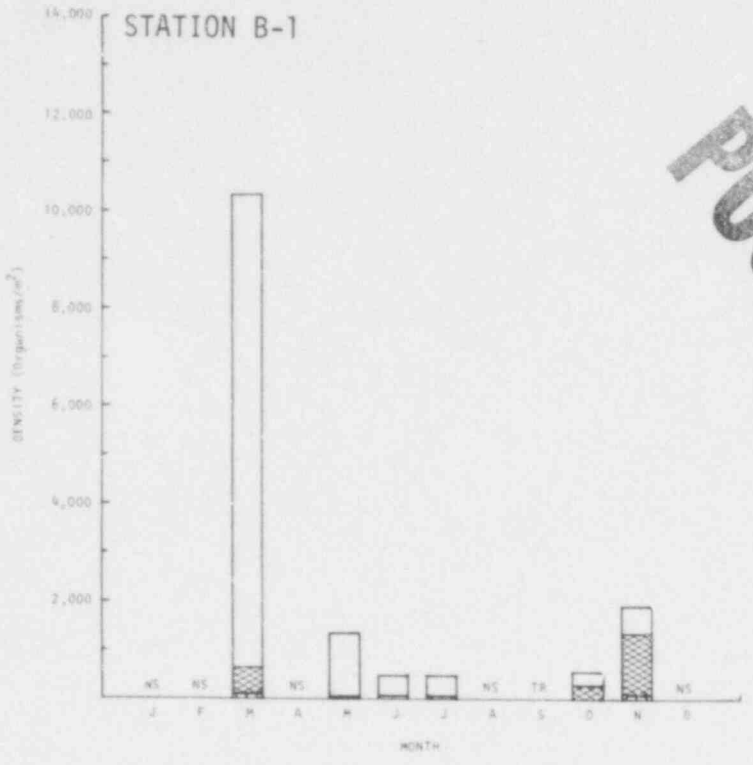
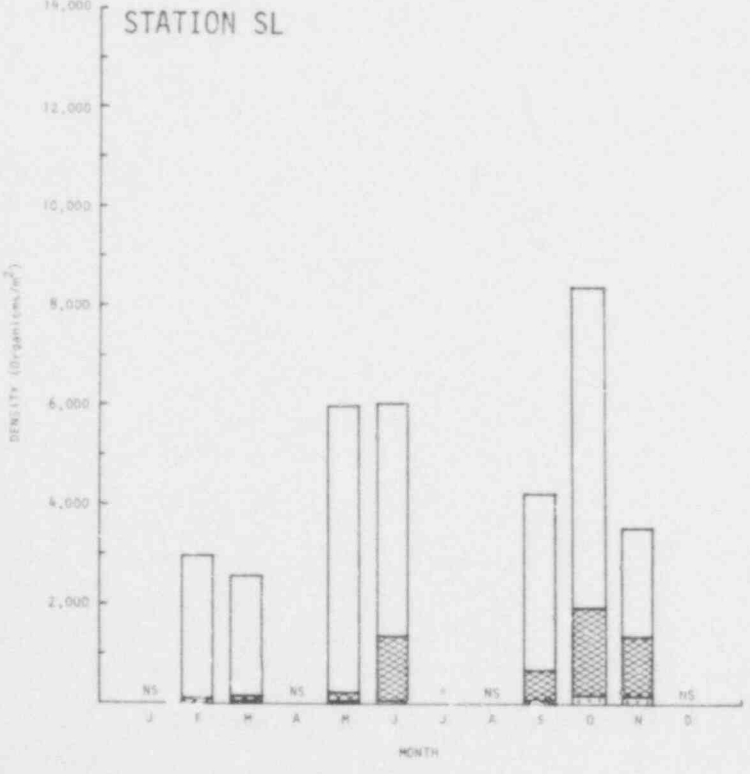
Figure 2.2-2. Total Densities (#/m^2) and Relative Abundance of Benthic Macroinvertebrates Collected by Petersen Dredge from Mississippi River near Red Wing, Minnesota, 1978





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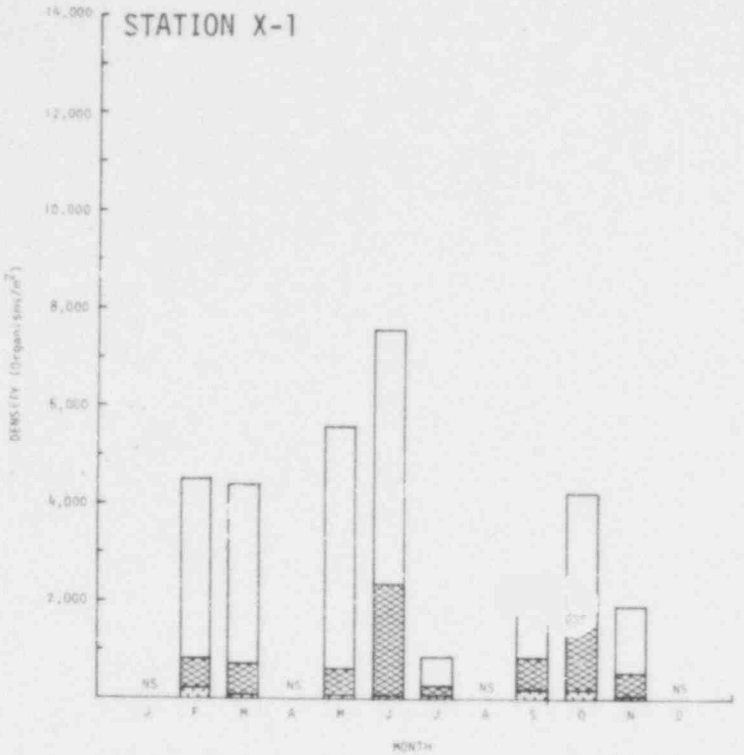

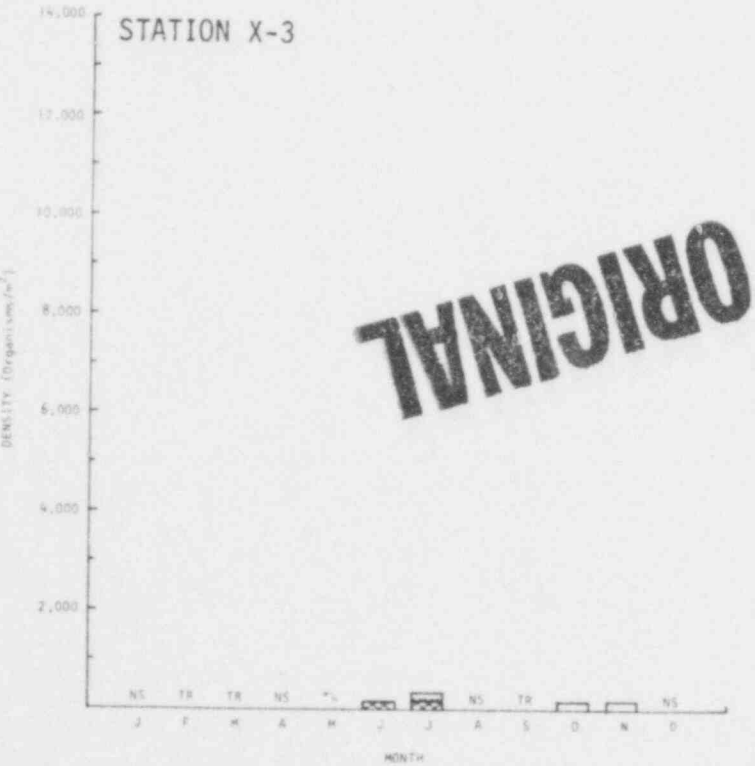

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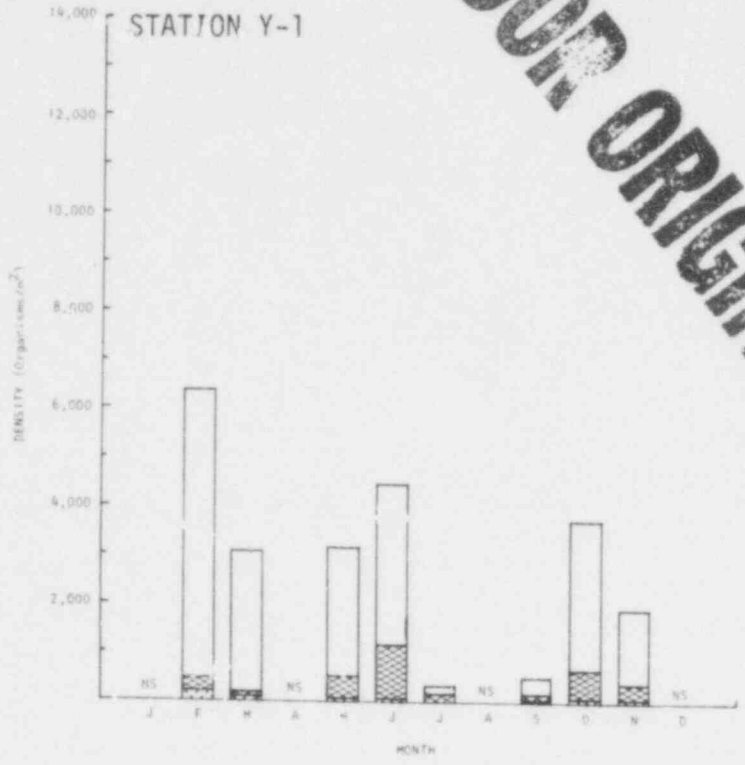

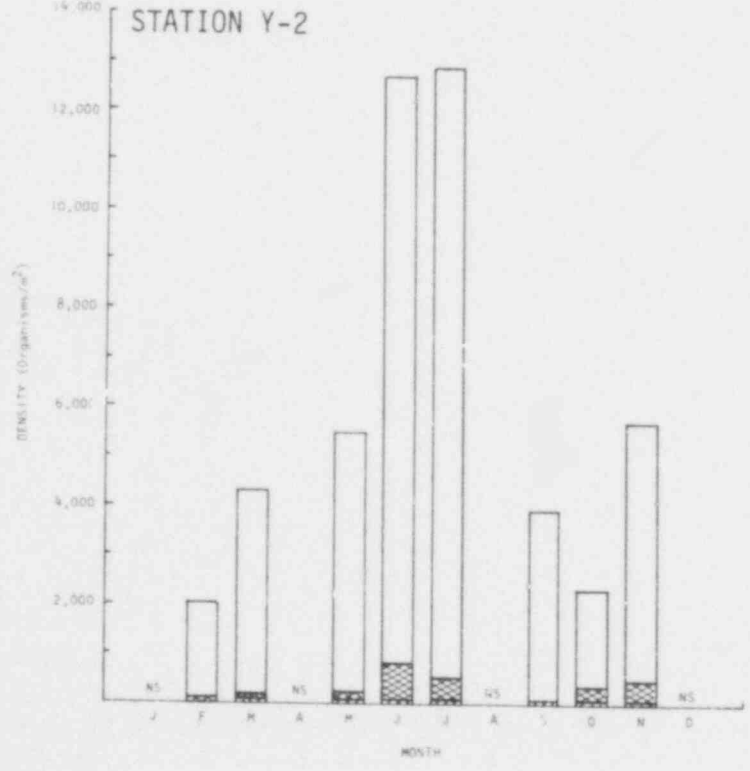

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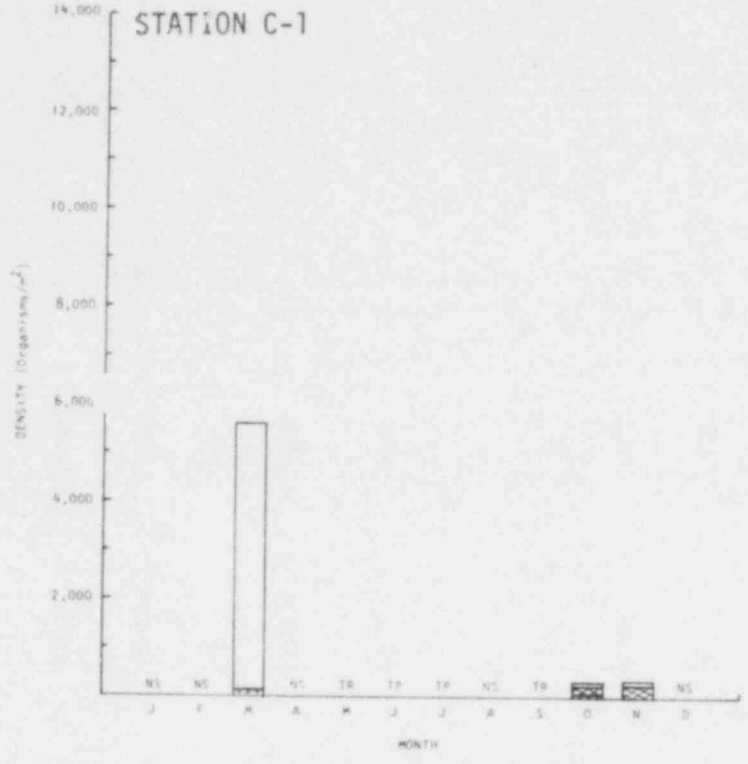


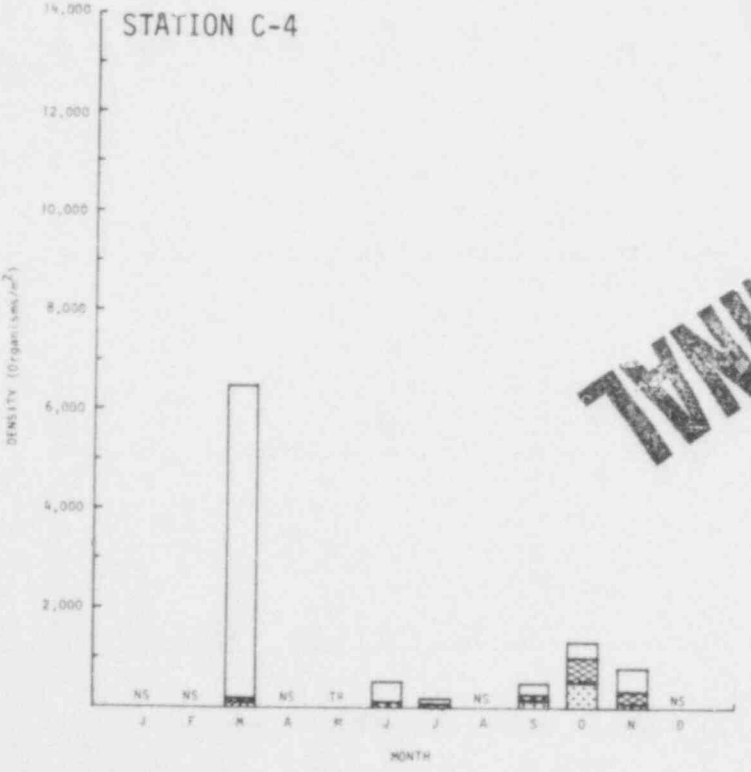
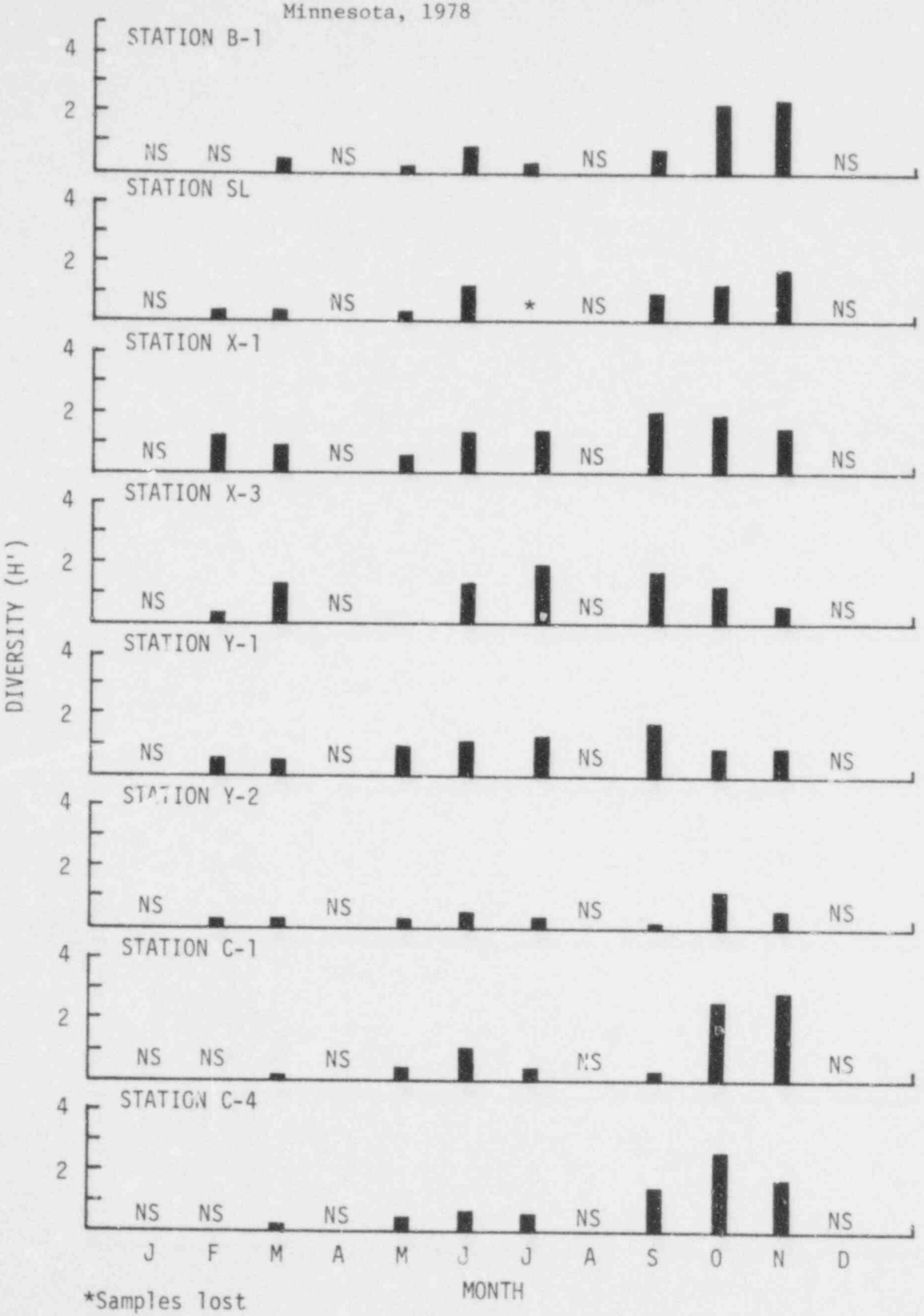


Figure 2.2-3. Benthic Community Diversity (H') as Collected by Petersen Dredge from Mississippi River near Red Wing, Minnesota, 1978



*Samples lost

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Figure 2.2-4. Total Densities (#/m^2) and Relative Abundance of Benthic Macroinvertebrates Collected by Multiplate Artificial Substate Samplers from Mississippi River near Red Wing, Minnesota, 1978

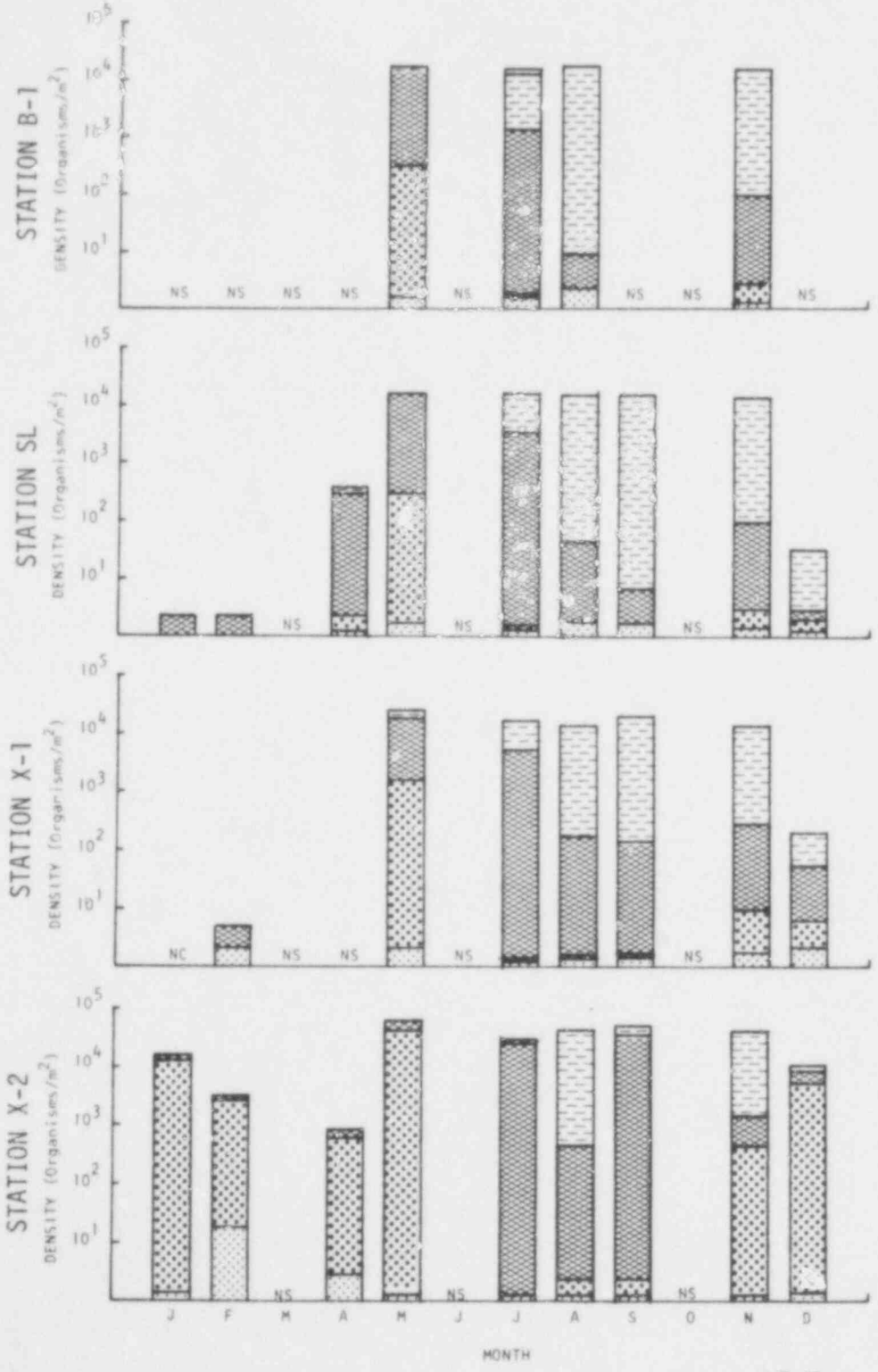

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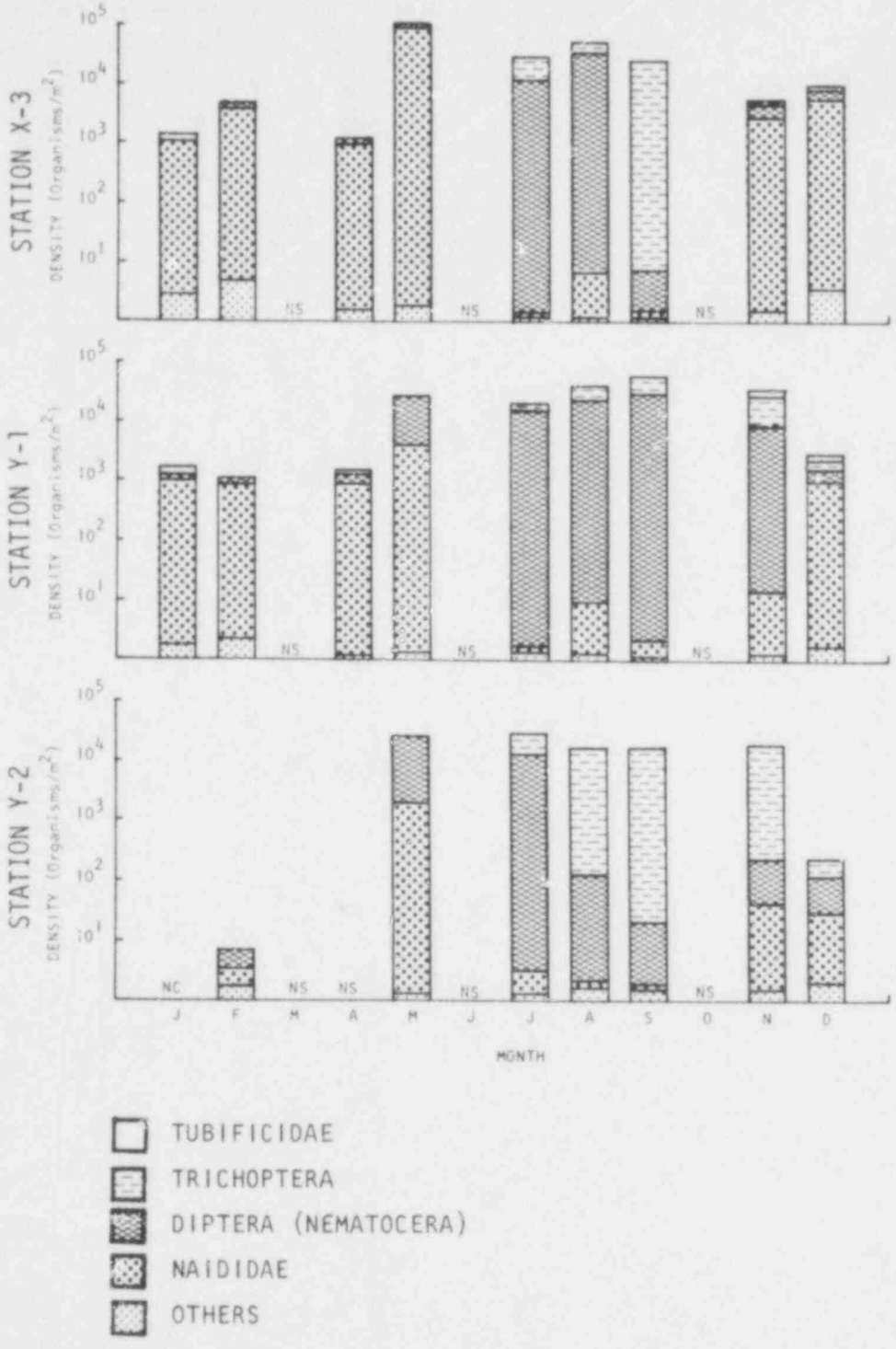
Figure 2.2-4. (cont)



NOTE: The relative abundance of each taxon presented in this figure does not reflect their actual densities relative to the logarithmic scale, but rather, their percent composition at each station as indicated by that portion of the bar comprised by each.

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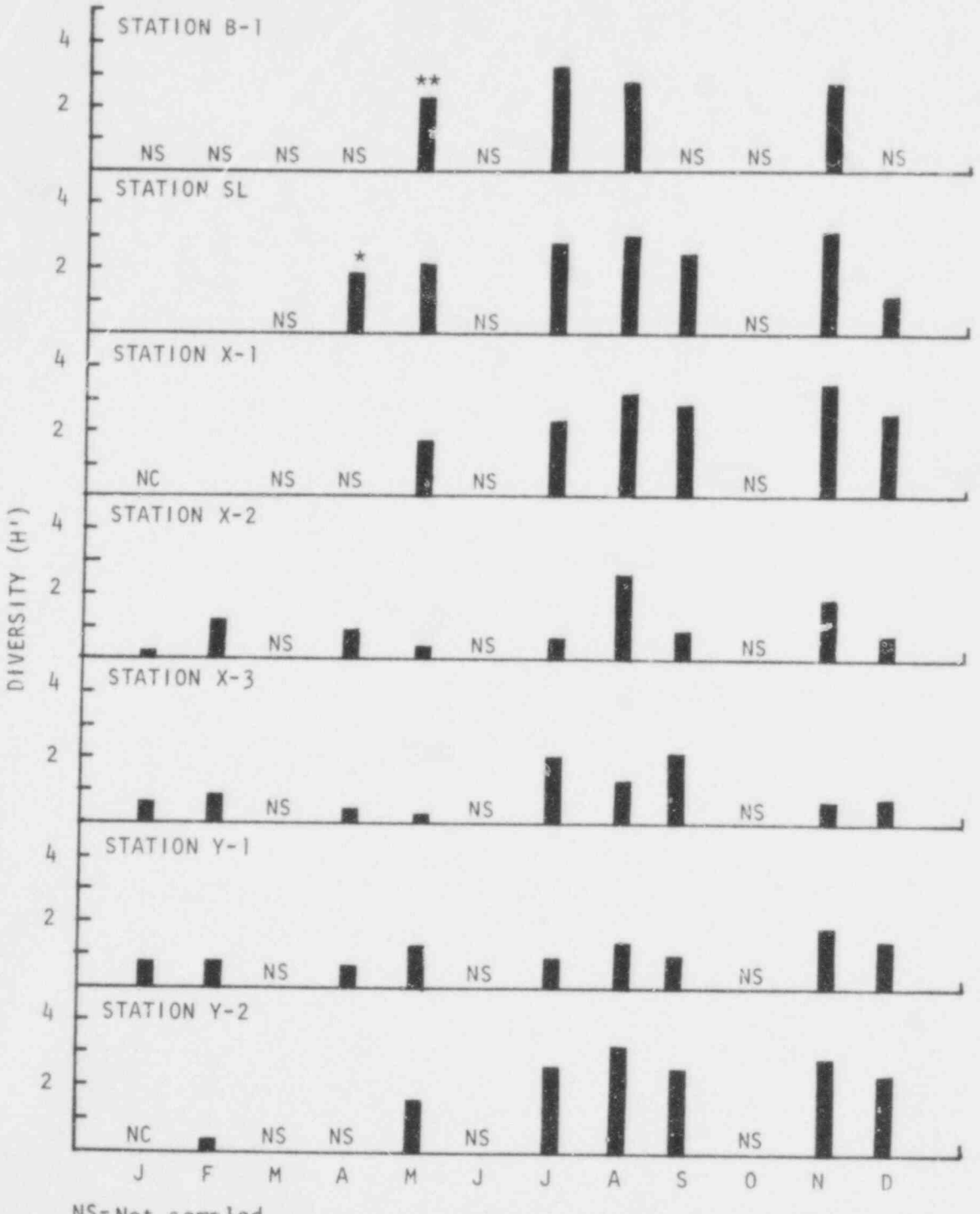
Figure 2.2-5. Benthic Community Diversity (H') as Collected by Multiplate Artificial Substrate Samples from Mississippi River near Red Wing, Minnesota, 1978



NS-Not sampled
NC-No catch
* Only 2 replicates collected
** Replicate 2 lost

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Figure 2.2-6. Mean Monthly Discharge at Lock and Dam #3 from Mississippi River near Red Wing, Minnesota, 1976-1978

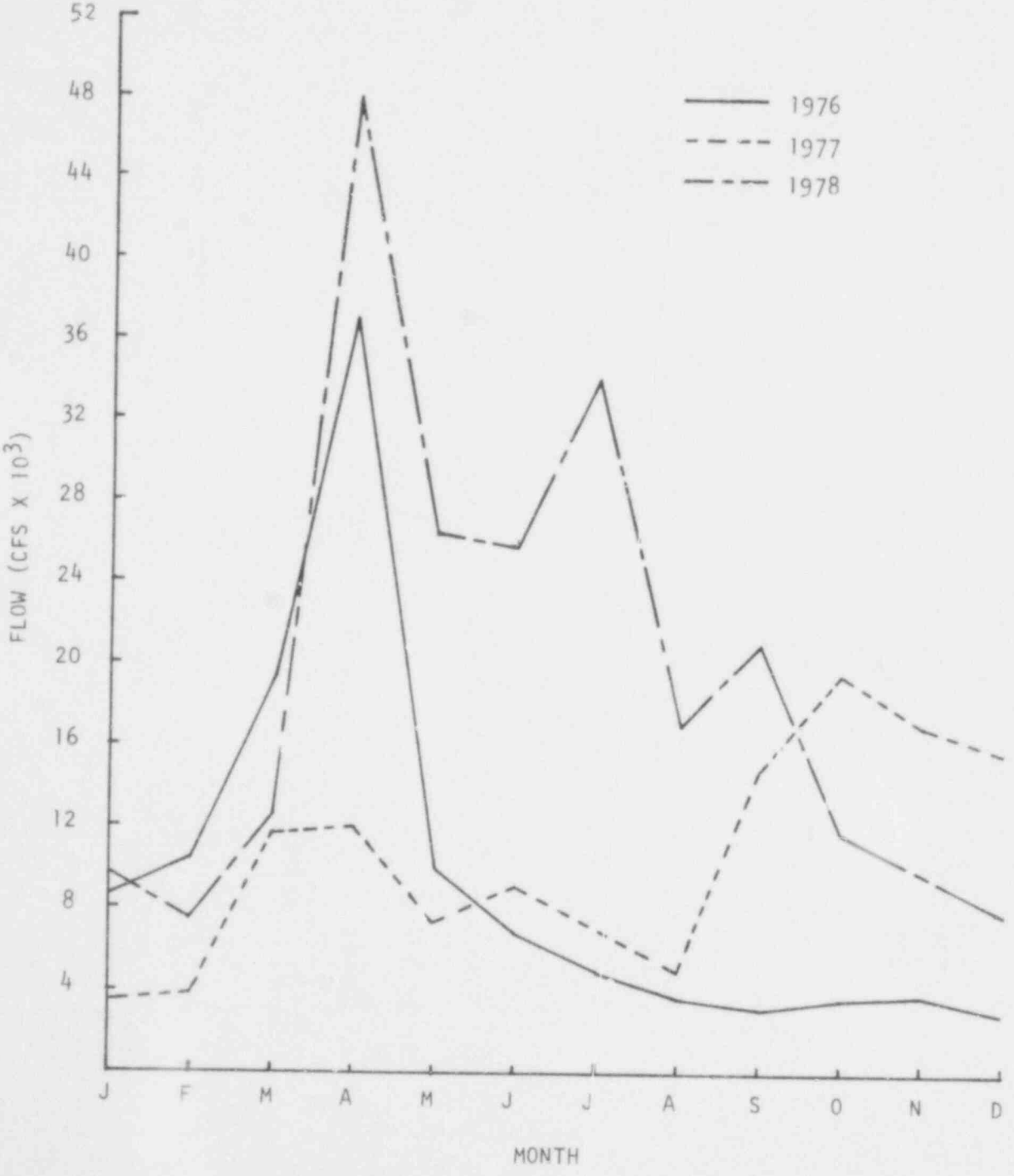

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TABLE 2.2-1. OCCURRENCE OF BENTHIC MACROINVERTEBRATE TAXA COLLECTED BY PETERSEN DREDGE FROM THE MISSISSIPPI RIVER NEAR RED WING, MINNESOTA DURING 1978

LIFE STAGE (LS) LISTINGS USED FOR BENTHOS TABLES:

01

01 - Adult	05 - Immature
02 - Larvae	06 - Juvenile
03 - Pupae	10 - Nymph
04 - Egg	11 - Colony
	12 - Undetermined

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NORTHERN STATES POWER COMPANY

PRAIRIE ISLAND NUCLEAR GENERATING PLANT

MACROINVERTEBRATE OCCURRENCE REPORT

PETERSEN DREDGE

TABLE 2.2-1 (cont)

SITE LOCATION CODES: 1=B-1; 2=SL; 3=X-1,X-3; 4=Y-1,Y-2; 5=C-1,C-4

LS	TAXA	FEB 12345	MAR 12345	MAY 12345	JUN 12345	JUL 12345	SEP 12345	OCT 12345	NOV 12345
0	CNIDARIA (TOTAL)								
0	HYDROZOA								
1	HYDRA (LPIL)			4					
0	NEMATODA (TOTAL)								
1	NEMATODA (LPIL)	234	12345	34	12345	1 345	2345	12345	12345
2	NEMATODA (LPIL)						4		
0	ENDOPROCTA								
0	ENDOPROCTA								
1	URNATELLA GRACILIS	4							
11	URNATELLA GRACILIS		1 45	4	34	34	34	34	4
0	OLIGOCHAETA (TOTAL)								
0	NAIDIDAE								
1	NAIDIDAE (LPIL)	34	1 4	5	3 5	5	34	1 5	1 5
0	TUBIFICIDAE								
1	BRANCHIURA SOWERBYI	34		2					4
1	TUBIFICIDAE (LPIL)	234	12345	12345	12345	1 345	12345	12345	12345
0	HIRUDINEA (TOTAL)								
0	GLOSSIPHONIIDAE								
1	HELOBDELLA STAGNALIS				3	3			2
1	PLACOBDELLA (LPIL)				4				
0	ERPOBDELLIDAE								
1	ERPOBDELLA (LPIL)				4				
6	HIRUDINEA (LPIL)		3						
0	GASTROPODA (TOTAL)								
0	HYDROBIIDAE (=AMNICOLIDAE)								
1	AMNICOLA (LPIL)								3
0	PHYSIDAE								
1	PHYSA (LPIL)							3	
0	PLEUROCERIDAE								
1	GONIOBASIS (LPIL)			5					
1	GASTROPODA (LPIL)			5			3		
0	BIVALVIA (TOTAL)								
0	SPHAERIIDAE								
2	SPHAERIUM (LPIL)			3					
1	SPHAERIUM (LPIL)				3	5	23 5	2345	3 5
1	PISIDIUM (LPIL)				5	5	23		3 5
5	SPHAERIIDAE (LPIL)					3			
0	UNIONIDAE								
5	UNIONIDAE (LPIL)					4		34	4
1	UNIONIDAE (LPIL)								3 5
0	ARACHNIDA (TOTAL)				DATE	03/21/79			
0	PROSTIGMATA				PAGE NO	1			
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TABLE 2.2-1 (cont)

PRAIRIE ISLAND NUCLEAR GENERATING PLANT

MACROINVERTEBRATE OCCURRENCE REPORT

PETERSEN DREDGE

S"TE LOCATION CODES: 1=B-1; 2=SL; 3=X-1,X-3; 4=Y-1,Y-2; 5=C-1,C-4

LS	TAXA	FEB 12345	MAR 12345	MAY 12345	JUN 12345	JUL 12345	SEP 12345	OCT 12345	NOV 12345
1	HYDRACARINA (LPIL)		1 3						
0	ISOPODA (TOTAL)								
0	ASELLIDAE								
1	ASELLUS (LPIL)		1 5						
0	AMPHIPODA (TOTAL)								
0	HYALELLIDAE								
1	HYALELLA AZTECA	4						4	
0	COLLEMBOLA (TOTAL)								
1	COLLEMBOLA (LPIL)							1	
0	EPHEMEROPTERA (TOTAL)								
0	ENIDAE								
10	CAENIS (LPIL)		1		4	34	4	1 34	3
0	EPHEMERIDA								
10	HEXAGENIA LIMBATA		4	23	4	34	2	23	1234
10	HEXAGENIA (LPIL)	34	1 4	4	4		3	23	12345
0	PLECOPTERA (TOTAL)								
0	ISOPERLIDAE								
10	ISOPERLA (LPIL)								5
0	COLEOPTERA POLYPHAGA (TOTAL)								
0	HYDROPHILIDAE								
1	HYDROPHILIDAE (LPIL)							1 5	
2	HYDROPHILIDAE (LPIL)							2	
0	ELMIDAE								
2	STENELMIS (LPIL)				4				
2	DUBIRAPHIA (LPIL)							3	
0	TRICHOPTERA (TOTAL)								
0	HYDROPSYCHIDAE								
2	HYDROPSYCHE ORRIS							5	
2	CHEUMATOPSYCHE (LPIL)					4			
2	POTAMYIA (LPIL)					4		5	
2	HYDROPSYCHIDAE (LPIL)					4		1 345	45
0	HYDROPTILIDAE								
2	HYDROPTILA (LPIL)					4		4	
0	LIMNEPHILIDAE								
2	LIMNEPHILIDAE (LPIL)							5	
0	LEPTOCERIDAE								
2	OECETIS (LPIL)						3	34	3
2	NECTOPSYCHE (=LEPTOCELLA)(LPIL)					4			
2	LEPTOCERIDAE (LPIL)							5	
0	POLYCENTROPODIDAE								
2	NEURECLIPSIS (LPIL)				4	4		1 4	
2	POLYCENTROPODIDAE					4			

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NORTHERN STATES POWER COMPANY

PRAIRIE ISLAND NUCLEAR GENERATING PLANT

MACROINVERTEBRATE OCCURRENCE REPORT

PETERSEN DREDGE

TABLE 2.2-1 (cont)

SITE LOCATION CODES: 1=B-1; 2=SL; 3=X-1,X-3; 4=Y-1,Y-2; 5=C-1,C-4

LS	TAXA	FEB 12345	MAR 12345	MAY 12345	JUN 12345	JUL 12345	SEP 12345	OCT 12345	NOV 12345
0	DIPTERA NEMATOCERA (TOTAL)								
0	CHAOBORIDAE								
2	CHAOBORUS PUNCTIPENNIS	3							
2	CHAOBORUS (LPIL)		2			34	23	45	12
0	CERATOPOGONIDAE								
2	PALPOMYIA (LPIL)	34							
2	CERATOPOGONIDAE (LPIL)		1234	34	2345	1 3	2345	12345	12345
0	CHIRONOMIDAE								
2	CHIRONOMUS (LPIL)	234	12345	2345	1234	34	234	2345	12345
2	ORTHOCLADIUS (LPIL)						1		1 3 5
2	CRYPTOCHIRONOMUS (LPIL)	34	12345	1234	12345	1 34	2345	12345	12345
2	CRICOTOPUS (LPIL)		4		45			4	1
2	TANYTARSUS (LPIL)	4	1 3	2	1 34	34	34	3 5	3
2	DICROTENDIPES (LPIL)		3	3	34	3	2 45	3	
2	POLYPEDILUM (LPIL)		1 5	4	1 345	1 345	1 3 5	1 345	1 5
2	ABLABESMYIA (LPIL)	34	123 5	234	2 4	34	23	234	12345
2	PROCLADIUS (LPIL)	234	12345	234	1234	34	234	12345	12345
2	CORYNONEURA (LPIL)							5	5
2	PARACHIRONOMUS (LPIL)		345	34	3		2	3	
2	GLYPTOTENDIPES (LPIL)	34	45	3	34	34	34	345	1 345
2	PHAENOPSECTRA (LPIL)			4	3				
2	EUKIEFFERIELLA (LPIL)								5
2	COELOTANYPUS (LPIL)	34	1234	34		3	23	2345	23
2	STICTOCHIRONOMUS (LPIL)		1						
2	TANYPUS (LPIL)			23	234	4	23		
2	TRISSOCLADIUS (LPIL)		1 5						
2	PSECTROCLADIUS (LPIL)		1	2345	4	34	5	1 45	1
2	GOELDICHIRONOMUS			4			23		
2	PARATENDIPES "A"					5			
2	PARATENDIPES (LPIL)		1	2 4					
2	PARACLADOPELMA (LPIL)				1	1 34	1 34	345	345
2	POTTHASTIA		1						1
2	ENDOCHIRONOMUS (LPIL)		1		1				
2	MONODIAMESA (LPIL)								5
2	SAETHERIA (LPIL)								5
2	EPICOCLADIUS						3		1 4
2	PARALAUTERBORNIELLA								1
3	CHIRONOMIDAE (LPIL)		3	2 5	1 345	34	2 45	1 3 5	
2	CHIRONOMIDAE (LPIL)					1		1	
0	SIMULIIDAE								
2	SIMULIUM (LPIL)						4		
0	ECTOPROCTA (TOTAL)								

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NORTHERN STATES POWER COMPANY

TABLE 2.2-1 (cont)

PRAIRIE ISLAND NUCLEAR GENERATING PLANT

MACROINVERTEBRATE OCCURRENCE REPORT

PETERSEN DREDGE

SITE LOCATION CODES: 1=B-1; 2=SL; 3=X-1,X-3; 4=Y-1,Y-2; 5=C-1,C-4

LS	TAXA	FEB 12345	MAR 12345	MAY 12345	JUN 12345	JUL 12345	SEP 12345	OCT 12345	NOV 12345
0	LOPHOPODIDAE								
1	FECTINATELLA MAGNIFICA	3							
8	PECTINATELLA MAGNIFICA				2				
0	PLUMATELLIDAE								
1	PLUMATELLA REPENS	34							
11	PLUMATELLA REPENS				345	5		5	5
8	PLUMATELLA REPENS						3		
0	CRISTATELLIDAE								
8	CRISTATELLA MUCEDO					4	34	234	2 45
11	ECTOPROCTA (LPIL)					4			

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TABLE 2.2-2. SUMMARY OF BENTHIC DATA COLLECTED BY PETERSEN DREDGE

		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Station B-1													
Density	(No./m^2)	NS	NS	10484.38	NS	1363.47	455.69	441.33	NS	78.94	570.51	1923.21	NS
Diversity (H')	(H')	NS	NS	.49	NS	.11	.94	.40	NS	.85	2.45	2.48	NS
Diversity (J')	(J')	NS	NS	.14	NS	.11	.45	.26	NS	.67	.79	.71	NS
No. Taxa	(N)	NS	NS	22	NS	2	10	7	NS	4	14	19	NS
Station SL (Sturgeon Lake)													
Density	(No./m^2)	NS	2960.17	2594.19	NS	5984.93	6045.92	*	NS	4275.41	8475.04	3537.85	NS
Diversity (H')	(H')	NS	.20	.37	NS	.26	1.36		NS	1.05	1.35	1.94	NS
Diversity (J')	(J')	NS	.14	.17	NS	.09	.44		NS	.31	.38	.[illegible]	NS
No. Taxa	(N)	NS	4	9	NS	12	9		NS	17	14	13	NS
Station X-1 (Intake)													
Density	(No./m^2)	NS	4553.28	4309.29	NS	5626.11	7621.09	843.20	NS	1747.40	4233.93	1930.39	NS
Diversity (H')	(H')	NS	1.33	1.00	NS	.64	1.49	1.57	NS	2.10	2.01	1.58	NS
Diversity (J')	(J')	NS	.36	.32	NS	.20	.44	.55	NS	.58	.53	.47	NS
No. Taxa	(N)	NS	15	12	NS	15	14	12	NS	20	22	18	NS
Station X-3 (Recir. Canal)													
Density	(No./m^2)	NS	32.29	53.82	NS	17.94	147.31	333.69	NS	86.11	121.99	111.23	NS
Diversity (H')	(H')	NS	.33	1.44	NS	0.00	1.43	2.08	NS	1.80	1.17	.82	NS
Diversity (J')	(J')	NS	.33	.91	NS	0.00	.[illegible]	.71	NS	.91	.68	.43	NS
No. Taxa	(N)	NS	2	5	NS	1	9	12	NS	10	6	4	NS
Station Y-1 (Discharge)													
Density	(No./m^2)	NS	6379.61	3118.04	NS	3232.87	4495.87	312.16	NS	498.74	3728.02	1905.27	NS
Diversity (H')	(H')	NS	.54	.63	NS	1.10	1.[illegible]	1.42	NS	1.87	1.11	1.09	NS
Diversity (J')	(J')	NS	.19	.22	NS	.34	.39	.64	NS	.73	.33	.37	NS
No. Taxa	(N)	NS	12	9	NS	14	16	7	NS	13	16	11	NS
Station Y-2 (Discharge)													
Density	(No./m^2)	NS	2052.39	4294.94	NS	5525.64	12,759.22	12,960.14	NS	3954.07	2314.32	5712.23	NS
Diversity (H')	(H')	NS	.43	.31	NS	.39	.59	.42	NS	.16	1.26	.69	NS
Diversity (J')	(J')	NS	.16	.11	NS	.13	.17	.11	NS	.08	.43	.23	NS
No. Taxa	(N)	NS	10	12	NS	11	16	23	NS	9	18	13	NS
Station C-1													
Density	(No./m^2)	NS	NS	5636.88	NS	5[illegible].23	53.82	17.94	NS	10.76	308.57	313.75	NS
Diversity (H')	(H')	NS	NS	.12	NS	.56	1.09	.33		.33	2.67	3.08	NS
Diversity (J')	(J')	NS	NS	.06	NS	.24	.83	.33	NS	.33	.88	.90	NS
No. Taxa	(N)	NS	NS	7	NS	5	5	2	NS	3	16	19	NS
Station C-4													
Density	(No./m^2)	NS	NS	6499.02	NS	25.12	516.68	121.99		459.27	1327.59	792.97	NS
Diversity (H')	(H')	NS	NS	.18	NS	.42	.74	.69	NS	1.59	2.64	1.78	NS
Diversity (J')	(J')	NS	NS	.07	NS	.26	.39	.25	NS	.71	.72	.67	NS
No. Taxa	(N)	NS	NS	10	NS	4	7	7	NS	7	18	15	NS

NS = NOT SAMPLED

* SAMPLES LOST

TABLE 2.2-3. MACROINVERTEBRATE DENSITY (#/m^2) AND RELATIVE ABUNDANCE FROM SAMPLES COLLECTED BY PETERSEN DREDGE NEAR RED WING, MINNESOTA DURING 1978

LIFE STAGE (LS) LISTINGS USED FOR BENTHOS TABLES:

01 - Adult	05 - Immature
02 - Larvae	06 - Juvenile
03 - Pupae	10 - Nymph
04 - Egg	11 - Colony
	12 - Undetermined

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NORTHERN STATES POWER COMPANY

Table 2.2-3 (cont)

PRAIRIE ISLAND NUCLEAR GENERATING PLANT

MACROINVERTEBRATE DENSITY (NUMBER PER SQUARE METER)

PETERSEN DREDGE

WITHIN-SITE REPORT

FEBRUARY

LS	TAXA	STURGEON LAKE 2	- X	S.E.	REL ABX
0	NEMATODA . OTAL)	14.35	14.35	-1.00	0.5
1	NEMATODA (LPIL)	14.35	14.35	-1.00	0.5
0	OLIGOCHAETA (TOTAL)	2881.23	2881.23	-1.00	97.3
0	TUBIFICIDAE				
1	TUBIFICIDAE (LPIL)	2881.23	2881.23	-1.00	97.3
0	DIPTERA NEMATOCERA (TOTAL)	64.59	64.59	-1.00	2.2
0	CHIRONOMIDAE				
2	CHIRONOMUS (LPIL)	61.00	61.00	-1.00	2.1
2	PROCLADIUS (LPIL)	3.59	3.59	-1.00	0.1
TOTAL		2960.17	2960.17	-1.00	100.0
DIVERSITY (H PRIME)		0.20	0.20	-1.00	
DIVERSITY (J PRIME)		0.14	0.14	-1.00	
NUMBER OF TAXA		4	4		

NORTHERN STATES POWER COMPANY

Table 2.2-3 (cont)

PRAIRIE ISLAND NUCLEAR GENERATING PLANT

MACROINVERTEBRATE DENSITY (NUMBER PER SQUARE METER)

PETERSEN DREDGE

WITHIN-SITE REPORT

INTAKE FEBRUARY

LS	TAXA	X-1	X-3	- X	S.E.	REL ABX
		3	4			
0	NEMATODA (TOTAL)	35.88	0.0	17.94	17.94	0.8
1	NEMATODA (LPIL)	35.88	0.0	17.94	17.94	0.8
0	OLIGOCHAETA (TOTAL)	3857.19	32.29	1944.74	1912.45	84.8
0	NAIDIDAE					
1	NAIDIDAE (LPIL)	154.29	0.0	77.14	77.14	3.4
0	TUBIFICIDAE					
1	BRANCHIURA SOWERBYI	64.59	17.94	41.26	23.32	1.8
1	TUBIFICIDAE (LPIL)	3638.32	14.35	1826.34	1811.98	79.7
0	EPHEMEROPTERA (TOTAL)	10.76	0.0	5.38	5.38	0.2
0	EPHEMERIDAE					
10	HEXAGENIA (LPIL)	10.76	0.0	5.38	5.38	0.2
0	DIPTERA NEMATOCERA (TOTAL)	635.09	0.0	317.55	317.55	13.8
0	CHAOBORIDAE					
2	CHAOBORUS PUNCTIPENNIS	10.76	0.0	5.38	5.38	0.2
0	CERATOPOGONIDAE					
2	PALPOMYIA (LPIL)	96.88	0.0	48.44	48.44	2.1
0	CHIRONOMIDAE					
2	CHIRONOMUS (LPIL)	129.17	0.0	64.59	64.59	2.8
2	CRYPTOCHIRONOMUS (LPIL)	136.35	0.0	68.17	68.17	3.0
2	ABLABESMYIA (LPIL)	25.12	0.0	12.56	12.56	0.5
2	PROCLADIUS (LPIL)	204.52	0.0	102.26	102.26	4.5
2	GLYPTOTENDIPES (LPIL)	3.59	0.0	1.79	1.79	0.1
2	COELOTANYPUS (LPIL)	28.70	0.0	14.35	14.35	0.6
0	ECTOPROCTA (TOTAL)	14.35	0.0	7.18	7.18	0.3
0	LOPHOPODIDAE					
1	PECTINATELLA MAGNIFICA	3.59	0.0	1.79	1.79	0.1
0	PLUMATELLIDAE					
1	PLUMATELLA REPENS	10.76	0.0	5.38	5.38	0.2
TOTAL		4553.28	32.29	2292.78	2260.49	100.0
DIVERSITY (H PRIME)		1.33	0.33	0.83	0.50	
DIVERSITY (J PRIME)		0.36	0.33	0.35	0.01	
NUMBER OF TAXA		15	2	15		

NORTHERN STATES POWER COMPANY

Table 2.2-3 (cont)

PRAIRIE ISLAND NUCLEAR GENERATING PLANT

MACROINVERTEBRATE DENSITY (NUMBER PER SQUARE METER)

PETERSEN DREDGE

WITHIN-SITE REPORT

DISCHARGE FEBRUARY

LS	TAXA	Y-1	Y-2	- X	S.E.	REL ABX
		5	6			
0	NEMATODA (TOTAL)	17.94	7.18	12.56	5.38	0.3
1	NEMATODA (LPIL)	17.94	7.18	12.56	5.38	0.3
0	ENDOPROCTA	10.76	0.0	5.38	5.38	0.1
0	ENDOPROCTA					
1	URNATELLA GRACILIS	10.76	0.0	5.38	5.38	0.1
0	OLIGOCHAETA (TOTAL)	6002.87	1973.45	3988.16	2014.71	94.6
0	NAIDIDAE					
1	NAIDIDAE (LPIL)	118.41	7.18	62.79	55.62	1.5
0	TUBIFICIDAE					
1	BRANCHIURA SOWERBYI	3.59	3.59	3.59	0.0	0.1
1	TUBIFICIDAE (LPIL)	5880.87	1962.68	3921.78	1959.10	93.0
0	AMPHIPODA (TOTAL)	3.59	0.0	1.79	1.79	0.0
0	HYALELLIDAE					
1	HYALELLA AZTECA	3.59	0.0	1.79	1.79	0.0
0	EPHEMEROPTERA (TOTAL)	0.0	10.76	5.38	5.38	0.1
0	EPHEMERIDAE					
10	HEXAGENIA (LPIL)	0.0	10.76	5.38	5.38	0.1
0	DIPTERA NEMATOCERA (TOTAL)	340.87	61.00	200.93	139.94	4.8
0	CERATOPOGONIDAE					
2	PALPOMYIA (LPIL)	0.0	10.76	5.38	5.38	0.1
0	CHIRONOMIDAE					
2	CHIRONOMUS (LPIL)	53.82	7.18	30.50	23.32	0.7
2	CRYPTOCHIRONOMUS (LPIL)	236.81	7.18	121.99	114.82	2.9
2	TANYTARSUS (LPIL)	7.18	0.0	3.59	3.59	0.1
2	ABLABESMYIA (LPIL)	0.0	28.70	14.35	14.35	0.3
2	PROCLADIUS (LPIL)	39.47	0.0	19.73	19.73	0.5
2	GLYPTOTENDIPES (LPIL)	3.59	0.0	1.79	1.79	0.0
2	COELOTANYPUS (LPIL)	0.0	7.18	3.59	3.59	0.1
9	ECTOPROCTA (TOTAL)	3.59	0.0	1.79	1.79	0.0
0	PLUMATELLIDAE					
1	PLUMATELLA REPENS	3.59	0.0	1.79	1.79	0.0
TOTAL		6379.61	2052.39	4215.99	2163.61	100.0
DIVERSITY (H PRIME)		0.54	0.43	0.48	0.06	
DIVERSITY (J PRIME)		0.19	0.16	0.17	0.02	
NUMBER OF TAXA		12	10	16		

NORTHERN STATES POWER COMPANY

PRAIRIE ISLAND NUCLEAR GENERATING PLANT

Table 2.2-3 (cont)

MACROINVERTEBRATE DENSITY (NUMBER PER SQUARE METER)

PETERSEN DREDGE

WITHIN-SITE REPORT

LS	TAXA	MARCH B-1 1	- X	S.E.	REL ABX
0	NEMATODA (TOTAL)	32.29	32.29	-1.00	0.3
1	NEMATODA (LPIL)	32.29	32.29	-1.00	0.3
0	ENDOPROCTA	10.76	10.76	-1.00	0.1
0	ENDOPROCTA				
11	URNATELLA GRACILIS	10.76	10.76	-1.00	0.1
0	OLIGOCHAETA (TOTAL)	9878.00	9878.00	-1.00	94.2
0	NAIDIDAE				
1	NAIDIDAE (LPIL)	14.35	14.35	-1.00	0.1
0	TUBIFICIDAE				
1	TUBIFICIDAE (LPIL)	9863.65	9863.65	-1.00	94.1
0	ARACHNIDA (TOTAL)	7.18	7.18	-1.00	0.1
0	PROSTIGMATA				
1	HYDRACARINA (LPIL)	7.18	7.18	-1.00	0.1
0	ISOPODA (TOTAL)	7.18	7.18	-1.00	0.1
0	ASELLIDAE				
1	ASELLUS (LPIL)	7.18	7.18	-1.00	0.1
0	EPHEMEROPTERA (TOTAL)	28.70	28.70	-1.00	0.3
0	CAENIDAE				
10	CAENIS (LPIL)	3.59	3.59	-1.00	0.0
0	EPHEMERIDAE				
10	HEXAGENIA (LPIL)	25.12	25.12	-1.00	0.2
0	DIPTERA NEMATOCERA (TOTAL)	520.27	520.27	-1.00	5.0
0	CERATOPOGONIDAE				
2	CERATOPOGONIDAE (LPIL)	28.70	28.70	-1.00	0.3
0	CHIRONOMIDAE				
2	CHIRONOMUS (LPIL)	86.11	86.11	-1.00	0.8
2	CRYPTOCHIRONOMUS (LPIL)	229.64	229.64	-1.00	2.2
2	TANYTARSUS (LPIL)	3.59	3.59	-1.00	0.0
2	POLYPEDILUM (LPIL)	14.35	14.35	-1.00	0.1
2	ABLABESMYIA (LPIL)	10.76	10.76	-1.00	0.1
2	PROCLADIUS (LPIL)	10.76	10.76	-1.00	0.1
2	COELOTANYPUS (LPIL)	78.94	78.94	-1.00	0.8
2	STICTOCHIRONOMUS (LPIL)	7.18	7.18	-1.00	0.1
2	TRISSOCLADIUS (LPIL)	25.12	25.12	-1.00	0.2
2	PSECTROCLADIUS (LPIL)	3.59	3.59	-1.00	0.0
2	PARATENDIPES (LPIL)	10.76	10.76	-1.00	0.1
2	POTTHASTIA	7.18	7.18	-1.00	0.1
2	ENDOCHIRONOMUS (LPIL)	3.59	3.59	-1.00	0.0
TOTAL		10484.38	10484.38	-1.00	100.0
DIVERSITY (H PRIME)		0.49	0.49	-1.00	
DIVERSITY (J PRIME)		0.14	0.14	-1.00	
NUMBER OF TAXA		22	22		

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NORTHERN STATES POWER COMPANY

PRAIRIE ISLAND NUCLEAR GENERATING PLANT

MACROINVERTEBRATE DENSITY (NUMBER PER SQUARE METER)

PETERSEN DREDGE

WITHIN-SITE REPORT

Table 2.2-3 (cont)

MARCH

STURGEON LAKE

LS	TAXA		X̄	S.E.	REL ABX
0	NEMATODA (TOTAL)	2	14.35	-1.00	0.6
1	NEMATODA (LPIL)	14.35	14.35	-1.00	0.6
0	OLIGOCHAETA (TOTAL)	2482.96	2482.96	-1.00	95.7
0	TUBIFICIDAE				
1	TUBIFICIDAE (LPIL)	2482.96	2482.96	-1.00	95.7
0	DIPTERA NEMATOCERA (TOTAL)	96.88	96.88	-1.00	3.7
0	CHAOBORIDAE				
2	CHAOBORUS (LPIL)	3.59	3.59	-1.00	0.1
0	CERATOPOGONIDAE				
2	CERATOPOGONIDAE (LPIL)	3.59	3.59	-1.00	0.1
0	CHIRONOMIDAE				
2	CHIRONOMUS (LPIL)	57.41	57.41	-1.00	2.2
2	CRYPTOCHIRONOMUS (LPIL)	7.18	7.18	-1.00	0.3
2	ABLABESMYIA (LPIL)	10.76	10.76	-1.00	0.4
2	PROCLADIUS (LPIL)	7.18	7.18	-1.00	0.3
2	COELOTANYPUS (LPIL)	7.18	7.18	-1.00	0.3
TOTAL		2594.19	2594.19	-1.00	100.0
DIVERSITY (H PRIME)		0.37	0.37	-1.00	
DIVERSITY (J PRIME)		0.17	0.17	-1.00	
NUMBER OF TAXA		9	9		

BOTTOM TYPE 0

ABOVE COMPUTED USING SAMPLE IDS
4091 4092 4093

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NORTHERN STATES POWER COMPANY

PRAIRIE ISLAND NUCLEAR GENERATING PLANT

Table 2.2-3 (cont)

MACROINVERTEBRATE DENSITY (NUMBER PER SQUARE METER)

PETERSEN DREDGE

WITHIN-SITE REPORT

LS	TAXA	INTAKE MARCH X-1	X-3	X	S.E.	REL ABX
0	PLATYHELMINTHES (TOTAL)	14.35	0.0	7.18	7.18	0.3
1	TURBELLARIA-(LPIL)	14.35	0.0	7.18	7.18	0.3
0	NEMATODA (TOTAL)	28.70	3.59	16.15	12.56	0.7
1	NEMATODA (LPIL)	28.70	3.59	16.15	12.56	0.7
0	OLIGOCHAETA (TOTAL)	3645.50	21.53	1833.51	1811.98	84.0
0	TUBIFICIDAE					
1	TUBIFICIDAE (LPIL)	3645.50	21.53	1833.51	1811.98	84.0
0	HIRUDINEA (TOTAL)	0.0	3.59	1.79	1.79	0.1
6	HIRUDINEA (LPIL)	0.0	3.59	1.79	1.79	0.1
0	ARACHNIDA (TOTAL)	3.59	0.0	1.79	1.79	0.1
0	PROSTIGMATA					
1	HYDRACARINA (LPIL)	3.59	0.0	1.79	1.79	0.1
0	DIPTERA NEMATOCERA (TOTAL)	617.15	25.12	321.13	296.02	14.7
0	CERATOPOGONIDAE					
2	CERATOPOGONIDAE (LPIL)	43.06	0.0	21.53	21.53	1.0
0	CHIRONOMIDAE					
2	CHIRONOMUS (LPIL)	46.65	0.0	23.32	23.32	1.1
2	CRYPTOCHIRONOMUS (LPIL)	226.05	0.0	113.02	113.02	5.2
2	TANYTARSUS (LPIL)	0.0	21.53	10.76	10.76	0.5
2	DICROTENDIPES (LPIL)	7.18	0.0	3.59	3.59	0.2
2	ABLABESMYIA (LPIL)	7.18	0.0	3.59	3.59	0.2
2	PROCLADIUS (LPIL)	243.99	0.0	121.99	121.99	5.6
2	PARACHIRONOMUS (LPIL)	3.59	0.0	1.79	1.79	0.1
2	COELOTANYPUS (LPIL)	39.47	0.0	19.73	19.73	0.9
3	CHIRONOMIDAE (LPIL)	0.0	3.59	1.79	1.79	0.1
TOTAL		4309.29	53.82	2181.55	2127.73	100.0
DIVERSITY (H PRIME)		1.00	1.44	1.22	0.22	
DIVERSITY (J PRIME)		0.32	0.91	0.62	0.30	
NUMBER OF TAXA		12	5	15		
BOTTOM TYPE	0					

ABOVE COMPUTED USING SAMPLE IDS
4101 4102 4103 4111
4112 4113

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PRAIRIE ISLAND NUCLEAR GENERATING PLANT

Table 2.2-3 (cont)

MACROINVERTEBRATE DENSITY (NUMBER PER SQUARE METER)

PETERSEN DREDGE

WITHIN-SITE REPORT

LS	TAXA	DISCHARGE MARCH Y-1	Y-2	X̄	S.E.	REL ABX
0	NEMATODA (TOTAL)	5	6	35.88	32.29	1.0
1	NEMATODA (LPIL)	68.17	3.59	35.88	32.29	1.0
0	ENDOPROCTA	68.17	3.59	8.97	1.79	0.2
0	ENDOPROCTA	10.76	7.18			
11	URNATELLA GRACILIS	10.76	7.18	8.97	1.79	0.2
0	OLIGOCHAETA (TOTAL)	2913.53	4187.30	3550.41	636.88	95.8
0	NAIDIDAE					
1	NAIDIDAE (LPIL)	0.0	61.00	30.50	30.50	0.8
0	TUBIFICIDAE					
1	TUBIFICIDAE (LPIL)	2913.53	4126.30	3519.91	606.39	95.0
0	EPHEMEROPTERA (TOTAL)	0.0	17.94	8.97	8.97	0.2
0	EPHEMERIDAE					
10	HEXAGENIA LIMBATA	0.0	7.18	3.59	3.59	0.1
10	HEXAGENIA (LPIL)	0.0	10.76	5.38	5.38	0.1
0	DIPTERA NEMATOCERA (TOTAL)	125.58	78.94	102.26	23.32	2.8
0	CERATOPOGONIDAE					
2	CERATOPOGONIDAE (LPIL)	0.0	21.53	10.76	10.76	0.3
0	CHIRONOMIDAE					
2	CHIRONOMUS (LPIL)	50.23	14.35	32.29	17.94	0.9
2	CRYPTOCHIRONOMUS (LPIL)	17.94	14.35	16.15	1.79	0.4
2	CRICOTOPUS (LPIL)	3.59	0.0	1.79	1.79	0.0
2	ABLABESMYIA (LPIL)	0.0	17.94	8.97	8.97	0.2
2	PROCLADIUS (LPIL)	10.76	7.18	8.97	1.79	0.2
2	PARACHIRONOMUS (LPIL)	3.59	0.0	1.79	1.79	0.0
2	GLYPTOTENDIPES (LPIL)	39.47	0.0	19.73	19.73	0.5
2	COELOTANYPUS (LPIL)	0.0	3.59	1.79	1.79	0.0
TOTAL		3118.04	4294.94	3706.49	588.45	100.0
DIVERSITY (H PRIME)		0.63	0.31	0.47	0.16	
DIVERSITY (J PRIME)		0.22	0.11	0.17	0.06	
NUMBER OF TAXA		9	12	15		
BOTTOM TYPE	0					

ABOVE COMPUTED USING SAMPLE IDS

4121 4122 4123 4131
4132 4133

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NORTHERN STATES POWER COMPANY

PRAIRIE ISLAND NUCLEAR GENERATING PLANT

Table 2.2-3 (cont)

MACROINVERTEBRATE DENSITY (NUMBER PER SQUARE METER)

PETERSEN DREDGE

WITHIN-SITE REPORT

MARCH

LS	TAXA	C-1	C-4	- X	S.E.	REL AB%
		7	8			
0	NEMATODA (TOTAL)	0.0	7.18	3.59	3.59	0.1
1	NEMATODA (LPIL)	0.0	7.18	3.59	3.59	0.1
0	ENDOPROCTA	3.59	3.59	3.59	0.0	0.1
0	ENDOPROCTA					
11	URNATELLA GRACILIS	3.59	3.59	3.59	0.0	0.1
0	OLIGOCHAETA (TOTAL)	5568.71	6383.21	5975.96	407.25	98.5
0	TUBIFICIDAE					
1	TUBIFICIDAE (LPIL)	5568.71	6383.21	5975.96	407.25	98.5
0	ISOPODA (TOTAL)	3.59	0.0	1.79	1.79	0.0
0	ASELLIDAE					
1	ASELLUS (LPIL)	3.59	0.0	1.79	1.79	0.0
0	DIPTERA NEMATOCERA (TOTAL)	61.00	104.05	82.53	21.53	1.4
0	CHIRONOMIDAE					
2	CHIRONOMUS (LPIL)	0.0	21.53	10.76	10.76	0.2
2	CRYPTOCHIRONOMUS (LPIL)	28.70	35.88	32.29	3.59	0.5
2	POLYPEDILUM (LPIL)	0.0	7.18	3.59	3.59	0.1
2	ABLABESMYIA (LPIL)	0.0	17.94	8.97	8.97	0.1
2	PROCLADIUS (LPIL)	3.59	0.0	1.79	1.79	0.0
2	PARACHIRONOMUS (LPIL)	0.0	3.59	1.79	1.79	0.0
2	GLYPTOTENDIPES (LPIL)	7.18	3.59	5.38	1.79	0.1
2	TRISSOCLADIUS (LPIL)	21.53	14.35	17.94	3.59	0.3
TOTAL		5636.88	6498.02	6067.45	430.57	100.0
DIVERSITY (H PRIME)		0.12	0.18	0.15	0.03	
DIVERSITY (J PRIME)		0.06	0.07	0.06	0.01	
NUMBER OF TAXA		7	10	12		
BOTTOM TYPE	0					

ABOVE COMPUTED USING SAMPLE IDS
4141 4142 4143 4151
4152 4153

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NORTHERN STATES POWER COMPANY

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MACROINVERTEBRATE DENSITY (NUMBER PER SQUARE METER)

PETERSEN DREDGE

WITHIN-SITE REPORT

Table 2.2-3 (cont)

LS	TAXA	MAY B-1	X	S.E.	PEL ABX
0	OLIGOCHAETA (TOTAL)	1			
0	TUBIFICIDAE	1345.53	1345.53	-1.00	98.7
1	TUBIFICIDAE (LPIL)	1345.53	1345.53	-1.00	98.7
0	DIPTERA NEMATOCERA (TOTAL)	17.94	17.94	-1.00	1.3
0	CHIRONOMIDAE				
2	CRYPTOCHIRONOMUS (LPIL)	17.94	17.94	-1.00	1.3
TOTAL		1363.47	1363.47	-1.00	100.0
DIVERSITY (H PRIME)		0.11	0.11	-1.00	
DIVERSITY (J PRIME)		0.11	0.11	-1.00	
NUMBER OF TAXA		2	2		
BOTTOM TYPE	0				

ABOVE COMPUTED USING SAMPLE IDS
4161 4162 4163

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PRAIRIE ISLAND NUCLEAR GENERATING PLANT

Table 2.2-3 (cont)

MACROINVERTEBRATE DENSITY (NUMBER PER SQUARE METER)

PETERSEN DREDGE

WITHIN-SITE REPORT

MAY

STURGEON LAKE

LS	TAXA	2	X	S.E.	REL AB%
0	OLIGOCHAETA (TOTAL)	5819.87	5819.87	-1.00	97.2
0	TUBIFICIDAE				
1	BRANCHIURA SOWERBYI	7.18	7.18	-1.00	0.1
1	TUBIFICIDAE (LPIL)	5812.70	5812.70	-1.00	97.1
0	EPHEMEROPTERA (TOTAL)	3.59	3.59	-1.00	0.1
0	EPHEMERIDAE				
10	HEXAGENIA LIMBATA	3.59	3.59	-1.00	0.1
0	DIPTERA NEMATOCERA (TOTAL)	161.46	161.46	-1.00	2.7
0	CHIRONOMIDAE				
2	CHIRONOMUS (LPIL)	50.23	50.23	-1.00	0.8
2	CRYPTOCHIRONOMUS (LPIL)	3.59	3.59	-1.00	0.1
2	TANYTARSUS (LPIL)	3.59	3.59	-1.00	0.1
2	ABLABESMYIA (LPIL)	14.35	14.35	-1.00	0.2
2	PROCLADIUS (LPIL)	7.18	7.18	-1.00	0.1
2	TANYPUS (LPIL)	25.12	25.12	-1.00	0.4
2	PSECTROCLADIUS (LPIL)	17.94	17.94	-1.00	0.3
2	PARATENDIPES (LPIL)	7.18	7.18	-1.00	0.1
3	CHIRONOMIDAE (LPIL)	32.29	32.29	-1.00	0.5
TOTAL		5984.93	5984.93	-1.00	100.0
DIVERSITY (H PRIME)		0.26	0.26	-1.00	
DIVERSITY (J PRIME)		0.09	0.09	-1.00	
NUMBER OF TAXA		12	12		
BOTTOM TYPE	0				

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4171 4172 4173

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PRAIRIE ISLAND NUCLEAR GENERATING PLANT

Table 2.2-3 (cont)

MACROINVERTEBRATE DENSITY (NUMBER PER SQUARE METER)

PETERSEN DREDGE

WITHIN-SITE REPORT INTAKE MAY

LS	TAXA	X-1	X-3	- X	S.E.	REL ABX
		3	4			
0	NEMATODA (TOTAL)	10.76	0.0	5.38	5.38	0.2
1	NEMATODA (LPIL)	10.76	0.0	5.38	5.38	0.2
0	OLIGOCHAETA (TOTAL)	5080.73	17.94	2549.34	2531.40	90.3
0	TUBIFICIDAE					
1	TUBIFICIDAE (LPIL)	5080.73	17.94	2549.34	2531.40	90.3
0	BIVALVIA (TOTAL)	3.59	0.0	1.79	1.79	0.1
0	SPHAERIIDAE					
2	SPHAERIUM (LPIL)	3.59	0.0	1.79	1.79	0.1
0	EPHEMEROPTERA (TOTAL)	10.76	0.0	5.38	5.38	0.2
0	EPHEMERIDAE					
10	HEXAGENIA LIMBATA	10.76	0.0	5.38	5.38	0.2
0	DIPTERA NEMATOCERA (TOTAL)	520.27	0.0	260.14	260.14	9.2
0	CERATOPOGONIDAE					
2	CERATOPOGONIDAE (LPIL)	17.94	0.0	8.97	8.97	0.3
0	CHIRONOMIDAE					
2	CHIRONOMUS (LPIL)	43.06	0.0	21.53	21.53	0.8
2	CRYPTOCHIRONOMUS (LPIL)	222.46	0.0	111.23	111.23	3.9
2	DICROTENDIPES (LPIL)	3.59	0.0	1.79	1.79	0.1
2	ABLABESMYIA (LPIL)	17.94	0.0	8.97	8.97	0.3
2	PROCLADIUS (LPIL)	136.35	0.0	68.17	68.17	2.4
2	PARACHIRONOMUS (LPIL)	17.94	0.0	8.97	8.97	0.3
2	GLYPTOTENDIPES (LPIL)	[illegible]	0.0	1.79	1.79	0.1
2	COELOTANYPUS (LPIL)	3.59	0.0	1.79	1.79	0.1
2	TANYPUS (LPIL)	17.94	0.0	8.97	8.97	0.3
2	PSECTROCLADIUS (LPIL)	35.88	0.0	17.94	17.94	0.6
TOTAL		5626.11	17.94	2822.03	2804.09	100.0
DIVERSITY (H PRIME)		0.64	0.0	0.32	0.32	
DIVERSITY (J PRIME)		0.20	0.0	0.10	0.10	
NUMBER OF TAXA		15	1	15		
BOTTOM TYPE	0					

ABOVE COMPUTED USING SAMPLE IDS
4181 4182 4183 4191
4192 4193

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NORTHERN STATES POWER COMPANY

PRAIRIE ISLAND NUCLEAR GENERATING PLANT

Table 2.2-3 (cont)

MACROINVERTEBRATE DENSITY (NUMBER PER SQUARE METER)

PETERSEN DREDGE

WITHIN-SITE REPORT

DISCHARGE MAY

LO	TAXA	Y-1	Y-2	X	S.E.	REL ABX
		5	6			
0	CNIDARIA (TOTAL)	14.35	0.0	7.18	7.18	0.2
0	HYDROZOA					
1	HYDRA (LPIL)	14.35	0.0	7.18	7.18	0.2
0	NEMATODA (TOTAL)	17.94	7.18	12.56	5.38	0.3
1	NEMATODA (LPIL)	17.94	7.18	12.56	5.38	0.3
0	ENDOPROCTA	10.76	0.0	5.38	5.38	0.1
0	ENDOPROCTA					
11	URNATELLA GRACILIS	10.76	0.0	5.38	5.38	0.1
0	OLIGOCHAETA (TOTAL)	2680.30	5296.02	3988.16	1307.86	91.1
0	TUBIFICIDAE					
1	TUBIFICIDAE (LPIL)	2680.30	5296.02	3988.16	1307.86	91.1
0	EPHEMEROPTERA (TOTAL)	0.0	17.94	8.97	8.97	0.2
0	EPHEMERIDAE					
10	HEXAGENIA (LPIL)	0.0	17.94	8.97	8.97	0.2
0	DIPTERA NEMATOCERA (TOTAL)	509.51	204.52	357.01	152.49	8.2
0	CERATOPOGONIDAE					
2	CERATOPOGONIDAE (LPIL)	0.0	57.41	28.70	28.70	0.7
0	CHIRONOMIDAE					
2	CHIRONOMUS (LPIL)	21.53	3.59	12.56	8.97	0.3
2	CRYPTOCHIRONOMUS (LPIL)	136.35	78.94	107.64	28.70	2.5
2	POLYPEDILUM (LPIL)	3.59	14.35	8.97	5.38	0.2
2	ABLABESMYIA (LPIL)	3.59	14.35	8.97	5.38	0.2
2	PROCLADIUS (LPIL)	190.17	10.76	100.47	89.70	2.3
2	PARACHIRONOMUS (LPIL)	7.18	0.0	3.59	3.59	0.1
2	PHAENOPSECTRA (LPIL)	28.70	10.76	19.73	8.97	0.5
2	COELOTANYPUS (LPIL)	0.0	14.35	7.18	7.18	0.2
2	PSECTROCLADIUS (LPIL)	7.18	0.0	3.59	3.59	0.1
2	GOELDICHIRONOMUS	7.18	0.0	3.59	3.59	0.1
2	PARATENDIPES (LPIL)	104.05	0.0	52.03	52.03	1.2
TOTAL		3232.87	5525.64	4379.25	1146.39	100.0
DIVERSITY (H PRIME)		1.10	0.39	0.75	0.35	
DIVERSITY (J PRIME)		0.34	0.13	0.23	0.11	
NUMBER OF TAXA		14	11	17		
BOTTOM TYPE	0					

ABOVE COMPUTED USING SAMPLE IDS
4201 4202 4203 4211
4212 4213

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PRAIRIE ISLAND NUCLEAR GENERATING PLANT

MACROINVERTEBRATE DENSITY (NUMBER PER SQUARE METER)

PETERSEN DREDGE

WITHIN-SITE REPORT

Table 2.2-3 (cont)

LS	TAXA	MAY C-1	C-4	X	S.E.	REL ABX
		7	8			
0	OLIGOCHAETA (TOTAL)	39.47	14.35	26.91	12.56	71.4
0	NAIDIDAE					
1	NAIDIDAE (LPIL)	3.59	0.0	1.79	1.79	4.8
0	TUBIFICIDAE					
1	TUBIFICIDAE (LPIL)	35.88	14.35	25.12	10.76	66.7
0	GASTROPODA (TOTAL)	0.0	7.18	3.59	3.59	9.5
0	PLEUROCERIDAE					
1	GONIOBASIS (LPIL)	0.0	3.59	1.79	1.79	4.8
1	GASTROPODA (LPIL)	0.0	3.59	1.79	1.79	4.8
0	DIPTERA NEMATOCERA (TOTAL)	10.76	3.59	7.18	3.59	19.0
0	CHIRONOMIDAE					
2	CHIRONOMUS (LPIL)	3.59	3.59	3.59	0.0	9.5
2	PSECTROCLADIUS (LPIL)	3.59	0.0	1.79	1.79	4.8
3	CHIRONOMIDAE (LPIL)	3.59	0.0	1.79	1.79	4.8
TOTAL		50.23	25.12	37.67	12.56	100.0
DIVERSITY (H PRIME)		0.56	0.42	0.49	0.07	
DIVERSITY (J PRIME)		0.23	0.26	0.25	0.01	
NUMBER OF TAXA		5	4	7		
BOTTOM TYPE	0					

ABOVE COMPUTED USING SAMPLE IDS
4221 4222 4223 4231
4232 4233

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NORTHERN STATES POWER COMPANY

PRAIRIE ISLAND NUCLEAR GENERATING PLANT

MACROINVERTEBRATE DENSITY (NUMBER PER SQUARE METER)

PETERSEN DREDGE

WITHIN-SITE REPORT

Table 2.2-3 (cont)

LS	TAXA	JUNE B-1 1	X	S.E.	REL ABX
0	NEMATODA (TOTAL)	10.76	10.76	-1.00	2.4
1	NEMATODA (LPIL)	10.76	10.76	-1.00	2.4
0	OLIGOCHAETA (TOTAL)	391.10	391.10	-1.00	85.8
0	TUBIFICIDAE				
1	TUBIFICIDAE (LPIL)	391.10	391.10	-1.00	85.8
0	DIPTERA NEMATOCERA (TOTAL)	53.82	53.82	-1.00	11.8
0	CHIRONOMIDAE				
2	CHIRONOMUS (LPIL)	7.18	7.18	-1.00	1.6
2	CRYPTOCHIRONOMUS (LPIL)	10.76	10.76	-1.00	2.4
2	TANYTARSUS (LPIL)	3.59	3.59	-1.00	0.8
2	POLYPEDILUM (LPIL)	3.59	3.59	-1.00	0.8
2	PROCLADIUS (LPIL)	10.76	10.76	-1.00	2.4
2	PARACLADOPELMA (LPIL)	10.76	10.76	-1.00	2.4
2	ENDOCHIRONOMUS (LPIL)	3.59	3.59	-1.00	0.8
3	CHIRONOMIDAE (LPIL)	3.59	3.59	-1.00	0.8
TOTAL		455.69	455.69	-1.00	100.0
DIVERSITY (H PRIME)		0.94	0.94	-1.00	
DIVERSITY (J PRIME)		0.45	0.45	-1.00	
NUMBER OF TAXA		10	10		
BOTTOM TYPE	0				

ABOVE COMPUTED USING SAMPLE IDS
4241 4242 4243

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NORTHERN STATES POWER COMPANY

Table 2.2-3 (cont)

PRAIRIE ISLAND NUCLEAR GENERATING PLANT

MACROINVERTEBRATE DENSITY (NUMBER PER SQUARE METER)

PETERSEN DREDGE

WITHIN-SITE REPORT

JUNE

STURGEON LAKE

LS	TAXA	2	X	S.E.	REL ABX
0	NEMATODA (TOTAL)	28.70	28.70	-1.00	0.5
1	NEMATODA (LPIL)	28.70	28.70	-1.00	0.5
0	OLIGOCHAETA (TOTAL)	4682.45	4682.45	-1.00	77.4
0	TUBIFICIDAE				
1	TUBIFICIDAE (LPIL)	4682.45	4682.45	-1.00	77.4
0	DIPTERA NEMATOCERA (TOTAL)	1331.18	1331.18	-1.00	22.0
0	CERATOPOGONIDAE				
2	CERATOPOGONIDAE (LPIL)	35.88	35.88	-1.00	0.6
0	CHIRONOMIDAE				
2	CHIRONOMUS (LPIL)	448.51	448.51	-1.00	7.4
2	CRYPTOCHIRONOMUS (LPIL)	247.58	247.58	-1.00	4.1
2	ABLABESMYIA (LPIL)	61.00	61.00	-1.00	1.0
2	PROCLADIUS (LPIL)	190.17	190.17	-1.00	3.1
2	TANYPUS (LPIL)	348.04	348.04	-1.00	5.8
0	ECTOPROCTA (TOTAL)	3.59	3.59	-1.00	0.1
0	LOPHOPODIDAE				
8	PECTINATELLA MAGNIFICA	3.59	3.59	-1.00	0.1
TOTAL		6045.92	6045.92	-1.00	100.0
DIVERSITY (H PRIME)		1.36	1.36	-1.00	
DIVERSITY (J PRIME)		0.44	0.44	-1.00	
NUMBER OF TAXA		9	9		
BOTTOM TYPE	0				

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4251 4252 4253

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NORTHERN STATES POWER COMPANY

Table 2.2-3 (cont)

PRAIRIE ISLAND NUCLEAR GENERATING PLANT

MACROINVERTEBRATE DENSITY (NUMBER PER SQUARE METER)

PETERSEN DREDGE

WITHIN-SITE REPORT

INTAKE JUNE

LS	TAXA	X-	X-3	- X	S.E.	PEL ABX
0	NEMATODA (TOTAL)	21.53	7.18	14.35	7.18	0.4
1	NEMATODA (LPIL)	21.53	7.18	14.35	7.18	0.4
0	ENDOPROCTA	7.18	0.0	3.59	3.59	0.1
0	ENDOPROCTA					
11	URNATELLA GRACILIS	7.18	0.0	3.59	3.59	0.1
0	OLIGOCHAETA (TOTAL)	5274.49	17.94	2646.21	2628.27	68.1
0	NAIDIDAE					
1	NAIDIDAE (LPIL)	0.0	3.59	1.79	1.79	0.0
0	TUBIFICIDAE					
1	TUBIFICIDAE (LPIL)	5274.49	14.35	2644.42	2630.07	68.1
0	HIRUDINEA (TOTAL)	3.59	0.0	1.79	1.79	0.0
0	GLOSSIPHONIIDAE					
1	HELOBDELLA STAGNALIS	3.59	0.0	1.79	1.79	0.0
0	BIVALVIA (TOTAL)	17.94	0.0	8.97	8.97	0.2
0	SPHAERIIDAE					
1	SPHAERIUM (LPIL)	17.94	0.0	8.97	8.97	0.2
0	DIPTERA NEMATOCERA (TOTAL)	2292.79	121.99	1207.39	1085.40	31.1
0	CERATOPOGONIDAE					
2	CERATOPOGONIDAE (LPIL)	78.94	0.0	39.47	39.47	1.0
0	CHIRONOMIDAE					
2	CHIRONOMUS (LPIL)	265.52	0.0	132.76	132.76	3.4
2	CRYPTOCHIRONOMUS (LPIL)	261.93	100.47	181.20	80.73	4.7
2	TANYTARSUS (LPIL)	0.0	3.59	1.79	1.79	0.0
2	DICROTENDIPES (LPIL)	0.0	7.18	3.59	3.59	0.1
2	POLYPEDILUM (LPIL)	0.0	3.59	1.79	1.79	0.0
2	PROCLADIUS (LPIL)	1420.88	0.0	710.44	710.44	18.3
2	PARACHIRONOMUS (LPIL)	50.23	0.0	25.12	25.12	0.6
2	GLYPTOTENDIPES (LPIL)	17.94	0.0	8.97	8.97	0.2
2	PHAENOPSECTRA (LPIL)	0.0	3.59	1.79	1.79	0.0
2	TANYPUS (LPIL)	179.40	0.0	89.70	89.70	2.3
3	CHIRONOMIDAE (LPIL)	17.94	3.59	10.76	7.18	0.3
0	ECTOPROCTA (TOTAL)	3.59	0.0	1.79	1.79	0.0
0	PLUMATELLIDAE					
11	PLUMATELLA REPENS	3.59	0.0	1.79	1.79	0.0
TOTAL		7621.09	147.11	3884.10	3736.99	100.0
DIVERSITY (H PRIME)		1.49	1.43	1.46	0.03	
DIVERSITY (J PRIME)		0.44	0.70	0.57	0.13	
NUMBER OF TAXA		14	9	19		
BOTTOM TYPE	0					

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NORTHERN STATES POWER [illegible]PANY

PRAIRIE ISLAND NUCLE[illegible]RATING PLANT

MACROINVERTEBRATE DE[illegible].NUMBER PER SQUARE METER)

PETERSEN DREDGE

WITHIN-STTE REPORT

Table 2.2-3 (cont)

DISCHARGE JUNE

LS	TAXA	Y-1	Y-2	X	S.E.	REL ABX
		5	6			
0	NEMATODA (TOTAL)	7.18	14.35	10.76	3.59	0.1
1	NEMATODA (LPIL)	7.18	14.35	10.76	3.59	0.1
0	ENDOPROCTA	10.76	0.0	5.38	5.38	0.1
0	ENDOPROCTA					
11	URNATELLA GRACILIS	10.76	0.0	5.38	5.38	0.1
0	OLIGOCHAETA (TOTAL)	3365.63	11772.52	7569.07	4203.44	87.7
0	TUBIFICIDAE					
1	TUBIFICIDAE (LPIL)	3365.63	11772.52	7569.07	4203.44	87.7
0	HIRUDINEA (TOTAL)	10.76	0.0	5.38	5.38	0.1
0	GLOSSIPHONIIDAE					
1	PLACOBDELLA (LPIL)	3.[illegible]	0.0	1.79	1.79	0.0
0	ERPOBDELLIDAE					
1	ERPOBDELLA (LPIL)	7.1	0.0	3.59	3.59	0.0
0	EPHEMEROPTERA (TOTAL)		3.59	5.38	1.79	0.1
0	CAENIDAE					
10	CAENIS (LPIL)	[illegible]	0.0	1.79	1.79	0.0
0	EPHEMERIDAE					
10	HEXAGENIA LIMBATA	3.59	0.0	1.79	1.79	0.0
10	HEXAGENIA (LPIL)	0.0	3.59	1.79	1.79	0.0
0	COLEOPTERA POLYPHAGA (TOTAL)	3.59	0.0	1.79	1.79	0.0
0	ELMIDAE					
2	STENELMIS (LPIL)	3.59	0.0	1.79	1.79	0.0
0	TRICHOPTERA (TOTAL)	0.0	3.59	1.79	1.79	0.0
0	POLYCENTROPODIDAE					
2	NEURECLIPSIS (LPIL)	0.0	3.59	1.79	1.79	0.0
0	DIPTERA NEMATOCERA (TOTAL)	1087.19	965.19	1026.19	61.00	11.9
0	CERATOPOGONIDAE					
2	CERATOPOGONIDAE (LPIL)	28.70	39.47	34.09	5.38	0.4
0	CHIRONOMIDAE					
2	CHIRONOMUS (LPIL)	21.53	358.81	190.17	168.64	2.2
2	CRYPTOCHIRONOMUS (LPIL)	121.99	254.75	188.37	66.38	2.2
2	CRICOTOPUS (LPIL)	0.0	3.59	1.79	1.79	0.0
2	TANYTARSUS (LPIL)	0.0	10.76	5.38	5.38	0.1
2	DICROTENDIPES (LPIL)	0.0	3.59	1.79	1.79	0.0
2	POLYPEDILUM (LPIL)	0.0	7.18	3.59	3.59	0.0
2	ABLABESMYIA (LPIL)	7.18	53.82	30.50	23.32	0.4
2	PROCLADIUS (LPIL)	792.97	21.53	407.25	385.72	4.7
2	GLYPTOTENDIPES (LPIL)	3.59	165.05	84.32	80.73	1.0
2	TANYPUS (LPIL)	111.23	0.0	55.62	55.62	0.6
2	PSECTROCLADIUS (LPIL)	0.0	43.06	21.53	21.53	0.2
3	CHIRONOMIDAE (LPIL)	0.0	3.59	1.79	1.79	0.0
0	ECTOPROCTA (TOTAL)	3.59	0.0	1.79	1.79	0.0

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Table 2.2-3 (cont)

PRAIRIE ISLAND NUCLEAR GENERATING PLANT

MACROINVERTEBRATE DENSITY (NUMBER PER SQUARE METER)

PETERSEN DREDGE

WITHIN-SITE REPORT DISCHARGE JUNE

LS	TAXA	Y-1	Y-2	$\bar{X}$	S.E.	REL ABX
		5	6			
0	PLUMATELLIDAE					
11	PLUMATELLA REPENS	3.59	0.0	1.79	1.79	0.0
	TOTAL	4495.87	12759.22	8627.55	4131.68	100.0
	DIVERSITY (H PRIME)	1.26	0.59	0.93	0.33	
	DIVERSITY (J PRIME)	0.39	0.17	0.28	0.11	
	NUMBER OF TAXA	16	16	24		
	BOTTOM TYPE 0					

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4281 4282 4283 4291
4292 4293

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NORTHERN STATES POWER COMPANY

PRAIRIE ISLAND NUCLEAR GENERATING PLANT

MACROINVERTEBRATE DENSITY (NUMBER PER SQUARE METER)

PETERSEN DREDGE

WITHIN-SITE REPORT

Table 2.2-3 (cont)

JUNE

LS	TAXA	C-1	C-4	X	S.E.	REL ABX
		7	8			
0	NEMATODA (TOTAL)	0.0	14.35	7.18	7.18	2.5
1	NEMATODA (LPIL)	0.0	14.35	7.18	7.18	2.5
0	OLIGOCHAETA (TOTAL)	32.29	462.86	247.5	215.29	86.8
0	NAIDIDAE					
1	NAIDIDAE (LPIL)	0.0	7.18	3.59	3.59	1.3
0	TUBIFICIDAE					
1	TUBIFICIDAE (LPIL)	32.29	455.69	243.99	211.70	85.5
0	BIVALVIA (TOTAL)	0.0	3.59	1.79	1.79	0.6
0	SPHAERIIDAE					
1	PISIDIUM (LPIL)	0.0	3.59	1.79	1.79	0.6
0	DIPTERA NEMATOCERA (TOTAL)	21.53	32.29	26.91	5.38	9.4
0	CERATOPOGONIDAE					
2	CERATOPOGONIDAE (LPIL)	3.59	0.0	1.79	1.79	0.6
0	CHIRONOMIDAE					
2	CRYPTOCHIRONOMUS (LPIL)	10.76	25.12	17.94	7.18	6.3
2	CRICOTOPUS (LPIL)	3.59	0.0	1.79	1.79	0.6
2	POLYPEDILUM (LPIL)	3.59	0.0	1.79	1.79	0.6
3	CHIRONOMIDAE (LPIL)	0.0	7.18	3.59	3.59	1.3
0	ECTOPROCTA (TOTAL)	0.0	3.59	1.79	1.79	0.6
0	PLUMATELLIDAE					
11	PLUMATELLA REPENS	0.0	3.59	1.79	1.79	0.6
TOTAL		53.82	516.68	285.25	231.43	100.0
DIVERSITY (H PRIME)		1.09	0.74	0.92	0.17	
DIVERSITY (J PRIME)		0.83	0.39	0.61	0.22	
NUMBER OF TAXA		5	7	10		

BOTTOM TYPE 0

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4301 4302 4303 4311
4312 4313

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NORTHERN STATES POWER COMPANY

PRAIRIE ISLAND NUCLEAR GENERATING PLANT

MACROINVERTEBRATE DENSITY (NUMBER PER SQUARE METER)

PETERSEN DREDGE

WITHIN-SITE REPORT

Table 2.2-3 (cont)

LS	TAXA	JULY B-1 1	X	S.E.	REL AB%
0	NEMATODA (TOTAL)	10.76	10.76	-1.00	2.4
1	NEMATODA (LPIL)	10.76	10.76	-1.00	2.4
0	OLIGOCHAETA (TOTAL)	409.04	409.04	-1.00	92.7
0	TUBIFICIDAE				
1	TUBIFICIDAE (LPIL)	409.04	409.04	-1.00	92.7
0	DIPTERA NEMATOCERA (TOTAL)	21.53	21.53	-1.00	4.9
0	CERATOPOGONIDAE				
2	CERATOPOGONIDAE (LPIL)	3.59	3.59	-1.00	0.8
0	CHIRONOMIDAE				
2	CRYPTOCHIRONOMUS (LPIL)	7.18	7.18	-1.00	1.6
2	POLYPEDILUM (LPIL)	3.59	3.59	-1.00	0.8
2	PARACLADOPELMA (LPIL)	3.59	3.59	-1.00	0.8
2	CHIRONOMIDAE (LPIL)	3.59	3.59	-1.00	0.8
TOTAL		441.33	441.33	-1.00	100.0
DIVERSITY (H PRIME)		0.40	0.40	-1.00	
DIVERSITY (J PRIME)		0.26	0.26	-1.00	
NUMBER OF TAXA		7	7		
BOTTOM TYPE	0				

ABOVE COMPUTED USING SAMPLE IDS
4321 4322 4323

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NORTHERN STATES POWER COMPANY

Table 2.2-3 (cont)

PRAIRIE ISLAND NUCLEAR GENERATING PLANT

MACROINVERTEBRATE DENSITY (NUMBER PER SQUARE METER)

PETERSEN DREDGE

WITHIN-SITE REPORT

INTAKE JULY

LS	TAXA	X-1	X-3	X	S.E.	REL ABX
		3	4			
0	NEMATODA (TOTAL)	14.35	10.76	12.56	1.79	2.1
1	NEMATODA (LPIL)	14.35	10.76	12.56	1.79	2.1
0	ENDOPROCTA	0.0	3.59	1.79	1.79	0.3
0	ENDOPROCTA					
11	URNATELLA GRACILIS	0.0	3.59	1.79	1.79	0.3
0	OLIGOCHAETA (TOTAL)	620.74	14.35	317.55	303.19	54.0
0	TUBIFICIDAE					
1	TUBIFICIDAE (LPIL)	620.74	14.35	317.55	303.19	54.0
0	HIRUDINEA (TOTAL)	3.59	0.0	1.79	1.79	0.3
0	GLOSSIPHONIIDAE					
1	HELOBDELLA STAGNALIS	3.59	0.0	1.79	1.79	0.3
0	BIVALVIA (TOTAL)	7.18	0.0	3.59	3.59	0.6
0	SPHAERIIDAE					
5	SPHAERIIDAE (LPIL)	7.18	0.0	3.59	3.59	0.6
0	EPHEMEROPTERA (TOTAL)	3.59	3.59	3.59	0.0	0.6
0	CAENIDAE					
10	CAENIS (LPIL)	0.0	3.59	1.79	1.79	0.3
0	EPHEMERIDAE					
10	HEXAGENIA LIMBATA	3.59	0.0	1.79	1.79	0.3
0	DIPTERA NEMATOCERA (TOTAL)	193.76	301.40	247.58	53.82	42.1
0	CHAOBORIDAE					
2	CHAOBORUS (LPIL)	3.59	0.0	1.79	1.79	0.3
0	CERATOPOGONIDAE					
2	CERATOPOGONIDAE (LPIL)	3.59	0.0	1.79	1.79	0.3
0	CHIRONOMIDAE					
2	CHIRONOMUS (LPIL)	21.53	0.0	10.76	10.76	1.8
2	CRYPTOCHIRONOMUS (LPIL)	53.82	179.40	116.61	62.79	19.8
2	TANYTARSUS (LPIL)	0.0	39.47	19.73	19.73	3.4
2	DICROTENDIPES (LPIL)	0.0	7.18	3.59	3.59	0.6
2	POLYPEDILUM (LPIL)	0.0	14.35	7.18	7.18	1.2
2	ABLABESMYIA (LPIL)	28.70	0.0	14.35	14.35	2.4
2	PROCLADIUS (LPIL)	78.94	0.0	39.47	39.47	6.7
2	GLYPTOTENDIPES (LPIL)	0.0	35.88	17.94	17.94	3.0
2	COELOTANYPUS (LPIL)	3.59	0.0	1.79	1.79	0.3
2	PSECTROCLADIUS (LPIL)	0.0	7.18	3.59	3.59	0.6
2	PARACLADOPELMA (LPIL)	0.0	7.18	3.59	3.59	0.6
3	CHIRONOMIDAE (LPIL)	0.0	10.76	5.38	5.38	0.9
TOTAL		843.20	333.69	588.45	254.75	100.0
DIVERSITY (H PRIME)		1.57	2.08	1.83	0.25	
DIVERSITY (J PRIME)		0.55	0.71	0.63	0.08	
NUMBER OF TAXA		12	12	21		
BOTTOM TYPE	0					

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NORTHERN STATES POWER COMPANY

PRAIRIE ISLAND NUCLEAR GENERATING PLANT

MACROINVERTEBRATE DENSITY (NUMBER PER SQUARE METER)

PETERSEN DREDGE

WITHIN-SITE REPORT

Table 2.2-3 (cont)

DISCHARGE JULY

LS	TAXA	Y-1	Y-2	X	S.E.	REL ABX
		5	6			
0	NEMATODA (TOTAL)	3.59	21.53	12.56	8.97	0.2
1	NEMATODA (LPIL)	3.59	21.53	12.56	8.97	0.2
0	ENDOPROCTA	3.59	0.0	1.79	1.79	0.0
0	ENDOPROCTA					
11	URNATELLA GRACILIS	3.59	0.0	1.79	1.79	0.0
0	OLIGOCHAETA (TOTAL)	143.52	12353.79	6248.65	6105.13	94.2
0	TUBIFICIDAE					
1	TUBIFICIDAE (LPIL)	143.52	12353.79	6248.65	6105.13	94.2
0	BIVALVIA (TOTAL)	0.0	3.59	1.79	1.79	0.0
0	UNIONIDAE					
5	UNIONIDAE (LPIL)	0.0	3.59	1.79	1.79	0.0
0	EPHEMEROPTERA (TOTAL)	0.0	25.12	12.56	12.56	0.2
0	CAENIDAE					
10	CAENIS (LPIL)	0.0	10.76	5.38	5.38	0.1
0	EPHEMERIDAE					
10	HEXAGENIA LIMBATA	0.0	14.35	7.18	7.18	0.1
0	TRICHOPTERA (TOTAL)	0.0	82.53	41.26	41.26	0.6
0	HYDROPSYCHIDAE					
2	CHEUMATOPSYCHE (LPIL)	0.0	14.35	7.18	7.18	0.1
2	POTAMYIA (LPIL)	0.0	10.76	5.38	5.38	0.1
2	HYDROPSYCHIDAE (LPIL)	0.0	3.59	1.79	1.79	0.0
0	HYDROPTILIDAE					
2	HYDROPTILA (LPIL)	0.0	3.59	1.79	1.79	0.0
0	LEPTOCERIDAE					
2	NECTOPSYCHE (=LEPTOCELLA)(LPIL)	0.0	3.59	1.79	1.79	0.0
0	POLYCENTROPODIDAE					
2	NEURECLIPSIS (LPIL)	0.0	39.47	19.73	19.73	0.3
2	POLYCENTROPODIDAE	0.0	7.18	3.59	3.59	0.1
0	DIPTERA NEMATOCERA (TOTAL)	161.46	466.45	313.96	152.49	4.7
0	CHAOBORIDAE					
2	CHAOBORUS (LPIL)	7.18	0.0	3.59	3.59	0.1
0	CHIRONOMIDAE					
2	CHIRONOMUS (LPIL)	0.0	7.18	3.59	3.59	0.1
2	CRYPTOCHIRONOMUS (LPIL)	32.29	139.94	86.11	53.82	1.3
2	TANYTARSUS (LPIL)	0.0	7.18	3.59	3.59	0.1
2	POLYPEDILUM (LPIL)	0.0	193.76	96.88	96.88	1.5
2	ABLABESMYIA (LPIL)	0.0	39.47	19.73	19.73	0.3
2	PROCLADIUS (LPIL)	107.64	0.0	53.82	53.82	0.8
2	GLYPTOTENDIPES (LPIL)	0.0	53.82	26.91	26.91	0.4
2	TANYPUS (LPIL)	14.35	0.0	7.18	7.18	0.1
2	PSECTROCLADIUS (LPIL)	0.0	17.94	8.97	8.97	0.1
2	PARACLADOPELMA (LPIL)	0.0	3.59	1.79	1.79	0.0

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PRAIRIE ISLAND NUCLEAR GENERATING PLANT

MACROINVERTEBRATE DENSITY (NUMBER PER SQUARE METER)

PETERSEN DREDGE

WITHIN-SITE REPORT

Table 2.2-3 (cont)

DISCHARGE JULY

LS	TAXA	Y-1	Y-2	- X	S.E.	REL ABX
		5	6			
3	CHIRONOMIDAE (LPIL)	0.0	3.59	1.79	1.79	0.0
0	ECTOPROCTA (TOTAL)	0.0	7.18	3.59	3.59	0.1
0	CRISTATELLIDAE					
8	CRISTATELLA MUCEDO	0.0	3.59	1.79	1.79	0.0
11	ECTOPROCTA (LPIL)	0.0	3.59	1.79	1.79	0.0
TOTAL		312.16	12960.14	6636.15	6323.99	100.0
DIVERSITY (H PRIME)		1.42	0.42	0.92	0.50	
DIVERSITY (J PRIME)		0.64	0.11	0.38	0.27	
NUMBER OF TAXA		7	23	27		
BOTTOM TYPE	0					

ABOVE COMPUTED USING SAMPLE IDS
4361 4362 4363 4371
4372 4373

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NORTHERN STATES POWER COMPANY

Table 2.2-3 (cont)

PRAIRIE ISLAND NUCLEAR GENERATING PLANT

MACROINVERTEBRATE DENSITY (NUMBER PER SQUARE METER)

PETERSEN DREDGE

WITHIN-SITE REPORT

JULY

LS	TAXA	C-1	C-4	X	S.E.	REL ABX
		7	8			
0	NEMATODA (TOTAL)	0.0	7.18	3.59	3.59	5.1
1	NEMATODA (LPIL)	0.0	7.18	3.59	3.59	5.1
0	OLIGOCHAETA (TOTAL)	0.0	61.00	30.50	30.50	43.6
0	NAIDIDAE					
1	NAIDIDAE (LPIL)	0.0	7.18	3.59	3.59	5.1
)	TUBIFICIDAE					
-	TUBIFICIDAE (LPIL)	0.0	53.82	26.91	26.91	38.5
0	BIVALVIA (TOTAL)	0.0	10.76	5.38	5.38	7.7
0	SPHAERIIDAE					
1	SPHAERIUM (LPIL)	0.0	7.18	3.59	3.59	5.1
1	PISIDIUM (LPIL)	0.0	3.59	1.79	1.79	2.6
0	DIPTERA NEMATOCERA (TOTAL)	17.94	39.47	28.70	10.76	41.0
0	CHIRONOMIDAE					
2	POLYPEDILUM (LPIL)	10.76	39.47	25.12	14.35	35.9
2	PARATENDIPES "A"	7.18	0.0	3.59	3.59	5.1
0	ECTOPROCTA (TOTAL)	0.0	3.59	1.79	1.79	2.6
0	PLUMATELLIDAE					
11	PLUMATELLA REPENS	0.0	3.59	1.79	1.79	2.6
TOTAL		17.94	121.99	69.97	52.03	100.0
DIVERSITY (H PRIME)		0.33	0.69	0.51	0.18	
DIVERSITY (J PRIME)		0.33	0.25	0.29	0.04	
NUMBER OF TAXA		2	7	8		

BOTTOM TYPE 0

ABOVE COMPUTED USING SAMPLE IDS
4381 4382 4383 4391
4392 4393

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NORTHERN STATES POWER COMPANY

PRAIRIE ISLAND NUCLEAR GENERATING PLANT

MACROINVERTEBRATE DENSITY (NUMBER PER SQUARE METER)

PETERSEN DREDGE

WITHIN-SITE REPORT

Table 2.2-3 (cont)

LS	TAXA	SEPTEMBER B-1 1	X̄	S.E.	REL ABX
0	OLIGOCHAETA (TOTAL)	61.00	61.00	-1.00	77.3
0	TUBIFICIDAE				
1	TUBIFICIDAE (LPIL)	61.00	61.00	-1.00	77.3
0	DIPTERA NEMATOCERA (TOTAL)	17.94	17.94	-1.00	22.7
0	CHIRONOMIDAE				
2	ORTHOCLADIUS (LPIL)	3.59	3.59	-1.00	4.5
2	POLYPEDILUM (LPIL)	10.76	10.76	-1.00	13.6
2	PARACLADOPELMA (LPIL)	3.59	3.59	-1.00	4.5
TOTAL		78.94	78.94	-1.00	100.0
DIVERSITY (H PRIME)		0.85	0.85	-1.00	
DIVERSITY (J PRIME)		0.67	0.67	-1.00	
NUMBER OF TAXA		4	4		
BOTTOM TYPE	0				

ABOVE COMPUTED USING SAMPLE IDS
4401 4402 4403

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NORTHERN STATES POWER COMPANY

PRAIRIE ISLAND NUCLEAR GENERATING PLANT

MACROINVERTEBRATE DENSITY (NUMBER PER SQUARE METER)

PETERSEN DREDGE

WITHIN-SITE REPORT

Table 2.2-3 (cont)

SEPTEMBER

LS	TAXA	STURGEON LAKE 2	X	S.E.	REL ABX
0	NEMATODA (TOTAL)	14.35	14.35	-1.00	0.3
1	NEMATODA (LPIL)	14.35	14.35	-1.00	0.3
0	OLIGOCHAETA (TOTAL)	3555.80	3555.80	-1.00	83.2
0	TUBIFICIDAE				
1	TUBIFICIDAE (LPIL)	3555.80	3555.80	-1.00	83.2
0	BIVALVIA (TOTAL)	32.29	32.29	-1.00	0.8
0	SPHAERIIDAE				
1	SPHAERIUM (LPIL)	25.12	25.12	-1.00	0.6
1	PISIDIUM (LPIL)	7.18	7.18	-1.00	0.2
0	EPHEMEROPTERA (TOTAL)	39.47	39.47	-1.00	0.9
0	EPHEMERIDAE				
10	HEXAGENIA LIMBATA	39.47	39.47	-1.00	0.9
0	DIPTERA NEMATOCERA (TOTAL)	631.50	631.50	-1.00	14.8
0	CHAOBORIDAE				
2	CHAOBORUS (LPIL)	7.18	7.18	-1.00	0.2
0	CERATOPOGONIDAE				
2	CERATOPOGONIDAE (LPIL)	21.53	21.53	-1.00	0.5
0	CHIRONOMIDAE				
2	CHIRONOMUS (LPIL)	243.99	243.99	-1.00	5.7
2	CRYPTOCHIRONOMUS (LPIL)	7.18	7.18	-1.00	0.2
2	DICROTENDIPES (LPIL)	3.59	3.59	-1.00	0.1
2	ABLABESMYIA (LPIL)	14.35	14.35	-1.00	0.3
2	PROCLADIUS (LPIL)	28.70	28.70	-1.00	0.7
2	PARACHIRONOMUS (LPIL)	3.59	3.59	-1.00	0.1
2	COELOTANYPUS (LPIL)	247.58	247.58	-1.00	5.8
2	TANYPUS (LPIL)	7.18	7.18	-1.00	0.2
2	GOELDICHIRONOMUS	43.06	43.06	-1.00	1.0
3	CHIRONOMIDAE (LPIL)	3.59	3.59	-1.00	0.1
TOTAL		4273.41	4273.41	-1.00	100.0
DIVERSITY (H PRIME)		1.05	1.05	-1.00	
DIVERSITY (J PRIME)		0.31	0.31	-1.00	
NUMBER OF TAXA		17	17		
BOTTOM TYPE	0				

ABOVE COMPUTED USING SAMPLE IDS
4411 4412 4413

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NORTHERN STATES POWER COMPANY

Table 2.2-3 (cont)

PRAIRIE ISLAND NUCLEAR GENERATING PLANT

MACROINVERTEBRATE DENSITY (NUMBER PER SQUARE METER)

PETERSEN DREDGE

WITHIN-SITE REPORT

INTAKE SEPTEMBER

LS	TAXA	X-1	X-3	X	S.E.	REL AB%
		3	4			
0	NEMATODA (TOTAL)	28.70	10.76	19.73	8.97	2.2
1	NEMATODA (LPIL)	28.70	10.76	19.73	8.97	2.2
0	ENDOPROCTA	3.59	3.59	3.59	0.0	0.4
0	ENDOPROCTA					
11	URNATELLA GRACILIS	3.59	3.59	3.59	0.0	0.4
0	OLIGOCHAETA (TOTAL)	1008.25	21.53	514.89	493.36	56.2
0	NAIDIDAE					
1	NAIDIDAE (LPIL)	25.12	0.0	12.56	12.56	1.4
0	TUBIFICIDAE					
1	TUBIFICIDAE (LPIL)	983.14	21.53	502.33	480.80	54.8
0	GASTROPODA (TOTAL)	0.0	3.59	1.79	1.79	0.2
1	GASTROPODA (LPIL)	0.0	3.59	1.79	1.79	0.2
0	BIVALVIA (TOTAL)	25.12	0.0	12.56	12.56	1.4
0	SPHAERIIDAE					
1	SPHAERIUM (LPIL)	21.53	0.0	10.76	10.76	1.2
1	PISIDIUM (LPIL)	3.59	0.0	1.79	1.79	0.2
0	EPHEMEROPTERA (TOTAL)	53.82	0.0	26.91	26.91	2.9
0	EPHEMERIDAE					
10	HEXAGENIA (LPIL)	53.82	0.0	26.91	26.91	2.9
0	TRICHOPTERA (TOTAL)	3.59	0.0	1.79	1.79	0.2
0	LEPTOCERIDAE					
2	OECETIS (LPIL)	3.59	0.0	1.79	1.79	0.2
0	DIPTERA NEMATOCERA (TOTAL)	620.74	43.06	331.90	288.84	36.2
0	CHAOBORIDAE					
2	CHAOBORUS (LPIL)	21.53	0.0	10.76	10.76	1.2
0	CERATOPOGONIDAE					
2	CERATOPOGONIDAE (LPIL)	28.70	3.59	16.15	12.56	1.8
0	CHIRONOMIDAE					
2	CHIRONOMUS (LPIL)	132.76	0.0	66.38	66.38	7.2
2	CRYPTOCHIRONOMUS (LPIL)	17.94	14.35	16.15	1.79	1.8
2	TANYTARSUS (LPIL)	0.0	14.35	7.18	7.18	0.8
2	POLYPEDILUM (LPIL)	0.0	3.59	1.79	1.79	0.2
2	ABLABESMYIA (LPIL)	89.70	0.0	44.85	44.85	4.9
2	PROCLADIUS (LPIL)	21.53	0.0	10.76	10.76	1.2
2	GLYPTOTENDIPES (LPIL)	0.0	7.18	3.59	3.59	0.4
2	COELOTANYPUS (LPIL)	236.81	0.0	118.41	118.41	12.9
2	TANYPUS (LPIL)	53.82	0.0	26.91	26.91	2.9
2	[illegible]OELDICHIRONOMUS	10.76	0.0	5.38	5.38	0.6
2	PARACLADOPELMA (LPIL)	3.59	0.0	1.79	1.79	0.2
2	EPICOCLADIUS	3.59	0.0	1.79	1.79	0.2
0	ECTOPROCTA (TOTAL)	3.59	3.59	3.59	0.0	0.4
0	PLUMATELLIDAE					

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NORTHERN STATES POWER COMPANY

Table 2.2-3 (cont)

PRAIRIE ISLAND NUCLEAR GENERATING PLANT

MACROINVERTEBRATE DENSITY (NUMBER PER SQUARE METER)

PETERSEN DREDGE

WITHIN-SITE REPORT

INTAKE SEPTEMBER

LS	TAXA	X-1	X-3	- X	S.E.	REL AB%
		3	4			
8	PLUMATELLA REPENS	0.0	3.59	1.79	1.79	0.2
0	CRISTATELLIDAE					
8	CRISTATELLA MUCEDO	3.59	0.0	1.79	1.79	0.2
TOTAL		1747.40	86.11	916.76	830.64	100.0
DIVERSITY (H PRIME)		2.10	1.80	1.95	0.15	
DIVERSITY (J PRIME)		0.58	0.91	0.74	0.17	
NUMBER OF TAXA		20	10	25		
BOTTOM TYPE	0					

ABOVE COMPUTED USING SAMPLE IDS

4421 4422 4423 4431
4432 4433

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NORTHERN STATES POWER COMPANY

Table 2.2-3 (cont)

PRAIRIE ISLAND NUCLEAR GENERATING PLANT

MACROINVERTEBRATE DENSITY (NUMBER PER SQUARE METER)

PETERSEN DREDGE

WITHIN-SITE REPORT

DISCHARGE SEPTEMBER

LS	TAXA	Y-1	Y-2	X	S.E.	REL AB%
		5	6			
0	NEMATODA (TOTAL)	10.76	21.53	16.15	5.38	0.7
1	NEMATODA (LPIL)	3.59	21.53	12.56	8.97	0.6
2	NEMATODA (LPIL)	7.18	0.0	3.59	3.59	0.2
0	ENDOPROCTA	7.18	7.18	7.18	0.0	0.3
0	ENDOPROCTA					
11	URNATELLA GRACILIS	7.18	7.18	7.18	0.0	0.3
0	OLIGOCHAETA (TOTAL)	362.40	3878.72	2120.56	1758.16	95.2
0	NAIDIDAE					
1	NAIDIDAE (LPIL)	3.59	0.0	1.79	1.79	0.1
0	TUBIFICIDAE					
1	TUBIFICIDAE (LPIL)	358.81	3878.72	2118.77	1759.96	95.2
0	EPHEMEROPTERA (TOTAL)	3.59	0.0	1.79	1.79	0.1
0	CAENIDAE					
10	CAENIS (LPIL)	3.59	0.0	1.79	1.79	0.1
0	DIPTERA NEMATOCERA (TOTAL)	111.23	46.65	78.94	32.29	3.5
0	CERATOPOGONIDAE					
2	CERATOPOGONIDAE (LPIL)	14.35	0.0	7.18	7.18	0.3
0	CHIRONOMIDAE					
2	CHIRONOMUS (LPIL)	21.53	17.94	19.73	1.79	0.9
2	CRYPTOCHIRONOMUS (LPIL)	7.18	10.76	8.97	1.79	0.4
2	TANYTARSUS (LPIL)	0.0	3.59	1.79	1.79	0.1
2	DICROTENDIPES (LPIL)	3.59	0.0	1.79	1.79	0.1
2	PROCLADIUS (LPIL)	53.82	3.59	28.70	25.12	1.3
2	GLYPTOTENDIPES (LPIL)	7.18	0.0	3.59	3.59	0.2
2	PARACLADOPELMA (LPIL)	0.0	7.18	3.59	3.59	0.2
3	CHIRONOMIDAE (LPIL)	3.59	0.0	1.79	1.79	0.1
0	SIMULIIDAE					
2	SIMULIUM (LPIL)	0.0	3.59	1.79	1.79	0.1
0	ECTOPROCTA (TOTAL)	3.59	0.0	1.79	1.79	0.1
0	CRISTATELLIDAE					
8	CRISTATELLA MUCEDO	3.59	0.0	1.79	1.79	0.1
TOTAL		498.74	3954.07	2226.41	1727.66	100.0
DIVERSITY (H PRIME)		1.87	0.19	1.03	0.84	
DIVERSITY (J PRIME)		0.73	0.08	0.40	0.32	
NUMBER OF TAXA		13	9	16		
BOTTOM TYPE	0					

ABOVE COMPUTED USING SAMPLE IDS
4441 4442 4443 4451
4452 4453

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NORTHERN STATES POWER COMPANY

PRAIRIE ISLAND NUCLEAR GENERATING PLANT

MACROINVERTEBRATE DENSITY (NUMBER PER SQUARE METER)

PETERSEN DREDGE

WITHIN-SITE REPORT

Table 2.2-3 (cont)

SEPTEMBER

LS	TAXA	C-1	C-4	X	S.E.	REL ABX
		7	8			
0	NEMATODA (TOTAL)	0.0	132.76	66.38	66.38	28
1	NEMATODA (LPIL)	0.0	132.76	66.38	66.38	28.2
0	OLIGOCHAETA (TOTAL)	0.0	193.76	96.88	96.88	41.2
0	TUBIFICIDAE					
1	TUBIFICIDAE (LPIL)	0.0	193.76	96.88	96.88	41.2
0	BIVALVIA (TOTAL)	0.0	39.47	19.73	19.73	8.4
0	SPHAERIIDAE					
1	SPHAERIUM (LPIL)	0.0	39.47	19.73	19.73	8.4
0	DIPTERA NEMATOCERA (TOTAL)	10.76	93.29	52.03	41.26	22.1
0	CERATOPOGONIDAE					
2	CERATOPOGONIDAE (LPIL)	0.0	21.53	10.76	10.76	4.6
0	CHIRONOMIDAE					
2	CRYPTOCHIRONOMUS (LPIL)	3.59	0.0	1.79	1.79	0.8
2	DICROTENDIPES (LPIL)	3.59	0.0	1.79	1.79	0.8
2	POLYPEDILUM (LPIL)	3.59	64.59	34.09	30.50	14.5
2	PSECTROCLADIUS (LPIL)	0.0	3.59	1.79	1.79	0.8
3	CHIRONOMIDAE (LPIL)	0.0	3.59	1.79	1.79	0.8
TOTAL		10.76	450.27	235.02	224.26	100.0
DIVERSITY (H PRIME)		0.33	1.59	0.96	0.63	
DIVERSITY (J PRIME)		0.33	0.71	0.52	0.19	
NUMBER OF TAXA		3	7	9		
BOTTOM TYPE	0					

ABOVE COMPUTED USING SAMPLE IDS
4461 4462 4463 4471
4472 4473

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NORTHERN STATES POWER COMPANY

PRAIRIE ISLAND NUCLEAR GENERATING PLANT

MACROINVERTEBRATE DENSITY (NUMBER PER SQUARE METER)

PETERSEN DREDGE

WITHIN-SITE REPORT

Table 2.2-3 (cont)

OCTOBER

LS	TAXA	B-1 1	X	S.E.	REL ABX
0	NEMATODA (TOTAL)	89.70	89.70	-1.00	15.7
1	NEMATODA (LPIL)	89.70	89.70	-1.00	15.7
0	OLIGOCHAETA (TOTAL)	215.29	215.29	-1.00	37.7
0	NAIDIDAE				
1	NAIDIDAE (LPIL)	21.53	21.53	-1.00	3.8
0	TUDIFICIDAE				
1	TUBIFICIDAE (LPIL)	193.76	193.76	-1.00	34.0
0	COLLEMBOLA (TOTAL)	7.18	7.18	-1.00	1.3
1	COLLEMBOLA (LPIL)	7.18	7.18	-1.00	1.3
0	EPHEMEROPTERA (TOTAL)	3.59	3.59	-1.00	0.6
0	CAENIDAE				
10	CAENIS (LPIL)	3.59	3.59	-1.00	0.6
0	COLEOPTERA POLYPHAGA (TOTAL)	3.59	3.59	-1.00	0.6
0	HYDROPHILIDAE				
1	HYDROPHILIDAE (LPIL)	3.59	3.59	-1.00	0.6
0	TRICHOPTERA (TOTAL)	7.18	7.18	-1.00	1.3
0	HYDROPSYCHIDAE				
2	HYDROPSYCHIDAE (LPIL)	3.59	3.59	-1.00	0.6
0	POLYCENTROPODIDAE				
2	NEURECLIPSIS (LPIL)	3.59	3.59	-1.00	0.6
0	DIPTERA NEMATOCERA (TOTAL)	243.99	243.99	-1.00	42.8
0	CERATOPOGONIDAE				
2	CERATOPOGONIDAE (LPIL)	10.76	10.76	-1.00	1.9
0	CHIRONOMIDAE				
2	CRYPTOCHIRONOMUS (LPIL)	71.76	71.76	-1.00	12.6
2	POLYPEDILUM (LPIL)	125.58	125.58	-1.00	22.0
2	PROCLADIUS (LPIL)	14.35	14.35	-1.00	2.5
2	PSECTROCLADIUS (LPIL)	3.59	3.59	-1.00	0.6
3	CHIRONOMIDAE (LPIL)	14.35	14.35	-1.00	2.5
2	CHIRONOMIDAE (LPIL)	3.59	3.59	-1.00	0.6
TOTAL		570.51	570.51	-1.00	100.0
DIVERSITY (H PRIME)		2.45	2.45	-1.00	
DIVERSITY (J PRIME)		0.79	0.79	-1.00	
NUMBER OF TAXA		14	14		
BOTTOM TYPE	0				

ABOVE COMPUTED USING SAMPLE IDS
4481 4482 4483

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PRAIRIE ISL LEAR GENERATING PLANT

MACROINVERTEB DENSITY (NUMBER PER SQUARE METER)

PETERSEN DREDG

WITHIN-SITE REP

Table 2.2-3 (cont)

OCTOBER

LS	TAXA	STURGEON LAKE 2	X	S.E.	REL ABX
0	NEMATODA (TOTAL)	104.05	104.05	-1.00	1.2
1	NEMATODA (LPIL)	104.05	104.05	-1.00	1.2
0	OLIGOCHAETA (TOTAL)	6541.08	6541.08	-1.00	77.2
0	TUBIFICIDAE				
1	TUBIFICIDAE (LPIL)	6541.08	6541.08	-1.00	77.2
0	BIVALVIA (TOTAL)	28.70	28.70	-1.00	0.3
0	SPHAERIIDAE				
1	SPHAERIUM (LPIL)	28.70	28.70	-1.00	0.3
0	EPHEMEROPTERA (TOTAL)	32.29	32.29	-1.00	0.4
0	EPHEMERIDAE				
10	HEXAGENIA LIMBATA	21.53	21.53	-1.00	0.3
10	HEXAGENIA (LPIL)	10.76	10.76	-1.00	0.1
0	COLEOPTERA POLYPHAGA (TOTAL)	3.59	3.59	-1.00	0.0
0	HYDROPHILIDAE				
2	HYDROPHILIDAE (LPIL)	3.59	3.59	-1.00	0.0
0	DIPTERA NEMATOCERA (TOTAL)	1761.75	1761.75	-1.00	20.8
0	CHAOBORIDAE				
2	CHAOBORUS (LPIL)	25.12	25.12	-1.00	0.3
0	CERATOPOGONIDAE				
2	CERATOPOGONIDAE (LPIL)	32.29	32.29	-1.00	0.4
0	CHIRONOMIDAE				
2	CHIRONOMUS (LPIL)	491.57	491.57	-1.00	5.8
2	CRYPTOCHIRONOMUS (LPIL)	46.65	46.65	-1.00	0.6
2	ABLABESMYIA (LPIL)	175.82	175.82	-1.00	2.1
2	PROCLADIUS (LPIL)	566.92	566.92	-1.00	6.7
2	COELOTANYPUS (LPIL)	423.39	423.39	-1.00	5.0
0	ECTOPROCTA (TOTAL)	3.59	3.59	-1.00	0.0
0	CRISTATELLIDAE				
8	CRISTATELLA MUCEDO	3.59	3.59	-1.00	0.0
TOTAL		8475.04	8475.04	-1.00	100.0
DIVERSITY (H PRIME)		1.35	1.35	-1.00	
DIVERSITY (J PRIME)		0.38	0.38	-1.00	
NUMBER OF TAXA		14	14		
BOTTOM TYPE	0				

ABOVE COMPUTED USING SAMPLE IDS
4491 4492 4493

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NORTHERN STATES POWER COMPANY

Table 2.2-3 (cont)

PRAIRIE ISLAND NUCLEAR GENERATING PLANT

MACROINVERTEBRATE DENSITY (NUMBER PER SQUARE METER)

PETERSEN DREDGE

WITHIN-SITE REPORT

LS	TAXA	INTAKE OCTOBER X-1	X-3		- X	S.E.	REL ABX
		3	4				
0	NEMATODA (TOTAL)	68.17	3.59		35.88	32.29	1.6
1	NEMATODA (LPIL)	68.17	3.59		35.88	32.29	1.6
0	ENDOPROCTA	0.0	10.76		5.38	5.38	0.2
0	ENDOPROCTA						
11	URNATELLA GRACILIS	0.0	10.76		5.38	5.38	0.2
0	OLIGOCHAETA (TOTAL)	2454.25	86.11		1270.18	1184.07	58.3
0	TUBIFICIDAE						
1	TUBIFICIDAE (LPIL)	2454.25	86.11		1270.18	1184.07	58.3
0	GASTROPODA (TOTAL)	0.0	14.35		7.18	7.18	0.3
0	PHYSIDAE						
1	PHYSA (LPIL)	0.0	14.35		7.18	7.18	0.3
0	BIVALVIA (TOTAL)	35.88	0.0		17.94	17.94	0.8
0	SPHAERIIDAE						
1	SPHAERIUM (LPIL)	21.53	0.0		10.76	10.76	0.5
0	UNIONIDAE						
5	UNIONIDAE (LPIL)	14.35	0.0		7.18	7.18	0.3
0	EPHEMEROPTERA (TOTAL)	53.82	0.0		26.91	26.91	1.2
0	CAENIDAE						
10	CAENIS (LPIL)	3.59	0.0		1.79	1.79	0.1
0	EPHEMERIDAE						
10	HEXAGENIA LIMBATA	35.88	0.0		17.94	17.94	0.8
10	HEXAGENIA (LPIL)	14.35	0.0		7.18	7.18	0.3
0	COLEOPTERA POLYPHAGA (TOTAL)	3.59	0.0		1.79	1.79	0.1
0	ELMIDAE						
2	DUBIRAPHIA (LPIL)	3.59	0.0		1.79	1.79	0.1
0	TRICHOPTERA (TOTAL)	7.18	0.0		3.59	3.59	0.2
0	HYDROPSYCHIDAE						
2	HYDROPSYCHIDAE (LPIL)	3.59	0.0		1.79	1.79	0.1
0	LEPTOCERIDAE						
2	OECETIS (LPIL)	3.59	0.0		1.79	1.79	0.1
0	DIPTERA NEMATOCERA (TOTAL)	1607.46	7.18		807.32	800.14	37.1
0	CERATOPOGONIDAE						
2	CERATOPOGONIDAE (LPIL)	25.12	0.0		12.56	12.56	0.6
0	CHIRONOMIDAE						
2	CHIRONOMUS (LPIL)	136.35	0.0		68.17	68.17	3.1
2	CRYPTOCHIRONOMUS (LPIL)	276.28	0.0		138.14	138.14	6.3
2	TANYTARSUS (LPIL)	3.59	0.0		1.79	1.79	0.1
2	DICROTENDIPES (LPIL)	3.59	0.0		1.79	1.79	0.1
2	POLYPEDILUM (LPIL)	7.18	0.0		3.59	3.59	0.2
2	ABLABESMYIA (LPIL)	71.76	0.0		35.88	35.88	1.6
2	PROCLADIUS (LPIL)	861.14	0.0		430.57	430.57	19.8
2	PARACHIRONOMUS (LPIL)	17.94	0.0		8.97	8.97	0.4

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Table 2.2-3 (cont)

PRAIRIE ISLAND NUCLEAR GENERATING PLANT

MACROINVERTEBRATE DENSITY (NUMBER PER SQUARE METER)

PETERSEN DREDGE

WITHIN-SITE REPORT

INTAKE OCTOBER

LS	TAXA	X-1	X-3	$\bar{X}$	S.E.	REL ABX
		3	4			
2	GLYPTOTENDIPES (LPIL)	0.0	3.59	1.79	1.79	0.1
2	COELOTANYPUS (LPIL)	200.93	0.0	100.47	100.47	4.6
2	PARACLADOPELMA (LPIL)	3.59	0.0	1.79	1.79	0.1
3	CHIRONOMIDAE (LPIL)	0.0	3.59	1.79	1.79	0.1
0	ECTOPROCTA (TOTAL)	3.59	0.0	1.79	1.79	0.1
0	CRISTATELLIDAE					
8	CRISTATELLA MUCEDO	3.59	0.0	1.79	1.79	0.1
TOTAL		4233.93	121.99	2177.96	2055.97	100.0
DIVERSITY (H PRIME)		2.01	1.17	1.59	0.42	
DIVERSITY (J PRIME)		0.53	0.68	0.61	0.07	
NUMBER OF TAXA		22	6	26		
BOTTOM TYPE	0					

ABOVE COMPUTED USING SAMPLE IDS
4501 4502 4503 4511
4512 4513

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PRAIRIE ISLAND NUCLEAR GENERATING PLANT

MACROINVERTEBRATE DENSITY (NUMBER PER SQUARE METER)

PETERSEN DREDGE

WITHIN-SITE REPORT

Table 2.2-3 (cont)

DISCHARGE OCTOBER

LS	TAXA	Y-1	Y-2	X	S.E.	REL ABX
		5	6			
0	NEMATODA (TOTAL)	64.59	28.70	46.65	17.94	1.5
1	NEMATODA (LPIL)	64.59	28.70	46.65	17.94	1.5
0	ENDOPROCTA	10.76	0.0	5.38	5.38	0.2
0	ENDOPROCTA					
11	URNATELLA GRACILIS	10.76	0.0	5.38	5.38	0.2
0	OLIGOCHAETA (TOTAL)	3035.52	1941.16	2488.34	547.18	82.4
0	TUBIFICIDAE					
1	TUBIFICIDAE (LPIL)	3035.52	1941.16	2488.34	547.18	82.4
0	BIVALVIA (TOTAL)	3.59	7.18	5.38	1.79	0.2
0	SPHAERIIDAE					
1	SPHAERIUM (LPIL)	0.0	7.18	3.59	3.59	0.1
0	UNIONIDAE					
5	UNIONIDAE (LPIL)	3.59	0.0	1.79	1.79	0.1
0	AMPHIPODA (TOTAL)	0.0	3.59	1.79	1.79	0.1
0	HYALELLIDAE					
1	HYALELLA AZTECA	0.0	3.59	1.79	1.79	0.1
0	EPHEMEROPTERA (TOTAL)	3.59	3.59	3.59	0.0	0.1
0	CAENIDAE					
10	CAENIS (LPIL)	3.59	3.59	3.59	0.0	0.1
0	TRICHOPTERA (TOTAL)	7.18	10.76	8.97	1.79	0.3
0	HYDROPSYCHIDAE					
2	HYDROPSYCHIDAE (LPIL)	0.0	3.59	1.79	1.79	0.1
0	HYDROPTILIDAE					
2	HYDROPTILA (LPIL)	0.0	3.59	1.79	1.79	0.1
0	LEPTOCERIDAE					
2	OECETIS (LPIL)	7.18	0.0	3.59	3.59	0.1
0	POLYCENTROPODIDAE					
2	NEURECLIPSIS (LPIL)	0.0	3.59	1.79	1.79	0.1
0	DIPTERA NEMATOCERA (TOTAL)	602.80	301.40	452.10	150.70	15.0
0	CHAOBORIDAE					
2	CHAOBORUS (LPIL)	3.59	0.0	1.79	1.79	0.1
0	CERATOPOGONIDAE					
2	CERATOPOGONIDAE (LPIL)	32.29	0.0	16.15	16.15	0.5
0	CHIRONOMIDAE					
2	CHIRONOMUS (LPIL)	172.23	25.12	98.67	73.56	3.3
2	CRYPTOCHIRONOMUS (LPIL)	301.40	215.29	258.34	43.06	8.6
2	CRICOTOPUS (LPIL)	0.0	14.35	7.18	7.18	0.2
2	TANYTARSUS (LPIL)	3.59	0.0	1.79	1.79	0.1
2	POLYPEDILUM (LPIL)	0.0	3.59	1.79	1.79	0.1
2	ABLABESMYIA (LPIL)	10.76	7.18	8.97	1.79	0.3
2	PROCLADIUS (LPIL)	28.70	17.94	23.32	5.38	0.8
2	GLYPTOTENDIPES (LPIL)	39.47	0.0	19.73	19.73	0.7

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Table 2.2-3 (cont)

PRAIRIE ISLAND NUCLEAR GENERATING PLANT

MACROINVERTEBRATE DENSITY (NUMBER PER SQUARE METER)

PETERSEN DREDGE

WITHIN-SITE REPORT

DISCHARGE OCTOBER

LS	TAXA	Y-1	Y-2	X	S.E.	REL ABX
		5	6			
2	COELOTANYPUS (LPIL)	7.18	3.59	5.38	1.79	0.2
2	PSECTROCLADIUS (LPIL)	3.59	3.59	3.59	0.0	0.1
2	PARACLADOPELMA (LPIL)	0.0	10.76	5.38	5.38	0.2
0	ECTOPROCTA (TOTAL)	0.0	17.94	8.97	8.97	0.3
0	CRISTATELLIDAE					
8	CRISTATELLA MUCEDO	0.0	17.94	8.97	8.97	0.3
TOTAL		3728.02	2314.32	3021.17	706.85	100.0
DIVERSITY (H PRIME)		1.11	1.26	1.18	0.08	
DIVERSITY (J PRIME)		0.33	0.43	0.38	0.05	
NUMBER OF TAXA		16	18	25		
BOTTOM TYPE	0					

ABOVE COMPUTED USING SAMPLE IDS
4521 4522 4523 4531
4532 4533

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NORTHERN STATES POWER COMPANY

Table 2.2-3 (cont)

PRAIRIE ISLAND NUCLEAR GENERATING PLANT

MACROINVERTEBRATE DENSITY (NUMBER PER SQUARE METER)

PETERSEN DREDGE

WITHIN-SITE REPORT

OCTOBER

LS	TAXA	C-1	C-4	X	S.E.	REL ABX
		7	8			
0	NEMATODA (TOTAL)	21.53	355.22	188.37	166.85	23.0
1	NEMATODA (LPIL)	21.53	355.22	188.37	166.85	23.0
0	OLIGOCHAETA (TOTAL)	7.18	294.22	150.70	143.52	18.4
0	NAIDIDAE					
1	NAIDIDAE (LPIL)	0.0	3.59	1.79	1.79	0.2
0	TUBIFICIDAE					
1	TUBIFICIDAE (LPIL)	7.18	290.64	148.91	141.73	18.2
0	BIVALVIA (TOTAL)	0.0	25.12	12.56	12.56	1.5
0	SPHAERIIDAE					
1	SPHAERIUM (LPIL)	0.0	25.12	12.56	12.56	1.5
1	COLEOPTERA POLYPHAGA (TOTAL)	0.0	3.59	1.79	1.79	0.2
0	HYDROPHILIDAE					
1	HYDROPHILIDAE (LPIL)	0.0	3.59	1.79	1.79	0.2
0	TRICHOPTERA (TOTAL)	50.23	107.64	78.94	28.70	9.6
0	HYDROPSYCHIDAE					
2	HYDROPSYCHE ORRIS	3.59	0.0	1.79	1.79	0.2
2	POTAMYIA (LPIL)	3.59	7.18	5.38	1.79	0.7
2	HYDROPSYCHIDAE (LPIL)	35.88	100.47	68.17	32.29	8.3
0	LIMNEPHILIDAE					
2	LIMNEPHILIDAE (LPIL)	3.59	0.0	1.79	1.79	0.2
0	LEPTOCERIDAE					
2	LEPTOCERIDAE (LPIL)	3.59	0.0	1.79	1.79	0.2
0	DIPTERA NEMATOCERA (TOTAL)	229.64	538.21	383.93	154.29	46.9
0	CHAOBORIDAE					
2	CHAOBORUS (LPIL)	10.76	0.0	5.38	5.38	0.7
0	CERATOPOGONIDAE					
2	CERATOPOGONIDAE (LPIL)	14.35	53.82	34.09	19.73	4.2
0	CHIRONOMIDAE					
2	CHIRONOMUS (LPIL)	7.18	3.59	5.38	1.79	0.7
2	CRYPTOCHIRONOMUS (LPIL)	3.59	14.35	8.97	5.38	1.1
2	TANYTARSUS (LPIL)	0.0	3.59	1.79	1.79	0.2
2	POLYPEDILUM (LPIL)	78.94	294.22	186.58	107.64	22.8
2	PROCLADIUS (LPIL)	3.59	0.0	1.79	1.79	0.2
2	CORYNONEURA (LPIL)	43.06	0.0	21.53	21.53	2.6
2	GLYPTOTENDIPES (LPIL)	0.0	14.35	7.18	7.18	0.9
2	COELOTANYPUS (LPIL)	0.0	3.59	1.79	1.79	0.2
2	PSECTROCLADIUS (LPIL)	21.53	100.47	61.00	39.47	7.5
2	PARACLADOPELMA (LPIL)	46.65	32.29	39.47	7.18	4.8
3	CHIRONOMIDAE (LPIL)	0.0	17.94	8.97	8.97	1.1
0	ECTOPROCTA (TOTAL)	0.0	3.59	1.79	1.79	0.2
0	PLUMATELLIDAE					
11	PLUMATELLA REPENS	0.0	3.59	1.79	1.79	0.2

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Table 2.2-3 (cont)

PRAIRIE ISLAND NUCLEAR GENERATING PLANT

MACROINVERTEBRATE DENSITY (NUMBER PER SQUARE METER)

PETERSEN DREDGE

WITHIN-SITE REPORT

OCTOBER

LS	TAXA	C-1	C-4	$\bar{X}$	S.E.	REL AB%
		7	8			
	TOTAL	308.57	1327.59	818.08	509.51	100.0
	DIVERSITY (H PRIME)	2.67	2.64	2.66	0.02	
	DIVERSITY (J PRIME)	0.88	0.72	0.80	0.08	
	NUMBER OF TAXA	16	18	24		
	BOTTOM TYPE 0					

ABOVE COMPUTED USING SAMPLE IDS
4541 4542 4543 4551
4552 4553

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Table 2.2-3 (cont)

PRAIRIE ISLAND NUCLEAR GENERATING PLANT

MACROINVERTEBRATE DENSITY (NUMBER PER SQUARE METER)

PETERSEN DREDGE

WITHIN-SITE REPORT

NOVEMBER

LS	TAXA	B-1 1	X	S.E.	REL ABX
0	NEMATODA (TOTAL)	32.29	32.29	-1.00	1.7
1	NEMATODA (LPIL)	32.29	32.29	-1.00	1.7
0	OLIGOCHAETA (TOTAL)	466.45	466.45	-1.00	24.3
0	NAIDIDAE				
1	NAIDIDAE (LPIL)	10.76	10.76	-1.00	0.6
0	TUBIFICIDAE				
1	TUBIFICIDAE (LPIL)	455.69	455.69	-1.00	23.7
0	EPHEMEROPTERA (TOTAL)	78.94	78.94	-1.00	4.1
0	EPHEMERIDAE				
10	HEXAGENIA LIMBATA	21.53	21.53	-1.00	1.1
10	HEXAGENIA (LPIL)	57.41	57.41	-1.00	3.0
0	DIPTERA NEMATOCERA (TOTAL)	1345.53	1345.53	-1.00	70.0
0	CHAOBORIDAE				
2	CHAOBORUS (LPIL)	3.59	3.59	-1.00	0.2
0	CERATOPOGONIDAE				
2	CERATOPOGONIDAE (LPIL)	17.94	17.94	-1.00	0.9
0	CHIRONOMIDAE				
2	CHIRONOMUS (LPIL)	337.28	337.28	-1.00	17.5
2	ORTHOCLADIUS (LPIL)	3.59	3.59	-1.00	0.2
2	CRYPTOCHIRONOMUS (LPIL)	175.82	175.82	-1.00	9.1
2	CRICOTOPUS (LPIL)	3.59	3.59	-1.00	0.2
2	POLYPEDILUM (LPIL)	57.41	57.41	-1.00	3.0
2	ABLABESMYIA (LPIL)	46.65	46.65	-1.00	2.4
2	PROCLADIUS (LPIL)	660.21	660.21	-1.00	34.3
2	GLYPTOTENDIPES (LPIL)	7.18	7.18	-1.00	0.4
2	PSECTROCLADIUS (LPIL)	10.76	10.76	-1.00	0.6
2	POTTHASTIA	3.59	3.59	-1.00	0.2
2	EPIOCOCLADIUS	3.59	3.59	-1.00	0.2
2	PARALAUTERBORNIELLA	14.35	14.35	-1.00	0.7
TOTAL		1923.21	1923.21	-1.00	100.0
DIVERSITY (H PRIME)		2.48	2.48	-1.00	
DIVERSITY (J PRIME)		0.71	0.71	-1.00	
NUMBER OF TAXA		19	19		
BOTTOM TYPE	0				

ABOVE COMPUTED USING SAMPLE IDS
4561 4562 4563

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PRAIRIE ISLAND NUCLEAR GENERATING PLANT

MACROINVERTEBRATE DENSITY (NUMBER PER SQUARE METER)

PETERSEN DREDGE

WITHIN-SITE REPORT

Table 2.2-3 (cont)

NOVEMBER

LS	TAXA	STURGEON LAKE 2	X	S.E.	REL ABX
0	NEMATODA (TOTAL)	111.23	111.23	-1.00	3.1
1	NEMATODA (LPIL)	111.23	111.23	-1.00	3.1
0	OLIGOCHAETA (TOTAL)	2167.21	2167.21	-1.00	61.3
0	TUBIFICIDAE				
1	TUBIFICIDAE (LPIL)	2167.21	2167.21	-1.00	61.3
0	HIRUDINEA (TOTAL)	10.76	10.76	-1.00	0.3
0	GLOSSIPHONIIDAE				
1	HELOBDELLA STAGNALIS	10.76	10.76	-1.00	0.3
0	EPHEMEROPTERA (TOTAL)	50.23	50.23	-1.00	1.4
0	EPHEMERIDAE				
10	HEXAGENIA LIMBATA	32.29	32.29	1.00	0.9
10	HEXAGENIA (LPIL)	17.94	17.94	1.00	0.5
0	DIPTERA NEMATOCERA (TOTAL)	1194.83	1194.83	-1.00	33.8
0	CHAOBORIDAE				
2	CHAOBORUS (LPIL)	53.82	53.82	-1.00	1.5
0	CERATOPOGONIDAE				
2	CERATOPOGONIDAE (LPIL)	25.12	25.12	-1.00	0.7
0	CHIRONOMIDAE				
2	CHIRONOMUS (LPIL)	369.57	369.57	-1.00	10.4
2	CRYPTOCHIRONOMUS (LPIL)	10.76	10.76	-1.00	0.3
2	ABLABESMYIA (LPIL)	111.23	111.23	-1.00	3.1
2	PROCLADIUS (LPIL)	409.04	409.04	-1.00	11.6
2	COELOTANYPUS (LPIL)	215.29	215.29	-1.00	6.1
0	ECTOPROCTA (TOTAL)	3.59	3.59	-1.00	0.1
3	CRISTATELLIDAE				
8	CRISTATELLA MUCEDO	3.59	3.59	-1.00	0.1
TOTAL		3537.85	3537.85	-1.00	100.0
DIVERSITY (H PRIME)		1.94	1.94	-1.00	
DIVERSITY (J PRIME)		0.57	0.57	-1.00	
NUMBER OF TAXA		13	13		
BOTTOM TYPE	0				

ABOVE COMPUTED USING SAMPLE IDS
4571 4572 4573

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NORTHERN STATES POWER COMPANY

Table 2.2-3 (cont)

PRAIRIE ISLAND NUCLEAR GENERATING PLANT

MACROINVERTEBRATE DENSITY (NUMBER PER SQUARE METER)

PETERSEN DREDGE

WITHIN-SITE REPORT INTAKE NOVEMBER

LS	TAXA	X-1	X-3	X	S.E.	REL ABX
		3	4			
0	NEMATODA (TOTAL)	46.65	10.76	28.70	17.94	2.8
1	NEMATODA (LPIL)	46.65	10.76	28.70	17.94	2.8
0	OLIGOCHAETA (TOTAL)	1349.12	89.70	719.41	629.71	70.5
0	TUBIFICIDAE					
1	TUBIFICIDAE (LPIL)	1349.12	89.70	719.41	629.71	70.5
0	GASTROPODA (TOTAL)	3.59	0.0	1.79	1.79	0.2
0	HYDROBIIDAE (=AMNICOLIDAE)					
1	AMNICOLA (LPIL)	3.59	0.0	1.79	1.79	0.2
0	BIVALVIA (TOTAL)	14.35	7.18	10.76	3.59	1.1
0	SPHAERIIDAE					
1	SPHAERIUM (LPIL)	3.59	0.0	1.79	1.79	0.2
1	PISIDIUM (LPIL)	10.76	0.0	5.38	5.38	0.5
0	UNIONIDAE					
1	UNIONIDAE (LPIL)	0.0	7.18	3.59	3.59	0.4
0	EPHEMEROPTERA (TOTAL)	25.12	0.0	12.56	12.56	1.2
0	CAENIDAE					
10	CAENIS (LPIL)	3.59	0.0	1.79	1.79	0.2
0	EPHEMERIDAE					
10	HEXAGENIA LIMBATA	7.18	0.0	3.59	3.59	0.4
10	HEXAGENIA (LPIL)	14.35	0.0	7.18	7.18	0.7
0	TRICHOPTERA (TOTAL)	3.59	0.0	1.79	1.79	0.2
0	LEPTOCERIDAE					
2	OECETIS (LPIL)	3.59	0.0	1.79	1.79	0.2
0	DIPTERA NEMATOCERA (TOTAL)	487.98	3.59	245.78	242.20	24.1
0	CERATOPOGONIDAE					
2	CERATOPOGONIDAE (LPIL)	3.59	0.0	1.79	1.79	0.2
0	CHIRONOMIDAE					
2	CHIRONOMUS (LPIL)	78.94	0.0	39.47	39.47	3.9
2	ORTHOCLADIUS (LPIL)	3.59	0.0	1.79	1.79	0.2
2	CRYPTOCHIRONOMUS (LPIL)	190.17	0.0	95.08	95.08	9.3
2	TANYTARSUS (LPIL)	0.0	3.59	1.79	1.79	0.2
2	ABLABESMYIA (LPIL)	3.59	0.0	1.79	1.79	0.2
2	PROCLADIUS (LPIL)	179.40	0.0	89.70	89.70	8.8
2	GLYPTOTENDIPES (LPIL)	17.94	0.0	8.97	3.97	0.9
2	COELOTANYPUS (LPIL)	3.59	0.0	1.79	1.79	0.2
2	PARACLADOPELMA (LPIL)	7.18	0.0	3.59	3.59	0.4
TOTAL		1930.39	111.23	1020.81	909.58	100.0
DIVERSITY (H PRIME)		1.53	0.82	1.20	0.38	
DIVERSITY (J PRIME)		0.67	0.43	0.55	0.02	
NUMBER OF TAXA		13	4	20		
BOTTOM TYPE	0					

NORTHERN STATES POWER COMPANY

PRAIRIE ISLAND NUCLEAR GENERATING PLANT

MACROINVERTEBRATE DENSITY (NUMBER PER SQUARE METER)

PETERSEN DREDGE

WITHIN-SITE REPORT

Table 2.2-3 (cont)

DISCHARGE NOVEMBER

LS	TAXA	Y-1	Y-2	X	S.E.	REL ABX
		5	6			
0	NEMATODA (TOTAL)	7.18	21.53	14.35	7.18	0.4
1	NEMATODA (LPIL)	7.18	21.53	14.35	7.18	0.4
0	ENDOPROCTA	10.76	0.0	5.38	5.38	0.1
0	ENDOPROCTA					
11	URNATELLA GRACILIS	10.76	0.0	5.38	5.38	0.1
0	OLIGOCHAETA (TOTAL)	1542.88	5274.49	3408.68	1865.81	89.5
0	TUBIFICIDAE					
1	BRANCHIURA SOWERBYI	3.59	0.0	1.79	1.79	0.0
1	TUBIFICIDAE (LPIL)	1539.29	5274.49	3406.89	1867.60	89.4
0	BIVALVIA (TOTAL)	0.0	14.35	7.18	7.18	0.2
0	UNIONIDAE					
5	UNIONIDAE (LPIL)	0.0	14.35	7.18	7.18	0.2
0	EPHEMEROPTERA (TOTAL)	7.18	14.35	10.76	3.59	0.3
0	EPHEMERIDAE					
10	HEXAGENIA LIMBATA	0.0	10.76	5.38	5.38	0.1
10	HEXAGENIA (LPIL)	7.18	3.59	5.38	1.79	0.1
0	TRICHOPTERA (TOTAL)	3.59	0.0	1.79	1.79	0.0
0	HYDROPSYCHIDAE					
2	HYDROPSYCHIDAE (LPIL)	3.59	0.0	1.79	1.79	0.0
0	DIPTERA NEMATOCERA (TOTAL)	333.69	383.93	358.81	25.12	9.4
0	CERATOPOGONIDAE					
2	CERATOPOGONIDAE (LPIL)	10.76	3.59	7.18	3.59	0.2
0	CHIRONOMIDAE					
2	CHIRONOMUS (LPIL)	111.23	96.88	104.05	7.18	2.7
2	CRYPTOCHIRONOMUS (LPIL)	139.94	251.17	195.55	55.62	5.1
2	ABLABESMYIA (LPIL)	0.0	3.59	1.79	1.79	0.0
2	PROCLADIUS (LPIL)	7.18	21.53	14.35	7.18	0.4
2	GLYPTOTENDIPES (LPIL)	64.59	0.0	32.29	32.29	0.8
2	PARACLADOPELMA (LPIL)	0.0	3.59	1.79	1.79	0.0
2	EPICOCLADIUS	0.0	3.59	1.79	1.79	0.0
0	ECTOPROCTA (TOTAL)	0.0	3.59	1.79	1.79	0.0
0	CRISTATELLIDAE					
8	CRISTATELLA MUCEDO	0.0	3.59	1.79	1.79	0.0
TOTAL		1905.27	5712.23	3808.75	1903.48	100.0
DIVERSITY (H PRIME)		1.09	0.69	0.89	0.20	
DIVERSITY (J PRIME)		0.37	0.23	0.30	0.07	
NUMBER OF TAXA		11	13	17		
BOTTOM TYPE	0					

ABOVE COMPUTED USING SAMPLE IDS
4601 4602 4603 4611
4612 4613

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NORTHERN STATES POWER COMPANY

PRAIRIE ISLAND NUCLEAR GENERATING PLANT

MACROINVERTEBRATE DENSITY (NUMBER PER SQUARE METER)

PETERSEN DREDGE

WITHIN-SITE REPORT

Table 2.2-3 (cont)

NOVEMBER

LS	TAXA	C-1	C-4	X	S.E.	REL ABX
		7	8			
0	NEMATODA (TOTAL)	17.94	17.94	17.94	0.0	3.2
1	NEMATODA (LPIL)	17.94	17.94	17.94	0.0	3.2
0	OLIGOCHAETA (TOTAL)	25.12	523.86	274.49	249.37	49.5
0	NAIDIDAE					
1	NAIDIDAE (LPIL)	3.59	0.0	1.79	1.79	0.3
0	TUBIFICIDAE					
1	TUBIFICIDAE (LPIL)	21.53	523.86	272.69	251.17	49.2
0	BIVALVIA (TOTAL)	3.59	10.76	7.18	3.59	1.3
0	SPHAERIIDAE					
1	SPHAERIUM (LPIL)	3.59	3.59	3.59	0.0	0.6
1	PISIDIUM (LPIL)	0.0	3.59	1.79	1.79	0.3
0	UNIONIDAE					
1	UNIONIDAE (LPIL)	0.0	3.59	1.79	1.79	0.3
0	EPHEMEROPTERA (TOTAL)	3.59	3.59	3.59	0.0	0.6
0	EPHEMERIDAE					
10	HEXAGENIA (LPIL)	3.59	3.59	3.59	0.0	0.6
0	PLECOPTERA (TOTAL)	0.0	3.59	1.79	1.79	0.3
0	ISOPERLIDAE					
10	ISOPERLA (LPIL)	0.0	3.59	1.79	1.79	0.3
0	TRICHOPTERA (TOTAL)	7.18	0.0	3.59	3.59	0.6
0	HYDROPSYCHIDAE					
2	HYDROPSYCHIDAE (LPIL)	7.18	0.0	3.59	3.59	0.6
0	DIPTERA NEMATOCERA (TOTAL)	254.75	229.64	242.20	12.56	43.7
0	CERATOPOGONIDAE					
2	CERATOPOGONIDAE (LPIL)	25.12	25.12	25.12	0.0	4.5
0	CHIRONOMIDAE					
2	CHIRONOMUS (LPIL)	50.23	0.0	25.12	25.12	4.5
2	ORTHOCLADIUS (LPIL)	17.94	3.59	10.76	7.18	1.9
2	CRYPTOCHIRONOMUS (LPIL)	39.47	46.65	43.06	3.59	7.8
2	POLYPEDILUM (LPIL)	39.47	125.53	82.53	43.06	14.9
2	ABLABESMYIA (LPIL)	3.59	0.0	1.79	1.79	0.3
2	PROCLADIUS (LPIL)	43.06	14.35	28.70	14.35	5.2
2	CORYNONEURA (LPIL)	3.59	7.18	5.38	1.79	1.0
2	GLYPTOTENDIPES (LPIL)	0.0	7.18	3.59	3.59	0.6
2	EUKIEFFERIELLA (LPIL)	7.18	0.0	3.59	3.59	0.6
2	PARACLADOPELMA (LPIL)	10.76	0.0	5.38	5.38	1.0
2	MONODIAMESA (LPIL)	3.59	0.0	1.79	1.79	0.3
2	SAETHERIA (LPIL)	10.76	0.0	5.38	5.38	1.0
0	ECTOPROCTA (TOTAL)	3.59	3.59	3.59	0.0	0.6
0	PLUMATELLIDAE					
11	PLUMATELLA REPENS	0.0	3.59	1.79	1.79	0.3
0	CRISTATELLIDAE					

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Table 2.2-3 (cont)

PRAIRIE ISLAND NUCLEAR GENERATING PLANT

MACROINVERTEBRATE DENSITY (NUMBER PER SQUARE METER)

PETERSEN DREDGE

WITHIN-SITE REPORT

NOVEMBER

LS	TAXA	C-1	C-4	$\bar{X}$	S.E.	REL ABX
		7	8			
8	CRISTATELLA MUCEDO	3.59	0.0	1.79	1.79	0.3
TOTAL		315.75	792.97	554.36	238.61	100.0
DIVERSITY (H PRIME)		3.08	1.78	2.43	0.65	
DIVERSITY (J PRIME)		0.90	0.67	0.78	0.12	
NUMBER OF TAXA		19	15	24		
BOTTOM TYPE	0					

ABOVE COMPUTED USING SAMPLE IDS
4621 4622 4623 4631
4632 4633

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TABLE 2.2-4. SUMMARY STATISTICAL INFORMATION FOR PETERSON DREDGE SAMPLES COLLECTED DURING 1978 NEAR RED WING, MINNESOTA

STATIONS	MONTHS	UNTRANSFORMED				TRANSFORMED				
3-6	2-11		X-1	X-3	Y-1	Y-2		X-1	X-3	Y-1	Y-2
		X-1	-	*	0	0	X-1	-	*	0	0
		X-3		-	*	*	X-3		-	*	*
		Y-1			-	0	Y-1			-	0
		Y-2				-	Y-2				-
GROUP SIMILARITIES:		X-3 X-1 Y-1 Y-2					X-3 X-1 Y-1 Y-2				

STATIONS	MONTHS																
1-8	3-6,9-11		B-1	SL	X-1	X-3	Y-1	Y-2	C-1	C-4		B-1	SL	X-1	X-3	Y-1	Y-2	C-1	C-4
		B-1	-	0	0	0	0	0	0	0	B-1	-	0	0	*	0	0	*	0
		SL		-	0	*	0	0	0	0	SL		-	0	*	0	0	*	*
		X-1			-	*	0	0	0	0	X-1			-	*	0	0	*	*
		X-3				-	0	*	0	0	X-3				-	*	*	0	*
		Y-1					-	0	0	0	Y-1					-	0	*	0
		Y-2						-	*	*	Y-2						-	*	*
		C-1							-	0	C-1							-	0
		C-4								-	C-4								-
GROUP SIMILARITIES:		X-3 C-1 C-4 B-1 Y-1 X-1 SL Y-2									X-3 C-1 C-4 B-1 Y-1 X-1 SL Y-2								

STATIONS	MONTHS																
1,3-8	3-11		B-1	X-1	X-3	Y-1	Y-2	C-1	C-4		B-1	X-1	X-3	Y-1	Y-2	C-1	C-4
		B-1	-	0	0	0	*	0	0	B-1	-	0	*	0	*	*	0
		X-1		-	0	0	*	0	0	X-1		-	*	0	0	*	*
		X-3			-	0	*	0	0	X-3			-	*	*	0	*
		Y-1				-	*	0	0	Y-1				-	0	*	0
		Y-2					-	*	*	Y-2					-	*	*
		C-1						-	0	C-1						-	*
		C-4							-	C-4							-
GROUP SIMILARITIES:		X-3 C-1 C-4 B-1 Y-1 X-1 Y-2								X-3 C-1 C-4 B-1 Y-1 X-1 Y-2							

* = Significant at the $\alpha = 0.05$ level

0 = No significant difference

TABLE 2.2-5. OCCURRENCE OF BENTHIC MACROINVERTEBRATE TAXA COLLECTED BY ARTIFICIAL SUBSTRATE SAMPLER FROM THE MISSISSIPPI RIVER NEAR RED WING, MINNESOTA DURING 1978

LIFE STAGE (LS) LISTINGS USED FOR BENTHOS TABLES:

01 - Adult	05 - Immature
02 - Larvae	06 - Juvenile
03 - Pupae	10 - Nymph
04 - Egg	11 - Colony
	12 - Undetermined

NORTHERN STATES POWER COMPANY

PRAIRIE ISLAND NUCLEAR GENERATING PLANT

MACROINVERTEBRATE OCCURRENCE REPORT

HESTER DENDY MULTIPLATE SAMPLER

TABLE 2.2-5 (cont)

SITE LOCATION CODES: 1=B-1; 2=SL; 3=X-1,X-2,X-3; 4=Y-1,Y-2

LS	TAXA	JAN 1234	FEB 1234	APR 1234	MAY 1234	JUL 1234	AUG 1234	SEP 1234	NOV 1234	DEC 1234
0	CNIDARIA (TOTAL)									
6	HYDROZOA									
1	HYDRA (LPIL)	4			1234		34	3	34	34
2	HYDRA (LPIL)				4					
11	CORDYLOPHORA LACUSTRIS					1	34	23	3	
1	HYDROZOA (LPIL)				3					
0	PLATYHELMINTHES(TOTAL)									
1	TURBELLARIA (LPIL)	34	3	3	4		1 3	34	34	34
0	NEMERTINA (TOTAL)									
1	NEMERTINA (LPIL)	34	34	34	34				34	34
0	NEMATODA (TOTAL)									
1	NEMATODA (LPIL)	34	34	34	1234	1234	34	234	1234	234
0	ENDOPROCTA									
0	ENDOPROCTA									
11	URNATELLA GRACILIS				3	34	34	34	34	34
0	OLIGOCHAETA (TOTAL)									
0	NAIDIDAE									
1	NAIDIDAE (LPIL)	34	34	234	1234	1234	234	234	1234	234
0	TUBIFICIDAE									
1	TUBIFICIDAE (LPIL)	34		2	34	1			4	34
0	LUMBRICULIDAE									
1	LUMBRICULIDAE (LPIL)					1				
0	HIRUDINEA (TOTAL)									
0	GLOSSIPHONIIDAE									
1	PLACOBDELLA (LPIL)								4	
0	ERPOBDELLIDAE									
1	ERPOBDELLA (LPIL)					4				
6	HIRUDINEA (LPIL)				3					
0	GASTROPODA (TOTAL)									
0	PHYSIDAE									
1	PHYSA (LPIL)	3	34	34	1 34	3			4	34
0	PLANORBIDAE									
1	GYRAULUS (LPIL)				4					
1	GASTROPODA (LPIL)		4		34					3
0	BIVALVIA (TOTAL)									
0	SPHAERIIDAE									
1	PISIDIUM (			2						
0	ARACHNIDA (TOTA.									
0	PROSTIGMATA									
1	HYDRACARINA (LPIL)				4	1234	1234	34	234	3
0	ISOPODA (TOTAL)									
0	ASELLIDAE									
1	ASELLUS (LPIL)				1 4	1 3		4		
1	ASELLIDAE (LPIL)					1				

NORTHERN STATES POWER COMPANY

PRAIRIE ISLAND NUCLEAR GENERATING PLANT

MACROINVERTEBRATE OCCURRENCE REPORT

HESTER DENDY MULTIPLATE SAMPLER

SITE LOCATION CODES: 1=B-1; 2=SL; 3=X-1,X-2,X-3; 4=Y-1,Y-2

TABLE 2.2-5 (cont)

LS	TAXA	JAN 1234	FEB 1234	APR 1234	MAY 1234	JUL 1234	AUG 1234	SEP 1234	NOV 1234	DEC 1234
0	AMPHIPODA (TOTAL)									
0	GAMMARIDAE (TOTAL)									
1	GAMMARUS (LPIL)					2				
0	CRANGONYCIDAE									
1	CRANGONYX GRACILIS				4					
0	HYALELLIDAE									
1	HYALELLA AZTECA	4			3	1234				3
6	AMPHIPODA (LPIL)				2					
6	EPHEMEROPTERA (TOTAL)									
0	SIPHLONURIDAE									
10	ISONYCHIA (LPIL)					12 4	1 4	234	1	
10	SIPHLONURIDAE (LPIL)					3				
0	BAETIDAE									
10	CENTROPTILUM (LPIL)				4					
10	BAETIS (LPIL)				234	123	1234	234	4	
10	PSEUDOCLEON (LPIL)				1234	4				
2	PSEUDOCLEON (LPIL)				3					
10	CLOEON (LPIL)				4					
10	BAETIDAE (LPIL)				12	234	3			
0	HEPTAGENIIDAE									
10	STENONEMA (LPIL)				1234	1234	1234	234	1234	34
1	STENONEMA (LPIL)				2					
10	HEPTAGENIIDAE (LPIL)				12 4					
0	LEPTOPHLEBIIDAE									
10	LEPTOPHLEBIA (LPIL)			4						
0	EPHEMERELLIDAE									
10	EPHEMERELLA (LPIL)				1					
0	TRICORYTHIDAE									
10	TRICORYTHODES (LPIL)					1234			4	
0	CAENIDAE									
10	CAENIS (LPIL)				1 34	1234	123	34	34	3
10	CAENIDAE (LPIL)					2				
0	POTAMANTHIDAE									
10	POTAMANTHUS (LPIL)								4	
0	EPHEMERIDAE									
10	HEXAGENIA (LPIL)								4	
10	EPHEMEROPTERA (LPIL)				1 34	12 4	4	2	4	
6	EPHEMEROPTERA (LPIL)				23					
0	ODONATA (TOTAL)									
0	COENAGRIONIDAE									
10	ENALLAGMA (LPIL)					34				
0	PLECOPTERA (TOTAL)									

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TABLE 2.2-5 (cont)

PRAIRIE ISLAND NUCLEAR GENERATING PLANT

MACROINVERTEBRATE OCCURRENCE REPORT

HESTER DENDY MULTIPLATE SAMPLER

SITE LOCATION CODES: 1=B-1; 2=SL; 3=X-1,X-2,X-3; 4=Y-1,Y-2

LS	TAXA	JAN 1234	FEB 1234	APR 1234	MAY 1234	JUL 1234	AUG 1234	SEP 1234	NOV 1234	DEC 1234
0	TAENIOPTERYGIDAE									
10	TAENIOPTERYX (LPIL)									3
10	STROPHOPTERYX (LPIL)		34							
0	PERLIDAE									
10	PERLESTA (LPIL)					2				
10	PERLIDAE (LPIL)					1				
0	ISOPERLIDAE									
10	ISOPERLA (LPIL)				3				34	4
2	ISOPERLA (LPIL)					1				
10	PLECOPTERA (LPIL)								23	
0	COLEOPTERA POLYPHAGA (TOTAL)									
0	ELMIDAE									
1	STENELMIS (LPIL)				4	2				
2	DUBIRAPHIA (LPIL)							4		
1	ELMIDAE (LPIL)									3
0	TRICHOPTERA (TOTAL)									
0	HYDROPSYCHIDAE									
2	HYDROPSYCHE ORRIS				12	1234	1234	234	1234	234
2	HYDROPSYCHE (LPIL)				12	1234	1234	234	1234	3
3	HYDROPSYCHE (LPIL)					1	1234	234	3	
2	CHEUMATOPSYCHE (LPIL)				1 4	1234	1234	234	1234	34
3	CHEUMATOPSYCHE (LPIL)					1	1234	34	3	
2	POTAMYIA (LPIL)					12 4	234	234	1234	234
2	HYDROPSYCHIDAE (LPIL)					1234	1234	234	1234	234
3	HYDROPSYCHIDAE (LPIL)					3				
0	HYDROPTILIDAE									
2	HYDROPTILA (LPIL)								1234	34
2	AGRAYLEA (LPIL)					12	3		1234	
10	AGRAYLEA (LPIL)						1			
2	ORTHOTRICHIA (LPIL)				34			4		4
2	HYDROPTILIDAE (LPIL)					2	3			
3	HYDROPTILIDAE (LPIL)					2	3			
0	LEPTOCERIDAE									
3	NECTOPSYCHE (=LEPTOCELLA)(LPIL)						1			
2	NECTOPSYCHE (=LEPTOCELLA)(LPIL)							3	3	
2	CERACLEA (=ATHRIPSODES)(LPIL)				234					
2	LEPTOCERIDAE (LPIL)					3				
0	BRACHYCENTRIDAE									
2	BRACHYCENTRUS (LPIL)					1				
0	POLYCENTROPODIDAE									
2	CYRNELLUS (LPIL)				34	34	34	34	1 34	
2	NEURECLIPSIS (LPIL)				23	1234	234	234	1234	34

NORTHERN STATES POWER COMPANY

TABLE 2.2-5 (cont)

PRAIRIE ISLAND NUCLEAR GENERATING PLANT

MACROINVERTEBRATE OCCURRENCE REPORT

HESTER DENDY MULTIPLATE SAMPLER

SITE LOCATION CODES: 1=B-1; 2=SL; 3=X-1,X-2,X-3; 4=Y-1,Y-2

LS	TAXA	JAN	FEB	APR	MAY	JUL	AUG	SEP	NOV	DEC
		1234	1234	1234	1234	1234	1234	1234	1234	1234
3	NEURECLIPSIS (LPIL)				3		234			
2	POLYCENTROPUS (LPIL)				2					
2	POLYCENTROPODIDAE				34	34	1 3	234	4	
3	TRICHOPTERA (LPIL)				1234	1234	1 34	234	3	
2	TRICHOPTERA (LPIL)					1 34	2	4	1	
0	DIPTERA NEMATOCERA (TOTAL)									
0	TIPULIDAE									
3	TIPULIDAE (LPIL)					4				
0	CHAOBORIDAE									
2	CHAOBORUS (LPIL)									4
0	CERATOPOGONIDAE									
2	CERATOPOGONIDAE (LPIL)				34	3			4	
0	CHIRONOMIDAE									
2	CHIRONOMUS (LPIL)				34				4	
2	ORTHOCLADIUS (LPIL)				1234	234				
2	CRYPTOCHIRONOMUS (LPIL)				1					
2	CRICOTOPUS (LPIL)	234	34	234	1234	1234	1 3	4	123	234
2	TANYTARSUS (LPIL)		34	234	1234	1234	1234	234	1234	34
2	DICROTENDIPES (LPIL)				1234	1234	34	34	1234	
2	POLYPEDILUM (LPIL)				1234	1234	1234	234	1234	34
2	ABLABESMYIA (LPIL)		4	4	1234	1234	1234	234	1234	4
2	MICROTENDIPES (LPIL)				1					
2	PROCLADIUS (LPIL)	4			4	3			4	
2	CORYNONEURA (LPIL)			2 4	3	3	4			
2	PARACHIRONOMUS (LPIL)			34	1234	1234				
2	GLYPTOTENDIPES (LPIL)	34	3	4	1234	1234	1234	234	1234	34
2	EUKIEFFERIELLA (LPIL)				123	12 4				
2	THIENEMANNIELLA			2 4	1234	1234	1234	3	1234	34
2	STENOCHIRONOMUS (LPIL)						4			
2	TANYPUS (LPIL)						3			
2	TRISSOCLADIUS (LPIL)		4		3					4
2	PSECTROCLADIUS (LPIL)			23	1234	1234	1234	234	1234	34
2	GOELDICHIRONOMUS					34				
2	MICROPSECTRA (LPIL)				3					
2	ENDOCHIRONOMUS (LPIL)			4	23					
2	NILOTANYPUS (LPIL)				234	2	2			
2	BRILLIA (LPIL)				3					
2	TRICHOCLADIUS									4
2	KIEFFERULUS					1				
3	CHIRONOMIDAE (LPIL)	4	4	3	1234	1234	1234	234	1 34	3
2	CHIRONOMIDAE (LPIL)		2	2	4	4		4	1	
0	SIMULIIDAE									

NORTHERN STATES POWER COMPANY

TABLE 2.2-5 (cont)

PRAIRIE ISLAND NUCLEAR GENERATING PLANT

MACROINVERTEBRATE OCCURRENCE REPORT

HESTER DENDY MULTIPLATE SAMPLER

SITE LOCATION CODES: 1=B-1; 2=SL; 3=X-1,X-2,X-3; 4=Y-1,Y-2

LS	TAXA	JAN 1234	FEB 1234	APR 1234	MAY 1234	JUL 1234	AUG 1234	SEP 1234	NOV 1234	DEC 1234
3	SIMULIUM (LPIL)					12 4				
2	SIMULIUM (LPIL)					1234				
2	SIMULIIDAE (LPIL)		4		1234					
3	SIMULIIDAE (LPIL)				1234					
0	DIPTERA BRACHYCERA (TOTAL)									
0	STRATIOMYIDAE									
2	KEMOLETUS					1				
0	RHAGIONIDAE									
2	ATHERIX					1				
0	EMPIDIDAE									
2	EMPIDIDAE (LPIL)					1	1234	234	123	
3	EMPIDIDAE (LPIL)						12 4	3		
0	ECTOPROCTA (TOTAL)									
0	LOPHOPODIDAE									
8	PECTINATELLA MAGNIFICA				34	1			3	
0	PLUMATELLIDAE									
11	PLUMATELLA REPENS			34	34	1 34	234	34	1234	34
0	PALUDICELLIDAE									
11	PALUDICELLA ARTICULATA					1				
0	CRISTATELLIDAE									
8	CRISTATELLA MUCEDO							4	234	34

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TABLE 2.2-6. SUMMARY OF BENTHIC DATA COLLECTED BY ARTIFICIAL SUBSTRATE SAMPLER

		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC
Station B-1													
Density	(No./m^2)	NS	NS	NS	NS	Φ20,086.08	NS	16,426.24	19,246.47	NS	NS	15,080.71	NS
Diversity (H')	(H')	NS	NS	NS	NS	2.31	NS	3.36	2.87	NS	NS	2.87	NS
Diversity (J')	(J')	NS	NS	NS	NS	.52	NS	.71	.74	NS	NS	.72	NS
No. Taxa	(N)	NS	NS	NS	NS	32	NS	45	23	NS	NS	25	NS
Station SL (Sturgeon Lake)													
Density	(No./m^2)	2.69	2.69	NS	*380.34	18,503.74	NS	18,420.39	15,306.75	17,298.15	NS	13,530.65	34.98
Diversity (E')	(H')	0.00	0.00	NS	1.87	2.33	NS	2.83	3.34	2.65	NS	3.31	1.24
Diversity (J')	(J')	0.00	0.00	NS	.79	.54	NS	.60	.81	.67	NS	.81	.72
No. Taxa	(N)	1	1	NS	9	32	NS	38	23	22	NS	24	6
Station X-1 (Intake)													
Density	(No./m^2)	0.00	5.38	NS	NS	34,106.50	NS	18,638.30	13,745.93	23,164.66	NS	12,432.70	131.86
Diversity (H')	(H')	0.00	0.00	NS	NS	1.82	NS	2.45	3.29	2.93	NS	3.46	2.68
Diversity (J')	(J')	0.00	0.00	NS	NS	.41	NS	.58	.79	.67	NS	.83	.91
No. Taxa	(N)	0	2	NS	NS	35	NS	29	26	28	NS	27	18
Station X-2 (Intake)													
Density	(No./m^2)	17,952.09	1410.12	NS	933.80	75,968.62	NS	27,147.45	35,877.25	53,035.51	NS	32,142.06	12,976.29
Diversity (H')	(H')	.22	1.27	NS	.97	.33	NS	.76	2.84	.93	NS	1.97	.81
Diversity (J')	(J')	.09	.66	NS	.47	.08	NS	.20	.65	.25	NS	.48	.20
No. Taxa	(N)	9	6	NS	9	24	NS	21	31	20	NS	26	25
Station X-3 (Recirc. Canal)													
Density	(No./m^2)	2642.62	6036.05	NS	2088.27	108,920.56	NS	29,041.94	67,351.81	27,631.84	NS	60,581.18	10,707.73
Diversity (H')	(H')	.59	.88	NS	.72	.35	NS	2.07	1.40	2.34	NS	.79	.85
Diversity (J')	(J')	.37	.50	NS	.30	.09	NS	.46	.36	.57	NS	.23	.24
No. Taxa	(N)	6	5	NS	8	22	NS	34	22	23	NS	19	20
Station Y-1 (Discharge)													
Density	(No./m^2)	2473.09	1130.25	NS	2333.58	28,420.32	NS	20,295.99	48,266.93	62,626.36	NS	39,580.16	3,078.58
Diversity (H')	(H')	.87	.93	NS	.81	1.31	NS	.99	1.39	1.03	NS	1.98	1.40
Diversity (J')	(J')	.35	.45	NS	.28	.29	NS	.24	.36	.26	NS	.44	.35
No. Taxa	(N)	12	10	NS	15	39	NS	27	20	27	NS	35	27
Station Y-2 (Discharge)													
Density	(No./m^2)	0.00	8.07	NS	NS	22,798.67	NS	26,975.21	19,138.82	20,247.55	NS	22,970.91	352.53
Diversity (H')	(H')	0.00	.25	NS	NS	1.68	NS	2.79	3.40	2.69	NS	2.94	2.45
Diversity (J')	(J')	0.00	.25	NS	NS	.39	NS	.61	.79	.64	NS	.72	.78
No. Taxa	(N)	0	3	NS	NS	32	NS	33	28	23	NS	26	16

NS = NOT SAMPLED

* ONLY 3 REPLICATES COLLECTED

¢ REPLICATE 2 LOST

TABLE 2.2-7. MACROINVERTEBRATE DENSITY (#/m^2) AND RELATIVE ABUNDANCE FROM SAMPLES COLLECTED BY ARTIFICIAL SUBSTRATE SAMPLER NEAR RED WING, MINNESOTA DURING 1978

LIFE STAGE (LS) LISTINGS USED FOR BENTHOS TABLES:

01 - Adult	05 - Immature
02 - Larvae	06 - Juvenile
03 - Pupae	10 - Nymph
04 - Egg	11 - Colony
	12 - Undetermined

NORTHERN STATES POWER COMPANY

Table 2.2-7 (cont)

PRAIRIE ISLAND NUCLEAR GENERATING PLANT

MACROINVERTEBRATE DENSITY (NUMBER PER SQUARE METER)

HESTER-DENDY MULTIPLATE SAMPLER

WITHIN-SITE REPORT

JANUARY

STURGEON LAKE

LS	TAXA	1	X	S.E.	REL ABX
0	DIPTERA NEMATOCERA (TOTAL)	2.69	2.69	-1.00	100.0
0	CHIRONOMIDAE				
2	CRICOTOPUS (LPIL)	2.69	2.69	-1.00	100.0
TOTAL		2.69	2.69	-1.00	100.0
DIVERSITY (H PRIME)		0.0	0.0	0.0	
DIVERSITY (J PRIME)		0.0	0.0	0.0	
NUMBER OF TAXA		1	1		
BOTTOM TYPE	0				

ABOVE COMPUTED USING SAMPLE IDS
26011 26012 26013 26014

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NORTHERN STATES POWER COMPANY

PRAIRIE ISLAND NUCLEAR GENERATING PLANT

Table 2.2-7 (cont)

MACROINVERTEBRATE DENSITY (NUMBER PER SQUARE METER)

HESTER-DENDY MULTIPLATE SAMPLER

WITHIN-SITE REPORT

INTAKE JANUARY

LS	TAXA	X-1	X-2	X-3	X̄	S.E.	REL ABX
		3	4	5			
0	PLATYHELMINTHES (TOTAL)	0.0	5.38	8.07	4.49	2.37	0.1
1	TURBELLARIA-(LPIL)	0.0	5.38	8.07	4.49	2.37	0.1
0	NEMERTINA (TOTAL)	0.0	113.02	220.67	111.23	63.71	1.6
1	NEMERTINA (LPIL)	0.0	113.02	220.67	111.23	63.71	1.6
0	NEMATODA (TOTAL)	0.0	465.55	137.24	200.93	138.12	2.9
1	NEMATODA (LPIL)	0.0	465.55	137.24	200.93	138.12	2.9
0	OLIGOCHAETA (TOTAL)	0.0	17339.54	2247.04	6528.52	5443.79	95.1
0	NAIDIDAE						
1	NAIDIDAE (LPIL)	0.0	17330.46	2244.35	6524.93	5441.47	95.0
0	TUBIFICIDAE						
1	TUBIFICIDAE (LPIL)	0.0	8.07	2.69	3.59	2.37	0.1
0	GASTROPODA (TOTAL)	0.0	10.76	29.60	13.46	8.65	0.2
0	PHYSIDAE						
1	PHYSA (LPIL)	0.0	10.76	29.60	13.46	8.45	0.2
0	EPHEMEROPTERA (TOTAL)	0.0	2.69	0.0	0.90	0.90	0.0
0	CAENIDAE						
10	CAENIS (LPIL)	0.0	2.69	0.0	0.90	0.90	0.0
0	DIPTERA NEMATOCERA (TOTAL)	0.0	16.15	0.0	5.38	5.38	0.1
0	CHIRONOMIDAE						
2	CRICOTOPUS (LPIL)	0.0	5.38	0.0	1.79	1.79	0.0
2	GLYPTOTENDIPES (LPIL)	0.0	10.76	0.0	3.59	3.59	0.1
TOTAL		0.0	17952.09	2642.62	6864.90	5595.84	100.0
DIVERSITY (H PRIME)		0.0	0.22	0.69	0.30	0.20	
DIVERSITY (J PRIME)		0.0	0.09	0.37	0.15	0.11	
NUMBER OF TAXA		0	9	6	9		
BOTTOM TYPE	0						

ABOVE COMPUTED USING SAMPLE IDS

26021	26022	26023	26024
26031	26032	26033	26034
26041	26042	26043	26044

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PRAIRIE ISLAND NUCLEAR GENERATING PLANT

Table 2.2-7 (cont)

MACROINVERTEBRATE DENSITY (NUMBER PER SQUARE METER)

HESTER-DENDY MULTIPLATE SAMPLER

WITHIN-SITE REPORT

DISCHARGE JANUARY

LS	TAXA	Y-1	Y-2	- X	S.E.	REL ABX
		6	7			
0	CNIDARIA (TOTAL)	5.36	0.0	2.69	2.69	0.2
0	HYDROZOA					
1	HYDRA (LPIL)	5.38	0.0	2.69	2.69	0.2
0	PLATYHELMINTHES (TOTAL)	5.38	0.0	2.69	2.69	0.2
1	TURBELLARIA-(LPIL)	5.38	0.0	2.69	2.69	0.2
0	NEMERTINA (TOTAL)	5.38	0.0	2.69	2.69	0.2
1	NEMERTINA (LPIL)	172.23	0.0	86.11	86.11	7.0
0	NEMATODA (TOTAL)	172.23	0.0	86.11	86.11	7.0
1	NEMATODA (LPIL)	2222.82	0.0	1111.41	1111.41	89.9
0	OLIGOCHAETA (TOTAL)					
0	NAIDIDAE	2155.54	0.0	1077.77	1077.77	87.2
1	NAIDIDAE (LPIL)					
0	TUBIFICIDAE	67.28	0.0	33.64	33.64	2.7
1	TUBIFICIDAE (LPIL)	2.69	0.0	1.35	1.35	0.1
0	AMPHIPODA (TOTAL)					
0	HYALELLIDAE	2.69	0.0	1.35	1.35	0.1
1	HYALELLA AZTECA	59.20	0.0	29.60	29.60	2.4
0	DIPTERA NEMATOCERA (TOTAL)					
0	CHIRONOMIDAE	8.07	0.0	4.04	4.04	0.3
2	CRYPTOCHIRONOMUS (LPIL)	40.37	0.0	20.18	20.18	1.6
2	CRICOTOPUS (LPIL)	2.69	0.0	1.35	1.35	0.1
2	PROCLADIUS (LPIL)	5.38	0.0	2.69	2.69	0.2
2	GLYPTOTENDIPES (LPIL)	2.69	0.0	1.35	1.35	0.1
3	CHIRONOMIDAE (LPIL)					
TOTAL		2473.09	0.0	1236.54	1236.54	100.0
DIVERSITY (H PRIME)		0.87	0.0	0.43	0.43	
DIVERSITY (J PRIME)		0.35	0.0	0.18	0.18	
NUMBER OF TAXA		12	0	12		

BOTTOM TYPE 0

ABOVE COMPUTED USING SAMPLE IDS

26051 26052 26053 26054
26061 26062 26063 26064

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Table 2.2-7 (cont)

PRAIRIE ISLAND NUCLEAR GENERATING PLANT

MACROINVERTEBRATE DENSITY (NUMBER PER SQUARE METER)

HESTER-DENDY MULTIPLATE SAMPLER

WITHIN-SITE REPORT

FEBRUARY

STURGEON LAKE

LS	TAXA	2	X	S.E.	REL ABX
0	DIPTERA NEMATOCERA (TOTAL)	2.69	2.69	-1.00	100.0
0	CHIRONOMIDAE				
2	CHIRONOMIDAE (LPIL)	2.69	2.69	-1.00	100.0
	TOTAL	2.69	2.69	-1.00	100.0
	DIVERSITY (H PRIME)	0.0	0.0	0.0	
	DIVERSITY (J PRIME)	0.0	0.0	0.0	
	NUMBER OF TAXA	1	1		

BOTTOM TYPE 0

ABOVE COMPUTED USING SAMPLE IDS
26081 26082 26083 26084

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PRAIRIE ISLAND NUCLEAR GENERATING PLANT

MACROINVERTEBRATE DENSITY (NUMBER PER SQUARE METER)

HESTER-DENDY MULTIPLATE SAMPLER

WITHIN-SITE REPORT

Table 2.2-7 (cont)

INTAKE FEBRUARY

LS	TAXA	X-1	X-2	X-3	X̄	S.E.	REL AB%
		3	4	5			
0	PLATYHELMINTHES (TOTAL)	0.0	2.69	0.0	0.90	0.90	0.0
1	TURBELLARIA-(LPIL)	0.0	2.69	0.0	0.90	0.90	0.0
0	NEMERTINA (TOTAL)	0.0	422.50	912.27	444.92	263.59	17.9
1	NEMERTINA (LPIL)	0.0	422.50	912.27	444.92	263.59	17.9
0	NEMATODA (TOTAL)	0.0	86.81	263.72	117.51	77.47	4.7
1	NEMATODA (LPIL)	0.0	86.81	263.72	117.51	77.47	4.7
0	OLIGOCHAETA (TOTAL)	0.0	874.60	4851.99	1908.86	1493.06	76.9
0	NAIDIDAE						
1	NAIDIDAE (LPIL)	0.0	874.60	4851.99	1908.86	1493.06	76.9
0	GASTROPODA (TOTAL)	0.0	18.84	2.69	7.18	5.88	0.3
0	PHYSIDAE						
1	PHYSA (LPIL)	0.0	18.84	2.69	7.18	5.88	0.3
0	PLECOPTERA (TOTAL)	2.69	0.0	0.0	0.90	0.90	0.0
0	TAENIOPTERYGIDAE						
10	STROPHOPTERYX (LPIL)	2.69	0.0	0.0	0.90	0.90	0.0
0	DIPTERA NEMATOCERA (TOTAL)	2.69	2.69	5.38	3.59	0.90	0.1
0	CHIRONOMIDAE						
2	CRICOTOPUS (LPIL)	2.69	0.0	0.0	0.90	0.90	0.0
2	TANYTARSUS (LPIL)	0.0	0.0	5.38	1.79	1.79	0.1
2	GLYPTOTENDIPES (LPIL)	0.0	2.69	0.0	0.90	0.90	0.0
TOTAL		5.38	1410.12	6036.05	2483.85	1821.81	100.0
DIVERSITY (H PRIME)		0.0	1.27	0.88	0.72	0.38	
DIVERSITY (J PRIME)		0.0	0.66	0.50	0.39	0.26	
NUMBER OF TAXA		2	6	5	9		
BOTTOM TYPE	0						

ABOVE COMPUTED USING SAMPLE IDS

26091	26092	26093	26094
26101	26102	26103	26104
26111	26112	26113	26114

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PRAIRIE ISLAND NUCLEAR GENERATING PLANT

MACROINVERTEBRATE DENSITY (NUMBER PER SQUARE METER)

HESTER DENDY MULTIPLATE SAMPLER

WITHIN-SITE REPORT

Table 2.2-7 (cont)

LS	TAXA	DISCHARGE Y-1	FEBRUARY Y-2	X̄	S.E.	REL ABX
		6	7			
0	NEMERTINA (TOTAL)	59.20	0.0	29.60	29.60	5.2
1	NEMERTINA (LPIL)	59.20	0.0	29.60	29.60	5.2
0	NEMATODA (TOTAL)	56.51	0.0	28.26	28.26	5.0
1	NEMATODA (LPIL)	56.51	0.0	28.26	28.26	5.0
0	OLIGOCHAETA (TOTAL)	974.17	2.69	488.43	485.74	85.8
0	NAIDIDAE					
1	NAIDIDAE (LPIL)	974.17	2.69	488.43	485.74	85.8
0	GASTROPODA (TOTAL)	10.76	0.0	5.38	5.38	0.9
0	PHYSIDAE					
1	PHYSA (LPIL)	5.38	0.0	2.69	2.69	0.5
1	GASTROPODA (LPIL)	5.38	0.0	2.69	2.69	0.5
0	PLECOPTERA (TOTAL)	0.0	2.69	1.35	1.35	0.2
0	TAENIOPTERYGIDAE					
10	STROPHOPTERYX (LPIL)	0.0	2.69	1.35	1.35	0.2
0	DIPTERA NEMATOCERA (TOTAL)	29.60	2.69	16.15	13.46	2.8
0	CHIRONOMIDAE					
2	CRICOTOPUS (LPIL)	16.15	0.0	8.07	8.07	1.4
2	TANYTARSUS (LPIL)	5.38	0.0	2.69	2.69	0.5
2	ABLABESMYIA (LPIL)	2.69	0.0	1.35	1.35	0.2
2	TRISSOCLADIUS (LPIL)	2.69	0.0	1.35	1.35	0.2
3	CHIRONOMIDAE (LPIL)	2.69	0.0	1.35	1.35	0.2
0	SIMULIIDAE					
2	SIMULIIDAE (LPIL)	0.0	2.69	1.35	1.35	0.2
TOTAL		1130.25	8.07	569.16	561.09	100.0
DIVERSITY (H PRIME)		0.93	0.25	0.59	0.34	
DIVERSITY (J PRIME)		0.45	0.25	0.35	0.10	
NUMBER OF TAXA		10	3	12		
BOTTOM TYPE	0					

ABOVE COMPUTED USING SAMPLE IDS

26121 26122 26123 26124
26131 26132 26133 26134

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NORTHERN STATES POWER COMPANY

PRAIRIE ISLAND NUCLEAR GENERATING PLANT

MACROINVERTEBRATE DENSITY (NUMBER PER SQUARE METER)

HESTER-DENDY MULTIPLATE SAMPLER

WITHIN-SITE REPORT

Table 2.2-7 (cont)

APRIL

STURGEON LAKE

LS	TAXA	2	X	S.E.	REL AB%
0	OLIGOCHAETA (TOTAL)	57.41	57.41	-1.00	15.1
0	NAIDIDAE				
1	NAIDIDAE (LPIL)	50.23	50.23	-1.00	13.2
0	TUBIFICIDAE				
1	TUBIFICIDAE (LPIL)	7.18	7.18	-1.00	1.9
0	BIVALVIA (TOTAL)	3.59	3.59	-1.00	0.9
0	SPHAERIIDAE				
1	PISIDIUM (LPIL)	3.59	3.59	-1.00	0.9
0	DIPTERA NEMATOCERA (TOTAL)	319.34	319.34	-1.00	84.0
0	CHIRONOMIDAE				
2	CRICOTOPUS (LPIL)	129.17	129.17	-1.00	34.0
2	TANYTARSUS (LPIL)	68.17	68.17	-1.00	17.9
2	CORYNONEURA (LPIL)	3.59	3.59	-1.00	0.9
2	THIENEMANNIELLA	3.59	3.59	-1.00	0.9
2	PSECTROCLADIUS (LPIL)	111.23	111.23	-1.00	29.2
2	CHIRONOMIDAE (LPIL)	3.59	3.59	-1.00	0.9
TOTAL		380.34	380.34	-1.00	100.0
DIVERSITY (H PRIME)		1.87	1.87	-1.00	
DIVERSITY (J PRIME)		0.79	0.79	-1.00	
NUMBER OF TAXA		9	9		
BOTTOM TYPE	0				

ABOVE COMPUTED USING SAMPLE IDS
26151 26152 26153

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Table 2.2-7 (cont)

PRAIRIE ISLAND NUCLEAR GENERATING PLANT

MACROINVERTEBRATE DENSITY (NUMBER PER SQUARE METER)

HESTER-DENDY MULTIPLATE SAMPLER

WITHIN-SITE REPORT

INTAKE APRIL

LS	TAXA	X-2	X-3	$\bar{X}$	S.E.	REL ABX
		4	5			
0	PLATYHELMINTHES (TOTAL)	2.69	0.0	1.35	1.35	0.1
1	TURBELLARIA-(LPIL)	2.69	0.0	1.35	1.35	0.1
0	NEMERTINA (TOTAL)	131.86	126.48	129.17	2.69	8.5
1	NEMERTINA (LPIL)	131.86	126.48	129.17	2.69	8.5
0	NEMATODA (TOTAL)	10.76	8.07	9.42	1.35	0.6
1	NEMATODA (LPIL)	10.76	8.07	9.42	1.35	0.6
0	OLIGOCHAETA (TOTAL)	731.97	1929.49	1330.73	598.76	88.1
0	NAIDIDAE					
1	NAIDIDAE (LPIL)	731.97	1929.49	1330.73	598.76	88.1
0	GASTROPODA (TOTAL)	0.0	2.69	1.35	1.35	0.1
0	PHYSIDAE					
1	PHYSA (LPIL)	0.0	2.69	1.35	1.35	0.1
0	DIPTERA NEMATOCERA (TOTAL)	53.82	16.15	34.98	18.84	2.3
0	CHIRONOMIDAE					
2	CRICOTOPUS (LPIL)	2.69	0.0	1.35	1.35	0.1
2	TANYTARSUS (LPIL)	29.60	8.07	18.84	10.76	1.2
2	PARACHIRONOMUS (LPIL)	8.07	0.0	4.04	4.04	0.3
2	PSECTROCLADIUS (LPIL)	13.46	5.38	9.42	4.04	0.6
3	CHIRONOMIDAE (LPIL)	0.0	2.69	1.35	1.35	0.1
0	ECTOPROCTA (TOTAL)	2.69	5.38	4.04	1.35	0.3
0	PLUMATELLIDAE					
11	PLUMATELLA REPENS	2.69	5.38	4.04	1.35	0.3
TOTAL		933.80	2088.27	1511.03	577.23	100.0
DIVERSITY (H PRIME)		0.97	0.52	0.75	0.23	
DIVERSITY (J PRIME)		0.47	0.30	0.33	0.09	
NUMBER OF TAXA		9	8	11		

BOTTOM TYPE 0

ABOVE COMPUTED USING SAMPLE IDS

26171 26172 26173 26174
26181 26182 26183 26184

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PRAIRIE ISLAND NUCLEAR GENERATING PLANT

MACROINVERTEBRATE DENSITY (NUMBER PER SQUARE METER)

HESTER-DENDY MULTIPLATE SAMPLER

WITHIN-SITE REPORT

Table 2.2-7 (cont)

DISCHARGE APRIL

LS	TAXA	Y-1		X	S.E.	REL ABX
		6				
0	NEMERTINA (TOTAL)	10.76		10.76	-1.00	0.5
1	NEMERTINA (LPIL)	10.76		10.76	-1.00	0.5
0	NEMATODA (TOTAL)	26.91		26.91	-1.00	1.2
1	NEMATODA (LPIL)	26.91		26.91	-1.00	1.2
0	OLIGOCHAETA (TOTAL)	1980.62		1980.62	-1.00	88.7
0	NAIDIDAE					
1	NAIDIDAE (LPIL)	1980.62		1980.62	-1.00	88.7
0	GASTROPODA (TOTAL)	2.69		2.69	-1.00	0.1
0	PHYSIDAE					
1	PHYSA (LPIL)	2.69		2.69	-1.00	0.1
0	EPHEMEROPTERA (TOTAL)	2.69		2.69	-1.00	0.1
0	LEPTOPHLEBIIDAE					
10	LEPTOPHLEBIA (LPIL)	2.69		2.69	-1.00	0.1
0	DIPTERA NEMATOCERA (TOTAL)	201.83		201.83	-1.00	9.0
0	CHIRONOMIDAE					
2	CRICOTOPUS (LPIL)	2.69		2.69	-1.00	0.1
2	TANYTARSUS (LPIL)	37.67		37.67	-1.00	1.7
2	ABLABESMYIA (LPIL)	2.69		2.69	-1.00	0.1
2	CORYNONEURA (LPIL)	8.07		8.07	-1.00	0.4
2	PARACHIRONOMUS (LPIL)	53.82		53.82	-1.00	2.4
2	GLYPTOTENDIPES (LPIL)	26.91		26.91	-1.00	1.2
2	THIENEMANNIELLA	8.07		8.07	-1.00	0.4
2	PSECTROCLADIUS (LPIL)	59.20		59.20	-1.00	2.7
2	ENDOCHIRONOMUS (LPIL)	2.69		2.69	-1.00	0.1
0	ECTOPROCTA (TOTAL)	8.07		8.07	-1.00	0.4
0	PLUMATELLIDAE					
11	PLUMATELLA REPENS	8.07		8.07	-1.00	0.4
TOTAL		2233.58		2233.58	-1.00	100.0
DIVERSITY (H PRIME)		0.81		0.81	-1.00	
DIVERSITY (J PRIME)		0.28		0.28	-1.00	
NUMBER OF TAXA		15		15		
BOTTOM TYPE	0					

ABOVE COMPUTED USING SAMPLE IDS
26191 26192 26193 26194

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PRAIRIE ISLAND NUCLEAR GENERATING PLANT

MACROINVERTEBRATE DENSITY (NUMBER PER SQUARE METER)

HESTER-DENDY MULTIPLATE SAMPLER

WITHIN-SITE REPORT

Table 2.2-7 (cont)

LS	TAXA	MAY B-1	X̄	S.E.	REL ABX
0	CNIDARIA (TOTAL)	1	143.52	-1.00	0.7
0	HYDROZOA	143.52			
1	HYDRA (LPIL)	143.52	143.52	-1.00	0.7
0	NEMATODA (TOTAL)	25.12	25.12	-1.00	0.1
1	NEMATODA (LPIL)	25.12	25.12	-1.00	0.1
0	OLIGOCHAETA (TOTAL)	10724.79	10724.79	-1.00	53.4
0	NAIDIDAE	10724.79			
1	NAIDIDAE (LPIL)	3.59	10724.79	-1.00	53.4
0	GASTROPODA (TOTAL)	3.59	3.59	-1.00	0.0
0	PHYSIDAE	3.59			
1	PHYSA (LPIL)	7.18	3.59	-1.00	0.0
0	ISOPODA (TOTAL)	7.18	7.18	-1.00	0.0
0	ASELLIDAE	7.18			
1	ASELLUS (LPIL)	1033.37	7.18	-1.00	0.0
0	EPHEMEROPTERA (TOTAL)	362.40	1033.37	-1.00	5.1
0	BAETIDAE	10.76	362.40	-1.00	1.8
10	PSEUDOCLEON (LPIL)	3.59	10.76	-1.00	0.1
10	BAETIDAE (LPIL)	7.18	3.59	-1.00	0.0
0	HEPTAGENIIDAE	25.12	7.18	-1.00	0.0
10	STENONEMA	10.76	25.12	-1.00	0.1
10	STENONEMA (LPIL)	609.97	10.76	-1.00	0.1
10	HEPTAGENIIDAE (LPIL)	53.82	3.59	-1.00	0.0
0	EPHEMERELLIDAE	28.70	609.97	-1.00	3.0
10	EPHEMERELLA (LPIL)	14.35	53.82	-1.00	0.3
0	CAENIDAE	7.18	28.70	-1.00	0.1
10	CAENIS (LPIL)	3.59	14.35	-1.00	0.1
10	EPHEMEROPTERA (LPIL)	8094.71	7.18	-1.00	0.0
0	TRICHOPTERA (TOTAL)	441.33	3.59	-1.00	0.0
0	HYDROPSYCHIDAE	3.59	8094.71	-1.00	40.3
2	HYDROPSYCHE ORRIS	394.69	441.33	-1.00	2.2
2	HYDROPSYCHE (LPIL)	818.08	3.59	-1.00	0.0
2	CHEUMATOPSYCHE (LPIL)	100.47	394.69	-1.00	2.0
3	TRICHOPTERA (LPIL)	358.81	818.08	-1.00	4.1
0	DIPTERA NEMATOCERA (TOTAL)	46.65	100.47	-1.00	0.5
0	CHIRONOMIDAE		358.81	-1.00	1.8
2	ORTHOCLADIUS (LPIL)		46.65	-1.00	0.2
2	CRYPTOCHIRONOMUS (LPIL)				
2	CRICOTOPUS (LPIL)				
2	TANYTARSUS (LPIL)				
2	DICROTENDIPES (LPIL)				
2	POLYPEDILUM (LPIL)				
2	ABLABESMYIA (LPIL)				

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PRAIRIE ISLAND NUCLEAR GENERATING PLANT

MACROINVERTEBRATE DENSITY (NUMBER PER SQUARE METER)

HESTER-DENDY MULTIPLATE SAMPLER

WITHIN-SITE REPORT

Table 2.2-7 (cont)

LS	TAXA	MAY B-1 1	X̄	S.E.	REL ABX
2	MICROTENDIPES (LPIL)	3.59	3.59	-1.00	0.0
2	PARACHIRONOMUS (LPIL)	21.53	21.53	-1.00	0.1
2	GLYPTOTENDIPES (LPIL)	64.59	64.59	-1.00	0.3
2	EUKIEFFERIELLA (LPIL)	154.29	154.29	-1.00	0.8
2	THIENEMANNIELLA	222.46	222.46	-1.00	1.1
2	PSECTROCLADIUS (LPIL)	635.09	635.09	-1.00	3.2
3	CHIRONOMIDAE (LPIL)	670.97	670.97	-1.00	3.3
0	SIMULIIDAE				
2	SIMULIIDAE (LPIL)	1977.04	1977.04	-1.00	9.8
3	SIMULIIDAE (LPIL)	2181.56	2181.56	-1.00	10.9
TOTAL		20086.08	20086.08	-1.00	100.0
DIVERSITY (H PRIME)		2.31	2.31	-1.00	
DIVERSITY (J PRIME)		0.52	0.52	-1.00	
NUMBER OF TAXA		32	32		
BOTTOM TYPE	9				

ABOVE COMPUTED USING SAMPLE IDS
26211 26213 26214

MISSED SAMPLE IDS
26212

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PRAIRIE ISLAND NUCLEAR GENERATING PLANT

MACROINVERTEBRATE DENSITY (NUMBER PER SQUARE METER)

HESTER-DENDY MULTIPLATE SAMPLER

WITHIN-SITE REPORT

MAY

LS	TAXA	STURGEON LAKE 2	X	S.E.	REL ABX
0	CNIDARIA (TOTAL)	602.80	602.80	-1.00	3.3
0	HYDROZOA				
1	HYDRA (LPIL)	602.80	602.80	-1.00	3.3
0	NEMATODA (TOTAL)	40.37	40.37	-1.00	0.2
1	NEMATODA (LPIL)	40.37	40.37	-1.00	0.2
0	OLIGOCHAETA (TOTAL)	9782.02	9782.02	-1.00	52.9
0	NAIDIDAE				
1	NAIDIDAE (LPIL)	9782.02	9782.02	-1.00	52.9
0	AMPHIPODA (TOTAL)	2.69	2.69	-1.00	0.0
6	AMPHIPODA (LPIL)	2.69	2.69	-1.00	0.0
0	EPHEMEROPTERA (TOTAL)	352.53	352.53	-1.00	1.9
0	BAETIDAE				
10	BAETIS (LPIL)	2.69	2.69	-1.00	0.0
10	PSEUDOCLEON (LPIL)	191.07	191.07	-1.00	1.0
10	BAETIDAE (LPIL)	16.15	16.15	-1.00	0.1
0	HEPTAGENIIDAE				
10	STENONEMA (LPIL)	13.46	13.46	-1.00	0.1
1	STENONEMA (LPIL)	2.69	2.69	-1.00	0.0
10	HEPTAGENIIDAE (LPIL)	8.07	8.07	-1.00	0.0
0	EPHEMERELLIDAE				
10	EPHEMERELLA	8.07	8.07	-1.00	0.0
6	EPHEMEROPTERA (LPIL)	110.33	110.33	-1.00	0.6
0	TRICHOPTERA (TOTAL)	18.84	18.84	-1.00	0.1
0	HYDROPSYCHIDAE				
2	HYDROPSYCHE ORRIS	2.69	2.69	-1.00	0.0
2	HYDROPSYCHE (LPIL)	2.69	2.69	-1.00	0.0
0	LEPTOCERIDAE				
2	CERACLEA (=ATHRIPSODES)(LPIL)	5.38	5.38	-1.00	0.0
0	POLYCENTROPODIDAE				
2	NEURECLIPSIS (LPIL)	2.69	2.69	-1.00	0.0
2	POLYCENTROPUS (LPIL)	2.69	2.69	-1.00	0.0
3	TRICHOPTERA (LPIL)	2.69	2.69	-1.00	0.0
0	DIPTERA NEMATOCERA (TOTAL)	7704.51	7704.51	-1.00	41.6
0	CHIRONOMIDAE				
2	ORTHOCLADIUS (LPIL)	34.98	34.98	-1.00	0.2
2	CRICOTOPUS (LPIL)	2088.27	2088.27	-1.00	11.3
2	TANYTARSUS (LPIL)	72.66	72.66	-1.00	0.4
2	DICROTENDIPES (LPIL)	96.88	96.88	-1.00	0.5
2	POLYPEDILUM (LPIL)	99.57	99.57	-1.00	0.5
2	ABLABESMYIA (LPIL)	16.15	16.15	-1.00	0.1
2	PARACHIRONOMUS (LPIL)	13.46	13.46	-1.00	0.1
2	GLYPTOTENDIPES (LPIL)	94.19	94.19	-1.00	0.5

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HESTER-DENDY MULTIPLATE SAMPLER

WITHIN-SITE REPORT

MAY

STURGEON LAKE

LS	TAXA	2	X̄	S.E.	REL ABX
2	EUKIEFFERIELLA (LPIL)	37.67	37.67	-1.00	0.2
2	THIENEMANNIELLA	444.03	444.03	-1.00	2.4
2	PSECTROCLADIUS (LPIL)	3985.47	3985.47	-1.00	21.5
2	ENDOCHIRONOMUS (LPIL)	2.69	2.69	-1.00	0.0
2	NILOTANYPUS (LPIL)	8.07	8.07	-1.00	0.0
3	CHIRONOMIDAE (LPIL)	422.50	422.50	-1.00	2.3
0	SIMULIIDAE				
2	SIMULIIDAE (LPIL)	145.32	145.32	-1.00	0.8
3	SIMULIIDAE (LPIL)	142.63	142.63	-1.00	0.8
TOTAL		18503.74	18503.74	-1.00	100.0
DIVERSITY (H PRIME)		2.33	2.33	-1.00	
DIVERSITY (J PRIME)		0.54	0.54	-1.00	
NUMBER OF TAXA		32	32		
BOTTOM TYPE	0				

ABOVE COMPUTED USING SAMPLE IDS
26221 26222 26223 26224

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HESTER-DENDY MULTIPLATE SAMPLER

WITHIN-SITE REPORT

INTAKE MAY

LS	TAXA	X-1	X-2	X-3	$\bar{X}$	S.E.	REL ABX
		3	4	5			
0	CNIDARIA (TOTAL)	2475.78	10.76	0.0	828.85	823.47	1.1
0	HYDROZOA						
1	HYDRA (LPIL)	2475.78	0.0	0.0	825.26	825.26	1.1
1	HYDROZOA (LPIL)	0.0	10.76	0.0	3.59	3.59	0.0
0	NEMERTINA (TOTAL)	0.0	24.22	126.48	50.23	38.76	0.1
1	NEMERTINA (LPIL)	0.0	24.22	126.48	50.23	38.76	0.1
0	NEMATODA (TOTAL)	26.91	123.79	5484.39	1878.36	1803.23	2.6
1	NEMATODA (LPIL)	26.91	123.79	5484.39	1878.36	1803.23	2.6
0	ENDOPROCTA	0.0	2.69	8.07	3.59	2.37	0.0
0	ENDOPROCTA						
11	URNATELLA GRACILIS	0.0	2.69	8.07	3.59	2.37	0.0
0	OLIGOCHAETA (TOTAL)	22561.89	73283.06	102906.31	66250.37	23458.47	90.8
0	NAIDIDAE						
1	NAIDIDAE (LPIL)	22561.89	73280.37	102906.31	66249.50	23458.34	90.8
0	TUBIFICIDAE						
1	TUBIFICIDAE (LPIL)	0.0	2.69	0.0	0.90	0.90	0.0
0	HIRUDINEA (TOTAL)	0.0	0.0	2.69	0.90	0.90	0.0
6	HIRUDINEA (LPIL)	0.0	0.0	2.69	0.90	0.90	0.0
0	GASTROPODA (TOTAL)	0.0	0.0	8.07	2.69	2.69	0.0
0	PHYSIDAE						
1	PHYSA (LPIL)	0.0	0.0	5.38	1.79	1.79	0.0
1	GASTROPODA (LPIL)	0.0	0.0	2.69	0.90	0.90	0.0
0	AMPHIPODA (TOTAL)	2.69	0.0	0.0	0.90	0.90	0.0
0	HYALELLIDAE						
1	HYALELLA AZTECA	2.69	0.0	0.0	0.90	0.90	0.0
0	EPHEMEROPTERA (TOTAL)	142.63	5.38	2.69	50.23	46.20	0.1
0	BAETIDAE						
10	BAETIS (LPIL)	16.15	2.69	0.0	6.28	4.99	0.0
10	PSEUDOCLEON (LPIL)	34.98	0.0	0.0	11.66	11.66	0.0
2	PSEUDOCLEON (LPIL)	45.75	0.0	0.0	15.25	15.25	0.0
0	HEPTAGENIDAE						
10	STENONEMA (LPIL)	2.69	0.0	0.0	0.90	0.90	0.0
0	CAENIDAE						
10	CAENIS (LPIL)	26.91	2.69	0.0	9.87	8.56	0.0
10	EPHEMEROPTERA (LPIL)	0.0	0.0	2.69	0.90	0.90	0.0
6	EPHEMEROPTERA (LPIL)	16.15	0.0	0.0	5.38	5.38	0.0
0	PLECOPTERA (TOTAL)	2.69	0.0	0.0	0.90	0.90	0.0
0	ISOPERLIDAE						
10	ISOPERLA (LPIL)	2.69	0.0	0.0	0.90	0.90	0.0
0	TRICHOPTERA (TOTAL)	21.53	5.38	5.38	10.76	5.38	0.0
0	HYDROPTILIDAE						
2	ORTHOTRICHIA (LPIL)	2.69	0.0	5.38	2.69	1.55	0.0

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PRAIRIE ISLAND NUCLEAR GENERATING PLANT

MACROINVERTEBRATE DENSITY (NUMBER PER SQUARE METER)

HESTER-DENDY MULTIPLATE SAMPLER

WITHIN-SITE REPORT

Table 2.2-7 (cont)

INTAKE MAY

LS	TAXA	X-1 3	X-2 4	X-3 5	X̄	S.E.	REL ABX
0	LEPTOCERIDAE						
2	CERACLEA (ATHRIPSODES)(LPIL)	5.38	2.69	0.0	2.69	1.55	0.0
0	POLYCENTROPODIDAE						
2	CYRNELLUS (LPIL)	2.69	0.0	0.0	0.90	0.90	0.0
2	NEURECLIPSIS (LPIL)	5.38	0.0	0.0	1.79	1.79	0.0
2	NEURECLIPSIS (LPIL)	2.69	0.0	0.0	0.90	0.90	0.0
2	POLYCENTROPODIDAE	2.69	0.0	0.0	0.90	0.90	0.0
3	TRICHOPTERA (LPIL)	0.0	2.69	0.0	0.90	0.90	0.0
0	DIPTERA NEMATOCERA (TOTAL)	8872.43	2502.69	355.22	3910.11	2557.43	5.4
0	CERATOPOGONIDAE						
2	CERATOPOGONIDAE (LPIL)	16.15	2.69	2.69	7.18	4.49	0.0
0	CHIRONOMIDAE						
2	CHIRONOMUS (LPIL)	2.69	0.0	0.0	0.90	0.90	0.0
2	ORTHOCLADIUS (LPIL)	40.37	0.0	0.0	13.46	13.46	0.0
2	CRICOTOPUS (LPIL)	1751.88	468.25	75.35	765.16	506.23	1.0
2	TANYTARSUS (LPIL)	113.02	16.15	24.22	51.13	31.03	0.1
2	DICROTENDIPES (LPIL)	99.57	26.91	13.46	46.65	26.75	0.1
2	POLYPEDILUM (LPIL)	177.61	8.07	0.0	61.89	57.90	0.1
2	ABLABESMYIA (LPIL)	83.42	2.69	2.69	29.60	26.91	0.0
2	CORYNONEURA (LPIL)	2.69	0.0	0.0	0.90	0.90	0.0
2	PARACHIRONOMUS (LPIL)	24.22	298.71	56.51	126.48	86.62	0.2
2	GLYPTOTENDIPES (LPIL)	400.97	34.98	56.51	164.15	118.57	0.2
2	EUKIEFFERIELLA (LPIL)	0.0	2.69	0.0	0.90	0.90	0.0
2	THIENEMANNIELLA	126.48	5.38	0.0	43.95	41.29	0.1
2	TRISSOCLADIUS (LPIL)	2.69	0.0	0.0	0.90	0.90	0.0
2	PSECTROCLADIUS (LPIL)	5446.71	1525.83	113.02	2361.86	1595.44	3.2
2	MICROPSECTRA (LPIL)	2.69	0.0	0.0	0.90	0.90	0.0
2	ENDOCHIRONOMUS (LPIL)	2.69	0.0	2.69	1.79	0.90	0.0
2	NILOTANYPUS (LPIL)	8.07	0.0	2.69	3.59	2.37	0.0
2	BRILLIA (LPIL)	2.69	0.0	0.0	0.90	0.90	0.0
3	CHIRONOMIDAE (LPIL)	503.23	83.42	5.38	197.34	154.59	0.3
0	SIMULIIDAE						
2	SIMULIIDAE (LPIL)	59.20	21.53	0.0	26.91	17.30	0.0
3	SIMULIIDAE (LPIL)	5.38	5.38	0.0	3.59	1.79	0.0
0	ECTOPROCTA (TOTAL)	0.0	10.76	21.53	10.76	6.21	0.0
0	LOPHOPODIDAE						
8	PECTINATELLA MAGNIFICA	0.0	0.0	10.76	3.59	3.59	0.0
0	PLUMATELLIDAE						
11	PLUMATELLA REPENS	0.0	10.76	10.76	7 18	3.59	0.0
TOTAL		34106.50	75968.62	108920.56	72993.56	21647.95	100.0
DIVERSITY (H PRIME)		1.82	0.33	0.35	0.83	0.50	
DIVERSITY (J PRIME)		0.41	0.08	0.09	0.20	0.11	

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PRAIRIE ISLAND NUCLEAR GENERATING PLANT

MACROINVERTEBRATE DENSITY (NUMBER PER SQUARE METER)

HESTER-DENDY MULTIPLATE SAMPLER

WITHIN-SITE REPORT

INTAKE MAY

LS	TAXA	X-1	X-2	X-3	$\bar{X}$	S.E.	REL ABX
		3	4	5			
	NUMBER OF TAXA	35	24	22	46		
	BOTTOM TYPE 0						

ABOVE COMPUTED USING SAMPLE IDS

26231	26232	26233	26234
26241	26242	26243	26244
26251	26252	26253	26254

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MACROINVERTEBRATE DENSITY (NUMBER PER SQUARE METER)

HESTER-DENDY MULTIPLATE SAMPLER

WITHIN-SITE REPORT

DISCHARGE MAY

LS	TAXA	Y-1	Y-2	X	S.E.	REL ABX
		6	7			
0	CNIDARIA (TOTAL)	137.24	48.44	92.84	44.40	0.4
0	HYDROZOA					
1	HYDRA (LPIL)	131.86	48.44	90.15	41.71	0.4
2	HYDRA (LPIL)	5.38	0.0	2.69	2.69	0.0
0	PLATYHELMINTHES (TOTAL)	8.07	0.0	4.04	4.04	0.0
1	TURBELLARIA-(LPIL)	8.07	0.0	4.04	4.04	0.0
0	NEMERTINA (TOTAL)	139.94	2.69	71.31	68.62	0.3
1	NEMERTINA (LPIL)	139.94	2.69	71.31	68.62	0.3
0	NEMATODA (TOTAL)	91.50	34.98	63.24	28.26	0.2
1	NEMATODA (LPIL)	91.50	34.98	63.24	28.26	0.2
0	OLIGOCHAETA (TOTAL)	22244.35	16022.61	19133.48	3110.87	74.7
0	NAIDIDAE					
1	NAIDIDAE (LPIL)	22241.66	16022.61	19132.13	3109.53	74.7
0	TUBIFICIDAE					
1	TUBIFICIDAE (LPIL)	2.69	0.0	1.35	1.35	0.0
0	GASTROPODA (TOTAL)	18.84	0.0	9.42	9.42	0.0
0	PHYSIDAE					
1	PHYSA (LPIL)	5.38	0.0	2.69	2.69	0.0
0	PLANORBIDAE					
1	GYRAULUS (LPIL)	5.38	0.0	2.69	2.69	0.0
1	GASTROPODA (LPIL)	8.07	0.0	4.04	4.04	0.0
0	ARACHNIDA (TOTAL)	2.69	2.69	2.69	0.0	0.0
0	PROSTIGMATA					
1	HYDRACARINA (LPIL)	2.69	2.69	2.69	0.0	0.0
0	ISOPODA (TOTAL)	2.69	0.0	1.35	1.35	0.0
0	ASELLIDAE					
1	ASELLUS (LPIL)	2.69	0.0	1.35	1.35	0.0
0	AMPHIPODA (TOTAL)	5.38	0.0	2.69	2.69	0.0
0	CRANGONYCIDAE					
1	CRANGONYX GRACILIS	5.38	0.0	2.69	2.69	0.0
0	EPHEMEROPTERA (TOTAL)	48.44	309.47	178.96	130.52	0.7
0	BAETIDAE					
10	CENTROPTILUM (LPIL)	10.76	0.0	5.38	5.38	0.0
10	BAETIS (LPIL)	2.69	16.15	9.42	6.73	0.0
10	PSEUDOCLEON (LPIL)	0.0	204.52	102.26	102.26	0.4
10	CLOEON (LPIL)	0.0	5.38	2.69	2.69	0.0
0	HEPTAGENIIDAE					
10	STENONEMA (LPIL)	2.69	2.69	2.69	0.0	0.0
10	HEPTAGENIIDAE (LPIL)	0.0	5.38	2.69	2.69	0.0
0	CAENIDAE					
10	CAENIS (LPIL)	26.91	5.38	16.15	10.76	0.1
10	EPHEMEROPTERA (LPIL)	5.38	69.97	37.67	32.29	0.1

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Table 2.2-7 (cont)

PRAIRIE ISLAND NUCLEAR GENERATING PLANT

MACROINVERTEBRATE DENSITY (NUMBER PER SQUARE METER)

HESTER-DENDY MULTIPLATE SAMPLER

WITHIN-SITE REPORT

DISCHARGE MAY

LS	TAXA	Y-1	Y-2	X	S.E.	REL ABX
		6	7			
0	COLEOPTERA POLYPHAGA (TOTAL)	0.0	2.69	1.35	1.35	0.0
0	ELMIDAE					
1	STENELMIS (LPIL)	0.0	2.69	1.35	1.35	0.0
0	TRICHOPTERA (TOTAL)	228.74	8.07	118.41	110.33	0.5
0	HYDROPSYCHIDAE					
2	CHEUMATOPSYCHE (LPIL)	0.0	2.69	1.35	1.35	0.0
0	HYDROPTILIDAE					
2	ORTHOTRICHIA (LPIL)	51.13	2.69	26.91	24.22	0.1
0	LEPTOCERIDAE					
2	CERACLEA (=ATHRIPSODES)(LPIL)	118.41	2.69	60.55	57.86	0.2
0	POLYCENTROPODIDAE					
2	CYRNELLUS (LPIL)	48.44	0.0	24.22	24.22	0.1
2	POLYCENTROPODIDAE	5.38	0.0	2.69	2.69	0.0
3	TRICHOPTERA (LPIL)	5.38	0.0	2.69	2.69	0.0
0	DIPTERA NEMATOCERA (TOTAL)	5473.62	6356.29	5914.95	441.33	23.1
0	CERATOPOGONIDAE					
2	CERATOPOGONIDAE (LPIL)	21.53	2.69	12.11	9.42	0.0
0	CHIRONOMIDAE					
2	CHIRONOMUS (LPIL)	2.69	0.0	1.35	1.35	0.0
2	ORTHOCLADIUS (LPIL)	2.69	0.0	1.35	1.35	0.0
2	CRICOTOPUS (LPIL)	212.59	1501.61	857.10	644.51	3.3
2	TANYTARSUS (LPIL)	29.60	379.44	204.52	174.92	0.8
2	DICROTENDIPES (LPIL)	142.63	113.02	127.83	14.80	0.5
2	POLYPEDILUM (LPIL)	13.46	94.19	53.82	40.37	0.2
2	ABLABESMYIA (LPIL)	201.83	26.91	114.37	87.46	0.4
2	PROCLADIUS (LPIL)	13.46	2.69	8.07	5.38	0.0
2	PARACHIRONOMUS (LPIL)	325.62	10.76	168.19	157.43	0.7
2	GLYPTOTENDIPES (LPIL)	947.26	113.02	530.14	417.11	2.1
2	THIENEMANNIELLA	13.46	349.84	181.65	168.19	0.7
2	PSECTROCLADIUS (LPIL)	3048.98	2249.73	2649.35	399.62	10.3
2	NILOTANYPUS (LPIL)	2.69	8.07	5.38	2.69	0.0
3	CHIRONOMIDAE (LPIL)	495.16	473.63	484.39	10.76	1.9
2	CHIRONOMIDAE (LPIL)	0.0	2.69	1.35	1.35	0.0
0	SIMULIIDAE					
2	SIMULIIDAE (LPIL)	0.0	640.47	320.24	320.24	1.3
3	SIMULIIDAE (LPIL)	0.0	387.51	193.76	193.76	0.8
0	ECTOPROCTA (TOTAL)	18.84	10.76	14.80	4.04	0.1
0	LOPHOPODIDAE					
8	PECTINATELLA MAGNIFICA	8.07	5.38	6.73	1.35	0.0
0	PLUMATELLIDAE					
11	PLUMATELLA REPENS	10.76	5.38	8.07	2.69	0.0
TOTAL		28420.32	22798.67	25609.49	2810.82	100.0

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NORTHERN STATES POWER COMPANY

PRAIRIE ISLAND NUCLEAR GENERATING PLANT

MACROINVERTEBRATE DENSITY (NUMBER PER SQUARE METER)

HESTER-DENDY MULTIPLATE SAMPLER

WITHIN-SITE REPORT

Table 2.2-7 (cont)

JULY

LS	TAXA	B-1 1	X̄	S.E.	REL ABX
0	CNIDARIA (TOTAL)	2.69	2.69	-1.00	0.0
0	HYDROZOA				
11	CORDYLOPHORA LACUSTRIS	2.69	2.69	-1.00	0.0
0	NEMATODA (TOTAL)	29.60	29.60	-1.00	0.2
1	NEMATODA (LPIL)	29.60	29.60	-1.00	0.2
0	OLIGOCHAETA (TOTAL)	196.45	196.45	-1.00	1.2
0	NAIDIDAE				
1	NAIDIDAE (LPIL)	172.23	172.23	-1.00	1.0
0	TUBIFICIDAE				
1	TUBIFICIDAE (LPIL)	21.53	21.53	-1.00	0.1
0	LUMBRICULIDAE				
1	LUMBRICULIDAE (LPIL)	2.69	2.69	-1.00	0.0
0	ARACHNIDA (TOTAL)	56.51	56.51	-1.00	0.3
0	PROSTIGMATA				
1	HYDRACARINA (LPIL)	56.51	56.51	-1.00	0.3
0	ISOPODA (TOTAL)	16.15	16.15	-1.00	0.1
0	ASELLIDAE				
1	ASELLUS (LPIL)	13.46	13.46	-1.00	0.1
1	ASELLIDAE (LPIL)	2.69	2.69	-1.00	0.0
0	AMPHIPODA (TOTAL)	5.38	5.38	-1.00	0.0
0	HYALELLIDAE				
1	HYALELLA AZTECA	5.38	5.38	-1.00	0.0
0	EPHEMEROPTERA (TOTAL)	920.34	920.34	-1.00	5.6
0	SIPHLONURIDAE				
10	ISONYCHIA (LPIL)	5.38	5.38	-1.00	0.0
0	BAETIDAE				
10	BAETIS (LPIL)	10.76	10.76	-1.00	0.1
0	HEPTAGENIIDAE				
10	STENONEMA (LPIL)	322.93	322.93	-1.00	2.0
0	TRICORYTHIDAE				
10	TRICORYTHODES (LPIL)	21.53	21.53	-1.00	0.1
0	CAENIDAE				
10	CAENIS (LPIL)	476.32	476.32	-1.00	2.9
10	EPHEMEROPTERA (LPIL)	83.42	83.42	-1.00	0.5
0	PLECOPTERA (TOTAL)	5.38	5.38	-1.00	0.0
0	PERLIDAE				
10	PERLIDAE (LPIL)	2.69	2.69	-1.00	0.0
0	ISOPERLIDAE				
2	ISOPERLA (LPIL)	2.69	2.69	-1.00	0.0
0	TRICHOPTERA (TOTAL)	4041.98	4041.98	-1.00	24.6
0	HYDROPSYCHIDAE				
2	HYDROPSYCHE ORRIS	1544.67	1544.67	-1.00	9.4

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Table 2.2-7 (cont)

PRAIRIE ISLAND NUCLEAR GENERATING PLANT

MACROINVERTEBRATE DENSITY (NUMBER PER SQUARE METER)

HESTER-DENDY MULTIPLATE SAMPLER

WITHIN-SITE REPORT

DISCHARGE MAY

LS TAXA	Y-1	Y-2	X̄	S.E.	REL ABX
	6	7			
DIVERSITY (H PRIME)	1.31	1.68	1.50	0.18	
DIVERSITY (J PRIME)	0.29	0.39	0.34	0.05	
NUMBER OF TAXA	39	32	45		
BOTTOM TYPE 0					

ABOVE COMPUTED USING SAMPLE IDS

26261 26262 26263 26264
26271 26272 26273 26274

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NORTHERN STATES POWER COMPANY

PRAIRIE ISLAND NUCLEAR GENERATING PLANT

MACROINVERTEBRATE DENSITY (NUMBER PER SQUARE METER)

HESTER-DENDY MULTIPLATE SAMPLER

WITHIN-SITE REPORT

Table 2.2-7 (cont)

LS	TAXA	JULY B-1 1	- X	S.E.	REL ABX
2	HYDROPSYCHE (LPIL)	877.29	877.29	-1.00	5.3
3	HYDROPSYCHE (LPIL)	29.60	29.60	-1.00	0.2
2	CHEUMATOPSYCHE (LPIL)	1205.60	1205.60	-1.00	7.3
3	CHEUMATOPSYCHE (LPIL)	37.67	37.67	-1.00	0.2
2	POTAMYIA (LPIL)	16.15	16.15	-1.00	0.1
2	HYDROPSYCHIDAE (LPIL)	26.91	26.91	-1.00	0.2
0	HYDROPTILIDAE				
2	AGRAYLEA (LPIL)	2.69	2.69	-1.00	0.0
0	BRACHYCENTRIDAE				
2	BRACHYCENTRUS (LPIL)	2.69	2.69	-1.00	0.0
0	POLYCENTROPODIDAE				
2	NEURECLIPSIS (LPIL)	5.38	5.38	-1.00	0.0
3	TRICHOPTERA (LPIL)	267.94	267.94	-1.00	1.8
2	TRICHOPTERA (LPIL)	5.38	5.38	-1.00	0.0
0	DIPTERA NEMATOCERA (TOTAL)	11106.02	11106.02	-1.00	67.6
0	CHIRONOMIDAE				
2	CRICOTOPUS (LPIL)	209.90	209.90	-1.00	1.3
2	TANYTARSUS (LPIL)	4733.58	4733.58	-1.00	28.8
2	DICROTENDIPES (LPIL)	64.59	64.59	-1.00	0.4
2	POLYPEDILUM (LPIL)	2290.10	2290.10	-1.00	13.9
2	ABLABESMYIA (LPIL)	551.67	551.67	-1.00	3.4
2	PARACHIRONOMUS (LPIL)	2.69	2.69	-1.00	0.0
2	GLYPTOTENDIPES (LPIL)	1953.71	1953.71	-1.00	11.9
2	EUKIEFFERIELLA (LPIL)	37.67	37.67	-1.00	0.2
2	THIENEMANNIELLA	2.69	2.69	-1.00	0.0
2	PSECTROCLADIUS (LPIL)	1003.77	1003.77	-1.00	6.1
2	KIEFFERULUS	24.22	24.22	-1.00	0.1
3	CHIRONOMIDAE (LPIL)	215.29	215.29	-1.00	1.3
0	SIMULIIDAE				
3	SIMULIUM (LPIL)	13.46	13.46	-1.00	0.1
2	SIMULIUM (LPIL)	2.69	2.69	-1.00	0.0
0	DIPTERA BRACHYCERA (TOTAL)	26.91	26.91	-1.00	0.2
0	STRATIOMYIDAE				
2	NEMOTELUS	2.69	2.69	-1.00	0.0
0	RHAGIONIDAE				
2	ATHERIX	2.69	2.69	-1.00	0.0
0	EMPIDIDAE				
2	EMPIDIDAE (LPIL)	21.53	21.53	-1.00	0.1
0	ECTOPROCTA (TOTAL)	18.84	18.84	-1.00	0.1
0	LOPHOPODIDAE				
8	PECTINATELLA MAGNIFICA	13.46	13.46	-1.00	0.1
0	PLUMATELLIDAE				

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PRAIRIE ISLAND NUCLEAR GENERATING PLANT

MACROINVERTEBRATE DENSITY (NUMBER PER SQUARE METER)

HESTER-DENDY MULTIPLATE SAMPLER

WITHIN-SITE REPORT

JULY

LG	TAXA	B-1	X	S.E.	REL 95%
		1			
11	PLUMATELLA REPENS	2.69	2.69	-1.00	0.0
0	PALUDICELLIDAE				
11	PALUDICELLA ARTICULATA	2.69	2.69	-1.00	0.0
TOTAL		16426.24	16426.24	-1.00	100.0
DIVERSITY (H PRIME)		3.36	3.36	-1.00	
DIVERSITY (J PRIME)		0.71	0.71	-1.00	
NUMBER OF TAXA		45	45		
BOTTOM TYPE	0				

ABOVE COMPUTED USING SAMPLE IDS
26281 26282 26283 26284

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PRAIRIE ISLAND NUCLEAR GENERATING PLANT

MACROINVERTEBRATE DENSITY (NUMBER PER SQUARE METER)

HESTER-DENDY MULTIPLATE SAMPLER

WITHIN-SITE REPORT

JULY

LS	TAXA	STURGEON LAKE 2	- X	S.E.	REL ABX
0	NEMATODA (TOTAL)	48.44	48.44	-1.00	0.3
1	NEMATODA (LPIL)	48.44	48.44	-1.00	0.3
0	OLIGOCHAETA (TOTAL)	433.26	433.26	-1.00	2.4
0	NAIDIDAE				
1	NAIDIDAE (LPIL)	433.26	433.26	-1.00	2.4
0	ARACHNIDA (TOTAL)	67.28	67.28	-1.00	0.4
0	PROSTIGMATA				
1	HYDRACARINA (LPIL)	67.28	67.28	-1.00	0.4
0	AMPHIPODA (TOTAL)	8.07	8.07	-1.00	0.0
0	GAMMARIDAE (TOTAL)				
1	GAMMARUS (LPIL)	2.69	2.69	-1.00	0.0
0	HYALELLIDAE				
1	HYALELLA AZTECA	5.38	5.38	-1.00	0.0
0	EPHEMEROPTERA (TOTAL)	376.75	376.75	-1.00	2.0
0	SIPHLONURIDAE				
10	ISONYCHIA (LPIL)	2.69	2.69	-1.00	0.0
0	BAETIDAE				
10	BAETIS (LPIL)	10.76	10.76	-1.00	0.1
10	BAETIDAE (LPIL)	24.22	24.22	-1.00	0.1
0	HEPTAGENIIDAE				
10	STENONEMA (LPIL)	118.41	118.41	-1.00	0.6
0	TRICORYTHIDAE				
10	TRICORYTHODES (LPIL)	2.69	2.69	-1.00	0.0
0	CAENIDAE				
10	CAENIS (LPIL)	199.14	199.14	-1.00	1.1
10	CAENIDAE (LPIL)	5.38	5.38	-1.00	0.0
10	EPHEMEROPTERA (LPIL)	13.46	13.46	-1.00	0.1
0	PLECOPTERA (TOTAL)	5.38	5.38	-1.00	0.0
0	PERLIDAE				
10	PERLESTA (LPIL)	5.38	5.38	-1.00	0.0
0	COLEOPTERA POLYPHAGA (TOTAL)	2.69	2.69	-1.00	0.0
0	ELMIDAE				
1	STENELMIS (LPIL)	2.69	2.69	-1.00	0.0
0	TRICHOPTERA (TOTAL)	2661.46	2661.46	-1.00	14.4
0	HYDROPSYCHIDAE				
2	HYDROPSYCHE ORRIS	1388.59	1388.59	-1.00	7.5
2	HYDROPSYCHE (LPIL)	139.94	139.94	-1.00	0.8
2	CHEUMATOPSYCHE (LPIL)	223.36	223.36	-1.00	1.2
2	POTAMYIA (LPIL)	8.07	8.07	-1.00	0.0
2	HYDROPSYCHIDAE (LPIL)	185.68	185.68	-1.00	1.0
0	HYDROPTILIDAE				
2	AGRAYLEA (LPIL)	8.07	8.07	-1.00	0.0

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Table 2.2-7 (cont)

PRAIRIE ISLAND NUCLEAR GENERATING PLANT

MACROINVERTEBRATE DENSITY (NUMBER PER SQUARE METER)

HESTER-DENDY MULTIPLATE SAMPLER

WITHIN-SITE REPORT

JULY

LS	TAXA	STURGEON LAKE				
		2			X	S.E.	REL ABX
2	HYDROPTILIDAE (LPIL)	8.07			8.07	-1.00	0.0
3	HYDROPTILIDAE (LPIL)	5.38			5.38	-1.00	0.0
0	POLYCENTROPODIDAE						
2	NEURECLIPSIS (LPIL)	279.87			279.87	-1.00	1.5
3	TRICHOPTERA (LPIL)	414.42			414.42	-1.00	2.2
0	DIPTERA NEMATOCERA (TOTAL)	14816.98			14816.98	-1.00	80.4
0	CHIRONOMIDAE						
2	ORTHOCLADIUS (LPIL)	2.69			2.69	-1.00	0.0
2	CRICOTOPUS (LPIL)	290.64			290.64	-1.00	1.6
2	TANYTARSUS (LPIL)	4714.74			4714.74	-1.00	25.6
2	DICROTENDIPES (LPIL)	236.81			236.81	-1.00	1.3
2	POLYPEDILUM (LPIL)	608.18			608.18	-1.00	3.3
2	ABLABESMYIA (LPIL)	228.74			228.74	-1.00	1.2
2	PARACHIRONOMUS (LPIL)	2.69			2.69	-1.00	0.0
2	GLYPTOTENDIPES (LPIL)	7346.61			7346.61	-1.00	39.9
2	EUKIEFFERIELLA (LPIL)	2.69			2.69	-1.00	0.0
2	THIENEMANNIELLA	56.51			56.51	-1.00	0.3
2	PSECTROCLADIUS (LPIL)	484.39			484.39	-1.00	2.6
2	NILOTANYPUS (LPIL)	21.53			21.53	-1.00	0.1
3	CHIRONOMIDAE (LPIL)	699.68			699.68	-1.00	3.8
0	SIMULIIDAE						
3	SIMULIUM (LPIL)	53.82			53.82	-1.00	0.3
2	SIMULIUM (LPIL)	67.28			67.28	-1.00	0.4
TOTAL		18420.30			18420.30	-1.00	100.0
DIVERSITY (H PRIME)		2.83			2.83	-1.00	
DIVERSITY (J PRIME)		0.60			0.60	-1.00	
NUMBER OF TAXA		38			38		
BOTTOM TYPE	0						

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26291 26292 26293 26294

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Table 2.2-7 (cont)

PRAIRIE ISLAND NUCLEAR GENERATING PLANT

MACROINVERTEBRATE DENSITY (NUMBER PER SQUARE METER)

HESTER-DENDY MULTIPLATE SAMPLER

WITHIN-SITE REPORT

INTAKE JULY

LS	TAXA	X-1	X-2	X-3	- X	S.E.	REL ABX
		3	4	5			
0	NEMATODA (TOTAL)	16.15	53.82	376.75	148.91	114.44	0.6
1	NEMATODA (LPIL)	16.15	53.82	376.75	148.91	114.44	0.6
0	ENDOPROCTA	0.0	43.06	21.53	21.53	12.43	0.1
0	ENDOPROCTA						
11	URNATELLA GRACILIS	0.0	43.06	21.53	21.53	12.43	0.1
0	OLIGOCHAETA (TOTAL)	446.72	118.41	376.75	313.96	99.84	1.3
0	NAIDIDAE						
1	NAIDIDAE (LPIL)	446.72	118.41	376.75	313.96	99.84	1.3
0	GASTROPODA (TOTAL)	0.0	21.53	10.76	10.76	6.21	0.0
0	PHYSIDAE						
1	PHYSA (LPIL)	0.0	21.53	10.76	10.76	6.21	0.0
0	ARACHNIDA (TOTAL)	0.0	0.0	32.29	10.76	10.76	0.0
0	PROSTIGMATA						
1	HYDRACARINA (LPIL)	0.0	0.0	32.29	10.76	10.76	0.0
0	ISOPODA (TOTAL)	0.0	0.0	10.76	3.59	3.59	0.0
0	ASELLIDAE						
1	ASELLUS (LPIL)	0.0	0.0	10.76	3.59	3.59	0.0
0	AMPHIPODA (TOTAL)	0.0	0.0	5.38	1.79	1.79	0.0
0	HYALELLIDAE						
1	HYALELLA AZTECA	0.0	0.0	5.38	1.79	1.79	0.0
0	EPHEMEROPTERA (TOTAL)	322.93	[illegible]	161.46	182.99	75.35	0.7
0	SIPHLONURIDAE						
10	SIPHLONURIDAE (LPIL)	10.76		0.0	3.59	3.59	0.0
0	BAETIDAE						
10	BAETIS (LPIL)	10.76	0.0	10.76	7.18	3.59	0.0
10	BAETIDAE (LPIL)	5.38	0.0	0.0	1.79	1.79	0.0
0	HEPTAGENIIDAE						
10	STENONEMA (LPIL)	37.67	21.53	26.91	28.70	4.75	0.1
0	TRICORYTHIDAE						
10	TRICORYTHODES (LPIL)	5.38	0.0	0.0	1.79	1.79	0.0
0	CAENIDAE						
10	CAENIS (LPIL)	252.96	43.06	123.79	139.94	61.13	0.6
0	ODONATA (TOTAL)	5.38	0.0	0.0	1.79	1.79	0.0
0	COENAGRIONIDAE						
10	ENALLAGMA (LPIL)	5.38	0.0	0.0	1.79	1.79	0.0
0	TRICHOPTERA (TOTAL)	2136.71	86.11	2551.13	1591.32	762.05	6.4
0	HYDROPSYCHIDAE						
2	HYDROPSYCHE ORRIS	1264.80	53.82	1544.67	954.43	457.50	3.8
2	HYDROPSYCHE (LPIL)	301.40	0.0	263.72	188.37	94.81	0.8
2	CHEUMATOPSYCHE (LPIL)	139.94	0.0	172.23	104.05	52.86	0.4
2	HYDROPSYCHIDAE (LPIL)	0.0	10.76	59.20	23.32	18.21	0.1
3	HYDROPSYCHIDAE (LPIL)	43.06	0.0	0.0	14.35	14.35	0.1

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PRAIRIE ISLAND NUCLEAR GENERATING PLANT

MACROINVERTEBRATE DENSITY (NUMBER PER SQUARE METER)

HESTER-DENDY MULTIPLATE SAMPLER

WITHIN-SITE REPORT

Table 2.2-7 (cont)

INTAKE JULY

LS	TAXA	X-1 3	X-2 4	X-3 5	X̄	S.E.	REL ABX
0	LEPTOCERIDAE						
2	LEPTOCERIDAE (LPIL)	0.0	0.0	10.76	3.59	3.59	0.0
0	POLYCENTROPODIDAE						
2	CYRNELLUS (LPIL)	75.35	0.0	5.38	26.91	24.27	0.1
2	NEURECLIPSIS (LPIL)	209.90	10.76	204.52	141.73	65.50	0.4
2	POLYCENTROPODIDAE	0.0	0.0	37.67	12.56	12.56	0.1
3	TRICHOPTERA (LPIL)	91.50	10.76	242.20	114.82	67.82	0.5
2	TRICHOPTERA (LPIL)	10.76	0.0	10.76	7.18	3.59	0.0
0	DIPTERA NEMATOCERA (TOTAL)	15710.43	26716.89	25468.23	22631.85	3479.43	90.7
0	CERATOPOGONIDAE						
2	CERATOPOGONIDAE (LPIL)	0.0	0.0	10.76	3.59	3.59	0.0
0	CHIRONOMIDAE						
2	ORTHOCLADIUS (LPIL)	21.53	0.0	0.0	7.18	7.18	0.0
2	CRICOTOPUS (LPIL)	145.32	0.0	473.63	206.31	140.03	0.8
2	TANYTARSUS (LPIL)	3304.63	193.76	3433.80	2310.73	1059.14	9.3
2	DICROTENDIPES (LPIL)	263.72	333.69	161.46	252.96	54.01	1.0
2	POLYPEDILUM (LPIL)	430.57	32.29	898.82	453.89	250.42	1
2	ABLABESMYIA (LPIL)	177.61	10.76	118.41	102.26	48.84	0.4
2	PROCLADIUS (LPIL)	10.76	0.0	0.0	3.59	3.59	0.0
2	CORYNONEURA (LPIL)	0.0	0.0	5.38	1.79	1.79	0.0
2	PARACHIRONOMUS (LPIL)	21.53	21.53	86.11	43.06	21.53	0.2
2	GLYPTOTENDIPES (LPIL)	9698.60	23842.84	18772.87	17438.10	4137.27	69.9
2	THIENEMANNIELLA	32.29	21.53	102.26	52.03	25.31	0.2
2	PSECTROCLADIUS (LPIL)	812.70	86.11	457.48	452.10	209.77	1.8
2	GOELDICHIRONOMUS	32.29	0.0	32.29	21.53	10.76	0.1
3	CHIRONOMIDAE (LPIL)	758.88	2163.62	909.58	1277.36	445.26	5.1
0	SIMULIIDAE						
2	SIMULIUM (LPIL)	0.0	10.76	5.38	5.38	3.11	0.0
0	ECTOPROCTA (TOTAL)	0.0	43.06	26.91	23.32	12.56	0.1
0	PLUMATELLIDAE						
11	PLUMATELLA REPENS	0.0	43.06	26.91	23.32	12.56	0.1
TOTAL		18638.30	27147.45	29041.94	24942.56	3199.22	100.0
DIVERSITY (H PRIME)		2.45	0.76	2.07	1.76	0.51	
DIVERSITY (J PRIME)		0.58	0.20	0.46	0.41	0.11	
NUMBER OF TAXA		29	21	34	40		
BOTTOM TYPE	0						

ABOVE COMPUTED USING SAMPLE IDS

26301	26302	26303	26304
26311	26312	26313	26314
26321	26322	26323	26324

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PRAIRIE ISLAND NUCLEAR GENERATING PLANT

MACROINVERTEBRATE DENSITY (NUMBER PER SQUARE METER)

HESTER-DENDY MULTIPLATE SAMPLER

WITHIN-SITE REPORT

Table 2.2-7 (cont)

DISCHARGE JULY

LS	TAXA	Y-1	Y-2	$\bar{X}$	S.E.	REL ADX
		6	7			
0	NEMATODA (TOTAL)	156.08	301.40	228.74	72.66	1.0
1	NEMATODA (LPIL)	156.08	301.40	228.74	72.66	1.0
0	ENDOPROCTA	16.15	0.0	8.07	8.07	0.0
0	ENDOPROCTA					
11	URNATELLA GRACILIS	16.15	0.0	8.07	8.07	0.0
0	OLIGOCHAETA (TOTAL)	48.44	2335.84	1192.14	1143.70	5.0
0	NAIDIDAE					
1	NAIDIDAE (LPIL)	48.44	2335.84	1192.14	1143.70	5.0
0	HIRUDINEA (TOTAL)	0.0	10.76	5.38	5.38	0.0
0	ERPOBDELLIDAE					
1	ERPOBDELLA (LPIL)	0.0	10.76	5.38	5.38	0.0
0	ARACHNIDA (TOTAL)	0.0	43.06	21.53	21.53	0.1
0	PROSTIGMATA					
1	HYDRACARINA (LPIL)	0.0	43.06	21.53	21.53	0.1
0	AMPHIPODA (TOTAL)	10.76	0.0	5.38	5.38	0.0
0	HYALELLIDAE					
1	HYALELLA AZTECA	10.76	0.0	5.38	5.38	0.0
0	EPHEMEROPTERA (TOTAL)	231.43	231.43	231.43	0.00	1.0
0	SIPHLONURIDAE					
10	ISONYCHIA (LPIL)	0.0	5.38	2.69	2.69	0.0
0	BAETIDAE					
10	PSEUDOCLEON (LPIL)	0.0	5.38	2.69	2.69	0.0
10	BAETIDAE (LPIL)	5.38	0.0	2.69	2.69	0.0
0	HEPTAGENIIDAE					
10	STENONEMA (LPIL)	48.44	91.50	69.97	21.53	0.3
0	TRICORYTHIDAE					
10	TRICORYTHODES (LPIL)	0.0	10.76	5.38	5.38	0.0
0	CAENIDAE					
10	CAENIS (LPIL)	177.61	86.11	131.86	45.75	0.6
0	EPHEMEROPTERA (LPIL)	0.0	32.29	16.15	16.15	0.1
0	ODONATA (TOTAL)	5.38	0.0	2.69	2.69	0.0
0	COENAGRIONIDAE					
10	ENALLAGMA (LPIL)	5.38	0.0	2.69	2.69	0.0
0	TRICHOPTERA (TOTAL)	538.21	2066.74	1302.48	764.26	5.5
0	HYDROPSYCHIDAE					
2	HYDROPSYCHE ORRIS	150.70	1103.34	627.02	476.32	2.7
2	HYDROPSYCHE (LPIL)	37.67	199.14	118.41	80.73	0.5
2	CHEUMATOPSYCHE (LPIL)	10.76	285.25	148.01	137.24	0.6
2	POTAMYIA (LPIL)	0.0	37.67	18.84	18.84	0.1
2	HYDROPSYCHIDAE (LPIL)	10.76	21.53	16.15	5.38	0.1
0	POLYCENTROPODIDAE					
2	CYRNELLUS (LPIL)	96.88	0.0	48.44	48.44	0.2

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PRAIRIE ISLAND NUCLEAR GENERATING PLANT

MACROINVERTEBRATE DENSITY (NUMBER PER SQUARE METER)

HESTER-DENDY MULTIPLATE SAMPLER

WITHIN-SITE REPORT

Table 2.2-7 (cont)

DISCHARGE JULY

LS	TAXA	Y-1	Y-2	X	S.E.	REL ABX
		6	7			
2	NEUROCLIPSIS (LPIL)	80.73	215.29	148.01	67.28	0.6
2	POLYCENTROPODIDAE	5.38	0.0	2.69	2.69	0.0
3	TRICHOPTERA (LPIL)	145.32	172.23	158.77	13.46	0.7
2	TRICHOPTERA (LPIL)	0.0	32.29	16.15	16.15	0.1
0	DIPTERA NEMATOCERA (TOTAL)	19268.02	21969.84	20618.93	1350.91	87.2
0	TIPULIDAE					
3	TIPULIDAE (LPIL)	0.0	10.76	5 38	5.38	0.0
0	CHIRONOMIDAE					
2	ORTHOCLADIUS (LPIL)	0.0	113.02	56.51	56.51	0.2
2	CRICOTOPUS (LPIL)	16.15	505.92	261.03	244.89	1.1
2	TANYTARSUS (LPIL)	279.87	6786.86	3533.37	3253.50	14.9
2	DICROTENDIPES (LPIL)	296 3	339.07	314.85	24.22	1.3
2	POLYPEDILUM (LPIL)	702 4	1410.12	756.19	653.93	3.2
2	ABLABESMYIA (LPIL)	80.73	134.55	107.64	26.91	0.5
2	PARACHIRONOMUS (LPIL)	10.76	32.29	21.53	10.76	0.1
2	CRYPTOTENDIPES (LPIL)	17561.89	10516.68	14039.28	3522.60	59.4
2	EUKIEFFERIELLA (LPIL)	0.0	37.67	18.84	18.84	0.1
2	THIENEMANNIELLA	10.76	86.11	48.44	37.67	0.2
2	PSECTROCLADIUS (LPIL)	16.15	446.72	231.43	215.29	1.0
2	GOELDICHIRONOMUS	0.0	177.61	88.81	88.81	0.4
3	CHIRONOMIDAE (LPIL)	898.82	1216.36	1057.59	158.77	4.5
2	CHIRONOMIDAE (LPIL)	0.0	5.38	2 69	2.69	0.0
0	SIMULIIDAE					
3	SIMULIUM (LPIL)	0.0	16.15	8.07	8.07	0.0
2	SIMULIUM (LPIL)	0.0	134.55	67.28	67.28	0.3
0	ECTOPROCTA (TOTAL)	21.53	16.15	18.84	2.69	0.1
0	PLUMATELLIDAE					
11	PLUMATELLA REPENS	21.53	16.15	18.84	2.69	0.1
TOTAL		20295.99	26975.21	23635.60	3339.61	100.0
DIVERSITY (H PRIME)		0.99	2.79	1.89	0.90	
DIVERSITY (J PRIME)		0.24	0.61	0.42	0.18	
NUMBER OF TAXA		27	33	39		

BOTTOM TYPE 0

ABOVE COMPUTED USING SAMPLE IDS

26331 26332 26333 26334
26341 26342 26343 26344

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PRAIRIE ISLAND NUCLEAR GENERATING PLANT

MACROINVERTEBRATE DENSITY (NUMBER PER SQUARE METER)

HESTER-DENDY MULTIPLATE SAMPLER

WITHIN-SITE REPORT

Table 2.2-7 (cont)

AUGUST

LS	TAXA	B-1 1	$\bar{X}$	S.E.	REL AB%
0	PLATYHELMINTHES (TOTAL)	10.76	10.76	-1.00	0.1
1	TURBELLARIA-(LPIL)	10.76	10.76	-1.00	0.1
0	ARACHNIDA (TOTAL)	118.41	118.41	-1.00	0.6
0	PROSTIGMATA				
1	HYDRACARINA (LPIL)	118.41	118.41	-1.00	0.6
0	EPHEMEROPTERA (TOTAL)	1453.18	1453.18	-1.00	7.6
0	SIPHLONURIDAE				
10	ISONYCHIA (LPIL)	21.53	21.53	-1.00	0.1
0	BAETIDAE				
10	BAETIS (LPIL)	796.56	796.56	-1.00	4.1
0	HEPTAGENIIDAE				
10	STENONEMA (LPIL)	624.33	624.33	-1.00	3.2
0	CAENIDAE				
10	CAENIS (LPIL)	10.76	10.76	-1.00	0.1
0	TRICHOPTERA (TOTAL)	14940.79	14940.79	-1.00	77.6
0	HYDROPSYCHIDAE				
2	HYDROPSYCHE ORRIS	4553.28	4553.28	-1.00	23.7
3	HYDROPSYCHE (LPIL)	581.27	581.27	-1.00	3.0
2	HYDROPSYCHE (LPIL)	1948.33	1948.33	-1.00	10.1
2	CHEUMATOPSYCHE (LPIL)	3229.28	3229.28	-1.00	16.8
3	CHEUMATOPSYCHE (LPIL)	64.59	64.59	-1.00	0.3
2	HYDROPSYCHIDAE (LPIL)	4402.58	4402.58	-1.00	22.9
0	HYDROPTILIDAE				
10	AGRAYLEA (LPIL)	10.76	10.76	-1.00	0.1
0	LEPTOCERIDAE				
3	NECTOPSYCHE (=LEPTOCELLA)(LPIL)	10.76	10.76	-1.00	0.1
0	POLYCENTROPODIDAE				
2	POLYCENTROPODIDAE	21.53	21.53	-1.00	0.1
3	TRICHOPTERA (LPIL)	118.41	118.41	-1.00	0.6
0	DIPTERA NEMATOCERA (TOTAL)	2486.54	2486.54	-1.00	12.9
0	CHIRONOMIDAE				
2	CRICOTOPUS (LPIL)	32.29	32.29	-1.00	0.2
2	TANYTARSUS (LPIL)	667.38	667.38	-1.00	3.5
2	POLYPEDILUM (LPIL)	1453.18	1453.18	-1.00	7.6
2	ABLABESMYIA (LPIL)	43.06	43.06	-1.00	0.2
2	GLYPTOTENDIPES (LPIL)	21.53	21.53	-1.00	0.1
2	THIENEMANNIELLA	10.76	10.76	-1.00	0.1
2	PSECTROCLADIUS (LPIL)	204.52	204.52	-1.00	1.1
3	CHIRONOMIDAE (LPIL)	53.82	53.82	-1.00	0.3
0	DIPTERA BRACHYCERA (TOTAL)	236.81	236.81	-1.00	1.2
0	EMPIDIDAE				
3	EMPIDIDAE (LPIL)	32.29	32.29	-1.00	0.2

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PRAIRIE ISLAND NUCLEAR GENERATING PLANT

MACROINVERTEBRATE DENSITY (NUMBER PER SQUARE METER)

HESTER-DENDY MULTIPLATE SAMPLER

WITHIN-SITE REPORT

Table 2.2-7 (cont)

AUGUST

LS	TAXA	B-1	$\bar{x}$	S.E.	REL ABX
		1			
2	EMPIDIDAE (LPIL)	204.52	204.52	-1.00	1.1
	TOTAL	19246.47	19246.47	-1.00	100.0
	DIVERSITY (H PRIME)	2.87	2.87	-1.00	
	DIVERSITY (J PRIME)	0.74	0.74	-1.00	
	NUMBER OF TAXA	23	23		
	BOTTOM TYPE 0				

ABOVE COMPUTED USING SAMPLE IDS
26351 26352 26353 26354

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PRAIRIE ISLAND NUCLEAR GENERATING PLANT

MACROINVERTEBRATE DENSITY (NUMBER PER SQUARE METER)

HESTER-DENDY MULTIPLATE SAMPLER

WITHIN-SITE REPORT

AUGUST

LS	TAXA	STURGEON LAKE 2	X	S.E.	REL AB%
0	OLIGOCHAETA (TOTAL)	64.59	64.59	-1.00	0.4
0	NAIDIDAE				
1	NAIDIDAE (LPIL)	64.59	64.59	-1.00	0.4
0	ARACHNIDA (TOTAL)	333.69	333.69	-1.00	2.2
0	PROSTIGMATA				
1	HALACARIDAE	64.59	64.59	-1.00	0.4
1	HYDRACARINA (LPIL)	269.11	269.11	-1.00	1.8
0	EPHEMEROPTERA (TOTAL)	613.56	613.56	-1.00	4.0
0	BAETIDAE				
10	BAETIS (LPIL)	344.46	344.46	-1.00	2.3
0	HEPTAGENIIDAE				
10	STENONEMA (LPIL)	236.81	236.81	-1.00	1.5
0	CAENIDAE				
10	CAENIS (LPIL)	32.29	32.29	-1.00	0.2
0	TRICHOPTERA (TOTAL)	9246.49	9246.49	-1.00	60.4
0	HYDROPSYCHIDAE				
2	HYDROPSYCHE ORRIS	1948.33	1948.33	-1.00	12.7
3	HYDROPSYCHE (LPIL)	376.75	376.75	-1.00	2.5
2	HYDROPSYCHE (LPIL)	1463.94	1463.94	-1.00	9.6
2	CHEUMATOPSYCHE (LPIL)	2120.56	2120.56	-1.00	13.9
3	CHEUMATOPSYCHE (LPIL)	118.41	118.41	-1.00	0.8
2	POTAMYIA (LPIL)	150.70	150.70	-1.00	1.0
2	HYDROPSYCHIDAE (LPIL)	1733.05	1733.05	-1.00	11.3
0	POLYCENTROPODIDAE				
2	NEURECLIPSIS (LPIL)	1248.65	1248.65	-1.00	8.2
3	NEURECLIPSIS (LPIL)	75.35	75.35	-1.00	0.5
2	TRICHOPTERA (LPIL)	10.76	10.76	-1.00	0.1
0	DIPTERA NEMATOCERA (TOTAL)	4994.61	4994.61	-1.00	32.6
0	CHIRONOMIDAE				
2	TANYTARSUS (LPIL)	828.85	828.85	-1.00	5.4
2	POLYPEDILUM (LPIL)	2777.18	2777.18	-1.00	18.1
2	ABLABESMYIA (LPIL)	118.41	118.41	-1.00	0.8
2	GLYPTOTENDIPES (LPIL)	753.50	753.50	-1.00	4.9
2	THIENEMANNIELLA	21.53	21.53	-1.00	0.1
2	PSECTROCLADIUS (LPIL)	247.58	247.58	-1.00	1.6
2	NILOTANYPUS (LPIL)	10.76	10.76	-1.00	0.1
3	CHIRONOMIDAE (LPIL)	236.81	236.81	-1.00	1.5
0	DIPTERA BRACHYCERA (TOTAL)	21.53	21.53	-1.00	0.1
0	EMPIDIDAE				
3	EMPIDIDAE (LPIL)	10.76	10.76	-1.00	0.1
2	EMPIDIDAE (LPIL)	10.76	10.76	-1.00	0.1
0	ECTOPROCTA (TOTAL)	32.29	32.29	-1.00	0.2

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PRAIRIE ISLAND NUCLEAR GENERATING PLANT

MACROINVERTEBRATE DENSITY (NUMBER PER SQUARE METER)

HESTER-DENDY MULTIPLATE SAMPLER

WITHIN-SITE REPORT

AUGUST

LS	TAXA	STURGEON LAKE ?	- X	S.E.	REL ABX
0	PLUMATELLIDAE				
11	PLUMATELLA REPENS	30.29	32.29	-1.00	0.2
TOTAL		15306.75	15306.75	-1.00	100.0
DIVERSITY (H PRIME)		3.34	3.34	-1.00	
DIVERSITY (J PRIME)		0.81	0.81	-1.00	
NUMBER OF TAXA		23	23		
BOTTOM TYPE	0				

ABOVE COMPUTED USING SAMPLE IDS
26361 26362 26363 26364

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PRAIRIE ISLAND NUCLEAR GENERATING PLANT

MACROINVERTEBRATE DENSITY (NUMBER PER SQUARE METER)

HESTER-DENDY MULTIPLATE SAMPLER

WITHIN-SITE REPORT

INTAKE AUGUST

LS	TAXA	X-1	X-2	X-3	X	S.E.	REL ABX
		3	4	5			
0	CNIDARIA (TOTAL)	21.53	0.0	10.76	10.76	6.21	0.0
0	HYDROZOA						
1	HYDRA (LPIL)	0.0	0.0	10.76	3.59	3.59	0.0
11	CORDYLOPHORA LACUSTRIS	21.53	0.0	0.0	7.18	7.18	0.0
0	PLATYHELMINTHES (TOTAL)	10.76	32.29	21.53	21.53	6.21	0.1
1	TURBELLARIA-(LPIL)	10.76	32.29	21.53	21.53	6.21	0.1
0	NEMATODA (TOTAL)	0.0	[illegible].06	742.73	261.93	240.72	0.7
1	NEMATODA (LPIL)	0.0	43.06	74[illegible]	261.93	240.72	0.7
0	ENDOPROCTA	0.0	32.29	[illegible]1.53	17.94	9.49	0.0
0	ENDOPROCTA						
11	URNATELLA GRACILIS	0.0	32.29	21[illegible]	17.94	9.49	0.0
0	OLIGOCHAETA (TOTAL)	204.52	2658.77	10301.[illegible]	4388.23	3040.28	11.3
0	NAIDIDAE						
1	NAIDIDAE (LPIL)	204.52	2658.77	10301[illegible]	4388.23	3040.28	11.3
0	ARACHNIDA (TOTAL)	64.59	75.35	0.[illegible]	46.65	23.53	0.1
0	PROSTIGMATA						
1	HYDRACARINA (LPIL)	64.59	75.35	0.0	46.65	23.53	0.1
0	EPHEMEROPTERA (TOTAL)	333.69	365.98	118.[illegible]	272.69	77.70	0.7
0	BAETIDAE						
10	BAETIS (LPIL)	204.52	204.52	64.[illegible]	157.88	46.65	0.4
10	BAETIDAE (LPIL)	0.0	53.82	0.[illegible]	17.94	17.94	0.0
0	HEPTAGENIIDAE						
10	STENONEMA (LPIL)	118.41	32.29	43.[illegible]	64.59	27.09	0.2
0	CAENIDAE						
10	CAENIS (LPIL)	10.76	75.35	10.[illegible]	32.29	21.53	0.1
0	TRICHOPTERA (TOTAL)	6189.45	15005.37	2045[illegible]	7746.67	3821.44	19.9
0	HYDROPSYCHIDAE						
2	HYDROPSYCHE ORRIS	1614.64	4155.00	753[illegible]	2174.38	1021.04	5.6
3	HYDROPSYCHE (LPIL)	182.99	150.70	21.[illegible]	118.41	49.33	0.3
2	HYDROPSYCHE (LPIL)	861.14	1248.65	365.[illegible]	825.26	255.44	2.1
2	CHEUMATOPSYCHE (LPIL)	559.74	3670.61	215.[illegible]	1481.68	1098.87	3.8
3	CHEUMATOPSYCHE (LPIL)	43.06	107.64	64.[illegible]	71.76	18.99	0.2
2	POTAMYIA (LPIL)	32.29	613.56	107.[illegible]	151.17	182.50	0.6
2	HYDROPSYCHIDAE (LPIL)	861.14	4004.30	452.[illegible]	1772.51	1122.12	4.5
0	HYDROPTILIDAE						
2	AGRAYLEA (LPIL)	21.53	0.0	0.0	7.18	7.18	0.0
2	HYDROPTILIDAE (LPIL)	0.0	10.76	0.0	3.59	3.59	0.0
3	HYDROPTILIDAE (LPIL)	0.0	10.76	0.0	3.59	3.59	0.0
0	POLYCENTROPODIDAE						
2	CYRNELLUS (LPIL)	43.06	96.88	0.0	46.65	28.02	0.1
2	NEURECLIPSIS (LPIL)	1657.70	409.04	10.76	692.50	496.10	1.8
3	NEURECLIPSIS (LPIL)	161.46	0.0	0.0	53.82	53.82	0.1

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Table 2.2-7 (cont)

PRAIRIE ISLAND NUCLEAR GENERATING PLANT

MAC MVERTEBRATE DENSITY (NUMBER PER SQUARE METER)

HES DENDY MULTIPLATE SAMPLER

WITHIN-SITE REPORT

INTAKE AUGUST

LS	TAXA	X-1	X-2	X-3	X̄	S.E.	REL AB%
		3	4	5			
2	POLYCENTROPODIDAE	75.35	64.59	0.0	46.65	23.53	0.1
3	TRICHOPTERA (LPIL)	75.35	462.86	53.82	197.34	132.90	0.5
0	DIPTERA NEMATOCERA (TOTAL)	6910.65	17621.09	54047.34	26193.02	14266.22	67.2
0	CHIRONOMIDAE						
2	CRICOTOPUS (LPIL)	0.0	64.59	0.0	21.53	21.53	0.1
2	TANYTARSUS (LPIL)	462.86	581.27	118.41	387.51	138.93	1.0
2	DICROTENDIPES (LPIL)	182.99	32.29	0.0	71.76	56.39	0.2
2	POLYPEDILUM (LPIL)	2368.14	1862.22	462.86	1564.41	569.81	4.0
2	ABLABESMYIA (LPIL)	182.99	139.94	10.76	111.23	51.75	0.3
2	GLYPTOTENDIPES (LPIL)	3143.16	13401.50	49461.79	22002.15	14045.54	56.4
2	THIENEMANNIELLA	21.53	32.29	0.0	17.94	9.69	0.0
2	TANYPUS (LPIL)	0.0	452.10	0.0	150.70	150	0.4
2	PSECTROCLADIUS (LPIL)	236.81	505.92	129.17	290.63	112.54	0.7
3	CHIRONOMIDAE (LPIL)	312.16	548.98	3864.37	1575.17	1146.64	4.0
0	DIPTERA BRACHYCERA (TOTAL)	10.76	10.76	0.0	7.18	3.59	0.0
0	EMPIDIDAE						
2	EMPIDIDAE (LPIL)	10.76	10.76	0.0	7.18	3.59	0.0
0	ECTOPROCTA (TOTAL)	0.0	32.29	43.06	25.12	12.94	0.1
0	PLUMATELLIDAE						
1	PLUMATELLA REPENS	0.0	32.29	43.06	25.12	12.94	0.1
TOTAL		13745.93	35877.25	67351.81	38991.66	15552.84	100.0
DIVERSITY (H PRIME)		3.29	2.84	1.40	2.51	0.57	
DIVERSITY (J PRIME)		0.79	0.65	0.36	0.60	0.13	
NUMBER OF TAXA		26	31	22	34		

BOTTOM TYPE 0

ABOVE COMPUTED USING SAMPLE IDS

26371 26372 26373 26374
26381 26382 26383 26384
26391 26392 26393 26394

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NORTHERN STATES POWER COMPANY

PRAIRIE ISLAND NUCLEAR GENERATING PLANT

MACROINVERTEBRATE DENSITY (NUMBER PER SQUARE METER)

HESTER-DENDY MULTIPLATE SAMPLER

WITHIN-SITE REPORT

Table 2.2-7 (cont)

DISCHARGE AUGUST

LS	TAXA	Y-1	Y-2	$\bar{X}$	S.E.	REL AB%
		6	7			
0	CNIDARIA (TOTAL)	53.82	43.06	48.44	5.38	0.1
0	HYDROZOA					
1	HYDRA (LPIL)	53.82	10.76	32.29	21.53	0.1
11	CORDYLOPHORA LACUSTRIS	0.0	32.29	16.15	16.15	0.0
0	NEMATODA (TOTAL)	775.03	32.29	403.66	371.37	1.2
1	NEMATODA (LPIL)	775.03	32.29	403.66	371.37	1.2
0	ENDOPROCTA	21.53	0.0	10.76	10.76	0.0
0	ENDOPROCTA					
11	URNATELLA GRACILIS	21.53	0.0	10.76	10.76	0.0
0	OLIGOCHAETA (TOTAL)	9924.65	613.56	5269.11	4655.54	15.6
0	NAIDIDAE					
1	NAIDIDAE (LPIL)	9924.65	613.56	5269.11	4655.54	15.6
0	ARACHNIDA (TOTAL)	0.0	193.76	96.88	96.88	0.3
0	PROSTIGMATA					
1	HYDRACARINA (LPIL)	0.0	193.76	96.88	96.88	0.3
0	EPHEMEROPTERA (TOTAL)	0.0	839.61	419.81	419.81	1.2
0	SIPHLONURIDAE					
10	ISONYCHIA (LPIL)	0.0	10.76	5.38	5.38	0.0
0	BAETIDAE					
10	BAETIS (LPIL)	0.0	581.27	290.64	290.64	0.9
0	HEPTAGENIIDAE					
10	STENONEMA (LPIL)	0.0	161.46	80.73	80.73	0.2
10	EPHEMEROPTERA (LPIL)	0.0	86.11	43.06	43.06	0.1
0	TRICHOPTERA (TOTAL)	2637.24	9278.79	5958.01	3320.77	17.7
0	HYDROPSYCHIDAE					
2	HYDROPSYCHE ORRIS	10.76	3132.40	1571.58	1560.82	4.7
3	HYDROPSYCHE (LPIL)	0.0	107.64	53.82	53.82	0.2
2	HYDROPSYCHE (LPIL)	32.29	979.55	505.92	473.63	1.5
2	CHEUMATOPSYCHE (LPIL)	32.29	1937.57	984.93	952.64	2.9
3	CHEUMATOPSYCHE (LPIL)	0.0	193.76	96.88	96.88	0.3
2	POTAMYIA (LPIL)	0.0	53.82	26.91	26.91	0.1
2	HYDROPSYCHIDAE (LPIL)	32.29	2195.91	1114.10	1081.81	3.3
0	POLYCENTROPODIDAE					
2	CYRNELLUS (LPIL)	1097.95	32.29	565.12	532.83	1.7
2	NEURECLIPSIS (LPIL)	1151.78	462.86	807.32	344.46	2.4
3	NEURECLIPSIS (LPIL)	150.70	10.76	80.73	69.97	0.2
3	TRICHOPTERA (LPIL)	129.17	172.23	150.70	21.53	0.4
0	DIPTERA NEMATOCERA (TOTAL)	34811.62	8083.95	21447.78	13363.83	63.6
0	CHIRONOMIDAE					
2	TANYTARSUS (LPIL)	86.11	710.44	398.28	312.16	1.2
2	DICROTENDIPES (LPIL)	53.82	10.76	32.29	21.53	0.1
2	POLYPEDILUM (LPIL)	96.88	3627.56	1862.22	1765.34	5.5

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PRAIRIE ISLAND NUCLEAR GENERATING PLANT

MACROINVERTEBRATE DENSITY (NUMBER PER SQUARE METER)

HESTER-DENDY MULTIPLATE SAMPLER

WITHIN-SITE REPORT

Table 2.2-7 (cont)

DISCHARGE AUGUST

LS	TAXA	Y-1	Y-2	X̄	S.E.	PEL ABX
		6	7			
2	ABLABESMYIA (LPIL)	322.93	139.94	231.43	91.50	0.7
2	CORYNONEURA (LPIL)	10.76	0.0	5.38	5.38	0.0
2	GLYPTOTENDIPES (LPIL)	32723.36	2443.49	17583.42	15139.93	52.2
2	THIENEMANNIELLA	0.0	53.82	26.91	26.91	0.1
2	STENOCHIRONOMUS (LPIL)	0.0	10.76	5.38	5.38	0.0
2	PSECTROCLADIUS (LPIL)	226.05	484.39	355.22	129.17	1.1
3	CHIRONOMIDAE (LPIL)	1291.71	602.80	947.25	344.46	2.8
0	DIPTERA BRACHYCERA (TOTAL)	0.0	21.53	10.76	10.76	0.0
0	EMPIDIDAE					
3	EMPIDIDAE (LPIL)	0.0	10.76	5.38	5.38	0.0
2	EMPIDIDAE (LPIL)	0.0	10.76	5.38	5.38	0.0
0	ECTOPROCTA (TOTAL)	43.06	32.29	37.67	5.38	0.1
0	PLUMATELLIDAE					
11	PLUMATELLA REPENS	43.06	32.29	37.67	5.38	0.1
TOTAL		48266.93	19138.82	33702.87	14564.05	100.0
DIVERSITY (H PRIME)		1.39	3.40	2.40	1.00	
DIVERSITY (J PRIME)		0.36	0.79	0.57	0.21	
NUMBER OF TAXA		20	28	30		
BOTTOM TYPE	0					

ABOVE COMPUTED USING SAMPLE IDS

26401 26402 26403 26404
26411 26412 26413 26414

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PRAIRIE ISLAND NUCLEAR GENERATING PLANT

MACROINVERTEBRATE DENSITY (NUMBER PER SQUARE METER)

HESTER-DENDY MULTIPLATE SAMPLER

WITHIN-SITE REPORT

SEPTEMBER

LS	TAXA	STURGEON LAKE 2	X	S.E.	REL ABX
0	CNIDARIA (TOTAL)	10.76	10.76	-1.00	0.1
0	HYDROZOA				
11	CORDYLOPHORA LACUSTRIS	10.76	10.76	-1.00	0.1
0	NEMATODA (TOTAL)	86.11	86.11	-1.00	0.5
1	NEMATODA (LPIL)	86.11	86.11	-1.00	0.5
0	OLIGOCHAETA (TOTAL)	21.53	21.53	-1.00	0.1
0	NAIDIDAE				
1	NAIDIDAE (LPIL)	21.53	21.53	-1.00	0.1
0	EPHEMEROPTERA (TOTAL)	731.97	731.97	-1.00	4.2
0	SIPHLONURIDAE				
10	ISONYCHIA (LPIL)	32.29	32.29	-1.00	0.2
0	BAETIDAE				
10	BAETIS (LPIL)	161.46	161.46	-1.00	0.9
0	HEPTAGENIIDAE				
10	STENONEMA (LPIL)	505.92	505.92	-1.00	2.9
10	EPHEMEROPTERA (LPIL)	32.29	32.29	-1.00	0.2
0	TRICHOPTERA (TOTAL)	13864.36	13864.36	-1.00	80.1
0	HYDROPSYCHIDAE				
2	HYDROPSYCHE ORRIS	6996.77	6996.77	-1.00	40.4
2	HYDROPSYCHE (LPIL)	398.28	398.28	-1.00	2.3
3	HYDROPSYCHE (LPIL)	32.29	32.29	-1.00	0.2
2	CHEUMATOPSYCHE (LPIL)	3767.49	3767.49	-1.00	21.8
2	POTAMYIA (LPIL)	258.34	258.34	-1.00	1.5
2	HYDROPSYCHIDAE (LPIL)	2195.91	2195.91	-1.00	12.7
0	POLYCENTROPODIDAE				
2	NEURECLIPSIS (LPIL)	86.11	86.11	-1.00	0.5
2	POLYCENTROPODIDAE	10.76	10.76	-1.00	0.1
3	TRICHOPTERA (LPIL)	118.41	118.41	-1.00	0.7
0	DIPTERA NEMATOCERA (TOTAL)	2551.13	2551.13	-1.00	14.7
0	CHIRONOMIDAE				
2	TANYTARSUS (LPIL)	914.96	914.96	-1.00	5.3
2	POLYPEDILUM (LPIL)	452.10	452.10	-1.00	2.6
2	ABLABESMYIA (LPIL)	43.06	43.06	-1.00	0.2
2	GLYPTOTENDIPES (LPIL)	785.79	785.79	-1.00	4.5
2	PSECTROCLADIUS (LPIL)	43.06	43.06	-1.00	0.2
3	CHIRONOMIDAE (LPIL)	312.16	312.16	-1.00	1.8
0	DIPTERA BRACHYCERA (TOTAL)	32.29	32.29	-1.00	0.2
0	EMPIDIDAE				
2	EMPIDIDAE (LPIL)	32.29	32.29	-1.00	0.2
TOTAL		17298.15	17298.15	-1.00	100.0
DIVERSITY (H PRIME)		2.65	2.65	-1.00	
DIVERSITY (J PRIME)		0.67	0.67	-1.00	

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PRAIRIE ISLAND NUCLEAR GENERATING PLANT

MACROINVERTEBRATE DENSITY (NUMBER PER SQUARE METER)

HESTER-DENDY MULTIPLATE SAMPLER

WITHIN-SITE REPORT

Table 2.2-7 (cont)

SEPTEMBER

STURGEON LAKE

LS	TAXA		- X	S.E.	REL ABY
	NUMBER OF TAXA	2			
	BOTTOM TYPE 0	22	22		

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26431 26432 26433 26434

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PRAIRIE ISLAND NUCLEAR GENERATING PLANT

MACROINVERTEBRATE DENSITY (NUMBER PER SQUARE METER)

HESTER-DENDY MULTIPLATE SAMPLER

WITHIN-SITE REPORT

Table 2.2-7 (cont)

INTAKE SEPTEMBER

LS	TAXA	X-1 3	X-2 4	X-3 5	X̄	S.E.	REL ABX
0	CNIDARIA (TOTAL)	10.76	43.06	10.76	21.53	10.76	0.1
0	HYDROZOA						
1	HYDRA (LPIL)	0.0	32.29	0.0	10.76	10.76	0.0
11	CORDYLOPHORA LACUSTRIS	10.76	10.76	10.76	10.76	0.0	0.0
0	PLATYHELMINTHES (TOTAL)	10.76	182.99	10.76	68.17	57.41	0.2
1	TURBELLARIA-(LPIL)	10.76	182.99	10.76	68.17	57.41	0.2
0	NEMATODA (TOTAL)	53.82	247.58	0.0	100.47	75.18	0.3
1	NEMATODA (LPIL)	53.82	247.58	0.0	100.47	75.18	0.3
0	ENDOPROCTA	0.0	43.06	32.29	25.12	12.94	0.1
0	ENDOPROCTA						
11	URNATELLA GRACILIS	0.0	43.06	32.29	25.12	12.94	0.1
0	OLIGOCHAETA (TOTAL)	301.40	3907.43	764.26	1657.70	1172.77	4.8
0	NAIDIDAE						
1	NAIDIDAE (LPIL)	301.40	3907.43	764.26	1657.70	1152.77	4.8
0	ARACHNIDA (TOTAL)	10.76	0.0	10.76	7.18	3.59	0.0
0	PROSTIGMATA						
1	HYDRACARINA (LPIL)	10.76	0.0	10.76	7.18	3.59	0.0
0	EPHEMEROPTERA (TOTAL)	828.85	32.29	172.23	344.46	245.54	1.0
0	SIPHLONURIDAE						
10	ISONYCHIA (LPIL)	10.76	0.0	0.0	3.59	3.59	0.0
0	BAETIDAE						
10	BAETIS (LPIL)	258.34	0.0	43.06	100.47	79.91	0.3
0	HEPTAGENIIDAE						
10	STENONEMA (LPIL)	559.74	32.29	118.41	236.81	163.37	0.7
0	CAENIDAE						
10	CAENIS (LPIL)	0.0	0.0	10.76	3.59	3.59	0.0
0	TRICHOPTERA (TOTAL)	11248.64	1926.80	22174.37	11783.27	5851.07	34.0
0	HYDROPSYCHIDAE						
2	HYDROPSYCHE ORRIS	4090.42	1001.08	12992.46	6027.98	3594.62	17.4
2	HYDROPSYCHE (LPIL)	728.78	376.75	484.39	609.97	182.08	1.8
3	HYDROPSYCHE (LPIL)	32.29	96.88	236.81	121.99	60.36	0.4
2	CHEUMATOPSYCHE (LPIL)	2626.48	204.52	2895.59	1908.86	855.70	5.5
3	CHEUMATOPSYCHE (LPIL)	0.0	10.76	21.53	10.76	6.21	0.0
2	POTAMYIA (LPIL)	301.40	75.35	269.11	215.29	70.59	0.6
2	HYDROPSYCHIDAE (LPIL)	1571.53	43.06	5123.79	2246.14	1504.96	6.5
0	LEPTOCERIDAE						
2	NECTOPSYCHE (=LEPTOCELLA)(LPIL)	10.76	0.0	0.0	3.59	3.59	0.0
0	POLYCENTROPODIDAE						
2	CYRNELLUS (LPIL)	258.34	32.29	96.88	129.17	67.22	0.4
2	NEURECLIPSIS (LPIL)	1356.30	10.76	0.0	455.69	450.32	1.3
2	POLYCENTROPODIDAE	10.76	0.0	0.0	3.59	3.59	0.0
3	TRICHOPTERA (LPIL)	21.53	75.35	53.82	50.23	15.64	0.1

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Table 2.2-7 (cont)

PRAIRIE ISLAND NUCLEAR GENERATING PLANT

MACROINVERTEBRATE DENSITY (NUMBER PER SQUARE METER)

HESTER-DENDY MULTIPLATE SAMPLER

WITHIN-SITE REPORT

INTAKE SEPTEMBER

LS	TAXA	X-1	X-2	X-3	$\bar{X}$	S.E.	REL ABX
		3	4	5			
0	DIPTERA NEMATOCERA (TOTAL)	10559.73	46609.25	4316.46	20495.15	13180.85	59.2
0	CHIRONOMIDAE						
2	TANYTARSUS (LPIL)	785.79	0.0	269.11	351.63	230.56	1.0
2	DICROTENDIPES (LPIL)	150.70	0.0	0.0	50.23	50.23	0.1
2	POLYPEDILUM (LPIL)	107.64	43.06	236.31	129.17	56.96	0.4
2	ABLABESMYIA (LPIL)	355.22	0.0	43.06	132.76	111.92	0.4
2	GLYPTOTENDIPES (LPIL)	8654.46	44800.86	3466.09	18973.80	13000.09	54.8
2	THIENEMANNIELLA	32.29	0.0	0.0	10.76	10.76	0.0
2	PSECTROCLADIUS (LPIL)	129.17	21.53	204.52	118.41	53.10	0.3
3	CHIRONOMIDAE (LPIL)	344.46	1743.81	96.88	728.38	512.72	2.1
0	DIPTERA BRACHYCERA (TOTAL)	96.83	0.0	96.88	64.59	32.29	0.2
0	EMPIDIDAE						
2	EMPIDIDAE (LPIL)	96.88	0.0	86.11	61.00	30.66	0.2
3	EMPIDIDAE (LPIL)	0.0	0.0	10.76	3.59	3.59	0.0
0	ECTOPROCTA (TOTAL)	43.06	43.06	43.06	43.06	0.0	0.1
0	PLUMATELLIDAE						
11	PLUMATELLA REPENS	43.06	43.06	43.06	43.06	0.0	0.1
TOTAL		23164.66	53035.51	27631.84	34610.67	9302.24	100.0
DIVERSITY (H PRIME)		2.93	0.93	2.34	2.07	0.59	
DIVERSITY (J PRIME)		0.67	0.25	0.57	0.50	0.13	
NUMBER OF TAXA		28	20	23	31		
BOTTOM TYPE	0						

ABOVE COMPUTED USING SAMPLE IDS

26441	26442	26443	26444
26451	26452	26453	26454
26461	26462	26463	26464

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PRAIRIE ISLAND NUCLEAR GENERATING PLANT

MACROINVERTEBRATE DENSITY (NUMBER PER SQUARE METER)

HESTER-DENDY MULTIPLATE SAMPLER

WITHIN-SITE REPORT

DISCHARGE SEPTEMBER

LS	TAXA	Y-1	Y-2	$\bar{X}$	S.E.	REL ABX
		6	7			
0	PLATYHELMINTHES (TOTAL)	53.82	0.0	26.91	26.91	0.1
1	TURBELLARIA-(LPIL)	53.82	0.0	26.91	26.91	0.1
0	NEMATODA (TOTAL)	495.16	21.53	258.34	236.81	0.6
1	NEMATODA (LPIL)	495.16	21.53	258.34	236.81	0.6
0	ENDOPROCTA	21.53	0.0	10.76	10.76	0.0
0	ENDOPROCTA					
11	URNATELLA GRACILIS	21.53	0.0	10.76	10.76	0.0
0	OLIGOCHAETA (TOTAL)	4338.00	247.58	2292.79	2045.21	5.5
0	NAIDIDAE					
1	NAIDIDAE (LPIL)	4338.00	247.58	2292.79	2045.21	5.5
0	ARACHNIDA (TOTAL)	0.0	75.35	37.67	37.67	0.1
0	PROSTIGMATA					
1	HYDRACARINA (LPIL)	0.0	75.35	37.67	37.67	0.1
0	ISOPODA (TOTAL)	10.76	0.0	5.38	5.38	0.0
0	ASELLIDAE					
1	ASELLUS (LPIL)	10.76	0.0	5.38	5.38	0.0
0	EPHEMEROPTERA (TOTAL)	86.11	538.21	312.16	226.05	0.8
0	SIPHLONURIDAE					
10	ISONYCHIA (LPIL)	0.0	10.76	5.38	5.38	0.0
0	BAETIDAE					
10	BAETIS (LPIL)	0.0	193.76	96.88	96.88	0.2
0	HEPTAGENIIDAE					
10	STENONEMA (LPIL)	64.59	333.69	199.14	134.55	0.5
0	CAENIDAE					
10	CAENIS (LPIL)	21.53	0.0	10.76	10.76	0.0
0	COLEOPTERA POLYPHAGA (TOT	10.76	0.0	5.38	5.38	0.0
0	ELMIDAE					
2	DUBIRAPHIA (LPIL)	10.76	0.0	5.38	5.38	0.0
0	TRICHOPTERA (TOTAL)	3875.13	14337.98	9106.55	5231.42	22.0
0	HYDROPSYCHIDAE					
2	HYDROPSYCHE ORRIS	150.70	6738.43	3444.56	3293.86	8.3
2	HYDROPSYCHE (LPIL)	75.35	516.68	296.02	220.67	0.7
3	HYDROPSYCHE (LPIL)	0.0	301.40	150.70	150.70	0.4
2	CHEUMATOPSYCHE (LPIL)	53.82	3616.79	1835.31	1781.49	4.4
3	CHEUMATOPSYCHE (LPIL)	0.0	32.29	16.15	16.15	0.0
2	POTAMYIA (LPIL)	10.76	279.87	145.32	134.55	0.4
2	HYDROPSYCHIDAE (LPIL)	75.35	2615.72	1345.53	1270.18	3.2
0	HYDROPTILIDAE					
2	ORTHOTRICHIA (LPIL)	10.76	0.0	5.38	5.38	0.0
0	POLYCENTROPODIDAE					
2	CYRNELLUS (LPIL)	2529.60	107.64	1318.62	1210.98	3.2
2	NEURECLIPSIS (LPIL)	721.21	43.06	382.13	339.07	0.9

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Table 2.2-7 (cont)

PRAIRIE ISLAND NUCLEAR GENERATING PLANT

MACROINVERTEBRATE DENSITY (NUMBER PER SQUARE METER)

HESTER-DENDY MULTIPLATE SAMPLER

WITHIN-SITE REPORT

DISCHARGE SEPTEMBER

LS	TAXA	Y-1	Y-2	- X	S.E.	REL AB%
		6	7			
2	POLYCENTROPODIDAE	43.06	0.0	21.53	21.53	0.1
3	TRICHOPTERA (LPIL)	64.59	86.11	75.35	10.76	0.2
2	TRICHOPTERA (LPIL)	139.94	0.0	69.97	69.97	0.2
0	DIPTERA NEMATOCERA (TOTAL)	53659.82	4919.26	29289.54	24370.28	70.7
0	CHIRONOMIDAE					
2	CRICOTOPUS (LPIL)	10.76	10.76	10.76	0.0	0.0
2	TANYTARSUS (LPIL)	0.0	333.69	166.85	166.85	0.4
2	DICROTENDIPES (LPIL)	21.53	0.0	10.76	10.76	0.0
2	POLYPEDILUM (LPIL)	32.29	182.99	107.64	75.35	0.3
2	ABLABESMYIA (LPIL)	365.98	32.29	199.14	166.85	0.5
2	GLYPTOTENDIPES (LPIL)	52378.89	4025.83	28202.36	24176.52	68.1
2	PSECTROCLADIUS (LPIL)	96.88	64.59	80.73	16.15	0.2
3	CHIRONOMIDAE (LPIL)	635.09	269.11	452.10	182.99	1.1
2	CHIRONOMIDAE (LPIL)	118.41	0.0	59.20	59.20	0.1
0	DIPTERA BRACHYCERA (TOTAL)	0.0	64.59	32.29	32.29	0.1
0	EMPIDIDAE					
2	EMPIDIDAE (LPIL)	0.0	64.59	32.29	32.29	0.1
0	ECTOPROCTA (TOTAL)	75.35	43.06	59.20	16.15	0.1
0	PLUMATELLIDAE					
11	PLUMATELLA REPENS	43.06	43.06	43.06	0.0	0.1
0	CRISTATELLIDAE					
8	CRISTATELLA MUCEDO	32.29	0.0	16.15	16.15	0.0
TOTAL		62626.36	20247.55	41436.95	21189.40	100.0
DIVERSITY (H PRIME)		1.03	2.69	1.86	0.83	
DIVERSITY (J PRIME)		0.26	0.64	0.45	0.19	
NUMBER OF TAXA		27	23	32		
BOTTOM TYPE	0					

ABOVE COMPUTED USING SAMPLE IDS

26471 26472 26473 26474
26481 26482 26483 26484

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PRAIRIE ISLAND NUCLEAR GENERATING PLANT

MACROINVERTEBRATE DENSITY (NUMBER PER SQUARE METER)

HESTER-DENDY MULTIPLATE SAMPLER

WITHIN-SITE REPORT

Table 2.2-7 (cont)

NOVEMBER

LS	TAXA	B-1 1	$\bar{X}$	S.E.	REL ABX
0	NEMATODA (TOTAL)	86.11	86.11	-1.00	0.6
1	NEMATODA (LPIL)	86.11	86.11	-1.00	0.6
0	OLIGOCHAETA (TOTAL)	1216.36	1216.36	-1.00	8.1
0	NAIDIDAE				
1	NAIDIDAE (LPIL)	1216.36	1216.36	-1.00	8.1
0	EPHEMEROPTERA (TOTAL)	365.98	365.98	-1.00	2.4
0	SIPHLONURIDAE				
10	ISONYCHIA (LPIL)	10.76	10.76	-1.00	0.1
0	HEPTAGENIIDAE				
10	STENONEMA (LPIL)	355.22	355.22	-1.00	2.4
0	TRICHOPTERA (TOTAL)	7728.73	7728.73	-1.00	51.2
0	HYDROPSYCHIDAE				
2	HYDROPSYCHE ORRIS	2088.27	2088.27	-1.00	13.8
2	HYDROPSYCHE (LPIL)	290.64	290.64	-1.00	1.9
2	CHEUMATOPSYCHE (LPIL)	818.08	818.08	-1.00	5.4
2	POTAMYIA (LPIL)	161.46	161.46	-1.00	1.1
2	HYDROPSYCHIDAE (LPIL)	4058.13	4058.13	-1.00	26.9
0	HYDROPTILIDAE				
2	HYDROPTILA (LPIL)	86.11	86.11	-1.00	0.6
2	AGRAYLEA (LPIL)	64.59	64.59	-1.00	0.4
0	POLYCENTROPODIDAE				
2	CYRNELLUS (LPIL)	21.53	21.53	-1.00	0.1
2	NEURECLIPSIS (LPIL)	129.17	129.17	-1.00	0.9
2	TRICHOPTERA (LPIL)	10.76	10.76	-1.00	0.1
0	DIPTERA NEMATOCERA (TOTAL)	5640.46	5640.46	-1.00	37.4
0	CHIRONOMIDAE				
2	CRICOTOPUS (LPIL)	21.53	21.53	-1.00	0.1
2	TANYTARSUS (LPIL)	2777.18	2777.18	-1.00	18.4
2	DICROTENDIPES (LPIL)	43.06	43.06	-1.00	0.3
2	POLYPEDILUM (LPIL)	527.45	527.45	-1.00	3.5
2	ABLABESMYIA (LPIL)	236.81	236.81	-1.00	1.6
2	GLYPTOTENDIPES (LPIL)	139.94	139.94	-1.00	0.9
2	THIENEMANNIELLA	10.76	10.76	-1.00	0.1
2	PSECTROCLADIUS (LPIL)	1862.22	1862.22	-1.00	12.3
3	CHIRONOMIDAE (LPIL)	10.76	10.76	-1.00	0.1
2	CHIRONOMIDAE (LPIL)	10.76	10.76	-1.00	0.1
0	DIPTERA BRACHYCERA (TOTAL)	32.29	32.29	-1.00	0.2
0	EMPIDIDAE				
2	EMPIDIDAE (LPIL)	32.29	32.29	-1.00	0.2
0	ECTOPROCTA (TOTAL)	10.76	10.76	-1.00	0.1
0	PLUMATELLIDAE				
11	PLUMATELLA REPENS	10.76	10.76	-1.00	0.1

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PRAIRIE ISLAND NUCLEAR GENERATING PLANT

MACROINVERTEBRATE DENSITY (NUMBER PER SQUARE METER)

HESTER-DENDY MULTIPLATE SAMPLER

WITHIN-SITE REPORT

Table 2.2-7 (cont)

NOVEMBER

LS	TAXA	B-1 1	X	S.E.	REL ABX
	TOTAL	15080.71	15080.71	-1.00	100.0
	DIVERSITY (H PRIME)	2.87	2.87	-1.00	
	DIVERSITY (J PRIME)	0.72	0.72	-1.00	
	NUMBER OF TAXA	25	25		
	BOTTOM TYPE 0				

ABOVE COMPUTED USING SAMPLE IDS
26491 26492 26493 26494

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PRAIRIE ISLAND NUCLEAR GENERATING PLANT

MACROINVERTEBRATE DENSITY (NUMBER PER SQUARE METER)

HESTER-DENDY MULTIPLATE SAMPLER

WITHIN-SITE REPORT

NOVEMBER

STURGEON LAKE

LS	TAXA	2	X	S.E.	REL ABX
0	NEMATODA (TOTAL)	53.82	53.82	-1.00	0.4
1	NEMATODA (LPIL)	53.82	53.82	-1.00	0.4
0	OLIGOCHAETA (TOTAL)	1087.19	1087.19	-1.00	8.0
0	NAIDIDAE				
1	NAIDIDAE (LPIL)	1087.19	1087.19	-1.00	8.0
0	ARACHNIDA (TOTAL)	21.53	21.53	-1.00	0.2
0	PROSTIGMATA				
1	HYDRACARINA (LPIL)	21.53	21.53	-1.00	0.2
0	EPHEMEROPTERA (TOTAL)	322.93	322.93	-1.00	2.4
0	HEPTAGENIIDAE				
10	STENONEMA (LPIL)	322.93	322.93	-1.00	2.4
0	PLECOPTERA (TOTAL)	10.76	10.76	-1.00	0.1
10	PLECOPTERA (LPIL)	10.76	10.76	-1.00	0.1
0	TRICHOPTERA (TOTAL)	6986.00	6986.00	-1.00	51.6
0	HYDROPSYCHIDAE				
2	HYDROPSYCHE ORRIS	559.74	559.74	-1.00	4.1
2	HYDROPSYCHE (LPIL)	731.97	731.97	-1.00	5.4
2	CHEUMATOPSYCHE (LPIL)	731.97	731.97	-1.00	5.4
2	POTAMYIA (LPIL)	882.67	882.67	-1.00	6.5
2	HYDROPSYCHIDAE (LPIL)	3627.56	3627.56	-1.00	26.8
0	HYDROPTILIDAE				
2	HYDROPTILA (LPIL)	75.35	75.35	-1.00	0.6
2	AGRAYLEA (LPIL)	43.06	43.06	-1.00	0.3
0	POLYCENTROPODIDAE				
2	NEURECLIPSIS (LPIL)	333.69	333.69	-1.00	2.5
0	DIPTERA NEMATOCERA (TOTAL)	5016.14	5016.14	-1.00	37.1
0	CHIRONOMIDAE				
2	CRICOTOPUS (LPIL)	10.76	10.76	-1.00	0.1
2	TANYTARSUS (LPIL)	1603.87	1603.87	-1.00	11.9
2	DICROTENDIPES (LPIL)	43.06	43.06	-1.00	0.3
2	POLYPEDILUM (LPIL)	1065.66	1065.66	-1.00	7.9
2	ABLABESMYIA (LPIL)	172.23	172.23	-1.00	1.3
2	GLYPTOTENDIPES (LPIL)	635.09	635.09	-1.00	4.7
2	THIENEMANNIELLA	107.64	107.64	-1.00	0.8
2	PSECTROCLADIUS (LPIL)	1377.83	1377.83	-1.00	10.2
0	DIPTERA BRACHYCERA (TOTAL)	10.76	10.76	-1.00	0.1
0	EMPIDIDAE				
2	EMPIDIDAE (LPIL)	10.76	10.76	-1.00	0.1
0	ECTOPROCTA (TOTAL)	21.53	21.53	-1.00	0.2
0	PLUMATELLIDAE				
11	PLUMATELLA REPENS	10.76	10.76	-1.00	0.1
0	CRISTATELLIDAE				

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HESTER-DENDY MULTIPLATE SAMPLER

WITHIN-SITE REPORT

Table 2.2-7 (cont)

NOVEMBER

LS	TAXA	STURGEON LAKE	X	S.E.	REL ABX
		2			
8	CRISTATELLA MUCEDO	10.76	10.76	-1.00	0.1
TOTAL		13530.65	13530.65	-1.00	100.0
DIVERSITY (H PRIME)		3.31	3.31	-1.00	
DIVERSITY (J PRIME)		0.81	0.8	-1.00	
NUMBER OF TAXA		24	2		
BOTTOM TYPE	0				

ABOVE COMPUTED USING SAMPLE IDS
26501 26502 26503 26504

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NORTHERN STATES POWER COMPANY

PRAIRIE ISLAND NUCLEAR GENERATING PLANT

MACROINVERTEBRATE DENSITY (NUMBER PER SQUARE METER)

HESTER-DENDY MULTIPLATE SAMPLER

WITHIN-SITE REPORT

Table 2.2-7 (cont)

INTAKE NOVEMBER

LS	TAXA	X-1	X-2	X-3	- X	S.E.	REL ABX
		3	4	5			
0	CNIDARIA (TOTAL)	204.52	10.76	0.0	71.76	66.45	0.2
0	HYDROZOA						
1	HYDRA (LPIL)	204.52	0.0	0.0	68.17	68.17	0.2
11	CORDYLOPHORA LACUSTRIS	0.0	10.76	0.0	3.59	3.59	0.0
0	PLATYHELMINTHES (TOTAL)	0.0	172.23	2120.56	764.26	679.32	2.2
1	TURBELLARIA-(LPIL)	0.0	172.23	2120.56	764.26	679.32	2.2
0	NEMERTINA (TOTAL)	0.0	0.0	10.76	3.59	3.59	0.0
1	NEMERTINA (LPIL)	0.0	0.0	10.76	3.59	3.59	0.0
0	NEMATODA (TOTAL)	10.76	139.94	753.50	301.40	229.10	0.9
1	NEMATODA (LPIL)	10.76	139.94	753.50	301.40	229.10	0.9
0	ENDOPROCTA	0.0	32.29	32.29	21.53	10.76	0.1
0	ENDOPROCTA						
11	URNATELLA GRACILIS	0.0	32.29	32.29	21.53	10.76	0.1
0	OLIGOCHAETA (TOTAL)	2131.32	17093.64	52852.53	24025.83	15046.61	68.5
0	NAIDIDAE						
1	NAIDIDAE (LPIL)	2131.32	17093.64	52852.53	24025.83	15046.61	68.5
0	ARACHNIDA (TOTAL)	43.06	10.76	0.0	17.94	12.94	0.1
0	PROSTIGMATA						
1	HYDRACARINA (LPIL)	43.06	10.76	0.0	17.94	12.94	0.1
0	EPHEMEROPTERA (TOTAL)	376.75	64.59	0.0	147.11	116.32	0.4
0	HEPTAGENIIDAE						
10	STENONEMA (LPIL)	376.75	43.06	0.0	139.94	119.06	0.4
0	CAENIDAE						
10	CAENIS (LPIL)	0.0	21.53	0.0	7.18	7.18	0.0
0	PLECOPTERA (TOTAL)	32.29	0.0	0.0	10.76	10.76	0.0
0	ISOPERLIDAE						
10	ISOPERLA (LPIL)	10.76	0.0	0.0	3.59	3.59	0.0
10	PLECOPTERA (LPIL)	21.53	0.0	0.0	7.18	7.18	0.0
0	TRICHOPTERA (TOTAL)	5080.73	10688.90	613.56	5461.06	2914.71	15.6
0	HYDROPSYCHIDAE						
2	HYDROPSYCHE ORRIS	365.98	7362.75	538.21	2755.65	2304.09	7.9
2	HYDROPSYCHE (LPIL)	21.53	0.0	0.0	7.18	7.18	0.0
3	HYDROPSYCHE (LPIL)	0.0	53.82	10.76	21.53	16.44	0.1
2	CHEUMATOPSYCHE (LPIL)	592.03	1173.30	32.29	599.21	329.40	1.7
3	CHEUMATOPSYCHE (LPIL)	0.0	43.06	0.0	14.35	14.35	0.0
2	POTAMYIA (LPIL)	1237.89	1700.75	10.76	983.14	504.21	2.8
2	HYDROPSYCHIDAE (LPIL)	2012.92	53.82	10.76	692.50	660.32	2.0
0	HYDROPTILIDAE						
2	HYDROPTILA (LPIL)	215.29	10.76	10.76	78.94	68.17	0.2
2	AGRAYLEA (LPIL)	0.0	32.29	0.0	10.76	10.76	0.0
0	LEPTOCERIDAE						
2	NECTOPSYCHE (=LEPTOCELLA)(LPIL)	10.76	0.0	0.0	3.59	3.59	0.0

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Table 2.2-7 (cont)

PRAIRIE ISLAND NUCLEAR GENERATING PLANT

MACROINVERTEBRATE DENSITY (NUMBER PER SQUARE METER)

PETERSEN-DENDY MULTIPLATE SAMPLER

WITHIN-SITE REPORT

INTAKE NOVEMBER

LS	TAXA	X-1	X-2	X-3		- X	S.E.	REL ABX
		3	4	5				
0	POLYCENTROPODIDAE							
2	CYRNELLUS (LPIL)	21.53	0.0	0.0		7.18	7.18	0.0
2	NEURECLIPSIS (LPIL)	602.80	118.41	0.0		240.40	184.39	0.7
3	TRICHOPTERA (LPIL)	0.0	139.94	0.0		46.65	46.65	0.1
0	DIPTERA NEMATOCERA (TOTAL)	4510.22	3864.37	4155.00		4176.53	186.75	11.9
0	CHIRONOMIDAE							
2	CRICOTOPUS (LPIL)	21.53	0.0	0.0		7.18	7.18	0.0
2	TANYTARSUS (LPIL)	925.73	75.35	43.06		348.04	288.99	1.0
2	DICROTENDIPES (LPIL)	0.0	0.0	10.76		3.59	3.59	0.0
2	POLYPEDILUM (LPIL)	398.28	161.46	10.76		190.17	112.78	0.5
2	ABLABESMYIA (LPIL)	172.23	32.29	0.0		68.17	52.86	0.2
2	GLYPTOTENDIPES (LPIL)	1709.86	3423.03	3918.19		3103.70	584.66	8.9
2	THIENEMANNIELLA	139.94	0.0	0.0		46.65	46.65	0.1
2	PSECTROCLADIUS (LPIL)	871.91	64.59	10.76		315.75	278.51	0.9
3	CHIRONOMIDAE (LPIL)	10.76	107.64	161.46		93.29	44.09	0.3
0	DIPTERA BRACHYCERA (TOTAL)	10.76	0.0	0.0		3.59	3.59	0.0
0	EMPIDIDAE							
2	EMPIDIDAE (LPIL)	10.76	0.0	0.0		3.59	3.59	0.0
0	ECTOPROCTA (TOTAL)	32.29	64.59	43.06		46.65	9.49	0.1
0	LOPHOPODIDAE							
8	PECTINATELLA MAGNIFICA	0.0	10.76	0.0		3.59	3.59	0.0
0	PLUMATELLIDAE							
11	PLUMATELLA REPENS	21.53	43.06	32.29		32.29	6.21	0.1
0	CRISTATELLIDAE							
8	CRISTATELLA MUCEDO	10.76	10.76	10.76		10.76	0.0	0.0
TOTAL		12432.70	32142.06	60581.18		35051.98	13975.71	100.0
DIVERSITY (H PRIME)		3.46	1.97	0.79		2.07	0.77	
DIVERSITY (J PRIME)		0.83	0.48	0.23		0.51	0.17	
NUMBER OF TAXA		27	26	19		36		

BOTTOM TYPE 0

ABOVE COMPUTED USING SAMPLE IDS

26511 26512 26513 26514
26521 26522 26523 26524
26531 26532 26533 26534

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PRAIRIE ISLAND NUCLEAR GENERATING PLANT

MACROINVERTEBRATE DENSITY (NUMBER PER SQUARE METER)

HESTER-DENDY MULTIPLATE SAMPLER

WITHIN-SITE REPORT

Table 2.2-7 (cont)

DISCHARGE NOVEMBER

LS	TAXA	Y-1	Y-2	X	S.E.	REL ABX
		6	7			
0	CNIDARIA (TOTAL)	86.11	86.11	86.11	0.0	0.3
0	HYDROZOA					
1	HYDRA (LPIL)	86.11	86.11	86.11	0.0	0.3
0	PLATYHELMINTHES (TOTAL)	139.94	0.0	69.97	69.97	0.2
1	TURBELLARIA-(LPIL)	139.94	0.0	69.97	69.97	0.2
0	NEMERTINEA (TOTAL)	43.06	0.0	21.53	21.53	0.1
1	NEMERTINI (LPIL)	43.06	0.0	21.53	21.53	0.1
0	NEMATODA (TOTAL)	161.46	161.46	161.46	0.00	0.5
1	NEMATODA (LPIL)	161.46	161.46	161.46	0.00	0.5
0	ENDOPROCTA	32.29	0.0	16.15	16.15	0.1
0	ENDOPROCTA					
11	URNATELLA GRACILIS	32.29	0.0	16.15	16.15	0.1
0	OLIGOCHAETA (TOTAL)	9634.01	8331.54	8982.77	651.24	28.7
0	NAIDIDAE					
1	NAIDIDAE (LPIL)	9192.68	8331.54	8762.11	430.57	28.0
0	TUBIFICIDAE					
1	TUBIFICIDAE (LPIL)	441.33	0.0	220.67	220.67	0.7
0	HIRUDINEA (TOTAL)	10.76	0.0	5.38	5.38	0.0
0	GLOSSIPHONIIDAE					
1	PLACOBDELLA (LPIL)	10.76	0.0	5.38	5.38	0.0
0	GASTROPODA (TOTAL)	21.53	0.0	10.76	10.76	0.0
0	PHYSIDAE					
1	PHYSA (LPIL)	21.53	0.0	10.76	10.76	0.0
0	ARACHNIDA (TOTAL)	0.0	150.70	75.35	75.35	0.2
0	PROSTIGMATA					
1	HYDRACARINA (LPIL)	0.0	150.70	75.35	75.35	0.2
0	EPHEMEROPTERA (TOTAL)	312.16	570.51	441.33	129.17	1.4
0	BAETIDAE					
10	BAETIS (LPIL)	0.0	10.76	5.38	5.38	0.0
0	HEPTAGENIIDAE					
10	STENONEMA (LPIL)	215.29	516.68	365.98	150.70	1.2
0	TRICORYTHIDAE					
10	TRICORYTHODES (LPIL)	10.76	0.0	5.38	5.38	0.0
0	CAENIDAE					
10	CAENIS (LPIL)	64.59	0.0	32.29	32.29	0.1
0	POTAMANTHIDAE					
10	POTAMANTHUS (LPIL)	10.76	0.0	5.38	5.38	0.0
0	EPHEMERIDAE					
10	HEXAGENIA (LPIL)	0.0	32.29	16.15	16.15	0.1
10	EPHEMEROPTERA (LPIL)	10.76	10.76	10.76	0.0	0.0
0	PLECOPTERA (TOTAL)	0.0	21.53	10.76	10.76	0.0
0	ISOPERLIDAE					

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PRAIRIE ISLAND NUCLEAR GENERATING PLANT

Table 2.2-7 (cont)

MACROINVERTEBRATE DENSITY (NUMBER PER SQUARE METER)

HESTER-DENDY MULTIPLATE SAMPLER

WITHIN-SITE REPORT

DISCHARGE NOVEMBER

LS	TAXA	Y-1	Y-2	X̄	S.E.	REL ABX
		6	7			
10	ISOPERLA (LPIL)	0.0	21.53	10.76	10.76	0.0
0	TRICHOPTERA (TOTAL)	4467.16	9612.48	7039.82	2572.66	22.5
0	HYDROPSYCHIDAE					
2	HYDROPSYCHE ORRIS	753.50	1980.62	1367.06	613.56	4.4
2	HYDROPSYCHE (LPIL)	21.53	75.35	48.44	26.91	0.2
2	CHEUMATOPSYCHE (LPIL)	441.33	1280.95	861.14	419.81	2.8
2	POTAMYIA (LPIL)	1270.18	1829.92	1550.05	279.87	5.0
2	HYDROPSYCHIDAE (LPIL)	473.63	3853.60	2163.62	1689.99	6.9
0	HYDROPTILIDAE					
2	HYDROPTILA (LPIL)	43.06	150.70	96.88	53.82	0.3
2	AGRAYLEA (LPIL)	0.0	21.53	10.76	10.76	0.0
0	POLYCENTROPODIDAE					
2	CYRNELLUS (LPIL)	322.93	0.0	161.46	161.46	0.5
2	NEURECLIPSIS (LPIL)	1141.01	344.46	742.73	398.28	2.4
2	POLYCENTROPODIDAE	0.0	75.35	37.67	37.67	0.1
0	DIPTERA NEMATOCERA (TOTAL)	24574.80	4025.83	14300.32	10274.48	45.7
0	CERATOPOGONIDAE					
2	CERATOPOGONIDAE (LPIL)	10.76	0.0	5.38	5.38	0.0
0	CHIRONOMIDAE					
2	CHIRONOMUS (LPIL)	10.76	0.0	5.38	5.38	0.0
2	TANYTARSUS (LPIL)	215.29	1410.12	812.70	597.42	2.6
2	DICROTENDIPES (LPIL)	43.06	0.0	21.53	21.53	0.1
2	POLYPEDILUM (LPIL)	129.17	775.03	452.10	322.93	1.4
2	ABLABESMYIA (LPIL)	398.28	43.06	220.67	177.61	0.7
2	PROCLADIUS (LPIL)	10.76	0.0	5.38	5.38	0.0
2	GLYPTOTENDIPES (LPIL)	23379.98	1291.71	12335.84	11044.13	39.4
2	THIENEMANNIELLA	10.76	53.82	32.29	21.53	0.1
2	PSECTROCLADIUS (LPIL)	215.29	419.81	317.55	102.26	1.0
3	CHIRONOMIDAE (LPIL)	150.70	32.29	91.50	59.20	0.3
0	ECTOPROCTA (TOTAL)	96.88	10.76	53.82	43.06	0.2
0	PLUMATELLIDAE					
11	PLUMATELLA REPENS	32.29	10.76	21.53	10.76	0.1
0	CRISTATELLIDAE					
8	CRISTATELLA MUCEDO	64.59	0.0	32.29	32.29	0.1
TOTAL		39580.16	22970.91	31275.54	8304.63	100.0
DIVERSITY (H PRIME)		1.98	2.94	2.46	0.48	
DIVERSITY (J PRIME)		0.44	0.72	0.58	0.14	
NUMBER OF TAXA		35	26	41		
BOTTOM TYPE	0					

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NORTHERN STATES POWER COMPANY

PRAIRIE ISLAND NUCLEAR GENERATING PLANT

MACROINVERTEBRATE DENSITY (NUMBER PER SQUARE METER)

HESTER-DENDY MULTIPLATE SAMPLER

WITHIN-SITE REPORT

Table 2.2-7 (cont)

DECEMBER

STURGEON LAKE

LS	TAXA					
					-	REL
					X	S.E. ABX
		2				
0	NEMATODA (TOTAL)	2.69			2.69	-1.00 7.7
1	NEMATODA (LPIL)	2.69			2.69	-1.00 7.7
0	OLIGOCHAETA (TOTAL)	5.38			5.38	-1.00 15.4
0	NAIDIDAE					
1	NAIDIDAE (LPIL)	5.38			5.38	-1.00 15.4
0	TRICHOPTERA (TOTAL)	24.22			24.22	-1.00 69.2
0	HYDROPSYCHIDAE					
2	HYDROPSYCHE ORRIS	13.46			13.46	-1.00 38.5
2	POTAMYIA (LPIL)	2.69			2.69	-1.00 7.7
2	HYDROPSYCHIDAE (LPIL)	8.07			8.07	-1.00 23.1
0	DIPTERA NEMATOCERA (TOTAL)	2.69			2.69	-1.00 7.7
0	CHIRONOMIDAE					
2	CRICOTOPUS (LPIL)	2.69			2.69	-1.00 7.7
TOTAL		34.98			34.98	-1.00 100.0
DIVERSITY (H PRIME)		1.24			1.24	-1.00
DIVERSITY (J PRIME)		0.72			0.72	-1.00
NUMBER OF TAXA		6			6	
BOTTOM TYPE	0					

ABOVE COMPUTED USING SAMPLE IDS
26571 26572 26573 26574

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PRAIRIE ISLAND NUCLEAR GENERATING PLANT

MACROINVERTEBRATE DENSITY (NUMBER PER SQUARE METER)

HESTER-DENDY MULTIPLATE SAMPLER

WITHIN-SITE REPORT

Table 2.2-7 (cont)

INTAKE DECEMBER

LS	TAXA	X-1	X-2	X-3	X̄	S.E.	REL ABX
		3	4	5			
0	CNIDARIA (TOTAL)	5.38	5.38	0.0	3.59	1.79	0.0
0	HYDROZOA						
1	HYDRA (LPIL)	5.38	5.38	0.0	3.59	1.79	0.0
0	PLATYHELMINTHES (TOTAL)	0.0	32.29	180.30	70.86	55.51	0.9
1	TURBELLARIA-(LPIL)	0.0	32.29	180.30	70.86	55.51	0.9
0	NEMERTINA (TOTAL)	2.69	18.84	500.54	174.02	163.32	2.2
1	NEMERTINA (LPIL)	2.69	13.84	500.54	174.02	163.32	2.2
0	NEMATODA (TOTAL)	0.0	263.72	182.99	148.91	78.02	1.9
1	NEMATODA (LPIL)	0.0	263.72	182.99	148.91	78.02	1.9
0	ENDOPROCTA	0.0	5.38	2.69	2.69	1.55	0.0
0	ENDOPROCTA						
11	LOPHOPODELLA GRACILIS	0.0	5.38	2.69	2.69	1.55	0.0
0	OLIGOCHAETA (TOTAL)	26.91	11646.93	8840.15	6838.00	3500.60	86.1
0	NAIDIDAE						
1	NAIDIDAE (LPIL)	26.91	11644.24	8837.46	6836.20	3499.1	86.1
0	TUBIFICIDAE						
1	TUBIFICIDAE (LPIL)	0.0	2.69	2.69	1.79	0.90	0.0
0	GASTROPODA (TOTAL)	2.69	88.81	766.95	286.15	241.68	3.6
0	PHYSIDAE						
1	PHYSA (LPIL)	2.69	86.11	766.95	285.25	242.05	3.6
1	GASTROPODA (LPIL)	0.0	2.69	0.0	0.90	0.90	0.0
0	ARACHNIDA (TOTAL)	0.0	2.69	5.38	2.69	1.55	0.0
0	PROSTIGMATA						
1	HYDRACHNA (LPIL)	0.0	2.69	5.38	2.69	1.55	0.0
0	AMPHIPODA (TOTAL)	2.69	0.0	0.0	0.90	0.90	0.0
0	HYALELLIDAE						
1	HYALELLA AZTECA	2.69	0.0	0.0	0.90	0.90	0.0
0	EPHEMEROPTERA (TOTAL)	2.69	13.46	2.69	6.28	3.59	0.1
0	HEPTAGENIIDAE						
10	STENONEMA (LPIL)	2.69	10.76	2.69	5.38	2.69	0.1
0	CAENIDAE						
10	CAENIS (LPIL)	0.0	2.69	0.0	0.90	0.90	0.0
0	PLECOPTERA (TOTAL)	2.69	0.0	0.0	0.90	0.90	0.0
0	TAENIOPTERYGIDAE						
10	TAENIOPTERYX (LPIL)	2.69	0.0	0.0	0.90	0.90	0.0
0	COLEOPTERA POLYPHAGA (TOTAL)	0.0	0.0	2.69	0.90	0.90	0.0
0	ELMIDAE						
1	ELMIDAE (LPIL)	0.0	0.0	2.69	0.90	0.90	0.0
0	TRICHOPTERA (TOTAL)	32.29	118.41	75.35	75.35	24.86	0.9
0	HYDROPSYCHIDAE						
2	HYDROPSYCHE ORRIS	8.07	80.73	48.44	45.75	21.02	0.6
2	HYDROPSYCHE (LPIL)	2.69	0.0	0.0	0.90	0.90	0.0

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Table 2.2-7 (cont)

PRAIRIE ISLAND NUCLEAR GENERATING PLANT

MACROINVERTEBRATE DENSITY (NUMBER PER SQUARE METER)

HESTER-DENDY MULTIPLATE SAMPLER

WITHIN-SITE REPORT

INTAKE DECEMBER

LS	TAXA	X-1	X-2	X-3	X	S.E.	REL ABX
		3	4	5			
2	CHEUMATOPSYCHE (LPIL)	5.38	16.15	8.07	9.87	3.23	0.1
2	POTAMYIA (LPIL)	0.0	16.15	8.07	8.07	4.66	0.1
2	HYDROPSYCHIDAE (LPIL)	2.69	2.69	5.38	3.59	0.90	0.0
0	HYDROPTILIDAE						
2	HYDROPTILA (LPIL)	5.38	0.0	0.0	1.79	1.79	0.0
0	POLYCENTROPODIDAE						
2	NEURECLIPSIS (LPIL)	8.07	2.69	5.38	5.38	1.55	0.1
0	DIPTERA NEMATOCERA (TOTAL)	53.82	764.26	139.94	319.34	223.85	4.0
0	CHIRONOMIDAE						
2	CRICOTOPUS (LPIL)	5.38	40.37	5.38	17.04	11.66	0.2
2	TANYTARSUS (LPIL)	0.0	13.46	0.0	4.49	4.49	0.1
2	POLYPEDILUM (LPIL)	2.69	8.07	0.0	3.59	2.37	0.0
2	GLYPTOTENDIPES (LPIL)	8.07	653.93	107.64	256.55	200.76	3.2
2	THIENEMANNIELLA	5.38	0.0	0.0	1.79	1.79	0.0
2	PSECTROCLADIUS (LPIL)	32.29	26.91	5.38	21.53	8.22	0.3
3	CHIRONOMIDAE (LPIL)	0.0	21.53	21.53	14.35	7.18	0.2
0	ECTOPROCTA (TOTAL)	0.0	16.15	8.07	8.07	4.66	0.1
0	PLUMATELLIDAE						
11	PLUMATELLA REPENS	0.0	10.76	8.07	6.28	3.23	0.1
0	CRISTATELLIDAE						
8	CRISTATELLA MUCEDO	0.0	5.38	0.0	1.79	1.79	0.0
TOTAL		131.86	12976.29	10707.73	7938.62	3957.94	100.0
DIVERSITY (H PRIME)		2.68	0.81	0.85	1.45	0.62	
DIVERSITY (J PRIME)		0.91	0.20	0.24	0.45	0.23	
NUMBER OF TAXA		18	25	20	31		
BOTTOM TYPE	0						

ABOVE COMPUTED USING SAMPLE IDS

26581 26582 26583 26584
26591 26592 26593 26594
26601 26602 26603 26604

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Table 2.2-7 (cont)

PRAIRIE ISLAND NUCLEAR GENERATING PLANT

MACROINVERTEBRATE DENSITY (NUMBER PER SQUARE METER)

HESTER-DENDY MULTIPLATE SAMPLER

WITHIN-SITE REPORT

DISCHARGE DECEMBER

LS	TAXA	Y-1	Y-2	$\bar{X}$	S.E.	REL ABX
		6	7			
0	CNIDARIA (TOTAL)	5.38	24.22	14.80	9.42	0.9
0	HYDROZOA					
1	HYDRA (LPIL)	5.38	24.22	14.80	9.42	0.9
0	PLATYHELMINTHES (TOTAL)	8.07	0.0	4.04	4.04	0.2
1	TURBELLARIA-(LPIL)	8.07	0.0	4.04	4.04	0.2
0	NEMERTINA (TOTAL)	2.69	0.0	1.35	1.35	0.1
1	NEMERTINA (LPIL)	2.69	0.0	1.35	1.35	0.1
0	NEMATODA (TOTAL)	161.46	10.76	86.11	75.35	5.0
1	NEMATODA (LPIL)	161.46	10.76	86.11	75.35	5.0
0	ENDOPROCTA	5.38	0.0	2.69	2.69	0.2
0	ENDOPROCTA					
11	URNATELLA GRACILIS	5.38	0.0	2.69	2.69	0.2
0	OLIGOCHAETA (TOTAL)	2465.02	169.54	1317.28	1147.74	76.8
0	NAIDIDAE					
1	NAIDIDAE (LPIL)	2462.33	169.54	1315.93	1146.39	76.7
0	TUBIFICIDAE					
1	TUBIFICIDAE (LPIL)	2.69	0.0	1.35	1.35	0.1
0	GASTROPODA (TOTAL)	32.29	0.0	16.15	16.15	0.9
0	PHYSIDAE					
1	PHYSA (LPIL)	32.29	0.0	16.15	16.15	0.9
0	EPHEMEROPTERA (TOTAL)	2.69	5.38	4.04	1.35	0.2
0	HEPTAGENIIDAE					
10	STENONEMA (LPIL)	2.69	5.38	4.04	1.35	0.2
0	PLECOPTERA (TOTAL)	8.07	5.38	6.73	1.35	0.4
0	ISOPERLIDAE					
10	ISOPERLA (LPIL)	8.07	5.38	6.73	1.35	0.4
0	TRICHOPTERA (TOTAL)	129.17	43.06	86.11	43.06	5.0
0	HYDROPSYCHIDAE					
2	HYDROPSYCHE ORRIS	5.38	16.15	10.76	5.38	0.6
2	CHEUMATOPSYCHE (LPIL)	8.07	5.38	6.73	1.35	0.4
2	POTAMYIA (LPIL)	21.53	2.69	12.11	9.42	0.7
2	HYDROPSYCHIDAE (LPIL)	24.22	16.15	20.18	4.04	1.2
0	HYDROPTILIDAE					
2	HYDROPTILA (LPIL)	13.46	0.0	6.73	6.73	0.4
2	ORTHOTRICHIA (LPIL)	2.69	0.0	1.35	1.35	0.1
0	POLYCENTROPODIDAE					
2	NEUREClIPSIS (LPIL)	53.82	2.69	28.26	25.57	1.6
-	DIPTERA NEMATOCERA (TOTAL)	244.89	94.19	169.54	75.35	9.9
0	CHAOBORIDAE					
2	CHAOBORUS (LPIL)	0.0	2.69	1.35	1.35	0.1
0	CHIRONOMIDAE					
2	CRICOTOPUS (LPIL)	5.38	45.75	25.57	20.18	1.5

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Table 2.2-7 (cont)

PRAIRIE ISLAND NUCLEAR GENERATING PLANT

MACROINVERTEBRATE DENSITY (NUMBER PER SQUARE METER)

NESTER-DENDY MULTIPLATE SAMPLER

WITHIN-SITE REPORT DISCHARGE DECEMBER

LS	TAXA	Y-1	Y-2	- X	S.E.	REL ABX
		6	7			
2	TANYTARSUS (LPIL)	8.07	0.0	4.04	4.04	0.2
2	POLYPEDILUM (LPIL)	10.76	0.0	5.38	5.38	0.3
2	ABLABESMYIA (LPIL)	24.22	2.69	13.46	10.76	0.8
2	GLYPTOTENDIPES (LPIL)	123.79	0.0	61.89	61.89	3.6
2	THIENEMANNIELLA	13.46	13.46	13.46	0.00	0.8
2	TRISSOCLADIUS (LPIL)	2.69	0.0	1.35	1.35	0.1
2	PSECTROCLADIUS (LPIL)	56.51	26.91	41.71	14.80	2.4
2	TRICHOCLADIUS	0.0	2.69	1.35	1.35	0.1
0	ECTOPROCTA (TOTAL)	13.46	0.0	6.73	6.73	0.4
0	PLUMATELLIDAE					
11	PLUMATELLA REPENS	8.07	0.0	4.04	4.04	0.2
0	CRISTATELLIDAE					
8	CRISTATELLA MUCEDO	5.38	0.0	2.69	2.69	0.2
TOTAL		3078.58	352.53	1715.55	1363.02	100.0
DIVERSITY (H PRIME)		1.40	2.45	1.92	0.52	
DIVERSITY (J PRIME)		0.35	0.78	0.57	0.22	
NUMBER OF TAXA		27	16	29		

BOTTOM TYPE 0

ABOVE COMPUTED USING SAMPLE IDS

26611 26612 26613 26614
26621 26622 26623 26624

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TABLE 2.2-8. SUMMARY STATISTICAL INFORMATION FOR HESTER-DENDY MULTIPLE SAMPLES COLLECTED DURING 1978 NEAR RED WING, MINNESOTA.

STATIONS 1-7 MONTHS 5-8,1.

UNTRANSFORMED

	B-1	SL	X-1	X-2	X-3	Y-1	Y-2
B-1	-	0	0	0	*	0	0
SL		-	0	0	*	0	0
X-1			-	0	*	0	0
X-2				-	*	0	0
X-3					-	*	*
Y-1						-	0
Y-2							-

GROUP SIMILARITIES: SL B-1 X-1 Y-2 Y-1 X-2 X-3

TRANSFORMED

	B-1	SL	X-1	X-2	X-3	Y-1	Y-2
B-1	-	0	0	*	*	0	0
SL		-	0	*	*	*	0
X-1			-	*	*	0	0
X-2				-	0	0	0
X-3					-	*	*
Y-1						-	0
Y-2							-

GROUP SIMILARITIES: SL B-1 X-1 Y-2 Y-1 X-2 X-3

STATIONS 2-7 MONTHS 1-2,5-12

	SL	X-1	X-2	X-3	Y-1	Y-2
SL	-	0	0	*	0	0
X-1		-	0	*	0	0
X-2			-	0	0	0
X-3				-	0	*
Y-1					-	0
Y-2						-

GROUP SIMILARITIES: SL X-1 Y-2 Y-1 X-2 X-3

	SL	X-1	X-2	X-3	Y-1	Y-2
SL	-	0	*	*	*	0
X-1		-	*	*	*	0
X-2			-	0	0	*
X-3				-	0	*
Y-1					-	*
Y-2						-

SL X-1 Y-2 Y-1 X-2 X-3

STATIONS 3-7 MONTHS 1-2,5-12

	X-1	X-2	X-3	Y-1	Y-2
X-1	-	0	*	0	0
X-2		-	0	0	0
X-3			-	0	*
Y-1				-	0
Y-2					-

GROUP SIMILARITIES: X-1 Y-2 Y-1 X-2 X-3

	X-1	X-2	X-3	Y-1	Y-2
X-1	-	*	*	*	0
X-2		-	0	0	*
X-3			-	0	*
Y-1				-	*
Y-2					-

X-1 X-2 Y-1 X-2 X-3

* = Significant at the $\alpha = 0.05$

0 = No significant difference

APPENDIX A2.2.1. SPLITTING PROCEDURE JUSTIFICATION

The purpose of this split analysis was to determine whether the distributions of the counts of the taxa in the 1/2 or 1/4 splits were the same, apart from random variation, as the distribution of the taxa counts in the whole sample. For this analysis the 1/2 and 1/4 splits were considered to be random samples from the whole, which was taken to be the population. Thus, the objective was to determine whether the random variation induced by the splitting was large enough to cause the distribution of the taxa counts in the splits to be significantly different from those in the whole.

The statistical method used was a chi-square test for the equality of the distribution of the taxa counts in the splits to that in the whole*. Expected counts for the 1/2 split are 1/2 of the counts in the whole sample, and for the 1/4 split they are 1/4 of the counts in the whole sample. The chi-square value is:

$$\sum_{\substack{\text{over} \\ \text{all taxa}}} \frac{(\text{Observed count in split} - \text{expected count})^2}{\text{expected count}}.$$

These chi-square values, along with the associated sample numbers, degrees of freedom, and probability values, are given in Table A2.2-1.

The only split that approaches significance (P=0.051) is the 1/4 A split from sample #2633-2. This result is due to 8 of the 12 taxa groups having counts smaller than 19 in the whole sample.

In summary, results of the chi-square test given in Table A2.2-1 show that the random variation induced by using 1/4 splits instead of the whole sample does not prevent assuming that the taxa counts from the 1/4 split and those from the whole sample follow the same distribution. Thus, inferences based on the 1/4 splits are valid.

* Steel, R.G.D., and James H. Torrie. 1960. Principles and Procedures of Statistics. McGraw Hill Book Co., Inc. New York. N.Y. pp. 366-378.

Table A2.2-1. Results of Sample Splitting Analysis

Sample	Split	Chi-square value	Degrees of Freedom	Prob> Chi-square
#2632-2	1/2	9.40	12	0.668
	1/4A	15.59	12	0.211
	1/4B	15.37	12	0.222
#2632-3	1/2	8.18	12	0.771
	1/4A	12.46	12	0.409
	1/4B	7.96	12	0.788
#2633-1	1/2	13.20	11	0.280
	1/4A	8.74	11	0.646
	1/4B	13.35	11	0.271
#2633-2	1/2	6.95	11	0.803
	1/4A	19.61	11	0.051
	1/4B	14.82	11	0.191
#2634-1	1/2	14.80	11	0.192
	1/4A	12.79	11	0.307
	1/4B	18.04	11	0.081

PRAIRIE ISLAND NUCLEAR GENERATING PLANT
ENVIRONMENTAL MONITORING PROGRAM
1978 ANNUAL REPORT
ECOLOGICAL STUDIES

IMPINGEMENT OF FISHES AND OTHER ORGANISMS ON THE PRAIRIE ISLAND PLANT COOLING WATER INTAKE TRAVELING SCREEN

(2.3)

by
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Environmental and Regulatory Activities Department
Northern States Power Company

2.3 IMPINGEMENT OF FISHES AND OTHER ORGANISMS ON THE INTAKE TRAVELING SCREENS

2.3.1 INTRODUCTION

Impingement losses at the Prairie Island Nuclear Generating Plant have been recorded and reported annually for five complete years, plus 83 days in 1973 when plant cooling water was circulated during preoperational testing and after commercial generation of power began with Unit 1 reactor in December (Anon. 1973). Impingement data for 1978, i.e., species composition and numbers, seasonal rates, and size range of fishes are presented and compared with 1977 and previous years impingement data. Non-fish type organisms such as turtles, crayfish, clams, birds, and small mammals impinged during 1978 are also listed.

2.3.2 MATERIALS AND METHODS

Sampling procedures for impinged organisms in 1978 were basically the same as in previous years. Weekly sampling periods began and ended with removal of fish and replacement of trash baskets at approximately 8:00 AM on Wednesdays from December 28, 1977 through December 27, 1978. Trash baskets were generally emptied Monday, Wednesday, and Friday of each week, except during the weeks of January 4 to 11 and January 18 to 25, when no collections were made. Debris and organisms were sorted and fishes were taxonomically enumerated. All fishes were counted individually, except on two dates in mid-January when impingement was exceptionally high; then the "pail method" was used to estimate numbers of gizzard shad[1] after other species were

[1] All fishes will be referred to by common name. A list of common and scientific names is included in Appendix A2.3.1.

sorted out. This method has been used in previous years and involves counting the number of gizzard shad required to fill one pail, and then multiply by the number of pails filled. Fishes removed from the bar rack were included in total impingement numbers. Fishes picked up along shore and floating in the recirculation canal and intake area were also included in impingement data. All live organisms were released in Sturgeon Lake or the plant discharge canal, and were included in total impingement numbers.

Total lengths in millimeters, were recorded for all fishes measured. Usually the lengths of a minimum of 50 young-of-the-year and all measurable adults were recorded when numbers were in excess of 50-100 fish of a given species or taxonomic group. When fish numbered less than 50 per species or taxonomic group, lengths of all specimens in measurable condition were recorded.

Several species were combined into taxonmic groups for reporting impingement losses. All members of the family Cyprinidae, with the exception of carp and bullhead minnows, were grouped as "shiner spp." or "minnow spp". Quillback, highfin, and river carpsucker may have been present, but no differentiation was made and all were grouped as "carpsucker spp.". All bullheads were recorded as "bullhead spp.", and "crappie spp." included both black and white crappies. Specimens in poor condition were identified to family or genus when possible, or listed as unidentified.

2.3.3 RESULTS

In 1978, 105,983 fishes were collected, of which 93,895 were gizzard shad and 12,088 were other species, representing 40 taxa from 15 families. Spotted sucker was reported for the first time in 1978, and largemouth bass and golden shiner were collected in 1978, but not in 1977. Species collected

in 1977 but not in 1978 included longnose gar, American eel, brown trout, and orangespotted sunfish. Several species of the families Cyprinidae, Catostomidae, and Ictaluridae collected in 1977 may also have been collected in 1978 but not shown in Appendix A2.3.1. Members of these families generally were not identified to species, but were grouped as "shiner spp." or "minnow spp.", "carpsucker spp.", and "bullhead spp." for ease in handling and reporting.

Gizzard shad comprised 88.6 percent of the total 1978 impingement figure. Other predominant taxa, in order of abundance and percent composition, included freshwater drum (3.3 percent), white bass (2.0 percent), channel catfish (1.9 percent), and crappie spp. (1.5 percent) (Table 2.3-1). Each of the remaining taxa represented less than one percent of the total number of fishes impinged. As also seen in Table 2.3-1, gizzard shad has been the most common species collected annually since the plant became operation in 1973, followed by freshwater drum (1973, 1974, 1977, and 1978), white bass (1976), or channel catfish (1975).

Approximately 80 percent fewer gizzard shad and white bass, and 95 percent fewer freshwater drum were impinged than in 1977. Channel catfish impingement decreased by nearly one-half. Impingement of crappie spp. and bluegill decreased from 5,530 and 2,317 in 1977 to 1,551 and 622 in 1978, respectively. The number of shiners and minnows collected decreased 40 percent, while bullhead impingement increased 40 percent over 1977.

Weekly impingement totals for all taxa ranged from 33 fishes in early December to 45,965 fishes in mid-January (Table 2.3-2). Highest impingement rates occurred in January through mid-February and were primarily comprised of gizzard shad (Figures 2.3-1 and 2). Impingement rates for most other taxa were generally low throughout the year (Figures

2.3-3 through 8). Highest numbers of channel catfish were collected in March (Figure 2.3-5). White bass impingement rates were highest in late April and early May, with another increase in late July, while 50 or fewer fishes per week were taken throughout the rest of the year. Increased impingement rates in late April and early May coincided with a cooling tower outage and returned service.

Seasonally, the greatest numbers of fishes were impinged in winter (Table 2.3-3). The greatest diversity of taxa and the greatest number of fishes, excluding gizzard shad, occurred in spring. Channel catfish were most frequently impinged in winter; white bass, bluegill, crappie spp., and freshwater drum in spring; and shiner/minnow spp. in fall. Approximately 95 percent of the bigmouth buffalo and bullheads and nearly 70 percent of the carp were collected in spring. Seasonal comparisons of impingement of all fishes and of gizzard shad for 1978 and previous years are presented in Tables 2.3-4 and 5.

Length frequency data are presented in Table 2.3-6 and Figures 2.3-9 through 14. Many of the larger specimens were collected from the bar rack and from the recirculation and intake canal areas. Proportionally, fewer young-of-the-year fishes were measured in 1978 than in 1977, following procedures described in Section 2.3.2 of this report. Young-of-the-year comprised 51.4 percent of the gizzard shad measured in 1978, as compared with 55.2 percent in 1977. In 1978, 23.0 percent of the white bass and 56.3 percent of the freshwater drum measured were less than 160 mm total length, whereas in 1977 more than 80 percent of the white bass and 75 percent of the freshwater drum were young-of-the-year. Although the percentage of young-of-the-year of those measured may not truly represent the actual percentage of the total number collected, it provides an indication of the sizes of fishes impinged. In the future, efforts

will be made to note the number of young-of-the-year not measured, so the percentage of young-of-the-year of all fishes collected can be calculated, rather than only of those measured.

Organisms, other than fishes, collected in trash baskets in 1978 are listed in Table 2.3-7. Turtles, clams, mudpuppies, and crayfish dominated the total number recorded. Rats, pigeons, and toads comprised 1.2 percent of the total. Many of the specimens were obviously dead prior to impingement. Those that survived the rigors of impingement were released in either Sturgeon Lake or the discharge canal.

Mississippi River flow (U.S Army Corps of Engineers, Lock and Dam 3 records), plant intake flow, and percent of river flow appropriated to the plant are listed for 1977 and 1978 in Table 2.3-8.

2.3.4 DISCUSSION

The composition of fishes impinged at the Prairie Island Plant in 1978 (Appendix A2.3.1) was similar to previous years, with a few exceptions. The spotted sucker, which has been reported by the Minnesota Department of Natural Resources (MDNR) personnel in the 1974, 1976, and 1978 fish population studies of the plant vicinity, was collected in the trash baskets for the first time in 1978. Other variations in taxonomic composition are presented in Section 2.3.3. Since 1973, 97.8 to 99.8 percent of fishes impinged annually were from eight taxa (Table 2.3-1). Gizzard shad has always been the most frequently impinged species at the Prairie Island Plant, followed by freshwater drum, white bass, or channel catfish. Gizzard shad comprised 88.6 percent of the 1978 impingement total and from 58.5 to 93.9 percent of the annual totals of previous years.

The total number of fishes impinged in 1978 was nearly five times less than in 1977. A marked reduction in impingement of gizzard shad and freshwater drum was primarily responsible for the decrease, although percent composition of gizzard shad increased slightly from 82.4 percent in 1977 to 88.6 percent in 1978. Impingement numbers decreased from 1977 for all of the predominant taxa except bullhead spp., while freshwater drum was the only predominant taxa for which percent composition decreased rather than increased in 1978 (Table 2.3-1). This indicates fewer fishes of other taxa were affected by impingement in 1978 than in 1977.

Seasonally, in 1978, unlike previous years, impingement was highest in winter and lowest in summer (Table 2.3-4). Fall impingement was considerably lower in 1978 than 1977, followed by spring, which has in the past been the season of lowest impingement. Fewer fishes have been collected in the fall each year since 1974, and annual decreases are nearly proportional with those seen for gizzard shad (Tables 2.3-4 and 5). An annual fall die-off of gizzard shad, which can be expected to occur when water temperatures drop below 12-15°C (Andersen 1974, Bodola 1966, and Wickliff 1953), has in prior years contributed a large portion of the annual total of impinged fishes. The die-off has been associated with impingement of up to 78.2 percent of the annual total of gizzard shad, as in the fall of 1974 (Table 2.3-5). Although there was no apparent massive fall die-off in 1978, impingement of 5,394 gizzard shad in late October and early November did create a definite peak over the exceptionally low weekly totals preceding and following that two-week period (Table 2.3-2 and Figures 2.3-1 and 2). Over 85 percent of the gizzard shad were collected in winter, mainly January and early February, by which time many of the 1977 year class had reached lengths of 140 mm or greater and were impinged as juveniles and adults.

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Gizzard shad are an important forage fish until they reach approximately 130 mm total length (Miller 1960). Of the 3,943 shad measured, 51.4 percent were less than 140 mm (Table 2.3-6 and Figure 2.3-9). Assuming this figure to be representative, slightly more than one-half of the shad impinged (48,262) was lost as potential forage, which represents less than one percent of the gizzard shad population of Sturgeon Lake, as estimated in 1973 by the MDNR (Andersen 1974).

Impingement has generally had the greatest effect on young-of-the-year fish which are not present or of impingeable size until summer or later, accounting for low numbers taken in spring. In 1978 increased spring impingement numbers for approximately three weeks in April and early May coincided with returned service of the cooling towers on April 13, following an outage for installation of temperature sensor by-pass valves. The majority of fishes reported during that period were adults and juveniles collected in the recirculation and intake canal areas and from the bar rack, as well as from trash baskets. This increased impingement rate may have masked the normal low spring impingement level, as well as skewed length frequency distributions more toward adult and juvenile ranges (Table 2.3-6 and Figures 2.3-9 through 14).

Impact assessment of impingement upon fish populations of the source cooling water body is difficult, because means of accurately estimating populations in sections of large river systems are lacking. Impingement of small numbers of several sport fish taxa in 1978, such as northern pike (33), largemouth and smallmouth bass (12), and walleye/sauger (88), cannot be expected to have any negative effect on their populations in the Prairie Island vicinity.

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Survival of fishes varies considerably, ranging from less than 25 percent to 60 percent, according to several authors (Eberley 1977). White bass are reported by MDNR (1974) to attain an average length of 109 mm by the end of their first year of growth. Impingement of 2,096 white bass in 1978, of which 14 percent were less than 120 mm, resulted in an estimated loss of approximately 1,400 potential adults, assuming 50 percent survival. Such losses, as compared with 1977 white bass impingement and MDNR angler harvest estimates (Eberley 1977), are not expected to affect the white bass population in the PINGP area.

Fluctuations in annual and seasonal impingement rates do not appear to be attributable to any one single factor, but more likely a combination of several. Plant trip-outs in winter months and the resultant cold shock have, in the past, contributed as much as 39 percent of the annual impingement total (Eberley 1976). No major plant trip-outs occurred during 1978 that may have been partially responsible for low impingement numbers.

Percentages of monthly mean Mississippi River flow entering the Prairie Island Plant intake canal during 1977 and 1978 are compared in Table 2.3-8. Monthly mean intake flow was generally lower in 1978 than 1977, and river flow was substantially higher during all but three months of 1978, resulting in reductions of percentage of mean river flow entering the intake canal for all months except October, November, and December. The lower amount of water appropriated and increased river flow may have also been partially responsible for low 1978 impingement numbers. Correlation of plant operating characteristics with impingement rates in 1973, 1974, and 1975 indicates flow parameters appear to be one key plant operational characteristic

affecting impingement (Mayhew and Hess 1975); however, flow volume or velocity are not always primary factors in impingement rates (Mayhew and Hess 1975).

Young-of-the-year have generally comprised a major portion of annual impingement totals, indicating year class strength may be a factor also influencing impingement rates, but no apparent correlation indicating such a relationship has been found at Prairie Island (Eberley 1976). MDNR personnel indicate "there appears to be no consistent relationship between gross impingement in a given year and overall gear catch rates or abundance indices from that year" (see Section 2.4).

2.3.5 SUMMARY

A total of 105,983 fishes representing 40 taxa and 15 families was impinged during 1978. Several non-fish organisms were collected, with spiny, soft-shell turtles being impinged most frequently. Gizzard shad comprised 88.6 percent of the 1978 impingement total, with the majority collected in winter. Gizzard shad loss was less than one percent of the estimated 1973 gizzard shad population of Sturgeon Lake. Other predominant taxa were freshwater drum, white bass, channel catfish, crappie spp., bluegill, bullhead spp., and shiner/minnow species. Fewer fishes of other taxa were affected by impingement in 1978 than in 1977.

Impingement numbers were highest in January and February, and generally low throughout the rest of 1978 with noticeable minor peaks in April-May and late October through mid-November.

Impingement losses of walleye/sauger and white bass represented less than two-tenths of one percent and less than five percent, respectively, of the 1976 angler harvest.

No single factor has been isolated as the most important factor affecting impingement rates. Some factors possibly influencing impingement rates at Prairie Island include river flow, cooling water appropriation, water temperatures, and year class strength.

2.3.6 LITERATURE CITED

Andersen, R. A. 1974. Impingement of fishes and other organisms on the Prairie Island intake traveling screens. In: Northern States Power Company Prairie Island Environmental Monitoring and Ecological Studies Program. 1974 Annual Report, Vol. II, Minneapolis, MN.

Anonymous. 1973. Impingement of fishes and other organisms on the Prairie Island Plant traveling screens. In: Northern States Power Company Prairie Island Environmental Monitoring and Ecological Studies Program. 1973 Annual Report, Vol. II, Minneapolis, MN.

Bailey, R. M., J.E. Fitch, E.S. Herald, E. A. Lachner, C. C. Lindsey, C. R. Robbins, and W. B. Scott. 1970. A list of common and scientific names of fishes from the United States and Canada American Fisheries Soc. Special Pub. No. 6. 150 pp.

Bodola, A. 1966. Life history of the gizzard shad, (Dorosoma cepedianum) (LeSueur), in western Lake Erie. U.S. Fish and Wild. Service. Fish. Bull. 65(2): 391-425.

Eberley, L. W. 1976. Impingement of fishes and other organisms on the Prairie Island Plant cooling water intake traveling screens. In: Northern States Power Company Prairie Island Environmental Monitoring and Ecological Studies Program. 1976 Annual Report, Vol. I, Minneapolis, MN.

Eberley, L. W. 1977. Impingement of fishes and other organisms on the Prairie Island Plant cooling water intake traveling screens. In: Northern States Power Company Prairie Island Environmental Monitoring and Ecological Studies Program. 1977 Annual Report, Vol. I, Minneapolis, MN.

Mayhew, D. A. and H. K. Hess. 1975. Impingement of fishes and other organisms on the Prairie Island Plant intake traveling screens. In: Northern States Power Company Prairie Island Environmental Monitoring and Ecological Studies Program. 1975 Annual Report, Vol. II, Minneapolis, MN.

Miller, R. R. 1960. Systematics and biology of the gizzard shad (Dorosoma cepedianum) and related fish. Fishery Bulletin 60:371-392.

Naplin, R. L. and J. L Geis. 1974. 1974 Progress report on the Prairie Island fish population study. In: Northern States Power Company Prairie Island Environmental

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Monitoring and Ecological Studies Program. 1974 Annual Report, Vol. II, Minneapolis, MN.

Wickliff, E. L. 1953. Gizzard shad rides again. Ohio Conserv. Bull. 17: 23-25.

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Table 2.3-1. Total number and percent composition of predominant fish taxa impinged from 1973 to 1978 at the Prairie Island Plant

TAXON	1978		1977		1976		1975		1974		1973	
	No.	% Comp.	No.	% Comp.	No.	% Comp.	No.	% Comp.	No.	% Comp.	No.	% Comp.
Gizzard shad	93,895	88.6	456,949	82.4	152,878	58.5	70,506	75.4	136,667	93.6	65,000	93.9
Freshwater drum	3,463	3.3	74,422	13.4	34,380	13.2	3,789	4.1	3,143	2.2	1,144	1.7
White bass	2,096	2.0	9,725	1.8	44,638	17.1	2,712	2.9	1,367	0.9	477	0.7
Channel catfish	2,032	1.9	3,977	0.7	8,457	3.2	6,223	6.7	637	0.4	24	0.1
Crappie spp.	1,551	1.5	5,530	1.0	6,852	2.6	2,0[illegible]	2.2	1,704	1.2	445	0.6
Bluegill	622	0.6	2,317	0.4	1,601	0.6	242	0.3	674	0.5	147	0.2
Bullhead spp.	455	0.4	274	0.1	3,554	1.4	3,651	3.9	158	0.1	895	1.3
Shiner & minnow spp.	232	0.2	386	0.1	5,580	2.1	2,231	2.4	776	0.5	581	0.8
TOTAL	104,346	98.5	553,580	99.8	257,940	98.7	91,384	97.8	145,126	99.4	68,713	99.3

Table 2.3-2. Number of Fish per Week Collected from the Trash Baskets at the Prairie Island Plant during 1978.

TAXA	WEEKLY PERIODS									
	12/28 to 1/4	1/4* to 1/11	1/11 to 1/18	1/18* to 1/25	7/25 to 2/1	2/1 to 2/8	2/8 to 2/15	2/15 to 2/22	2/22 to 3/1	3/1 to 3/8
Chestnut lamprey	-		-		-	-	-	-	-	-
Silver lamprey	2		2		-	1	-	1	-	-
Unidentified lamprey	-		-		-	-	-	-	-	-
Shortnose gar	-		-		-	-	-	-	-	-
Bowfin	-		-		-	-	-	-	-	-
Gizzard shad	2,984		45,757		24,020	7,274	1,531	330	115	27
Goldeye	-		-		-	-	2	-	-	-
Mooneye	-		-		-	-	-	-	-	-
Northern pike	-		-		-	-	-	-	-	-
Carp	2		1		2	-	3	1	4	2
Shiner spp.	6		1		-	-	-	-	1	-
Bullhead minnow	-		-		-	-	-	-	-	-
Minnow spp.	-		-		-	-	-	-	-	-
Carpsucker spp.	1		-		2	-	1	-	-	-
White sucker	-		-		-	-	-	-	-	-
Spotted sucker	-		-		-	-	-	-	-	-
Unidentified catostomidae	-		-		-	-	-	-	-	-
Bigmouth buffalo	-		2		-	1	1	5	1	-
Smallmouth buffalo	-		-		-	-	-	1	-	1
Buffalo spp.	-		-		-	-	-	-	-	-
Silver redhorse	-		-		-	-	-	-	-	-
Shorthead redhorse	-		-		-	-	-	-	1	1
Bullhead spp.	-		2		-	1	-	-	-	-
Tadpole madtom	-		1		-	-	1	-	-	-
Channel catfish	38		35		75	66	76	84	129	161
Flathead catfish	-		-		-	1	-	-	-	1
Trout perch	-		-		-	-	-	-	-	-
Burbot	3		-		-	-	-	-	-	-
White bass	50		50		12	27	16	20	25	14
Rock bass	-		-		-	-	-	1	-	-
Smallmouth bass	-		-		-	-	1	-	-	-
Largemouth bass	-		-		-	-	-	-	-	-
Green sunfish	-		1		1	1	-	-	-	-
Bluegill	10		8		9	3	2	5	2	1
Crappie spp.	9		12		11	13	10	5	4	5
Unidentified centrarchidae	-		-		-	-	-	1	-	-
Yellow perch	-		-		-	-	-	-	-	-
Logperch	-		-		-	-	-	-	-	-
Sauger	-		-		-	-	-	-	-	-
Walleye	-		-		-	-	-	-	-	2
Stizostedion spp.	-		-		-	-	-	-	-	-
Freshwater drum	226		92		95	60	51	35	32	27
Unidentified fish & skeleton	10		1		-	-	4	2	3	1
TOTAL	3,341		45,965		24,227	7,448	1,699	491	317	243
TOTAL LESS SHAD	357		208		207	174	168	161	202	216

*No fish collected

Table 2.3-2 . (Continued)

TAXA	WEEKLY PERIODS						
	3/8 to 3/15	3/15 to 3/22	3/22 to 3/29	3/29 to 4/5	4/5 to 4/12	4/12 to 4/19	4/19 to 4/26
Chestnut lamprey	-	-	-	1	-	1	-
Silver lamprey	1	-	-	-	1	-	-
Unidentified lamprey	-	-	-	-	-	-	-
Shortnose gar	-	-	-	-	-	1	-
Bowfin	-	-	-	-	2	6	2
Gizzard shad	15	6	16	102	78	292	149
Goldeye	-	-	-	-	1	1	-
Mooneye	-	-	1	-	-	1	1
Northern pike	-	-	-	-	-	-	1
Carp	-	2	3	-	-	132	140
Shiner spp.	-	-	2	1	-	10	-
Bullhead minnow	-	-	-	-	-	2	-
Minnow spp.	-	-	-	-	1	-	-
Carpsucker spp.	-	-	2	5	1	37	3
White sucker	-	-	-	-	-	1	-
Spotted sucker	-	-	-	-	-	-	1
Unidentified catostomidae	-	-	-	-	-	-	-
Bigmouth buffalo	-	-	1	11	9	219	97
Smallmouth buffalo	-	-	-	-	1	5	1
Buffalo spp.	-	-	-	-	-	-	-
Silver redhorse	-	-	-	-	-	-	-
Shorthead redhorse	-	-	1	1	-	2	1
Bullhead spp.	-	-	-	2	5	391	6
Tadpole madtom	-	-	1	-	-	1	-
Channel catfish	253	138	74	61	55	77	27
Flathead catfish	-	-	-	1	-	-	2
Trout perch	-	-	-	-	-	1	-
Burbot	-	-	-	-	-	-	-
White bass	6	10	11	55	96	512	171
Rock bass	1	-	-	4	3	4	5
Smallmouth bass	-	-	-	-	-	-	2
Largemouth bass	-		-	-	-	2	-
Green sunfish	-	3	-	-	-	1	-
Bluegill	2	3	43	46	18	100	22
Crappie spp.	5	4	14	52	107	162	83
Unidentified centrarchidae	-	-	-	-	-	-	-
Yellow perch	-	-	1	2	3	3	1
Log perch	-	-	-	-	-	-	-
Sauger	-	1	-	-	-	1	-
Walleye	-	-	3	1	-	3	2
Stizostedion spp.	-	-	-	-	-	-	-
Freshwater drum	23	19	30	69	57	310	82
Unidentified fish & skeleton	3	6	4	2	-	15	26
TOTAL	309	192	207	416	438	2,293	825
TOTAL LESS SHAD	294	186	191	314	360	2,001	676

Table ..3-2 . (Continued)

TAXA	WEEKLY PERIODS								
	4/26 to 5/3	5/3 to 5/10	5/10 to 5/17	5/17 to 5/24	5/24 to 5/31	5/31 to 6/7	6/7 to 6/14	6/14 to 6/21	6/21 to 6/28
Chestnut lamprey	-	-	-	-	-	-	-	-	-
Silver lamprey	-	-	1	-	-	-	-	-	-
Unidentified lamprey	-	1	-	-	-	-	-	-	-
Shortnose gar	-	-	-	-	-	-	-	-	-
Bowfin	2	-	-	1	-	1	-	-	-
Gizzard shad	927	1,290	308	27	12	10	3	2	3
Goldeye	-	1	-	1	-	-	-	-	-
Mooneye	1	-	-	-	1	-	-	-	-
Northern pike	-	-	-	-	-	-	1	1	3
Carp	94	-	4	2	-	2	11	1	5
Shiner spp.	-	-	-	-	1	15	2	1	6
Bullhead minnow	-	-	-	-	-	-	-	-	-
Minnow spp.	-	-	-	-	-	-	-	-	-
Carpsucker spp.	8	2	1	1	-	2	-	-	2
White sucker	-	-	-	-	-	-	1	-	-
Spotted sucker	-	-	-	-	-	-	-	-	-
Unidentified catostomidae	-	-	-	-	-	-	-	-	-
Bigmouth buffalo	26	3	2	-	-	18	11	2	-
Smallmouth buffalo	5	-	-	-	-	-	-	-	-
Buffalo spp.	-	-	-	-	-	-	-	-	-
Silver redhorse	-	-	-	1	-	-	-	-	-
Shorthead redhorse	1	-	-	1	2	1	-	2	1
Bullhead spp.	7	4	2	3	2	5	3	-	3
Tadpole madtom	-	-	-	1	-	-	-	-	-
Channel catfish	14	9	8	25	10	34	107	5	12
Flathead catfish	4	1	-	-	-	-	37	-	-
Trout perch	-	-	-	-	-	-	-	-	-
Burbot	-	-	-	-	-	-	-	-	-
White bass	317	74	28	17	8	4	8	13	15
Rock bass	5	2	1	2	2	1	1	-	1
Smallmouth bass	-		1	-	-	3	-	-	-
Largemouth bass	-	-	-	-	-	-	-	-	-
Green sunfish	3	6	4	10	5	1	-	2	3
Bluegill	12	24	33	-	4	29	9	4	3
Crappie spp.	55	46	116	37	13	21	29	41	72
Unidentified centrarchidae	-	-	-	-	-	-	-	-	-
Yellow perch	1	1	1	1	-	-	2	-	1
Log perch	-	-	-	-	-	-	-	-	-
Sauger	-	2	2	-	3	2	5	2	5
Walleye	5	2	3	2	-	1	-	-	1
Stizostedion spp.	1	1	-	-	-	-	3	1	-
Freshwater drum	143	74	58	57	60	69	71	44	161
Unidentified fish & skeleton	42	6	7	1	1	-	6	1	1
TOTAL	1,673	1,549	580	191	124	220	310	123	298
TOTAL LESS SHAD	746	259	272	154	112	210	308	121	295

Table 2.3-2 . (Continued)

TAXA	WEEKLY PERIODS									
	6/28 to 7/5	7/5 to 7/12	7/12 to 7/19	7/19 to 7/26	7/26 to 8/2	8/2 to 8/9	8/9 to 8/16	8/16 to 8/23	8/23 to 8/30	8/30 to 9/6
Chestnut lamprey	-	1	-	-	-	-	-	-	-	-
Silver lamprey	-	-	-	-	-	-	1	-	-	-
Unidentified lamprey	-	-	-	-	-	-	-	-	-	-
Shortnose gar	-	-	-	-	-	-	-	-	-	-
Bowfin	-	-	-	-	-	-	-	-	-	-
Gizzard shad	9	14	64	425	115	14	10	31	42	27
Goldeye	-	-	-	-	-	-	-	-	-	-
Mooneye	2	-	-	-	-	-	-	-	1	-
Northern pike	2	3	4	7	3	3	-	1	-	2
Carp	8	12	63	33	8	-	5	4	1	6
Shiner spp.	3	3	11	19	6	1	-	3	2	-
Bullhead minnow	-	-	-	-	-	-	-	-	-	-
Minnow spp.	-	-	-	3	1	-	-	-	-	-
Carpsucker spp.	-	1	4	5	-	-	-	1	-	-
White sucker	-	-	-	-	-	-	-	-	-	-
Spotted sucker	-	-	-	-	-	-	-	-	-	-
Unidentified catostomidae	-	-	-	-	-	1	-	-	-	-
Bigmouth buffalo	1	-	-	1	1	-	-	-	-	-
Smallmouth buffalo	-	-	1	-	-	-	-	-	-	-
Buffalo spp.	-	-	-	1	-	-	-	-	-	-
Silver redhorse	-	-	-	-	-	-	-	-	-	-
Shorthead redhorse	2	1	-	-	-	-	-	1	1	-
Bullhead spp.	6	5	4	2	-	-	-	-	-	-
Tadpole madtom	-	1	-	2	-	-	-	-	-	-
Channel catfish	5	14	21	13	7	8	2	3	3	9
Flathead catfish	-	-	1	6	1	3	1	-	1	1
Trout perch	-	-	-	-	-	-	-	-	-	-
Burbot	-	-	-	-	-	-	-	-	-	-
White bass	6	8	39	114	105	16	14	5	2	6
Rock bass	1	-	-	-	-	1	-	-	-	-
Smallmouth bass	-	1	-	-	-	-	-	-		-
Largemouth bass	-	-	-	-	-	-	-	-	-	-
Green sunfish	-	4	2	2	1	1	-	-	-	-
Bluegill	5	3	1	1	2	2	-	-	-	2
Crappie spp.	61	42	18	54	87	34	13	11	10	17
Unidentified centrarchidae	-	-	-	-	-	-	-	-	-	-
Yellow perch	-	-	-	-	1	-	-	-	-	1
Log perch	-	-	-	1	1	-	-	-	-	-
Sauger	2	1	-	-	-	-	-	-	1	-
Walleye	1	-	1	1	-	-	-	1	-	2
Stizostedion spp.	1	-	1	-	2	1	2	-	-	-
Freshwater drum	87	47	45	67	91	60	48	35	36	44
Unidentified fish & skeleton	-	-	-	-	-	-	-	-	-	-
TOTAL	202	159	280	758	432	145	96	96	100	117
TOTAL LESS SHAD	193	145	216	332	317	131	86	65	58	90

Table 2.3-2 . ((Continued)

TAXA	WEEKLY PERIODS								
	9/6 to 9/13	9/13 to 9/20	9/20 to 9/27	9/27 to 10/4	10/4 to 10/11	10/11 to 10/18	10/18 to 10/25	10/25 to 11/1	11/1 to 11/8
Chestnut lamprey	-	-	-	-	-	-	-	-	-
Silver lamprey	-	-	1	-	-	-	-	1	-
Unidentified lamprey	-	-	-	-	-	-	-	-	-
Shortnose gar	-	-	-	-	-	-	-	-	-
Bowfin	1	-	-	-	-	-	-	-	-
Gizzard shad	19	170	408	144	395	458	304	1,049	4,345
Goldeye	-	-	-	-	-	-	-	-	-
Mooneye	-	-	-	-	-	-	-	-	-
Northern pike	1	-	-	-	-	1	-	-	-
Carp	2	3	1	2	2	-	-	-	-
Shiner spp.	8	11	27	9	7	-	-	3	5
Bullhead minnow	-	-	-	-	-	-	-	-	-
Minnow spp.	-	5	18	7	7	1	-	6	3
Carpsucker spp.	-	-	-	1	-	1	-	-	-
White sucker	-	-	-	-	-	-	-	-	-
Spotted sucker	-	-	-	-	-	-	-	-	-
Unidentified catostomidae	-	-	-	-	-	-	-	-	-
Bigmou.. buffalo	-	-	-	-	1	1	-	-	-
Smallmouth buffalo	-	-	-	-	-	-	-	-	-
Buffalo spp.	-	-	-	-	-	-	-	-	-
Silver redhorse	-	-	-	-	-	-	-	-	-
Shorthead redhorse	-	1	-	-	-	-	-	-	-
Bullhead spp.	-	-	-	2	-	-	-	-	-
Tadpole madtom	1	-	-	-	-	-	1	-	-
Channel catfish	9	13	14	15	11	9	25	68	60
Flathead catfish	8	1	1	1	-	1	-	1	1
Trout perch	-	-	-	-	-	-	-	-	-
Burbot	-	-	-	-	-	-	-	-	-
White bass	12	6	4	6	13	13	3	7	15
Rock bass	-	-	-	-	1	-	1	-	-
Smallmouth bass	-	-	-	-	1	-	-	-	1
Largemouth bass	-	-	-	-	-	-	-	-	-
Green sunfish	-	-	1	1	1	1	1	-	-
Bluegill	6	17	62	53	25	8	7	5	8
Crappie spp.	32	59	60	47	35	8	4	3	-
Unidentified centrarchidae	-	-	-	-	-	-	-	-	-
Yellow perch	-	-	-	-	-	-	-	-	-
Log perch	-	-	-	1	-	-	-	-	-
Sauger	-	-	-	1	1	1	-	1	-
Walleye	1	-	-	-	-	-	-	2	-
Stizostedion spp.	3	-	-	-	-	-	-	-	-
Freshwater drum	45	35	30	104	20	149	89	90	32
Unidentified fish & skeleton	-	-	-	-	-	-	-	-	-
TOTAL	148	321	627	394	705	652	435	1,236	4,470
TOTAL LESS SHAD	129	151	219	250	310	194	131	187	125

Table 2.3-2 . (Continued)

TAXA	11/8 to 11/15	11/15 to 11/22	11/22 to 11/29	11/29 to 12/6	12/6 to 12/13	12/13 to 12/20	12/20 to 12/27	TOTAL
Chestnut lamprey	-	1	-	-	-	-	-	4
Silver lamprey	-	-	-	-	1	1	-	14
Unidentified lamprey	-	-	-	-	-	-	-	1
Shortnose gar	-	-	-	-	-	-	-	1
Bowfin	-	-	-	-	-	-	-	15
Gizzard shad	375	81	8	7	38	40	24	93,895
Goldeye	-	-	-	-	-	-	-	6
Mooneye	-	-	-	-	-	-	-	8
Northern pike	-	-	-	-	-	-	-	33
Carp	1	-	-	-	-	-	-	562
Shiner spp.	1	2	-	1	-	7	-	175
Bullhead minnow	-	-	-	-	-	-	-	2
Minnow spp.	5	-	-	-	-	-	-	57
Carpsucker spp.	-	1	-	-	-	-	-	82
White sucker	-	-	-	-	-	-	-	2
Spotted sucker	-	-	-	-	-	-	-	1
Unidentified catostomidae	-	-	-	-	-	-	-	1
Bigmouth buffalo	-	-	-	-	-	-	-	414
Smallmouth buffalo	-	-	-	-	-	-	-	15
Buffalo spp.	-	-	-	-	-	-	-	1
Silver redhorse	-	-	-	-	-	-	-	1
Shorthead redhorse	-	1	-	-	-	-	-	22
Bullhead spp.	-	-	-	-	-	-	-	455
Tadpole madtom	-	-	1	-	-	-	-	12
Channel catfish	15	43	30	16	21	22	3	2,032
Flathead catfish	1	-	-	-	-	-	-	76
Trout perch	-	-	-	-	-	-	-	1
Burbot	-	-	-	-	-	-	-	3
White bass	17	41	9	2	12	17	45	2,096
Rock bass	1	-	-	-	-	-	-	38
Smallmouth bass	-	-	-	-	-	-	-	10
Largemouth bass	-	-	-	-	-	-	-	2
Green sunfish	-	-	1	-	-	-	-	55
Bluegill	3	6	1	-	4	8	1	622
Crappie spp.	6	13	4	-	4	2	1	1,551
Unidentified centrarchidae	-	-	-	-	-	-	-	2
Yellow perch	-	-	-	-	-	-	-	19
Log perch	-	-	-	-	-	-	-	3
Sauger	2	1	-	-	1	-	-	36
Walleye	1	-	-	1	-	-	-	36
Stizostedion spp.	-	-	-	-	-	-	-	16
Freshwater drum	38	83	18	6	18	12	4	3,463
Unidentified fish & skeleton	-	-	-	-	-	-	1	143
TOTAL	466	273	72	33	99	109	79	105,983
TOTAL LESS SHAD	91	192	64	26	61	69	55	12,088

Table 2.3-3. Number of fish and percent of yearly total for each taxa, by season, for fishes collected from the trash baskets at the Prairie Island Plant during 1978.

TAXA	WINTER Dec 28 to Mar 29		SPRING Mar 29 to Jun 14		SUMMER June 14 to Sep 13		FALL Sep 13 to Dec 27	
	Number	% of Total	Number	% of Total	Number	% of Total	Number	% of Total
Chestnut lamprey	-	-	2	50.0	1	25.0	1	25.0
Silver lamprey	7	50.0	2	14.3	1	7.1	4	28.6
Unidentified lamprey	-	-	1	100.0	-	-	-	-
Shortnose gar	-	-	1	100.0	-	-	-	-
Bowfin	-	-	14	93.3	1	6.7	-	-
Gizzard shad	82,075	87.4	3,198	3.4	776	0.8	7,846	8.4
Goldeye	2	33.3	4	66.7	-	-	-	-
Mooneye	1	12.5	4	50.0	3	37.5	-	-
Northern pike	-	-	2	6.1	30	90.9	1	3.0
Carp	20	3.6	385	68.5	148	26.3	9	1.6
Shiner spp.	10	5.7	29	16.6	63	36.0	73	41.7
Bullhead minnow	-	-	2	100.0	-	-	-	-
Minnow spp.	-	-	1	1.8	4	7.0	52	91.2
Carpsucker spp.	6	7.3	60	73.2	13	15.9	3	3.7
White sucker	-	-	2	100.0	-	-	-	-
Spotted sucker	-	-	1	100.0	-	-	-	-
Unidentified catostomidae	-	-	-	-	1	100.0	-	-
Bigmouth buffalo	11	2.7	396	95.7	5	1.2	2	0.5
Smallmouth buffalo	2	13.3	12	80.0	1	6.7	-	-
Buffalo spp.	-	-	-	-	1	100.0	-	-
Silver redhorse	-	-	1	100.0	-	-	-	-
Shorthead redhorse	3	13.6	9	40.9	8	36.4	2	9.1
Bullhead spp.	3	0.7	430	94.5	20	4.4	2	0.4
Tadpole madtom	3	25.0	2	16.7	5	41.7	2	16.7
Channel catfish	1,129	55.6	427	21.0	111	5.5	365	18.0
Flathead catfish	2	2.6	45	59.2	22	28.9	7	9.2
Trout perch	-	-	1	100.0	-	-	-	-
Burbot	3	100.0	-	-	-	-	-	-
White bass	241	11.5	1,290	61.5	355	16.9	210	10.0
Rock bass	2	5.3	30	78.9	3	7.9	3	7.9

Table 2.3-3. (Continued)

TAXA	WINTER Dec 28 to Mar 29		SPRING Mar 29 to Jun 14		SUMMER June 14 to Sep 13		FALL Sep 13 to Dec 27	
	Number	% of Total	Number	% of Total	Number	% of Total	Number	% of Total
Smallmouth bass	1	10.0	6	60.0	1	10.0	2	20.0
Largemouth bass	-	-	2	100.0	-	-	-	-
Green sunfish	6	10.9	30	54.5	13	23.6	6	10.9
Bluegill	88	14.1	297	[illegible]7	29	4.7	208	33.4
Crappie spp.	92	5.9	721	4[illegible]	492	31.7	246	15.9
Unidentified centrarchidae	1	50.0	1	50.0	-	-	-	-
Yellow perch	1	5.3	15	78.9	3	15.8	-	-
Logperch	-	-	-	-	2	66.7	1	33.3
Sauger	1	[illegible].8	16	44.4	11	30.6	8	22.2
Walleye	5	3.9	19	52.8	8	22.2	4	11.1
Stizostedion spp.	-	-	5	31.3	11	68.8	-	-
Freshwater drum	690	19.9	1,050	30.3	810	23.4	913	26.4
Unidentified fish & skeleton	34	23.8	106	74.1	2	1.4	1	0.7
TOTAL	84,439	79.7	8,619	8.1	2,954	2.8	9,971	9.4
TOTAL LESS GIZZARD SHAD	2,364	19.6	5,421	44.9	2,178	18.0	2,125	17.6

Table 2.3-4. Percentage of all fish impinged seasonally at the Prairie Island Plant from 1974 to 1978.

	PERCENT OF TOTAL IMPINGEMENT				
Season	1978	1977	1976	1975	1974
Winter	79.7	4.5	30.1	23.3	20.2
Spring	8.1	1.1	1.3	9.2	0.6
Summer	2.8	62.3	27.2	11.4	3.4
Fall	9.4	32.1	41.4	56.1	75.8

Table 2.3-5. Percentage of gizzard shad impinged seasonally at the Prairie Island Plant from 1974 to 1978.

	PERCENT OF TOTAL IMPINGEMENT				
Season	1978	1977	1976	1975	1974
Winter	87.4	4.1	48.8	29.7	20.7
Spring	3.4	0.7	0.3	3.4	0.1
Summer	0.8	69.9	13.4	7.0	1.0
Fall	8.4	25.2	37.5	59.9	78.2

Table 2.3-6. 1978 PRAIRIE ISLAND ANNUAL IMPINGEMENT LENGTH - FREQUENCY DISTRIBUTION

Total Length (mm)	FREQUENCY								
	Chestnut Lamprey	Silver Lamprey	Unid. Lamprey	Shortnose gar	Bowfin	Gizzard Shad	Goldeye	Mooneye	Northern Pike
0-19									
20-39						1			
40-59						117			
60-79						316			
80-99						314			
100-119						620			3
120-139						648			3
140-159						539			5
160-179						416	2		5
180-199		1			1	102	1		5
200-219	1	1			1	7			4
220-239		2				2			1
240-259		3				3			1
260-279	1	2				16			
280-299		3				93			
300-319	1	1	1			335	1	3	
320-339		1				255		2	1
340-359						55		1	
360-379					1	34			
380-399					1	25			

Table 2.3-6 (Continued).

Total Length (mm)	Chestnut Lamprey	Silver Lamprey	Unid. Lamprey	Shortnose gar	Bowfin	Gizzard Shad	Goldeye	Mooneye	Northern Pike
					FREQUENCY				
400-419						9	2	1	
420-439						1			
440-459									1
460-479					2				
480-499									
500-519					1				1
520-539									
540-559					1				
560-579					2				1
580-599									1
600-619				1					
620-639									
640-659					2				1
660-679									
680-699									
700-719					1				
720-739					1				
740-759									
760-779									
780-799					1				
TOTAL		14	1	1	15	3,927	6	7	33

Table 2.3-6 (Continued).

Total Length (mm)	FREQUENCY Carp	Bullhead Minnow	Shiner spp	Minnow spp	Carpsucker spp	White Sucker	Spotted Sucker	Smallmouth Buffalo
0-19								
20-39								
40-59	7		25	8	3			
60-79	59	1	72	35	5			
80-99	54	1	48	10	4			
100-119	16		3		1			1
120-139	2							
140-159	3				2			1
160-179	1				11			
180-199	3				3			
200-219	4				4			
220-239	2				2	1		2
240-259	1				3			
260-279	3				2			2
280-299	1				4			
300-319	6				8			2
320-339	5				6			1
340-359	1				4			2
360-379	9				1			
380-399	12				2			1
400-419	23						1	

Table 2.3-6 (Continued).

Total Length (mm)	FREQUENCY							
	Carp	Bullhead Minnow	Shiner spp	Minnow spp	Carpsucker spp	White Sucker	Spotted Sucker	Smallmouth Buffalo
420-439	28				1			
440-459	44				1			
460-479	35				3	1		1
480-499	35				1			
500-519	22				1			
520-539	24							
540-559	19							
560-579	1							
580-599								
600-619	2							
620-639	1							
640-659	3							
660-679	4							
680-699								
700-719								
720-739								
740-759								
760-779	2							
780-799								
800-819								
820-839	1							
840-859	1							
TOTAL	434	2	148	53	72	2	1	13

Table 2.3-6 (Continued).

Total Length (mm)	Bigmouth Buffalo	Buffalo spp.	Tadpole Madton	Flathead Catfish	Trout Perch	Burbot	White Bass	Silver Redhorse
			FREQUENCY					
0-19								
20-39								
40-59	2		1				34	
60-79		1	3	7	1		142	
80-99	1		4	4			23	
100-119	1		1	6			21	
120-139	1			3			71	
140-159	5			6			59	
160-179	9			2			22	
180-199	17						34	
200-219	40						243	
220-239	57			1			334	
240-259	56						209	
260-279	23						102	
280-299	10						42	
300-319	5					2	47	
320-339	4			2			67	
340-359	3						39	
360-379	4					1	18	
380-399	6			1			10	

Table 2.3-6 (Continued).

Total Length (mm)	Bigmouth Buffalo	Buffalo spp.	Tadpole Madton	Flathead Catfish	Trout Perch	Burbot	White Bass	Silver Redhorse
				FREQUENCY				
400-419				1			3	
420-439				2			1	
440-459	3							1
460-479	1			1				
480-499	2							
500-519	4			2				
520-539	2			1				
540-559	3							
560-579	4			1				
580-599	4			3				
600-619				1				
620-639	1			3				
640-659	3							
660-679	1			2				
680-699				1				
700-719				1				
720-739	1							
TOTAL	273	1	9	51	1	3	1,521	1

Table 2.3-6 (Continued).

Total Length (mm)	Shorthead Redhorse	Unid. Catostomidae	Bullhead spp.	Channel Catfish	Rock Bass	Green Sunfish	Bluegill	Smallmouth Bass
				FREQUENCY				
0-19								
20-39							1	
40-59				3			117	
60-79	1	1	4	21		2	78	
80-99			11	31	2	4	84	
100-119	2		16	52	4	10	64	
120-139			26	71	2	28	76	
140-159			75	276	6	8	52	1
160-179			40	361	7	1	59	
180-199			3	348	8		32	2
200-219			5	220	6		10	
220-239			3	93				1
240-259			3	47				
260-279			4	32				
280-299			3	25				
300-319			3	16				1
320-339	1			10				2
340-359	2			7				2
360-379	4			4				
380-399	3			3				

Table 2.3-6 (Continued).

Total Length (mm)	FREQUENCY							
	Shorthead Redhorse	Unid. Catostomidae	Bullhead spp.	Channel Catfish	Rock Bass	Green Sunfish	Bluegill	Smallmouth Bass
400-419	1			2				
420-439	4			6				
440-459	1			7				
460-479				5				
480-499								
500-519				3				
520-539				1				
540-559				1				
560-579				2				
580-599				5				
600-619								
620-639				2				
640-659								
660-679				1				
680-699								
700-719								
620-739								
640-759				1				
TOTAL	19	1	197	1,656	35	53	564	10

Table 2.3-6 (Continued).

FREQUENCY

Total Length (mm)	Largemouth Bass	Crappie	Unid. Centrarchidae	Yellow Perch	Log-perch	Sauger	Walleye	Stizostedion spp.	Freshwater Drum
0-19									
20-39									
40-59		43			1				19
60-79		184		2	1			1	61
80-99		258		1	1		1	4	92
100-119		228					2		269
120-139	1	112						3	814
140-159		87	1			3	3		447
160-179		102		4				1	216
180-199		162		4		3	2		110
200-219		152		6					117
220-239		78		1		5	2	4	152
240-259		48				5	5	1	132
260-279		23		1		6	1	2	146
280-299		14				2	2		146
300-319		3				2			118
320-339						2	1		88
340-359							2		57
360-379	1					3	3		21
380-399									13

Table 2.3-6 (Continued).

Total Length (mm)	Largemouth Bass	Crappie	Unid. Centrarchid	Yellow Perch	Log-perch	Sauger	Walleye	Stizostedion spp.	Freshwater Drum
				FREQUENCY					
400-419						1	4		3
420-439						1	2		
440-459						1	1		
460-479							1		
480-499							1		1
500-519							1		
520-539									
540-559									
560-579							1		
580-599							1		
600-619									
620-639							1		
TOTAL	2	1,494	1	19	3	34	36	16	3,025

Table 2.3-7. Total number of non-fish organisms collected from the Prairie Island trash baskets during 1978.

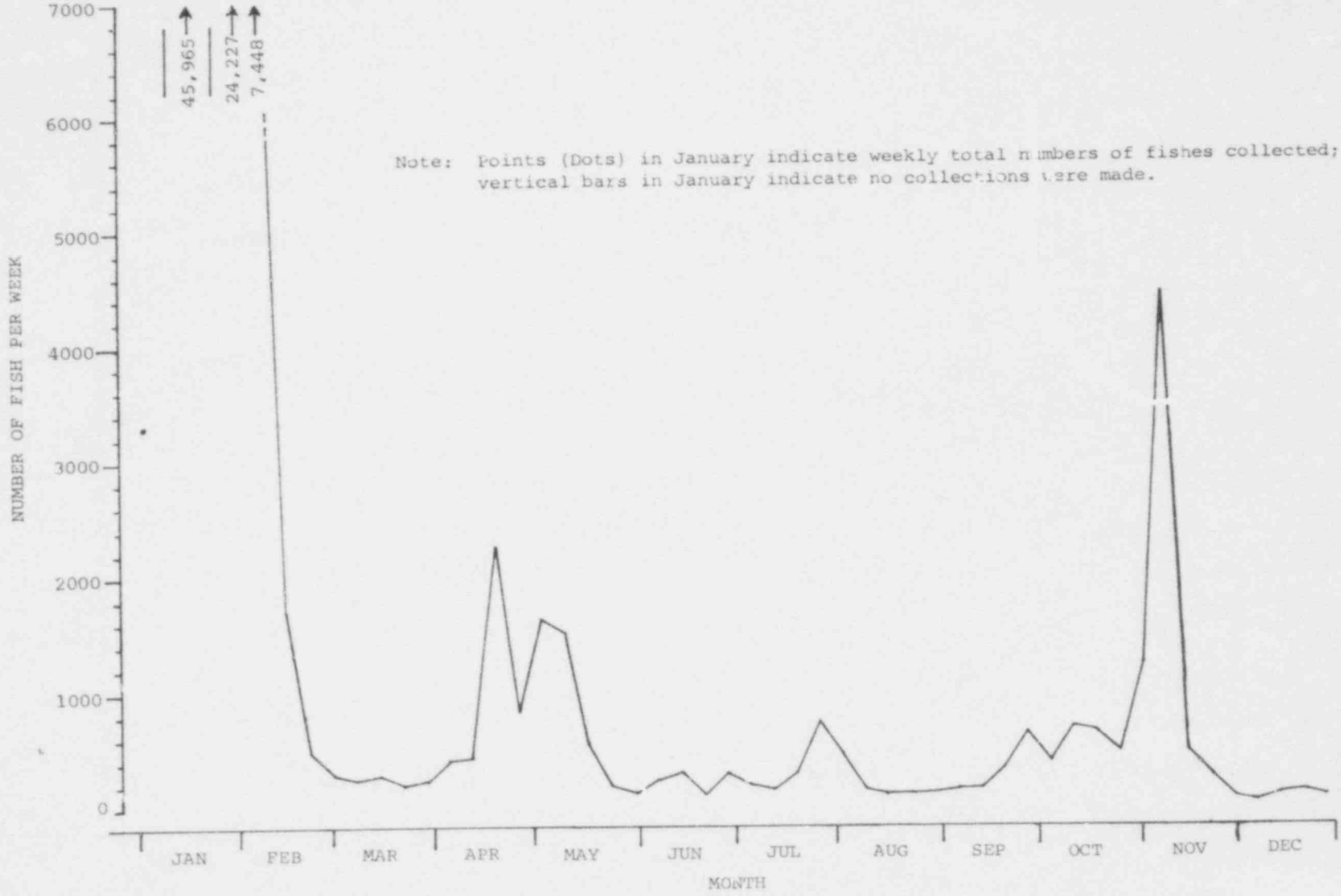
Spiny softshell turtle	94
Painted turtle	37
Clam	33
Mud puppy	33
Unidentified crayfish	18
Orconectes virilis	9
Orconectes immunis	7
Birds & skeletons	6
Snapping turtle	6
Map turtle	3
Snake	2
Pocket gopher	2
Coot	1
False map turtle	1
Leopard frog	1
Muskrat	1
Pigeon	1
Rat	
Toad	1
TOTAL	257

276 352

Table 2.3-8 Percentage of Mean Monthly Mississippi River Flow Entering the Prairie Island Plant Intake Canal During 1977 and 1978.

Month	Mean Intake Flow (cfs)		River Flow (cfs)		Percentage of Mean Monthly River Flow Entering Intake Canal	
	1977	1978	1977	1978	1977	1978
Jan	216	188	3,426	9,732	6.3	1.9
Feb	211	185	3,965	7,398	5.3	2.5
Mar	204	185	11,647	12,609	1.8	1.5
Apr	179	224	12,053	47,630	1.5	0.5
May	507	391	7,355	25,349	6.9	1.5
Jun	645	538	9,159	25,791	7.0	2.1
Jul	1,144	631	7,241	34,086	15.8	1.9
Aug	724	634	4,867	16,972	14.9	3.7
Sep	489	518	14,783	21,256	3.3	2.4
Oct	315	220	19,461	11,841	1.6	1.9
Nov	230	190	17,056	9,749	1.4	2.0
Dec	184	185	15,888	7,877	1.2	2.4

Figure 2.3-1. Numbers of Fish Collected per Week from the Prairie Island Plant Trash Baskets during 1978.



Note: Points (Dots) in January indicate weekly total numbers of fishes collected; vertical bars in January indicate no collections were made.

Figure 2.3-2. Numbers of Gizzard Shad Collected per Week from the Prairie Island Plant Trash Baskets during 1978.

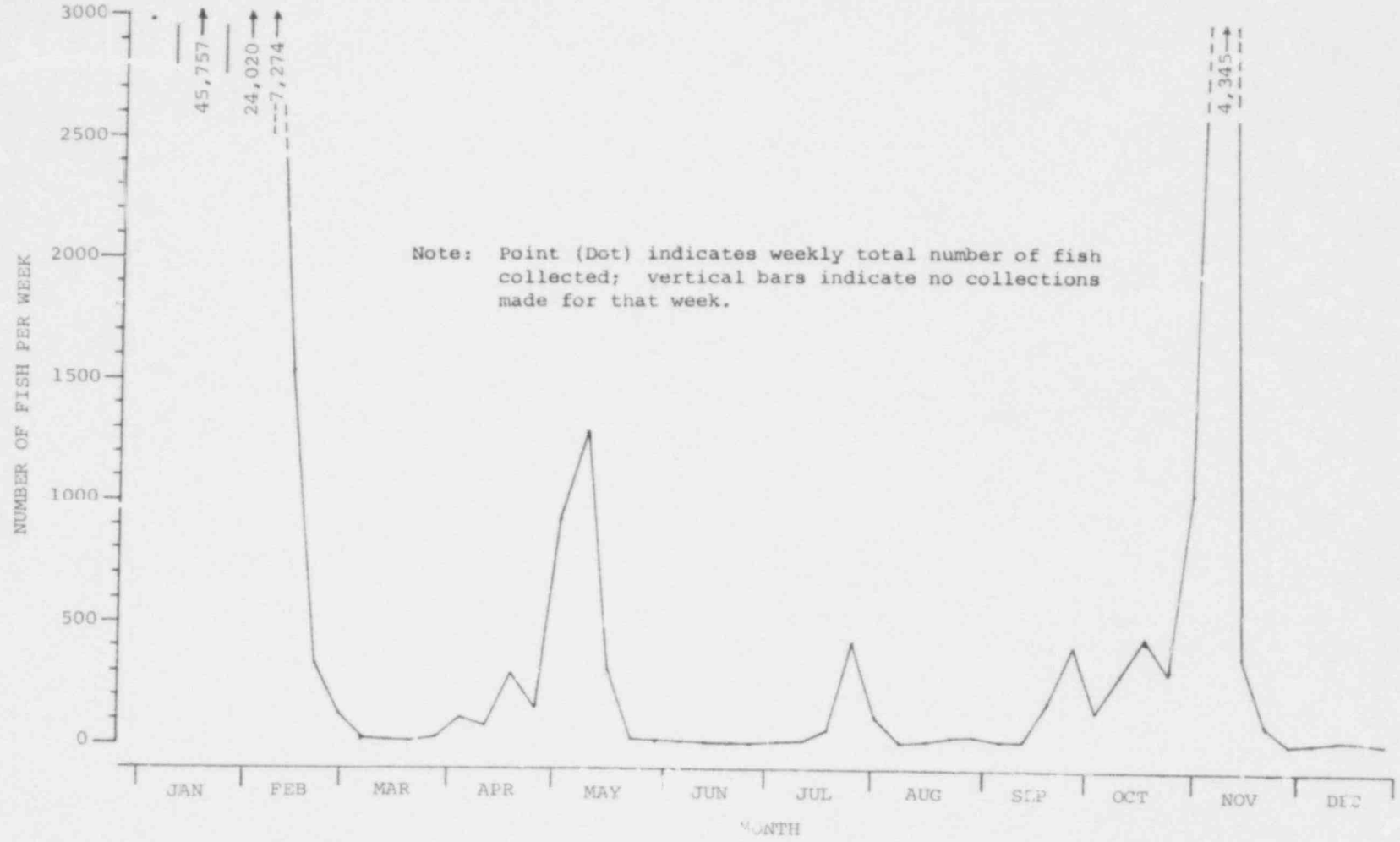


Figure 2.3-3. Numbers of Fish (Less Gizzard Shad) per Week from the Prairie Island Plant Trash Baskets during 1978.

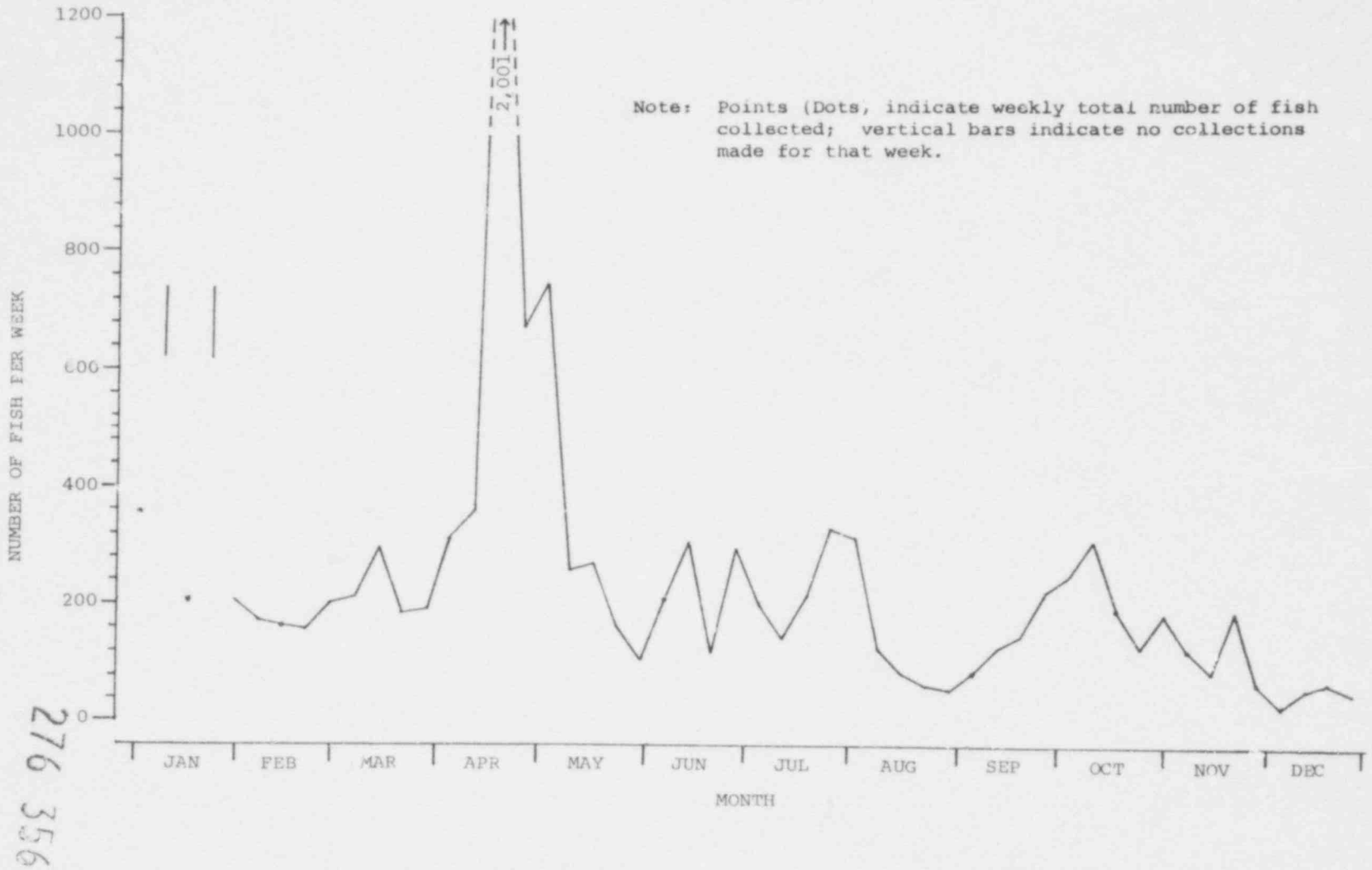
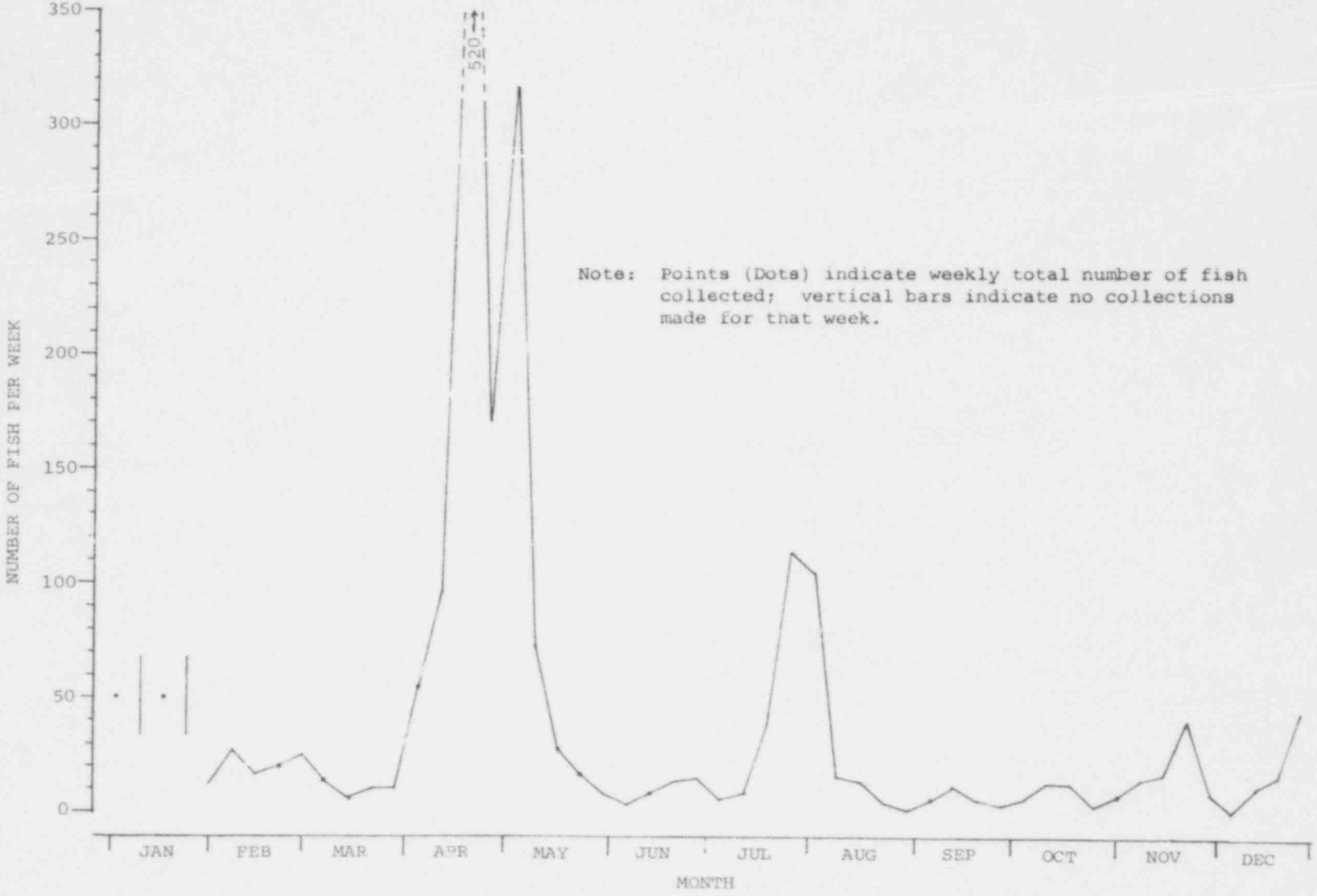


Figure 2.3-4. Numbers of White Bass Collected per Week from the Prairie Island Plant Trash Baskets during 1978.



Note: Points (Dots) indicate weekly total number of fish collected; vertical bars indicate no collections made for that week.

Figure 2.3-5. Numbers of Channel Catfish per Week Collected from the Prairie Island Plant Trash Baskets during 1978.

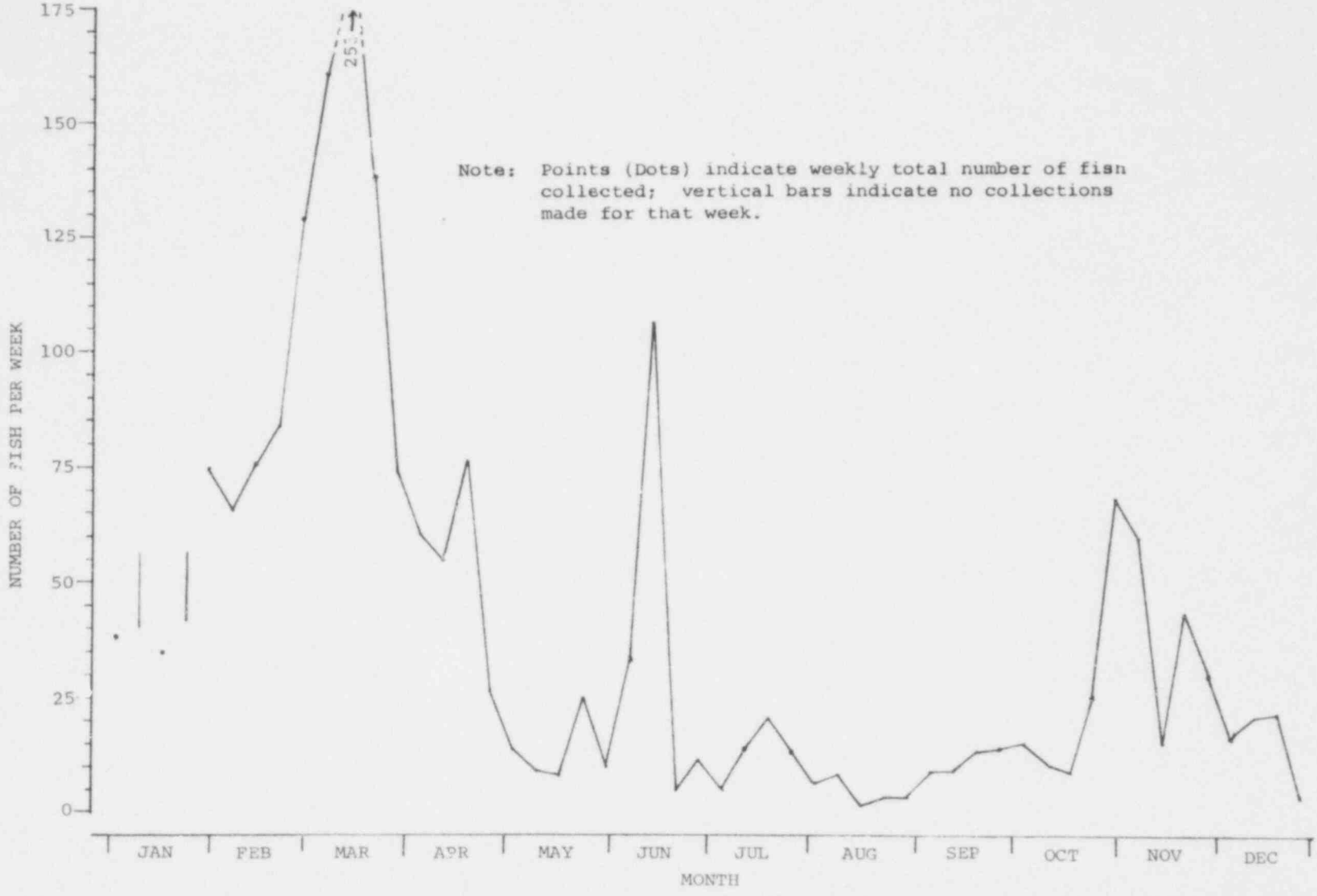


Figure 2.3- . Numbers of Freshwater Drum Collected per Week from the Prairie Island Plant Trash Baskets during 1978.

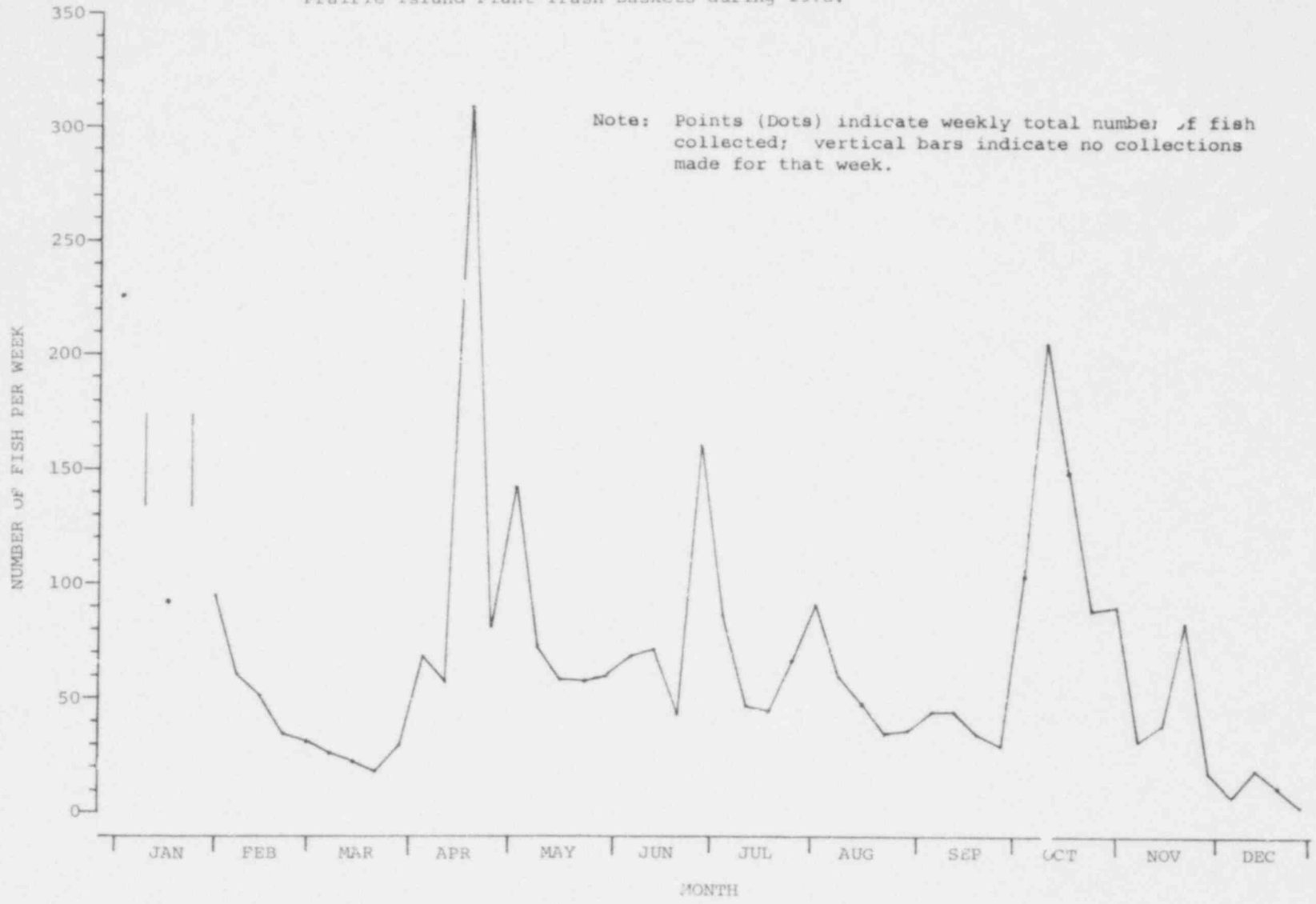


Figure 2.3-7. Numbers of Crappie Spp. per Week Collected from the Prairie Island Plant Trash Baskets during 1978.

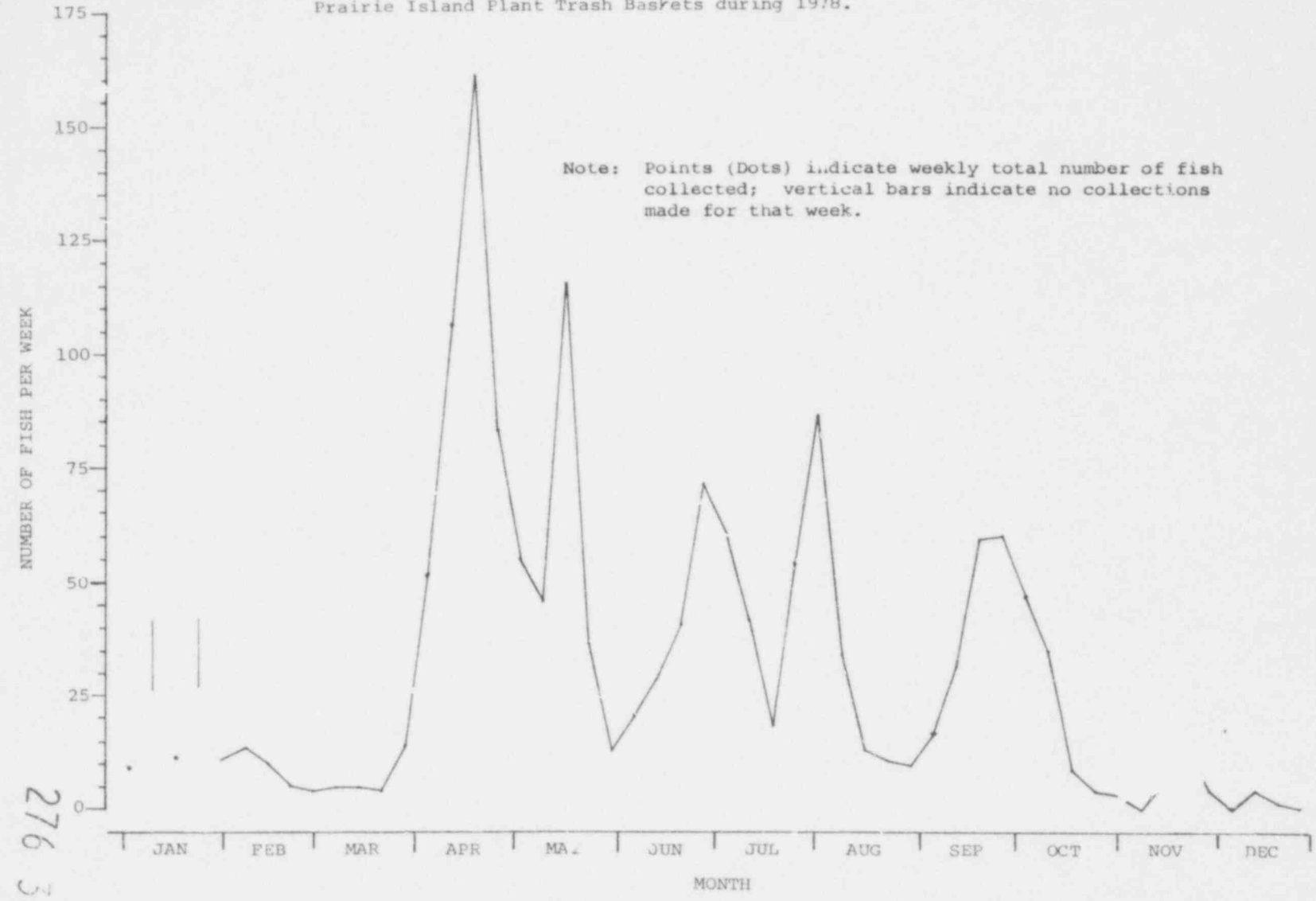


Figure 2.3-8. Numbers of Bluegill Collected per Week from the Prairie Island Trash Baskets during 1978.

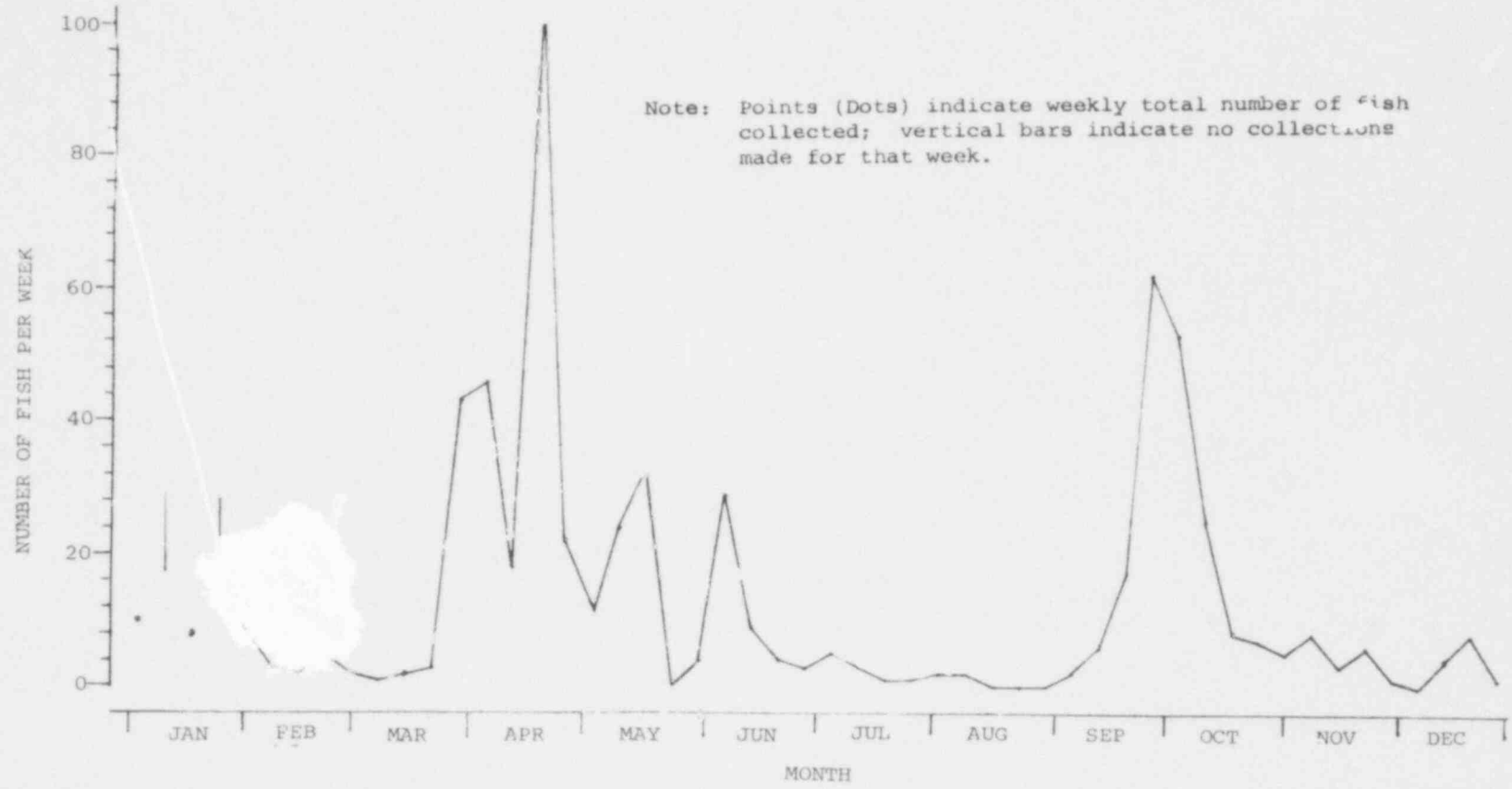


Figure 2.3-9. Length Frequency of Gizzard Shad Impinged at the Prairie Island Plant during 1978.

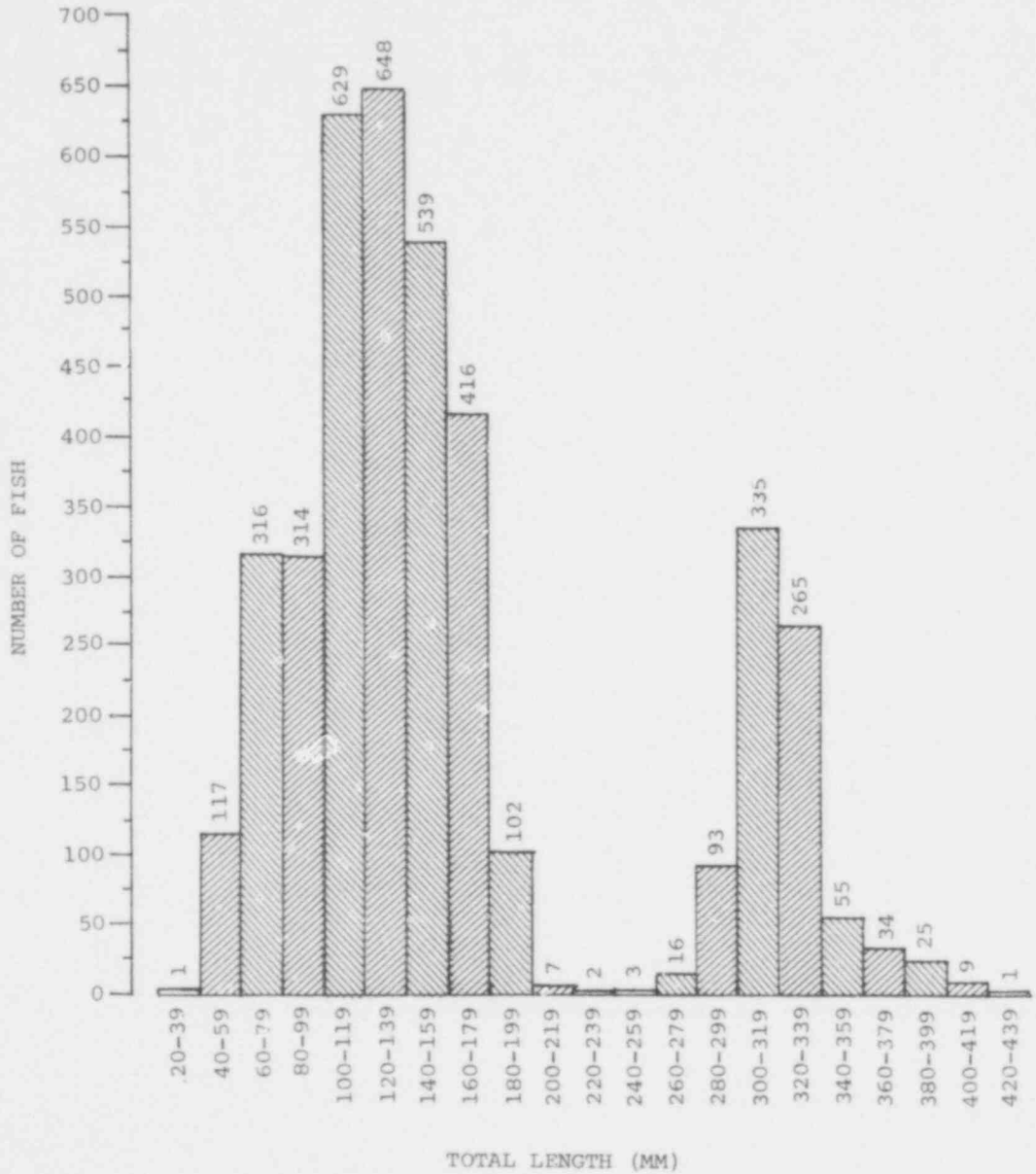


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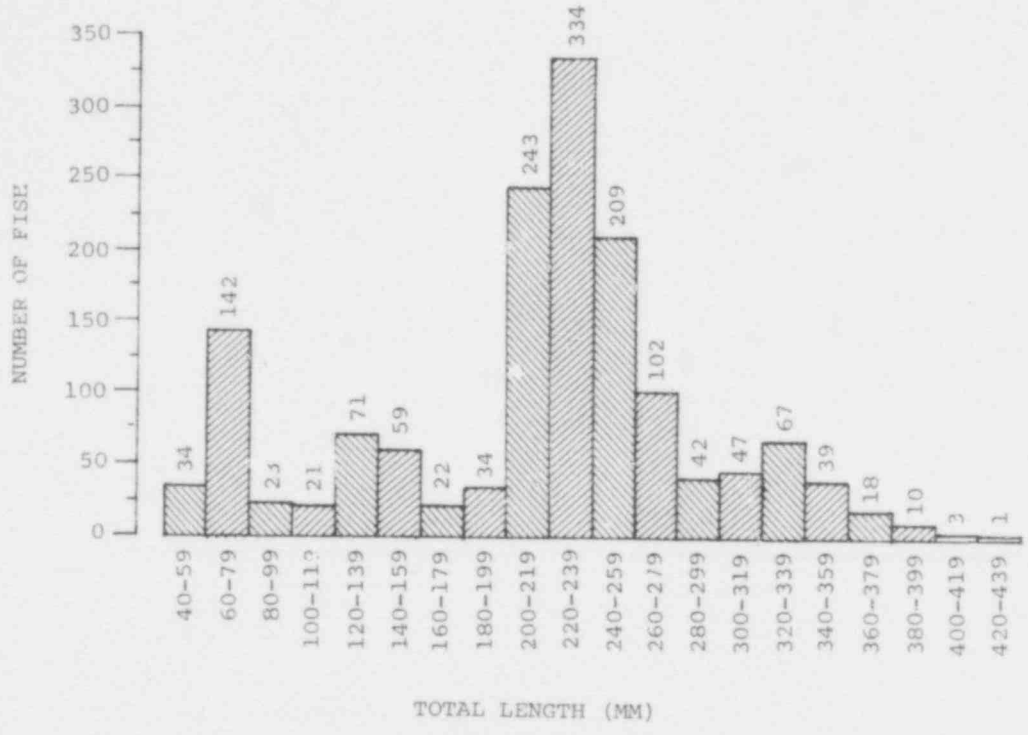
Figure 2.3-10. Length Frequency of White Bass Impinged at the Prairie Island Plant during 1978.



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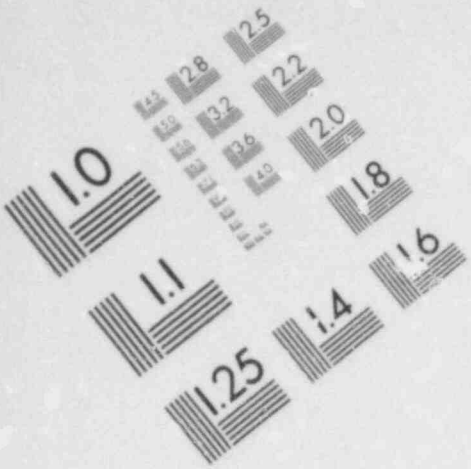


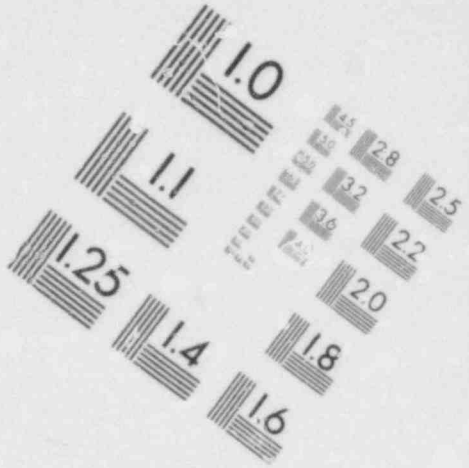
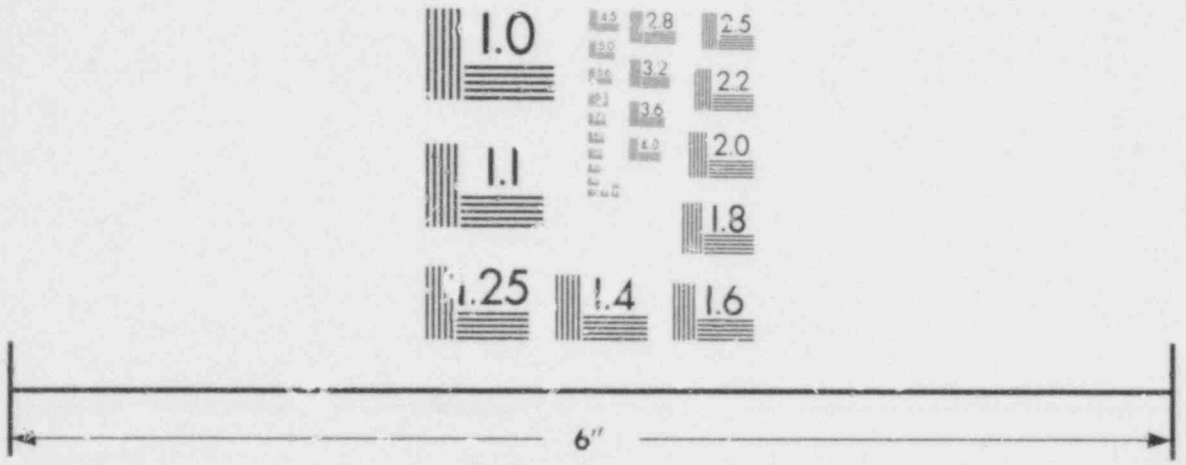
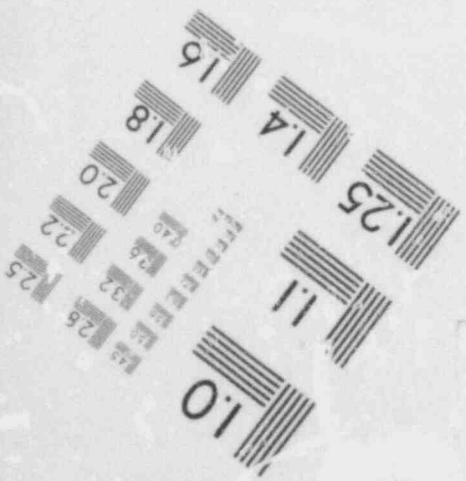


IMAGE EVALUATION
TEST TARGET (MT-3)





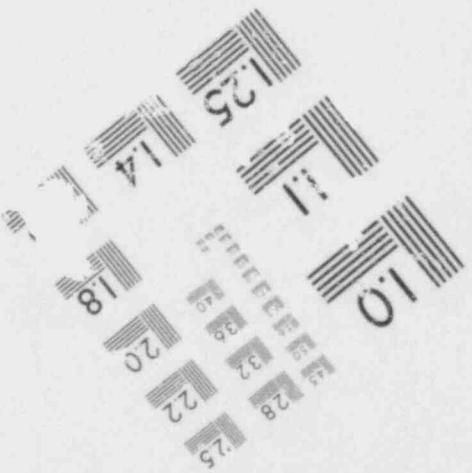


Figure 2.3-11. Length Frequency of Freshwater Drum Impinged at the Prairie Island Plant during 1978.

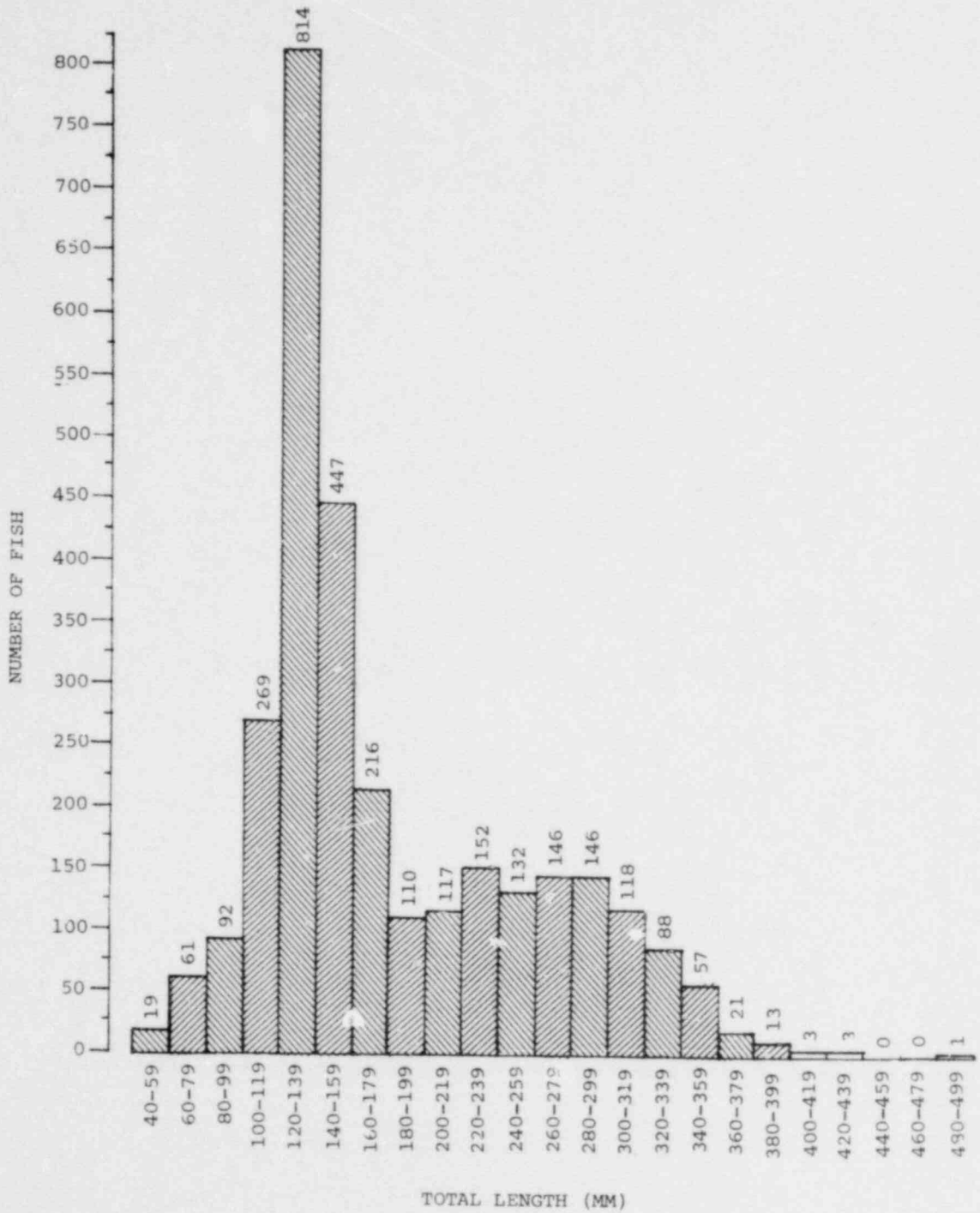


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Figure 2.3-12. Length Frequency of Channel Catfish Impinged at the Prairie Island Plant during 1978.

Figure 2.3-13. Length Frequency of Bluegill Impinged at the Prairie Island Plant during 1978.

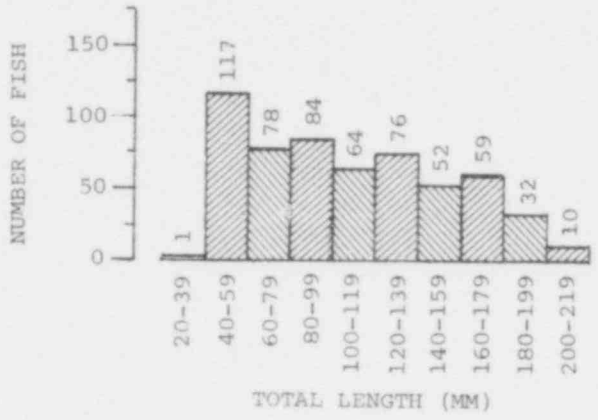
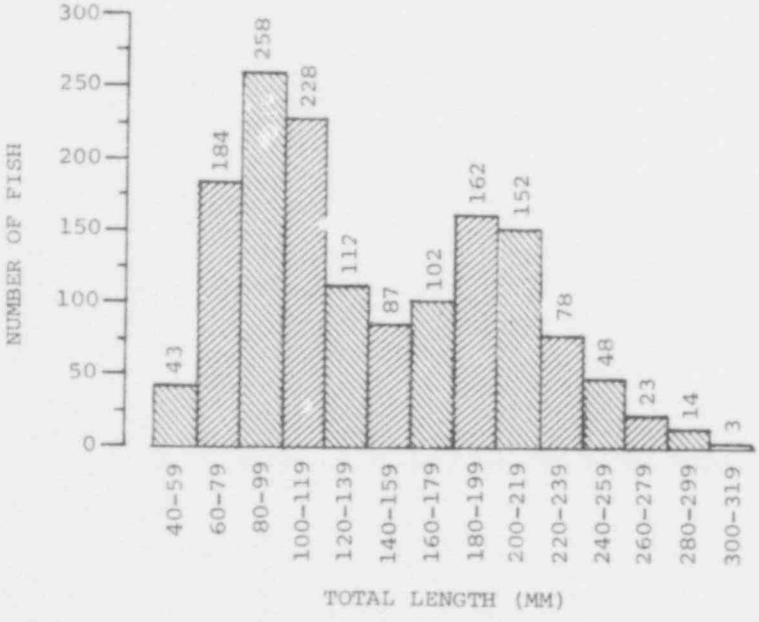


Figure 2.3-14. Length Frequency of Crappie Spp. Impinged at the Prairie Island Plant during 1978.



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APPENDIX A2.3.1
COMMON AND SCIENTIFIC NAMES OF FISHES IMPINGED
AT THE PRAIRIE ISLAND PLANT DURING 1978
(After Bailey et al. 1970)

Common Name	Scientific Name
Chestnut lamprey	Ichthyomyzon casteneus
Silver lamprey	I. unicuspis
Shortnose gar	Lepisosteus platostomus
Bowfin	Amia calva
Gizzard shad	Dorosoma capedianum
Goldeye	Hiodon alosoides
Mooneye	H. tergisus
Northern pike	Esox lucius
Carp	Cyprinus carpio
Silver chub	Hybopsis storeriana
Golden shiner	Notemigonus crysoleucas
Spottail shiner	N tropis hudsonius
Bullhead minn[illegible]	Pimephales vigilax
Carpsucker s[illegible]ies	Carpiodes spp.
White sucker	Catostomus commersoni
Smallmouth buffalo	Ictiobus bubalus
Bigmouth buffalo	I. cyprinellus
Spotted sucker	Minytrema melanops
Silver redhorse	Moxostoma anisurum
Shorthead redhorse	M. macrolepidotum
Black bullhead	Ictalurus melas
Yellow bullhead	I. natalis
Channel catfish	I. punctatus
Tadpole madtom	Noturus gyrinus
Flathead catfish	Pylodictus olivaris
Trout perch	Percopsis omiscomaycus
Burbot	Lota lota
White bass	Morone chrysops
Rock bass	Ambloplites rupestris
Green sunfish	Lepomis cyanellus
Bluegill	L. macrochirus
Smallmouth bass	Micropterus dolomieui
Largemouth b[illegible]	M. salmoides
White crappie	Pomoxis annularis
Black crappie	P. nigromaculatus
Yellow perch	Perca flavescens
Logperch	Percina caprodes
Sauger	Stizostedion canadense
Walleye	S. vitreum
Freshwater drum	Aplodinotus grunniens

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ENVIRONMENTAL MONITORING AND ECOLOGICAL STUDIES PROGRAM

1978 ANNUAL REPORT

VOLUME 2

PRAIRIE ISLAND NUCLEAR GENERATING PLANT

NEAR RED WING, MINNESOTA

NSP

Cover Illustration

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PRAIRIE ISLAND NUCLEAR GENERATING PLANT

ENVIRONMENTAL MONITORING PROGRAM

1978 ANNUAL REPORT

ECOLOGICAL STUDIES

1978 PROGRESS REPORT ON THE PRAIRIE ISLAND FISH POPULATION STUDY

(2.4)

Prepared for

Northern States Power Company
Minneapolis, Minnesota

by

Scott P. Gustafson
Joseph L. Geis
Carl J. Bublitz

Minnesota Department of Natural Resources
Division of Fish and Wildlife
Ecological Services Section

April, 1979

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2.4.1 INTRODUCTION

This study is part of a continuing comprehensive investigation to determine environmental effects of the Prairie Island Nuclear Generating Plant (PINGP) on fish populations in the Mississippi River and its backwaters near Red Wing, Minnesota.

Several parameters were used to measure changes in the population which might be related to plant operation. These parameters include population structure (e.g., abundance and species composition), fish distribution, and condition. Changes in environmental conditions should be reflected in these parameters.

2.4.1.1 Scope

The total study includes a fish population study and a creel survey; this progress report deals only with the fish population study. The creel survey was not conducted in 1978, but will be resumed in 1979. The report describes field work carried out in 1978 and analyzes data collected. Dates of the regular sampling seasons in 1978 were: "spring", May 31 - July 12; "summer", August 1 - September 6; and "fall", September 12 - October 27.

2.4.1.2 Study Area

The five sections of the study area (Figure 2.4-1) are described by Hawkinson (1974). Each section or area consists of 10 numbered stations beginning with zero at the upstream end and ending with nine at the downstream station. Sampling is done at designated sites within stations to eliminate any sampling bias which might result if different sites within a station were sampled each season or year.

However, water stage influences distribution of fishes and may result in some differences in catch between seasons or during the same season in different years. Figures 2.4-2 through 2.4-5 indicate all original sampling sites for each type of gear. Some of these sampling sites are no longer used (see Materials and Methods section).

2.4.2 MATERIALS AND METHODS

2.4.2.1 Gear

To monitor the abundance of fish near PINGP, fish were collected using five types of sampling gear: trap net, gill net, boom shocker, trawl, and seine. An illustration of each type of gear can be found in Naplin and Geis (1975). A list of common and scientific names and methods of capture of fishes in the area of PINGP in 1978 is presented in Table 2.4-1. This table also lists previous years in which each species was captured. The sampling schedule is designed so that each type of gear is used during similar calendar periods every year.

2.4.2.1.1 Trap Netting

Since 1975, river trap nets, described by Krosch (1967), were set for four nominal 24-hour periods at each of four stations in Section 0 and 4 and at each of five stations in Sections 1 and 3 (Table 2.4-2), as described by Gustafson and Geis (1977). As in previous years, no trap nets were set in Section 2 because of swift currents and heavy barge traffic. Some of the trap nets set in the main channel in Sections 3 and 4 occasionally rolled because of river currents and waves from river traffic. To prevent rolling, nets were held in place by stakes pounded into the bottom alongside the front frame. Catch data from sets in which the net did not fish properly were not used in calculations.

2.4.2.1.2 Gill Netting

Standard 250- X 6-foot experimental gill nets were used in Sections 0, 1, and 3 (Table 2.4-2). Eight nominal 24-hour sets were made in each section by making two nominal 24-hour sets at four stations. Sampling with gill nets was done only during the spring and fall sampling seasons. The stations netted were the same stations used since 1975 (Gustafson and Geis 1977).

2.4.2.1.3 Electrofishing

One 15-minute electrofishing run was made in each station in each section during summer and fall sampling seasons. During the spring sampling season Stations 0-0 through 3-4 (35 stations) were sampled. Stations 3-5 through 4-9 were not sampled because of equipment problems. All runs were conducted during daylight hours. The electrofishing unit was the same used in previous years. Electrical output was regulated by adjusting engine rpm. An output range of 5.5 to 7.0 amperes was most productive; an attempt was made to maintain an output of 6.5 amperes or less.

2.4.2.1.4 Trawling

Trawling was done in the plant intake area, discharge canal, and two stations in North Lake as in 1974 through 1977. A minimum of 15 minutes of trawling in two or more runs was completed in each station with the same trawl used in previous years.

2.4.2.1.5 Seining

Shoreline seining was done in all five sections and was generally restricted to areas with water depth less than 2 m. The seine is 1/4-inch knotless nylon, 50 feet long by

4 feet deep, with a 4- X 4- X 4-foot bag. This is the same seine used since 1974. The mean area covered in each seine haul in 1978 was approximately 298 m^2.

2.4.2.2 Tagging

The tagging program initiated in 1974 was continued on a limited scale in 1978. Fish were tagged with model FD-68D Floy spaghetti tags. Each tag consists of a length of yellow vinyl tubing approximately 1/16-inch in diameter with a molded "T" shaped nylon anchor which extends entirely through the tube. Tags were imprinted with the legend, MINN DNR ST PAUL F_____, and serially numbered. Tags were applied with a tagging gun described by Naplin and Geis (1975).

In May and June, 124 fish were tagged in the discharge areas as part of the population estimate described later in this report. During the second attempt at a population estimate in July 1978, 28 fish were tagged.

2.4.2.3 Scale Samples

Scale samples were taken during summer and fall sampling periods in 1978. It was estimated that a sample size of about 150 fish would be sufficient for determining population structure (Arthur Peterson 1976, personal communication). Previous sampling data indicated that for some species this sample size could be collected with a single type of gear. For other species a combination of all gear types was needed to get a large enough sample. Aging of the 1978 scale samples was not completed in time to include the age structure data in this report.

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2.4.2.4 Population Estimate

Two mark-recapture experiments were performed to estimate the number of fish present in the heated discharge of PINGP during late spring and midsummer 1978. Fish from Station 3-2 (Figure 2.4-6), the discharge area, were collected during the two experiments. The first attempt was started May 23 and continued nine days through June 6, 1978. The second attempt was started July 18 and [illegible] were collected five days through July 26, 1978.

Before sampling for the first population estimate began, an attempt was made to block off part of the heated discharge area with a 16-foot (4.9 m) deep, 1 1/2 inch (3.8 cm) bar measure mesh seine. About 1.4 ha were enclosed by the seine (Figure 2.4-6). The portion of the discharge area where the seine was placed is about 3 m maximum depth. The lead line was a rope with approximately 18 kg concrete anchors attached at 1.5 to 3 m intervals. In areas with swift current, the anchors were spaced at narrow intervals, while wider intervals were used in areas with little current. Scuba divers inspected the seine the same day it was set and found the bottom of the seine as much as 15 cm above the bottom of the discharge canal. The seine was removed after the last sampling day of this experiment (June 6).

Starting on May 23, fish were collected by AC electrofishing and trap netting, and on the last sampling day by gill netting. The boom shocker, trap nets, and gill nets were the same ones used for the regular population study. Sampling was done throughout the enclosed area. Most electrofishing runs were along shorelines, because the electrofishing gear is only effective to a depth of approximately 2 m.

A second population estimate was attempted during July 1978. No attempt was made to block off the discharge canal with a seine. We felt the seine may have been unsuccessful in preventing movement into or out of the enclosed area during the previous estimate because of the open space between the seine and the bottom of the discharge canal. Trap nets were set on July 17 and lifted on July 18. A pulse DC boom shocker was used to collect fishes on July 19, 20, 24, 25, and 26. The sampling was terminated because few fish were collected and no marked fish were recaptured.

More than one type of gear was used during the population estimates to maximize the number of fishes sampled. One advantage of using more than one type of gear in a population estimate is that each gear has a slightly different selectivity for size and species. A wider range of sizes and species is likely to be collected as the number of different gears increases. A second advantage is that there is less likely to be selection for or against fish which have already been collected and released. Ricker (1975) recommends using a different gear to capture fish for marking than is used for recapturing fish. Since this was a multiple mark-recapture experiment, it was not possible to follow this recommendation completely.

As fish were collected they were placed in a holding tank in the boat until they were measured and marked. The following eight species were marked with Floy tags or fin-clips: carp, channel catfish, flathead catfish, white bass, smallmouth bass, sauger, walleye, and freshwater drum. No fish less than 190 mm total length were marked. All carp and freshwater drum 190 mm or greater were fin-clipped. Channel catfish 190 mm through 299 mm were fin-clipped, while those 300 mm and over were tagged. For the other species, individuals from 190 mm through 249 mm were fin-clipped, while those 250 mm or greater were tagged. Fish

which were severely deformed, diseased, or which appeared to be highly stressed were not marked. All recaptures during sampling were recorded.

A population estimate by species was made using the method of Schnabel (1938) as modified by Chapman (1952, 1954), and cited by Ricker (1975) using the following equation:

$$N = \frac{\sum(C_t M_t)}{R + 1} .$$

Ricker (1975) defines these symbols as follows:

N = size of population at time of marking

M_t = total number of marked fish at large at start of the t^{th} day (or other interval), i.e., the number previously marked less any accidentally killed at previous recapture.

C_t = total sample taken on day t

R_t = number of recaptures in the sample C_t

$R = \sum R_t$ = total recaptures during the experiment.

A symbol not mentioned specifically by Ricker, but which is useful in tabulations, is M_i, where

M_i = number of fish tagged on day i.

Ricker (1975) suggests dividing the fish into two or more length groups to make a more accurate population estimate. However, because of the low numbers of returns during the May-June 1978 population estimate, it was not statistically advantageous to use more than one length group.

Population estimates were calculated only for carp, white bass, walleye, and freshwater drum, because few individuals of the other species were marked and/or recaptured. Ninety-five percent confidence intervals were calculated for these four species. Confidence intervals were calculated using Appendix II in Ricker (1975).

Weights for carp, white bass, walleye, and freshwater drum were calculated using respective 1978 summer length-weight equations and lengths measured at the time fish were tagged. These weights were used to calculate an average weight per fish of each species. The average weights were used to calculate standing crops for respective species.

2.4.3 RESULTS

2.4.3.1 Gear

2.4.3.1.1 Trap Netting

During 1978 a total of 6,322 fish representing 36 species were caught in 201 nominal 24-hour trap net sets. Tables 2.4-3 through 2.4-5 summarize trap net catches by area and season. Table 2.4-6 is a length-frequency of fishes caught with trap nets during 1978.

The following six species comprised 83.5 percent of the total trap net catch: black crappie (24.5 percent), white bass (19.1 percent), freshwater drum (16.5 percent), carp (9.1 percent) white crappie (8.1 percent), and bluegill (6.2 percent).

The total catch of black crappie was higher during summer (467) and fall (890) than during spring (195). The catch rate (number of fish per lift) for summer and fall was highest below Lock and Dam 3, 7.79/lift and 25.40/lift,

respectively, but in spring was lowest below Lock and Dam 3 (1.09/lift). During summer and fall, the lowest black crappie catch rate was obtained in the plant area, 6.60/lift and 3.70/lift, respectively. The highest spring catch rate occurred above PINGP (4.33/lift).

The total catch of white bass increased from 262 in spring, to 360 in summer, and to 584 in fall. The catch rate for summer and fall was highest in the plant area, 8.05/lift and 9.35/lift, respectively, but in spring was lowest in the plant area (1.95/lift). During summer and fall, the lowest white bass catch rate was obtained below Lock and Dam 3, 2.07/lift and 7.40/lift, respectively. The highest spring catch rate for white bass occurred above PINGP (6.06/lift).

The total catch of freshwater drum for spring (535) was more than double either summer (263) or fall (246) catches. The catch rate for spring and fall was highest below Lock and Dam 3, 16.64/lift and 6.13/lift, respectively. The highest summer catch rate occurred in the plant area (6.35/ lift). During each season the catch rate was lowest above PINGP (1.79/lift to 2.44/lift).

The total catch of white crappie increased from 147 in spring to 200 in fall. The catch rate for spring and fall was highest in the plant area, while during summer the catch rate was highest below Lock and Dam 3. The catch rates for white crappie ranged from 0.82/lift to 5.30/lift.

The total catch for carp was higher during spring (262) and summer (184) than during fall (132). During spring the highest catch rate for carp was above PINGP, and during summer and fall it was highest below Lock and Dam 3. Catch rates for carp ranged from 0.30/lift to 5.39/lift.

Total catch for bluegill ranged from 101 in spring to 178 in summer. Catch rates ranged from 0/lift to 6.71/lift.

Catch rates of both sauger and walleye were low in all areas during 1978 trap netting. Catch rates for sauger ranged from 0.09/lift to 0.65/lift and for walleye from 0.14/lift to 1.09/lift.

2.4.3.1.2 Gill Netting

A total of 2,505 fish of 28 species were captured in 48 nominal 24-hour gill net sets during 1978. Spring gill netting accounted for 64.9 percent of the total number of fish caught by gill nets in 1978. Gizzard shad were the most commonly caught fish, totaling 33.9 percent of the combined spring and fall catch. Gizzard shad were more than twice as abundant as the second most abundant species (white bass), which comprised 13.6 percent of the total catch. Other important species were sauger (8.3 percent), freshwater drum (6.1 percent), carp (5.9 percent), and shorthead redhorse (5.7 percent). Table 2.4-7 summarizes gill net catches by area and season and Table 2.4-8 lists length-frequencies of gill net-caught fishes.

The highest catch rate for gizzard shad was in the plant area during fall. 40.25 fish per 24-hour gill net set (40.25/lift). Spring catch rates were 15.06/lift above PINGP and 12.63/lift in the plant area. The lowest catch rate was 11.56/lift during fall above PINGP. The majority of gizzard shad caught in gill nets in spring were yearlings and adults, whereas most of those caught during fall were from the 1978 year class.

White bass catch rates were higher during spring than during fall. During spring 14.69/lift were caught above PINGP,

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while 6.25/lift were caught in the plant area. Fall catch rates declined to 2.31/lift and 2.38/lift, respectively.

Carp were most abundant during spring above PINGP where the catch rate was 6.50/lift. In the plant area 3.38/lift were caught during spring. The lowest catch rate was 0.50/lift in the plant area during fall.

Sauger was the third most abundant species in the 1978 gill net catch. Catch rates both above and in the plant area were similar ranging from 3.88/lift to 5.38/lift for spring and 4.50/lift to 4.00/lift for fall, respectively.

Most freshwater drum collected in gill nets in 1978 were taken during spring; the catch rates were 5.00/lift above PINGP and 4.38/lift in the plant area. Lowest catch rates for freshwater drum were found above PINGP, 0.58/lift during fall.

Highest shorthead redhorse gill net catches were in spring, 5.00/lift above PINGP and 6.00/lift in the plant area. The lowest catch rate for shorthead redhorse was 0.63/lift above PINGP during fall.

2.4.3.1.3 Electrofishing

In 1978, 5,500 fish of 39 species were collected during 33.75 hours of day electrofishing. The 1978 catch represented a decrease of 4,402 fish from the corresponding 1977 catch. Part of this decline resulted from electrical generator problems which prevented spring sampling in part of the plant area and below Lock and Dam 3. Five species accounted for 73.4 percent of the total 1978 electrofishing catch: gizzard shad (23.3 percent), freshwater drum (17.3 percent), bluegill (12.6 percent), carp (10.9 percent), and emerald shiner (9.3 percent). Four other species totaled

14.5 percent of the catch: white bass (6.3 percent), small mouth bass (3.6 percent), sauger (2.6 percent), and shorthead redhorse (2.0 percent). Tables 2.4-9 through 2.4-11 summarize day electrofishing catches by season and area. Length-frequencies of all fishes caught by electrofishing during 1978 are listed in Table 2.4-12.

Total electrofishing catch of gizzard shad in 1978 (1,280) represented a substantial drop from the corresponding 1977 catch (4,782). This decline resulted partially from a reduction in the catch of young-of-the-year fish in 1978. Catch rates for gizzard shad generally increased as the sampling year progressed, probably because young-of-the-year gizzard shad became more vulnerable to electrofishing. Catch rates of gizzard shad ranged from 3.20 fish per hour (3.20/hour) in the plant area during spring to 88.40/hour below Lock and Dam 3 during fall.

Freshwater drum ranked second among the species most commonly caught by electrofishing. Except during fall, catch rates for freshwater drum were higher in above-plant areas than in other sections. Catch rates ranged from 2.40/hour in the plant area during both spring and fall to 58.67/hour above the plant during summer.

Highest catch rates for bluegills occurred in the plant area (62.80/hour) and below Lock and Dam 3 (64.80/hour) in the fall. The lowest catch rate occurred in fall above PINGP (5.33/hour). Spring and summer catch rates for bluegill ranged from 7.20/hour to 38.00/hour.

Catch rates for carp ranged from 9.60/hour in the plant area during spring to 44.00/hour below Lock and Dam 3 during fall.

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Emerald shiners were caught least frequently in spring above the plant and most frequently in summer below Lock and Dam 3. Catch rates ranged from 2.40/hour to 69.60/hour, respectively.

2.4.3.1.4 Trawling

During 1978, 427 fish representing 19 species were collected during 3.00 hours of trawling. The 1978 catch represented a sharp decline from the corresponding 1977 trawling catch (5,944). Most of this decline was due to an unusually large catch of young-of-the-year gizzard shad in 1977 (4,486) followed by a small catch (42) in 1978. The following five species accounted for 85.7 percent of the 1978 trawling catch: white crappie (26.9 percent), freshwater drum (21.3 percent), black crappie (19.7 percent), gizzard shad (10.1 percent), and bluegill (7.7 percent). Tables 2.4-13 through 2.4-15 summarize trawling catches by season. Length-frequencies of fishes collected by trawling in 1978 are listed in Table 2.4-16.

Of 115 white crappie caught by trawling during 1978, 79 (68.7 percent) were young-of-the-year. White crappie were most abundant in summer (79) and fall (27) trawl catches. For both seasons the catch came exclusively from North Lake. The only plant area catch of white crappie occurred in spring, accounting for four of the nine white crappie caught during that season.

Freshwater drum were most abundant in summer trawl catches (63). For all seasons combined, 53 freshwater drum were caught in North Lake and 38 in the plant area.

Of 84 black crappie caught trawling during 1978, 81 were caught above PINGP. All but one of the 43 gizzard shad caught by trawling were young-of-the-year. Trawling catches

of bluegill (33) were limited to summer and fall seasons above PINGP.

2.4.3.1.5 Seining

In 1978, 2,093 fishes were collected by 47 seine hauls, which covered an estimated total surface area of 1.40 ha. Twenty-nine species were collected. Four species comprised 76.9 percent of the total catch: emerald shiner (36.0 percent), gizzard shad (21.5 percent), white bass (10.3 percent), and spottail shiner (9.1 percent). Tables 2.4-17 through 2.4-19 summarize seine catches by area and season. Length-frequencies of all fishes collected by seining in 1978 are listed in Table 2.4-20.

High catches of emerald shiner below Lock and Dam 3 in spring caused that species to be most abundant in the total 1978 catch. In spring the emerald shiner catch rate was 4,225.00 fish per hectare (4,225.00/ha) below Lock and Dam 3. For each season, catch rates of emerald shiner were highest below Lock and Dam 3 (ranging from 350.00/ha to 4,225.00/ha). The lowest spring catch rate occurred in the plant area (137.50/ha), while lowest summer and fall catch rates occurred above PINGP (36.00/ha and 144.83/ha).

Gizzard shad was the second most abundant species in the 1978 total seining catch. Most of these gizzard shad were young-of-the-year. The highest catch of gizzard shad was 2,475.00/ha during spring in the plant area. The lowest spring catch rate for gizzard shad was 300.00/ha below Lock and Dam 3. Seining during summer and fall above PINGP yielded lower numbers of gizzard shad per hectare than the other two areas. Catches of gizzard shad above the plant declined from 374.07/ha during spring to 27.59/ha during fall. In the plant area the gizzard shad catch increased from 116.67/ha during summer to 400.00/ha during fall. The

catch below Lock and Dam 3 decreased from 458.33/ha during summer to 42.86/ha during fall.

White bass young-of-the-year were readily caught by seining during the spring sampling season, but became less abundant in seine hauls as the year progressed. White bass was the third most abundant species in spring seine hauls, comprising 12.9 percent of the total spring seine catch. The highest white bass catch rate by seining was 687.50/ha in the plant area during spring. In the same area the catch rate of white bass was 50.00/ha during summer and 14.29/ha in fall.

The total catch of spottail shiners was highest during spring (88), followed by summer (77) and fall (26). For each season, catch rates for spottail shiner were lowest below Lock and Dam 3 (ranging from 0/ha to 8.33/ha) and highest in the plant area (ranging from 100.00/ha to 837.50/ha).

2.4.3.2 Tagging Study

A total of 150 fish were tagged during 1978 as part of the Prairie Island fish study. July 26 was the last date fish were tagged in 1978. Channel catfish was the most commonly tagged species (66), and white bass (35) the second most commonly tagged species. Tags returned in 1978 included fish tagged in 1978 as well as fish tagged in previous years.

A total of 5,940 fishes were tagged from April 9, 1974 through December 31, 1978. During this period, 676 tags were returned, an overall tag return rate of 11.4 percent. Species with the highest number of tags returned were white bass (347), sauger (131), and walleye (122).

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Table 2.4-21 summarizes the number of each species tagged and the number of tags returned for the period April 9, 1974 through December 31, 1978. Largemouth bass had the highest tag return rate (22.73 percent), but the total number tagged was small (22). Northern pike had the second hi st tag return rate (21.00 percent). Approximately one-half of northern pike recaptured were caught in sampling gear while conducting the fish population study. For other species the majority of tags returned were reported by anglers.

Table 2.4-22 summarizes movements of fish tagged and recaptured from 1974 through 1978. Of eight species of fishes recaptured, northern pike, channel catfish, white bass, largemouth bass, sauger, and walleye showed a net downstream movement; flathead catfish showed no net movement; and smallmouth bass exhibited a net upstream movement. Channel catfish exhibited the greatest mean net downstream movement (24.4 miles per fish). During 1978, however, an angler-caught channel catfish was reported from the Minnesota River 128 miles upstream from the location where it was tagged. Sauger had the second largest mean net downstream movement (11.6 miles). Mean net downstream movement of walleye, northern pike, white bass, and largemouth bass ranged from 0.2 to 4.6 miles.

The mean net downstream movement displayed by these fish may, at least partly, be an artifact of the data. The primary source of tag return data has been anglers. Since angling pressure is not randomly distributed (Gustafson et al. 1978b), the recapture locations of tagged fish may not be representative of actual tagged fish distribution. For example, there is little fis. pressure between Lock and Dam 3 and Prescott, Wisconsin. Tagged fish may be present in this area, but they are not likely to be recaptured because of low fishing pressure there.

2.4.3.3 Length-Weight Relationships

Separate length-weight relationships of 14 species were calculated for summer and fall. Data from all sections and gears were combined to calculate length-weight relationships (Table 2.4-23).

Expected weights for 14 species at specific lengths were calculated using the length-weight equations from 1978. Table 2.4-24 lists the 1978 expected weights plus expected weights based on length-weight equations from one or more previous years. Analysis indicates that expected weights at a given length may vary as much as 24.0 percent from year to year. However, there is no apparent trend in expected weights for any of these species.

2.4.3.4 Population Estimate

During the May-June multiple mark-recapture sampling, 13 freshwater drum, 3 carp, 2 white bass, 2 walleye, and 1 sauger were recaptured. Population estimates were made for carp, white bass, walleye, and freshwater drum. The estimates for the last sampling date (June 6) were used as the final estimates because they were considered the most accurate. The maximum number of marked fish were at large on the last sampling day. Ninety-five percent confidence intervals are used in this section. Table 2.4-25 lists details of the estimate calculations.

The estimated number of carp in the enclosed area was 2,587, with confidence limits of 1,057 to 6,463. The area enclosed by the blocking seine, as determined by planimeter, was 1.4 ha. The density of carp in the enclosed area was 1,848 fish/ha with confidence limits of 755 fish/ha to 4,616 fish/ha. The mean weight of carp collected in the enclosed

area was 1.60 kg. The estimated standing crop of carp in the enclosed area was 2,957 kg/ha.

There were an estimated 54 white bass (38.6 fish/ha) with a confidence interval of 23 to 127 (16.4 to 90.7 fish/ha) in the enclosed area during the May-June study. The mean weight of the 17 white bass marked during the study was 0.30 kg. The estimated standing crop of white bass in the enclosed area was 12 kg/ha.

An estimated 81 walleye with a confidence interval of 34 to 216 fish were present in the enclosed area of discharge canal during the study. The mean weight of the 21 marked walleye was 1.20 kg, which resulted in an estimated standing crop of 70 kg/ha.

The estimated number of freshwater drum in the enclosed area was 3,682 (2,630 fish/ha) with confidence limits of 2,202 to 6,483 (1,573 to 4,631 fish/ha). The mean weight of the 317 marked drum was 0.26 kg, which resulted in an estimated standing crop of 684 kg/ha.

No estimate was made for sauger, because just three sauger were marked and only one was recaptured. Five smallmouth bass, 18 flathead catfish, and 77 channel catfish were marked during the May-June study, but none were recaptured.

During the July estimate there were more carp marked (55) than any other species. Freshwater drum was the second most commonly marked species (34). In addition, 32 white bass, 5 sauger, 4 smallmouth bass, 2 channel catfish, and 1 flathead catfish were marked. Population estimates were not made for the July mark-recapture attempt, because none of the fish marked during the July study were recaptured during that study.

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2.4.4 DISCUSSION

2.4.4.1 Abundance Indices

Abundance indices measure abundance of major fish species in each year relative to a base period. This method of handling catch data was devised by Hile (1962); calculations and applications to the Prairie Island fish study were explained by Naplin and Geis (1975).

In 1978 data from all seasons and sections and all gears except seining were used in calculating abundance indices. The four-year period, 1973 through 1976, was used as the base period. Mean catch rates from this base period were used to calculate expected catches for 1978. Twelve species, important in the catch during previous years, were selected for abundance comparisons: shortnose gar, gizzard shad, northern pike, carp, shorthead redhorse, white bass, bluegill, white crappie, black crappie, sauger, walleye, and freshwater drum.

Abundance indices for most species varied considerably from year to year. Table 2.4-26 lists the abundance indices for 12 species from 1973 through 1978.

For each of the above 12 species, the abundance index for each year was plotted against time. The equation for the linear regression of abundance indices versus time was calculated using the least squares method and the correlation coefficient (r) was computed for each regression equation (Figure 2.4-7). These calculations were made to determine whether trends in abundance could be noted.

Abundance indices for northern pike and sauger showed statistically significant declines at the 95 percent level.

With six years of data (four degrees of freedom) a correlation coefficient (r) must have an absolute value of 0.811 or greater to be significant at the 95 percent level. Northern pike has shown the most consistent decline of any of the 12 species (r = -0.941), even though the 1978 abundance index for this species was up slightly from 1977.

Sauger have also declined significantly since 1973. The correlation coefficient for this species was -0.828. The abundance index increased from 0.40 in 1977 to 0.78 in 1978. Additional data will be needed to determine whether or not this increase signals a real change from the downward trend of previous years.

Black crappie is the only species that has shown a statistically significant increasing trend in abundance indices since 1973. Abundance indices for black crappie were relatively constant from 1973 through 1976 (0.91-1.11); they then increased by a factor of three to 1977 and 1978 levels of 3.31 and 3.39. The 1977 and 1978 abundance indices increases were due to a great increase in trap net catches. Although the data indicate a signficant change in abundance, it appears that the change was not linear, and the data points could be better fit by a sigmoid curve.

Of the remaining nine species, white crappie was closest to having a significant trend with a correlation coefficient of 0.695. The decline in abundance indices from 1977 to 1978 resulted in a decrease from the correlation coefficient of 0.801 reported by Gustafson et al. (1978a).

Abundance indices for shortnose gar, gizzard shad, carp, shorthead redhorse, white bass, bluegill, white crappie, walleye, and freshwater drum showed no significant trends from 1973 through 1978. Eight of these species had correlation coefficients having absolute values of 0.485 or less.

Abundance indices for these eight species varied considerably during the six years. Abundance indices for shortnose gar, gizzard shad, bluegill, and white crappie showed a considerable decline from 1977 to 1978, while abundance indices for carp, shorthead redhorse, white bass, and freshwater drum declined slightly between 1977 and 1978.

2.4.4.2 Population Estimates

Population estimates for carp, white bass, and walleye in the discharge canal from the May-June 1978 mark-recapture study were lower than estimates for these species in previous mark-recapture studies. For example, the December 1976 estimate for carp was about 9,100 compared with about 2,600 for the June 1978 estimate. Numbers of carp marked in these two years were similar. The confidence interval for the 1976 estimate was extremely wide, because only one marked carp was recaptured. Three marked carp were recaptured during the 1978 estimate resulting in a narrower confidence interval. Confidence intervals for these two estimates overlap, so it is possible that there is no real difference between the estimates (Table 2.4-27). The 1976 estimates may be overestimated or underestimated, because there was no physical barrier to restrict movement into or out of the discharge canal. We feel, however, temperature differences between the thermal discharge and ambient river water tended to restrict movement into or out of the discharge canal. It is also possible that carp and other species involved in the May-June 1978 estimate were able to move into or out of the enclosed area by swimming under the blocking seine.

The estimate of white bass in the May-June 1978 study was 54, compared with 4,632 in December 1977 and 7,051 in December 1976 (Table 2.4-27). During the 1978 mark-recapture study, only 17 white bass were marked compared with

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727 in the 1977 study and 508 in the 1976 study. It is apparent that there were many more white bass in the discharge area during December 1976 and December 1977 than were there during May-June 1978.

Christenson and Smith (1965), as cited by Peterson (1975), report an average standing crop of 68 pounds/acre (76.4 kg/ha) of game fishes in Mississippi River backwaters. The December 1976 standing crop estimate of white bass in the discharge canal, a portion of which is a flowing slough, was 345.5 kg/ha (Gustafson and Geis 1977). The December 1977 estimate was 228.3 kg/ha (Gustafson et al. 1978). The December 1977 standing crop estimate for white bass is over 3.3 times higher and the December 1976 estimate is over 5 times higher than the average standing crop of all game fishes (76.4 kg/ha) reported above. Since white bass make up only a portion of the average standing crop of game fishes in Mississippi River backwaters, the 1976 and 1977 values are considerably more than 5 and 3.3 times the average standing crop of white bass. These data indicate that white bass are attracted to the warm water discharge of the Prairie Island Plant during at least December. Observed angling success during January, February, and March in the discharge canal indicates that white bass are also attracted to the warm water during these months.

The June 1978 estimated standing crop of 12 kg/ha of white bass in the discharge canal is probably within the range that might be expected for Mississippi River backwaters. Catch data from trap netting, gill netting, and electrofishing above the plant during all three sampling seasons in 1978 indicate that white bass are about one-third of the game fish by numbers.

Dennis Heisey, Minnesota Department of Natural Resources (personal communication 1979), indicated he felt we should

make population estimates from the 1978 mark-recapture data even though the sample sizes are small. Mr. Heisey felt we should present the estimates and include our evaluation of the estimates, and readers could then make their own evaluations of the estimates to determine if the data suit their needs.

Gustafson et al. (1978) reported that no population estimate was calculated for walleye from the December 1977 data, because the authors believed the number marked and/or returned was insufficient to make a reliable estimate. Since the 1977 data have larger sample sizes than the 1978 data, we decided to calculate a population estimate for walleye using unpublished data from December 1977. The December 30, 1977 estimate of walleye in the discharge canal is 306 with 95 percent confidence limits of 137 and 766 fish. The total number of marked walleye was 50 and the number recaptured was four (Table 2.4-27).

We feel that the sampling methods used, electrofishing and angling, were not selective toward marked or unmarked fish. Movement of fish into or out of the discharge canal should have been somewhat restricted by temperature. The small sample size and variability in catch from day to day resulted in the wide confidence limits.

The June 6, 1978 mark-recapture estimate of 81 walleye was considerably less than the December 8, 1976 estimate of 1,053 walleye and was also less than the December 30, 1977 estimate of 306 (Table 2.4-27). It is our opinion that the low number of walleye present in the discharge during the May-June mark-recapture study was at least partially attributable to high temperatures.

For May 22, 1978, the date the blocking seine was installed, the plant log indicated a temperature of 82.8°F (28.2°C) at

the discharge gates and 74.2°F (23.4°C) at a resistance thermal device (RTD) about 40 m from the gates. These temperatures are above those preferred by walleye, according to several authors. Koenst and Smith (1976) estimated the preferred temperature for walleye and sauger juveniles to be 22°C. They cite Hile and Juday (1941) as saying that the preferred temperature of adult walleye in summer is 20.6°C. Eddy and Underhill (1974) state that when surface water warms above 22.2°C, walleye seek cooler water. Dendy (1948) reported that in Norris Reservoir during July, walleye would be in 25°C water when oxygen concentration was sufficient. Temperatures in the discharge area were higher than the preferred temperatures for walleye stated by most of these authors. We believe most walleye had probably sought cooler temperatures most those in the discharge, and few walleye were in the discharge area when it was enclosed by the blocking seine.

During the May-June mark-recapture study, 317 freshwater drum were marked and 13 were recaptured. The estimate of 3,682 freshwater drum for the 1978 study (Table 2.4-27) indicates this species was abundant in the enclosed area. No attempt had been made to mark freshwater drum during the 1976 or 1977 studies, so there are no data for comparison with the 1978 estimates.

The authors anticipated that few fish would be present in the discharge canal during the summer because of high water temperatures. To verify this hypothesis, a mark-recapture study was attempted in the discharge canal from July 17 through July 26, 1978. The study was terminated because low numbers of fish were being collected. No population estimates could be made because no marked fish were recaptured. However, the low numbers of fish collected during sampling with trap nets and electrofishing indicate that low numbers of fish were present in the discharge area.

Temperature information from the plant log indicates that from July 18 through July 26, 1978 the temperature at the discharge gates ranged from 79.4° to 89.9°F (26.3° to 32.2°C). Temperatures at the close in RTD ranged from 76.2° to 86.2°F (24.6° to 30.1°C). Most warm water fishes would be expected to avoid these temperatures and seek cooler water.

2.4.4.3 Impingement

From 1974 through 1977, six species, gizzard shad, channel catfish, white bass, black and white crappie, and freshwater drum have comprised over 91 percent of the fish impinged each year on the traveling screens at PINGP. During 1978 these six species comprised over 97 percent of the fish impinged. Overall catch rates and abundance indices for these six species were compared with impingement data.

A total of 105,983 fishes were impinged on the traveling screens at PINGP during 1978. This is slightly higher than the number impinged in 1975 (93,466), but considerably lower than the number impinged in 1974 (146,063), 1976 (261,294), and 1977 (554,590). Impingement information in this section is from Andersen (1975), Mayhew and Hess (1976), Eberley (1977), Eberley (1978), and Section 2.3 of this report.

The total number of gizzard shad impinged each year was 136,667 in 1974; 70,506 in 1975; 152,878 in 1976; 456,949 in 1977; and 93,895 in 1978. The number impinged and electrofishing and trawling catch rates were higher in 1977 than any other year. There does not appear to be any consistent relationship between electrofishing and trawling catch rates for other years and the number of gizzard shad impinged that year.

There is no apparent relationship between abundance indices and number of gizzard shad impinged from 1974 to 1976. However, from 1976 to 1977, both the abundance index and the number of impinged gizzard shad increased sharply. During 1977 large numbers of young-of-the-year gizzard shad were collected during the population study and by impingement. From 1977 to 1978 both impingement and the abundance indices for gizzard declined markedly. Only about nine percent of the gizzard shad impinged in 1978 were from the 1978 year class; most of the remainder were from the 1977 year class. These data do not indicate any consistent trends between gear catches or abundance indices and the number of gizzard shad impinged at Prairie Island.

Freshwater drum (3,463) comprised 3.3 percent of the fish impinged in 1978. This is one-tenth the number impinged in 1976 (34,380), and less than one-twentieth the number impinged in 1977 (74,422). Electrofishing catch rates above the plant during spring were higher in 1978 than they were from 1974 through 1977. Incomplete 1978 spring electrofishing in the other two sampling areas precluded further comparisons. For all areas, summer 1978 electrofishing catches of freshwater drum were lower than in 1977, while fall catches in 1978 were higher than in 1977. Trawling catches of freshwater drum in the plant area were lower in 1978 than in all other years. There is no consistent relationship between gear catch rates and impingement of freshwater drum at PINGP.

A total of 2,096 white bass (2.0 percent of the total impingement) were impinged at PINGP in 1978. Over twenty-one times as many white bass were impinged in 1976 (44,638). The 1976 catch rates in the plant area during the three seasons ranged from one and one-half to over four and one-half times as high as in 1978.

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The abundance index for white bass in 1974 was higher than the 1976 abundance index, but 1,367 white bass were impinged in 1974 compared with 44,638 in 1976. In 1975, 2,712 white bass were impinged, but the 1975 abundance index was lower than either the 1974 or 1976 indices. The abundance index for 1977 was similar to 1976, but over four and one-half times as many white bass were impinged in 1976 as in 1977. There is no apparent relationship between abundance indices and the number impinged.

A total of 2,032 channel catfish were impinged in 1978 compared with 3,977 in 1977; 8,457 in 1976; 6,223 in 1975; and 637 in 1974. Trawling catches of channel catfish in the plant area were 3 in 1978, 61 in 1977, 465 in 1976, 3 in 1975, and 23 in 1974. Comparison of impingement and trawling catch rates in the plant area indicates no consistent relationship.

A total of 1,551 white and black crappies were impinged in 1978 compared with 5,530 in 1977; 6,852 in 1976; 2,030 in 1975; and 1,704 in 1974. Abundance indices for each year for both white and black crappies showed no consistent relationship with the numbers impinged. Abundance indices showed a considerable increase from 1976 to 1977 for both white and black crappies, but the number impinged declined. From 1977 to 1978, the abundance index for white crappie declined and for black crappie rose slightly, while impingement of crappies declined by 72 percent.

Some of the dissimilarity between numbers of fish impinged and abundance indices might result from size selectivity of the sampling gear. It has been observed (Eberley 1977) that impingement affects primarily the smaller size classes of fishes at PINGP. Trap nets, gill nets, and electrofishing gear do not sample small fish as efficiently as larger fish. Density and distribution of fish near a plant intake

also have a great influence on the number of fish impinged (Sharma 1978). Abundance indices presented in this report indicate the density of organisms in the study area in a given year. However, abundance indices may not be representative of the density and distribution of fish near the intake. Also, distribution of fish changes throughout the year. There appears to be no consistent relationship between gross impingement in a given year and overall gear catch rates or abundance indices from that year.

2.4.5 SUMMARY

A sixth season of sampling was conducted in 1978 to determine the effects of the Prairie Island Nuclear Generating Plant (PINGP) near Red Wing, Minnesota on the fish population of the Mississippi River in the vicinity of the plant. Five types of sampling gear, trap nets, gill nets, boom shocker, trawl, and minnow seine, were used to collect fishes to monitor changes in the population. Using these five gears, 16,846 fish were collected during the regular sampling season. This is slightly less than one-half the number of fish collected during similar sampling in 1977. Additional fish were collected during two multiple mark-recapture studies in 1978.

From April 9, 1974 through December 31, 1978 a total of 5,940 fish were tagged with Floy spaghetti tags. During this period, information on 676 tag returns was received -- an overall tag return rate of 11.4 percent. Tag return information for northern pike, channel catfish, white bass, largemouth bass, sauger, and walleye showed a net downstream movement; flathead catfish showed no net movement; and smallmouth bass showed a net upstream movement.

Data from 1973 through 1978 were used to calculate abundance indices for 12 species of fishes. Data from trap nets, gill

nets, trawling, and electrofishing from all seasons and all stations were used in these calculations. Abundance indices for northern pike and sauger showed statistically significant declines at the 95 percent level for the six-year period. Black crappie is the only species showing a statistically significant increasing trend for the six-year period. Abundance indices for shortnose gar, gizzard shad, carp, shorthead redhorse, white bass, bluegill, white crappie, walleye, and freshwater drum varied considerably during the six years. Correlation coefficients for these nine species indicated no significant trends in abundances from 1973 through 1978.

Population estimates for carp, white bass, and walleye in the discharge canal from a multiple mark-recapture study from May 22 through June 6, 1978 were lower than estimates for these species from December 1976 or December 1977. Data from an attempted multiple mark-recapture study in the discharge canal from July 17 through July 26, 1978 indicated that few fish were present in the discharge canal during that period.

Six species, gizzard shad, channel catfish, white bass, black and white crappie, and freshwater drum, have comprised over 91 percent of the fishes impinged each year on the traveling screens at PINGP. Catch rate data and abundance indices for these six species from 1974 through 1978 were compared with impingement rates for the respective years. These comparisons indicated no consistent relationships between catch rates and/or abundance indices and the number of fishes impinged at PINGP during respective years.

2.4.6 ACKNOWLEDGMENTS

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helped collect, compile, and summarize data for this report. Chris Tomford helped with field work. Dennis Heisey assisted with statistical treatments and computer data processing. Howard Krosch helped with data analysis and experimental design as well as reviewing early drafts of this manuscript. Arthur Peterson provided advice on data analysis. Data entry operators of Minnesota Department of Natural Resources, Bureau of Management Systems, keypunched most of the raw data collected in 1978. Sharon Flynn, Jeanne Somero, Betty Thill, Jane Uphus, and Laurie Zitzman typed tables and early drafts of this report.

2.4.7 LITERATURE CITED

Andersen, R.A. 1975. Impingement of fishes and other organisms on the Prairie Island Plant intake traveling screens. Pages 755-824b in Prairie Island Nuclear Generating Plant Environmental Monitoring Program 1974 Annual Report, Vol. II. Northern States Power Co. Minneapolis, Minn.

Chapman, D.G. 1952. Inverse, multiple and sequential sample censuses. Biometrics 8:286-306.

_____. 1954. The estimation of biological populations. Ann. Math. Stat. 25:1-15.

Christenson, L.M. and L.L. Smith. 1965. Characteristics of fish populations in Upper Mississippi backwater areas. U.S. Dep. Interior, Fish and Wildlife Circular 212.

Dendy, J.S. 1948. Predicting depth distribution of fish in three TVA storage-type reservoirs. Trans. Amer. Fish. Soc. for 1945. 75:65-71.

Eberley, L.W. 1977. Impingement of fishes and other organisms on the Prairie Island Plant cooling water intake traveling screens. Pages 2.5.1-1 through 2.5.1-56 in Prairie Island Nuclear Generating Plant Environmental Monitoring Program 1976 Annual Report, Vol. I. Northern States Power Co. Minneapolis, Minn.

_____. 1978. Impingement of fishes and other organisms on the Prairie Island Plant cooling water intake traveling screens. Pages 2.3-1 through 2.3-56 in Prairie Island Nuclear Generating Plant Environmental Monitoring Program 1977 Annual Report, Vol. I. Northern States Power Co. Minneapolis, Minn.

Eddy, S., and J.C. Underhill. 1974. Northern fishes. University of Minnesota Press, Minneapolis, Minn. 414 pp.

Gustafson, S.P., H.L. Fierstine, J.L. Geis. 1978a. 1977 Progress report on the Prairie Island fish population study. Pages 2.4-1 through 2.4-152 in Prairie Island Nuclear Generating Plant Environmental Monitoring Program 1977 Annual Report, Vol. I. Northern States Power Co. Minneapolis, Minn.

_____. 1978b. Progress report on the Prairie Island creel survey February 23-November 22, 1977. Pages 2.5-1 through 2.5-67 in Prairie Island Nuclear Generating Plant Environmental Monitoring Program 1977 Annual Report, Vol. II. Northern States Power Co. Minneapolis, Minn.

Gustafson, S.P. and J.L. Geis. 1977. 1976 Progress report on the Prairie Island fish population study. Pages 2.5.2-1 through 2.5.2-148 in Prairie Island Nuclear Generating Plant Environmental Monitoring Program 1976 Annual Report, Vol. II. Northern States Power Co. Minneapolis, Minn.

Hawkinson, B.W. 1974. 1973 fish population study progress report on the Mississippi River near Prairie Island. Pages C-5.1 through C-5.58 in Prairie Island Nuclear Generating Plant Environmental Monitoring Program 1973 Annual Report, Vol. I. Northern States Power Co. Minneapolis, Minn.

Hile, R. and C. Juday. 1941. Bathymetric distribution of fish in lakes of the northeastern highlands, Wisconsin. Trans. Wis. Acad. Sci., Arts Lett. 33:147-187.

Hile, R. 1962. Collection and analysis of commercial fishery statistics in the Great Lakes. Great Lakes Fish Comm., Tech. Report No. 5. 31 pp.

Koenst, W.M., and L.L. Smith Jr. 1976. Thermal requirements of the early life history stages of walleye, Stizostedion vitreum vitreum, and sauger, Stizostedion canadense. J. Fish. Res. Board Can. 33:1130-1138.

Krosch, H.F. 1967. The 1967 progress report on the Lake St. Croix fish population study. In Environmental Monitoring and Ecological Studies Program 1967 Annual Report for the Allen S. King Generating Plant, Oak Park Heights, Minn. Northern States Power Co., Minneapolis, Minn.

Mayhew, D.A. and H.K. Hess. 1976. Impingement of fish and other organisms on the Prairie Island Plant intake traveling screens. Pages 2.5.1-1 through 2.5.1-71 in Prairie Island Nuclear Generating Plant Environmental Monitoring Program 1976 Annual Report, Vol. I. Northern States Power Co., Minneapolis, Minn.

Naplin, R.L. and J.L. Geis. 1975. 1974 Progress report on the Prairie Island fish population study. Pages 563-715 in Prairie Island Nuclear Generating Plant Environmental Monitoring Program 1974 Annual Report, Vol. II. Northern States Power Co., Minneapolis, Minn.

Peterson, A.R. 1975. Analysis of the composition of fish populations in Minnesota's rivers and streams. Minnesota Dept. of Nat. Res., Div. of Fish and Wildlife, Environment Section, Investigation Report No. 335.

Ricker, W.E. 1975. Computation and interpretation of biological statistics of fish populations. Fisheries Research Board of Canada, Bull. 191. Ottawa, Canada. 382 pp.

Schnabel, Z.E. 1938. The estimation of the total fish population of a lake. Am. Math. Mon. 45:348-352.

Sharma, R.K. 1978. Perspectives on fish impingement. Pages 351-356 in L.D. Jensen, ed. Fourth national workshop on entrainment and impingement. E.A. Communications, Melville, New York.

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FIGURE 2.4-1 AREA INCLUDED IN PRAIRIE ISLAND FISH POPULATION STUDY AND CREEL SURVEY

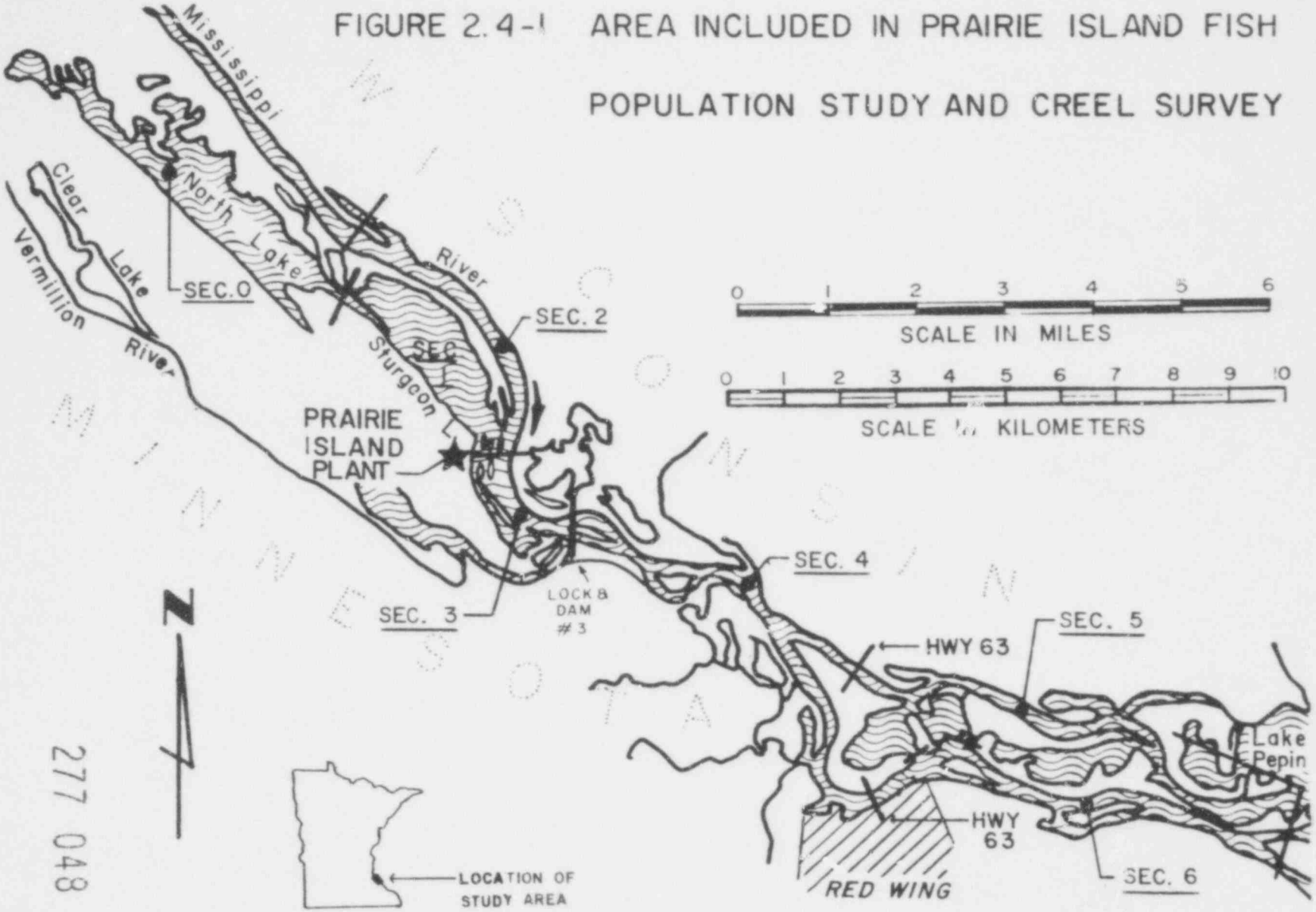
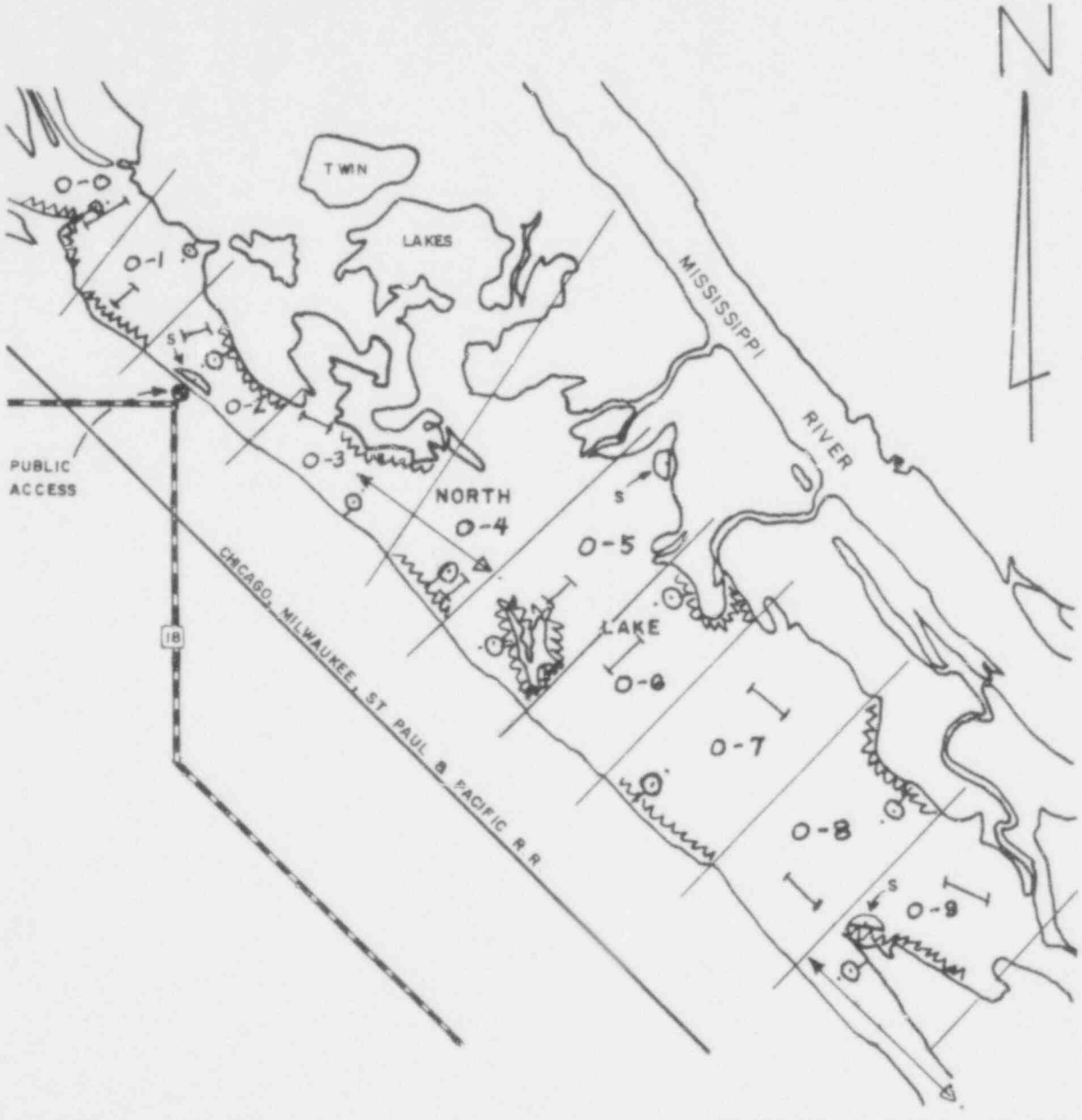


Figure 2.4-2 Sampling stations in North Lake (Section 0)

NORTH LAKE

section 0, stations 0-0 through 0-9



MILES

0 1/4 1/2 3/4 1

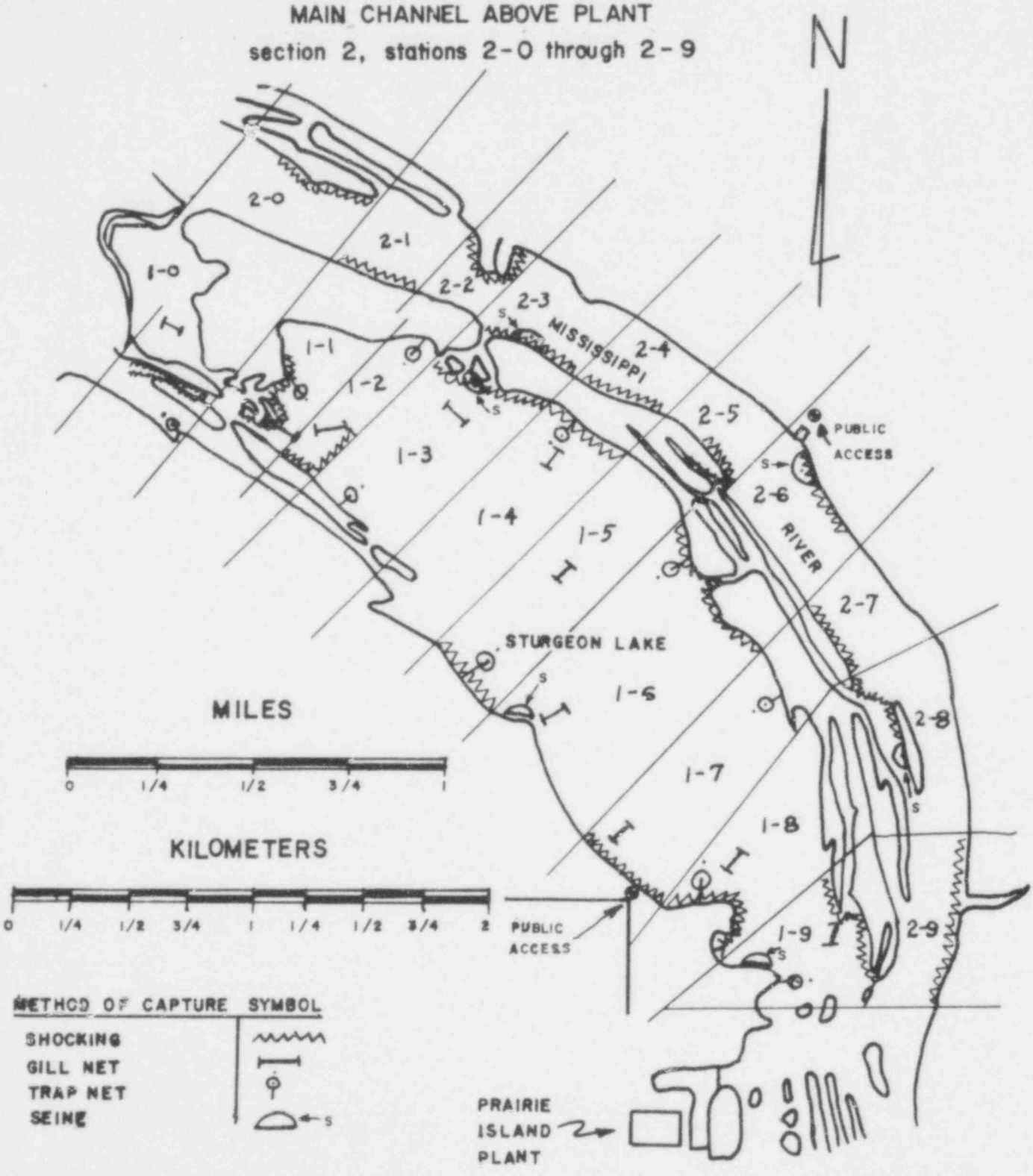
KILOMETERS

0 1/4 1/2 3/4 1

METHOD OF CAPTURE	SYMBOL
GILL NET	
SHOCKING	
SEINE	
TRAWL	
TRAP NET	

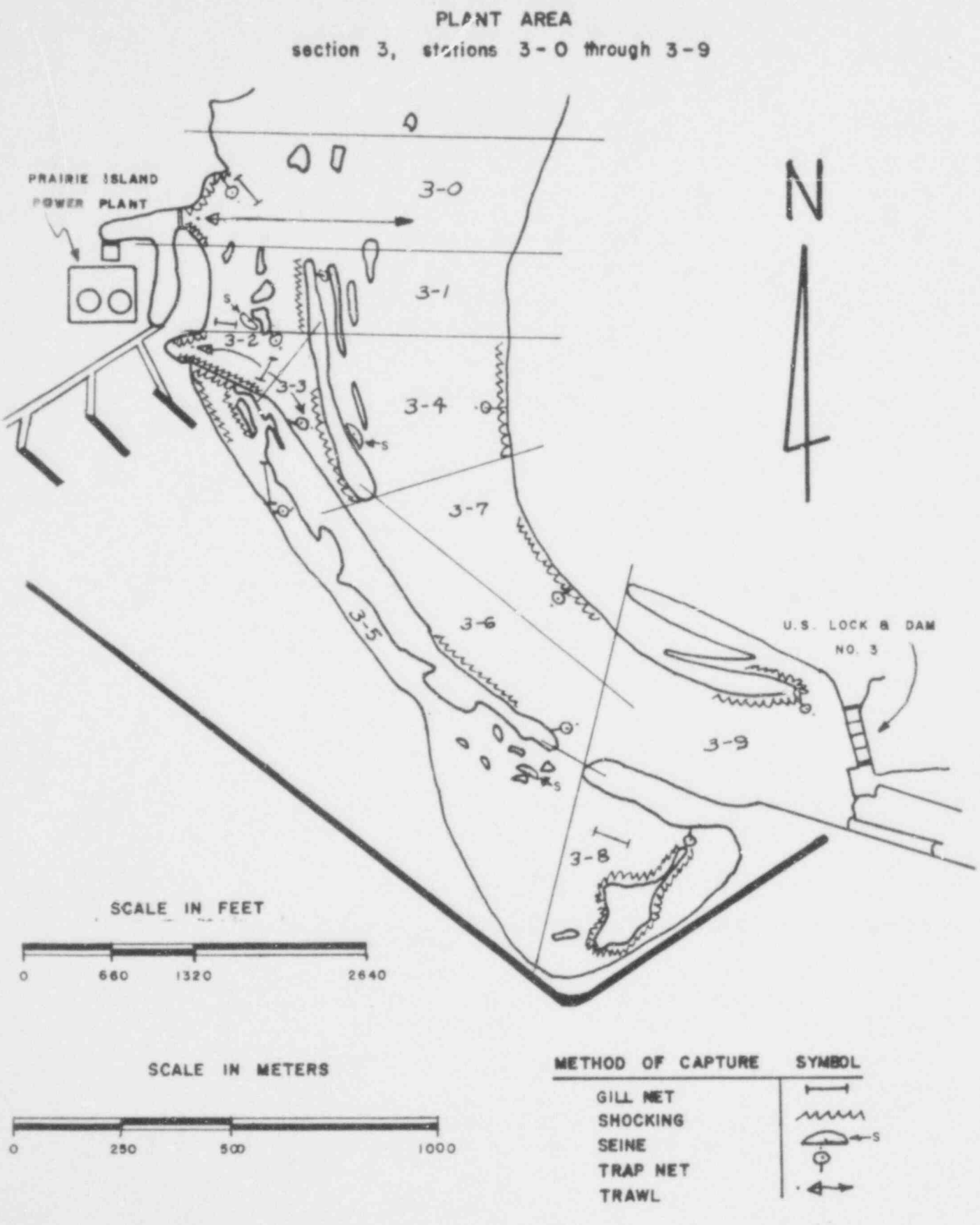
277 049

Figure 2.4-3 Sampling stations in Sturgeon Lake (Section 1) and in the navigation channel above the Prairie Island Plant (Section 2)



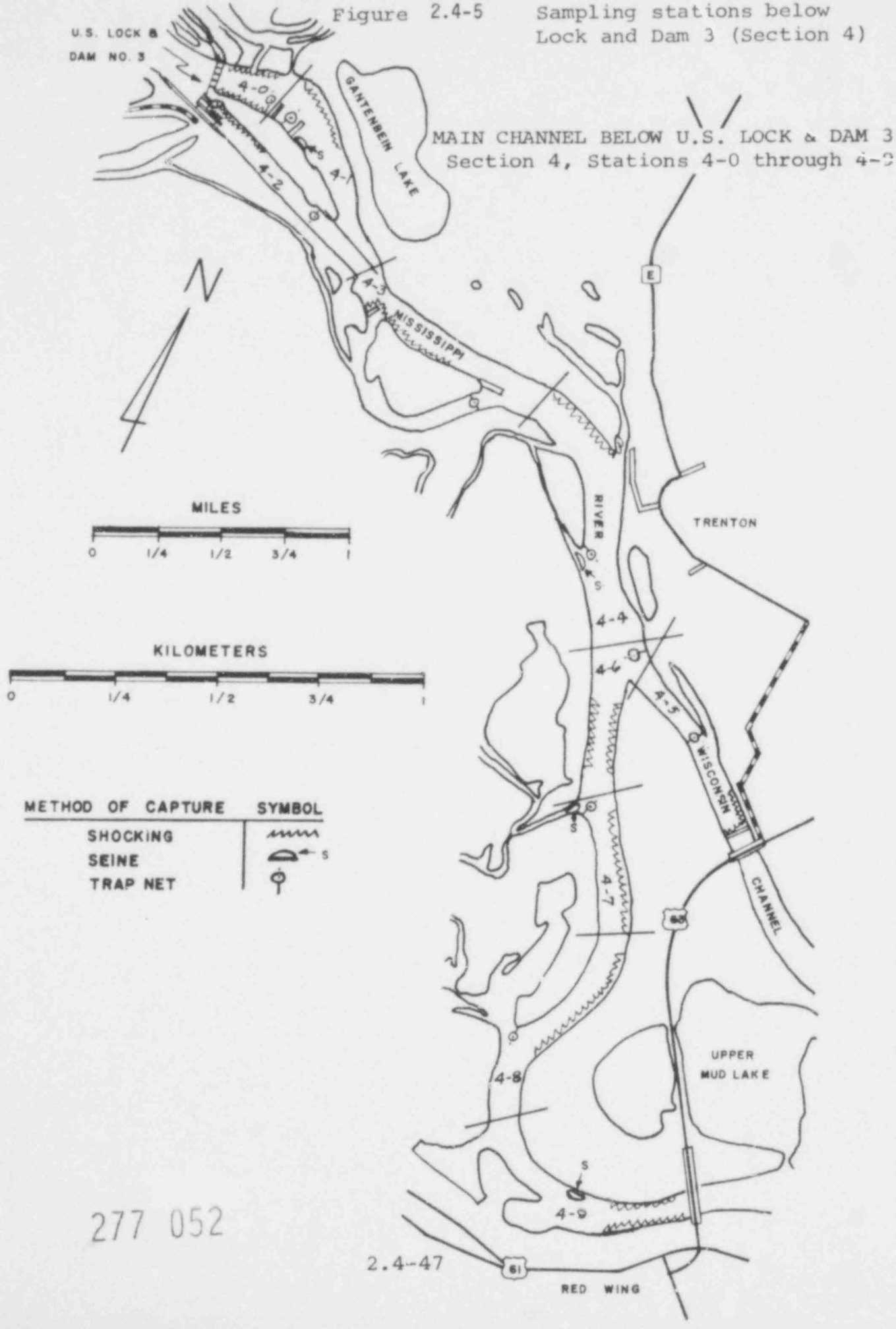
277 050

Figure 2.4-4 Sampling stations in the plant area (Section 3)



277 051

Figure 2.4-5 Sampling stations below Lock and Dam 3 (Section 4)



277 052

Figure 2.4-6 Area enclosed by blocking seine during May-June 1978 population estimate in discharge area of Prairie Island Nuclear Generating Plant, Red Wing, Minnesota.

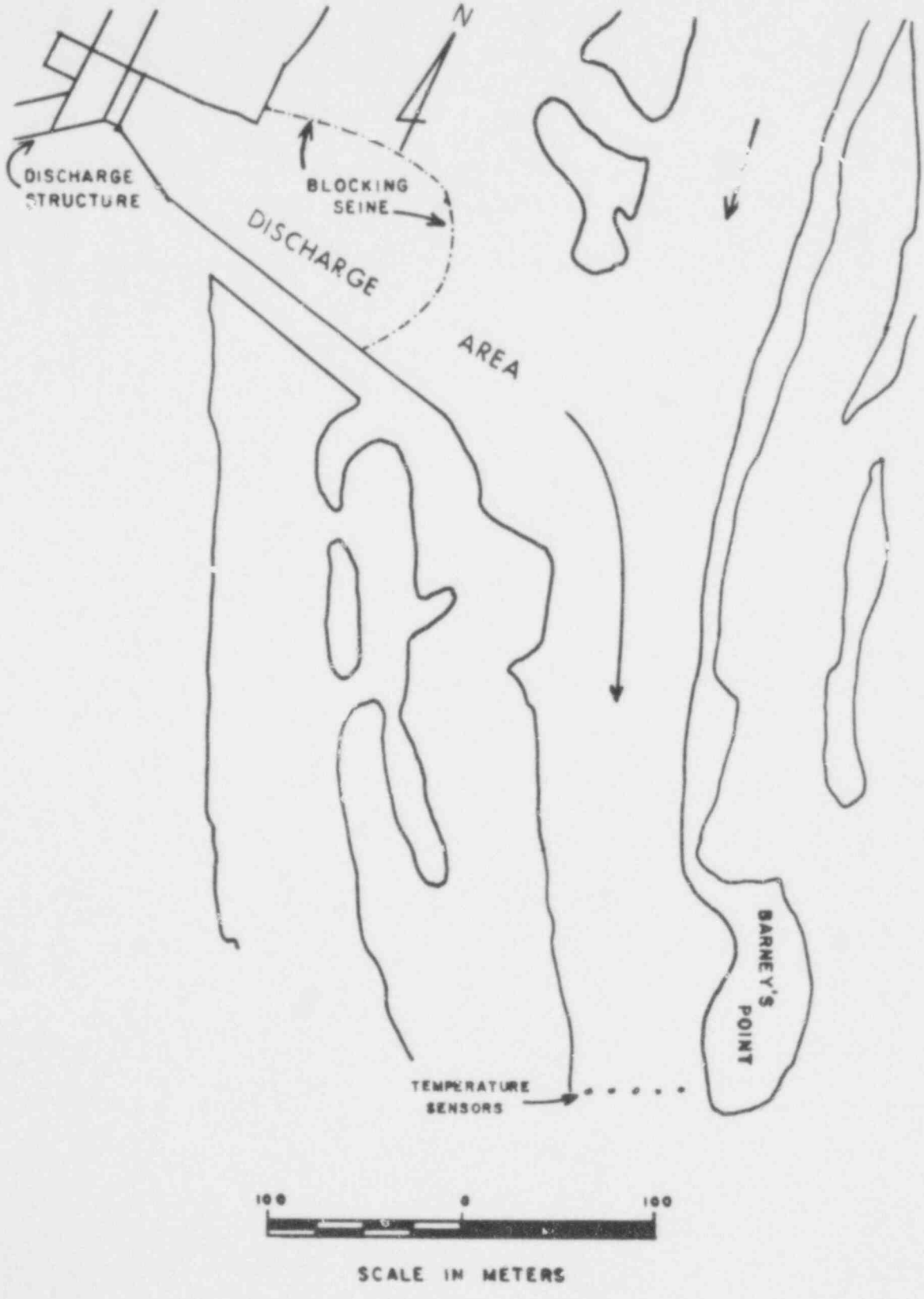


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Figure 2.4-7 Abundance indices calculated from spring, summer, and fall trap netting, gill netting, electrofishing, and trawling data for 12 major species in the Mississippi River and connecting waters near the Prairie Island Nuclear Generating Plant, Red Wing, Minnesota, 1973-1978.

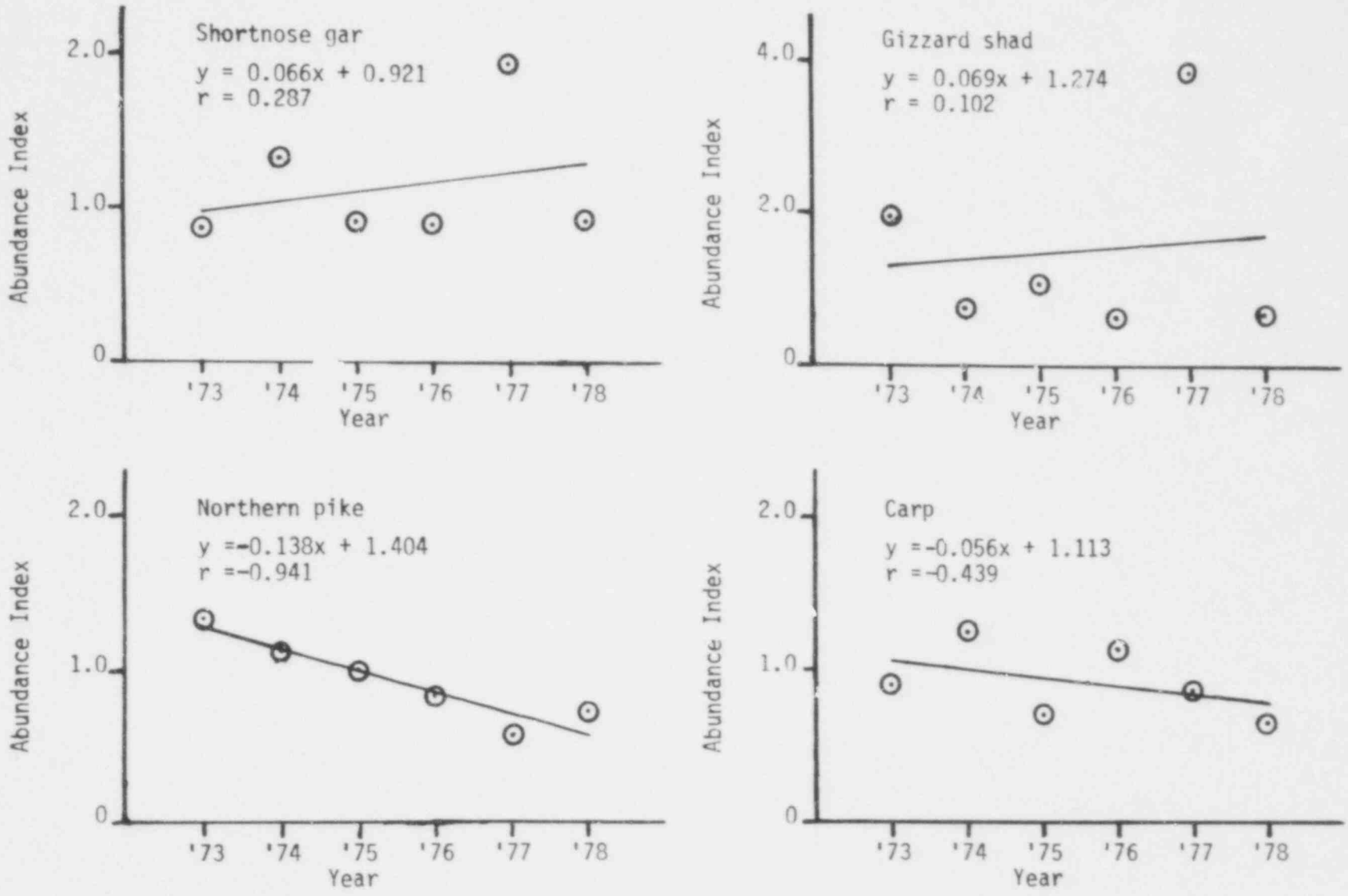

Figure 2.4-7 Abundance indices calculated from spring, summer, and fall trap netting, gill netting, electrofishing, and trawling data for 12 major species in the Mississippi River and connecting waters near the Prairie Island Nuclear Generating Plant, Red Wing, Minnesota 1973-1978 (cont.).

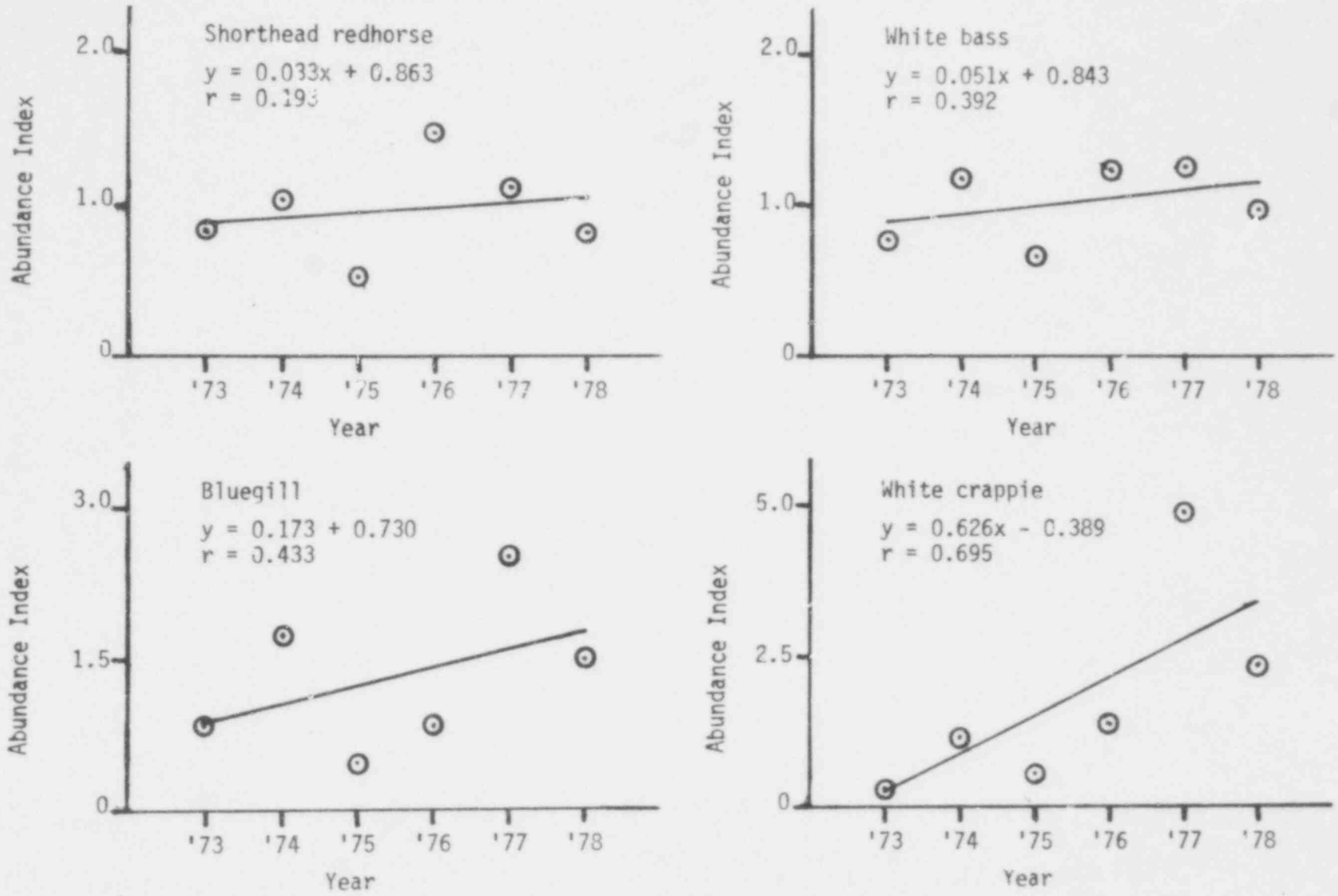

Figure 2.4-7 Abundance indices calculated from spring, summer, and fall trap netting, gill netting, electrofishing, and trawling data for 12 major species in the Mississippi River and connecting waters near the Prairie Island Nuclear Generating Plant, Red Wing, Minnesota, 1973-1978 (cont.).

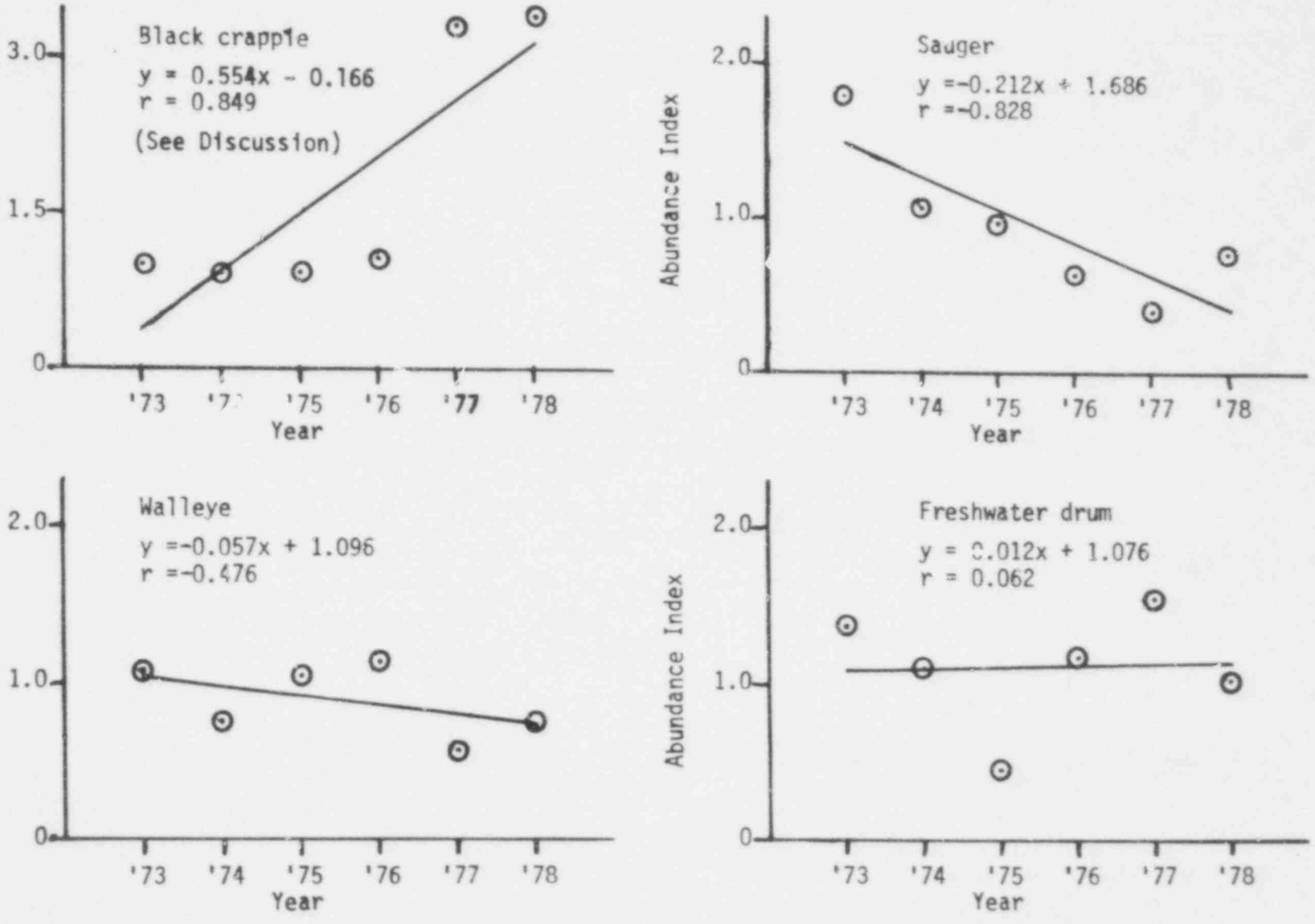

Table 2.4-1 Common and scientific names and methods of capture of fish in the Mississippi River and connecting waters near the Prairie Island Nuclear Generating Plant, Red Wing, Minnesota, 1973-1978. (Sheet 1 of 3)

Common Name	Scientific Name	Method of Capture 1978					1973	1974	1975	1976	1977
		Gill Net	Trap Net	Electro-fishing	Trawl	Seine					
Chestnut lamprey	*Icthyomyzon castaneus*		X	X				X		X	
Silver lamprey	*Icthyomyzon unicuspis*			X				X	X	X	X
Lake sturgeon	*Acipenser fulvescens*									X	X
Longnose gar	*Lepisosteus osseus*	X	X				X	X	X	X	X
Shortnose gar	*Lepisosteus platostomus*	X	X	X	X	X	X	X	X	X	X
Bowfin	*Amia calva*	X	X	X	X		X	X	X	X	X
American eel	*Anguilla rostrata*		X				X	X		X	X
Gizzard shad	*Dorosoma cepedianum*	X	X	X	X	X	X	X	X	X	X
Goldeye	*Hiodon alosoides*	X	X				X	X	X	X	X
Mooneye	*Hiodon tergisus*	X	X	X			X	X	X	X	X
Northern pike	*Esox lucius*	X	X	X		X	X	X	X	X	X
Carp	*Cyprinus carpio*	X	X	X	X	X	X	X	X	X	X
Brassy minnow	*Hybonathus hankinsoni*							X	X		
Silvery minnow	*Hybonathus nuchalis*							X			
Speckled chub	*Hybopsis aestivalis*									X	
Silver chub	*Hybopsis storeriana*			X		X		X	X	X	X
Golden shiner	*Notemigonus crysoleucas*							X			X
Emerald shiner	*Notropis atherinoides*			X		X		X	X	X	X
River shiner	*Notropis blennius*					X		X	X		X
Common shiner	*Notropis cornutus*							X	X	X	
Pugnose minnow	*Notropis emiliae*			X		X		X	X	X	
Blacknose shiner	*Notropis heterolepis*							X			
Spottail shiner	*Notropis hudsonius*			X	X	X		X	X	X	X
Red shiner*	*Notropis lutrensis*								X		
Rosyface shiner	*Notropis rubellus*							X	X		
Spotfin shiner	*Notropis spilopterus*			X		X		X	X	X	X
Redfin shiner	*Notropis umbratilis*								X	X	
Mimic shiner	*Notropis volucellus*							X	X		
Bluntnose minnow	*Pimephales notatus*							X	X		X
Fathead minnow	*Pimephales promelas*							X			X
Bullhead minnow	*Pimephales vigilax*			X		X		X	X	X	X
Carpsucker species**	*Carpoides species*			X		X	X	X	X	X	X

*Red shiner probably misidentified breeding male spotfin shiner (1975).
**Prior to 1978 carpsuckers were identified to genus only.

Table 2.4-1 Common and scientific names and methods of capture of fish in the Mississippi River and connecting waters near the Prai ie Island Nuclear Generating Plant, Red Wing, Minnesota, 1973-1978. (Sheet 2 of 3)

Common Name	Scientific Name	Method of Capture 1978					1973	1974	1975	1976	1977
		Gill Net	Trap Net	Electro-fishing	Trawl	Seine					
River carpsucker	*Carpoides carpio*		X	X							
Quillback carpsucker	*Carpoides cyprinus*	X	X	X	X	X					
Highfin carpsucker	*Carpoides velifer*	X									
White sucker	*Catostomus commersoni*		X	X		X		X	X	X	X
Northern hogsucker	*Hypentelium nigricans*		X								
Smallmouth buffalo	*Ictiobus bubalus*	X	X	X	X	X	X	X	X	X	X
Bigmouth buffalo	*Ictiobus cyprinellus*	X	X	X	X	X	X	X	X	X	X
Spotted sucker	*Minytrema melanops*		X					X		X	
Silver redhorse	*Moxostoma anisurum*		X	X			X	X	X	X	X
River redhorse	*Moxostoma carinatum*							X			
Golden redhorse	*Moxostoma erythrurum*										X
Shorthead redhorse	*Moxostoma macrolepidotum*	X	X	X	X	X	X	X	X	X	X
Black bullhead	*Ictalurus melas*	X	X					X	X	X	X
Yellow bullhead	*Ictalurus natalis*	X	X		X		X	X		X	X
Brown bullhead	*Ictalurus nebulosus*		X				X	X	X	X	X
Channel catfish	*Ictalurus punctatus*	X	X	X	X	X	X	X	X	X	X
Tadpole madtom	*Noturus gyrinus*					X			X	X	X
Flathead catfish	*Pylodictis olivaris*	X	X	X			X	X	X	X	X
Trout perch	*Percopsis omiscomaycus*							X	X	X	X
Burbot	*Lota lota*							X	X	X	X
Brook silverside	*Labidesthes sicculus*										X
White bass	*Morone chrysops*	X	X	X	X	X	X	X	X	X	X
Rock bass	*Ambloplites rupestris*	X	X	X			X	X	X	X	X
Hybrid sunfish***	*Lepomis X*		X	X				X			X
Green sunfish	*Lepomis cyanellus*	X		X			X	X	X	X	X
Pumpkinseed	*Lepomis gibbosus*		X				X	X	X		
Orangespotted sunfish	*Lepomis humilis*			X							X
Bluegill	*Lepomis macrochirus*	X	X	X	X	X	X	X	X	X	X
Smallmouth bass	*Micropterus dolomieui*		X	X		X	X	X	X	X	X
Largemouth bass	*Micropterus salmoides*	X	X	X			X	X		X	X
White crappie	*Pomoxis annularis*	X	X	X	X	X	X	X	X	X	X
Black crappie	*Pomoxis nigromaculatus*	X	X	X	X	X	X	X	X	X	X
Johnny darter	*Etheostoma nigrum*			X		X		X	X	X	X
Yellow perch	*Perca flavescens*	X	X	X		X	X	X	X	X	X
Log perch	*Percina caprodes*			X		X		X	X	X	X

***Most hybrid sunfish were likely Lepomis cyanellus X Lepomis macrochirus.

Table 2.4-1 Common and scientific names and methods of capture of fish in the Mississippi River and connecting waters near the Prairie Island Nuclear Generating Plant, Red Wing, Minnesota, 1973-1978. (Sheet 3 of 3)

Common Name	Scientific Name	Method of Capture 1978					1973	1974	1975	1976	1977
		Gill Net	Trap Net	Electro-fishing	Trawl	Seine					
Sauger	*Stizostedion canadense*	X	X	X	X	X	X	X	X	X	X
Walleye	*Stizostedion vitreum vitreum*	X	X	X	X	X	X	X	X	X	X
Freshwater drum	*Aplodinotus grunniens*	X	X	X	X	X	X	X	X	X	X

Table 2.4-2 Trap net and gill net stations used from 1975 through 1978 in the Mississippi River and connecting waters near the Prairie Island Nuclear Generating Plant, Red Wing, Minnesota.

Trap net				Gill net		
0-2	1-0	3-0	4-1	0-1	1-2	3-0
0-4	1-1	3-2	4-3	0-3	1-3	3-2
0-6	1-4	3-3	4-6	0-6	1-6	3-5
0-9	1-5	3-5	4-7	0-8	1-9	3-8
	1-9	3-7				

Table 2.4-3 Summary of trap net catches from the Mississippi River and connecting waters near the Prairie Island Nuclear Generating Plant, Red Wing, Minnesota, spring 1978.

Species	Above Plant		Plant Area (from plant intake to Lock and Dam 3		Below Lock and Dam 3	
	No.	No./lift (for 33 lifts)	No.	No./lift (for 20 lifts)	No.	No./lift (for 11 lifts)
Longnose gar	2	0.06	0	0	0	0
Shortnose gar	42	1.27	2	0.10	0	0
Bowfin	9	0.27	0	0	1	0.09
American eel	1	0.03	0	0	0	0
Gizzard shad	15	0.45	10	0.50	0	0
Goldeye	0	0	1	0.05	0	0
Mooneye	13	0.39	2	0.10	0	0
Northern pike	35	1.06	2	0.10	2	0.18
Carp	178	5.39	38	1.90	46	4.18
River carpsucker	8	0.24	0	0	1	0.09
Quillback carpsucker	13	0.39	1	0.05	0	0
White sucker	2	0.06	0	0	2	0.18
Smallmouth buffalo	0	0	1	0.05	0	0
Bigmouth buffalo	7	0.21	4	0.20	3	0.27
Spotted sucker	1	0.03	0	0	0	0
Silver redhorse	11	0.33	1	0.05	0	0
Shorthead redhorse	80	2.42	19	0.95	8	0.73
Black bullhead	1	0.03	2	0.10	3	0.27
Yellow bullhead	1	0.03	0	0	0	0
Brown bullhead	1	0.03	0	0	0	0
Channel catfish	3	0.09	1	0.05	0	0
Flathead catfish	1	0.03	1	0.05	2	0.18
White bass	200	6.06	39	1.95	23	2.09
Rock bass	4	0.12	0	0	0	0
Bluegill	76	2.30	25	1.25	0	0
Largemouth bass	1	0.03	0	0	0	0
White crappie	85	2.58	53	2.65	9	0.82
Black crappie	143	4.33	40	2.00	12	1.09
Yellow perch	1	0.33	0	0	0	0
Sauger	17	0.52	12	0.60	1	0.09
Walleye	29	0.88	3	0.15	12	1.09
Freshwater drum	59	1.79	293	14.65	183	16.64
Total	1039	31.48	550	27.50	308	28.00

Table 2.4-4 Summary of trap net catches from the Mississippi River and connecting waters near the Prairie Island Nuclear Generating Plant, Red Wing, Minnesota, summer 1978.

Species	Above Plant		Plant Area (from plant intake to Lock and Dam 3)		Below Lock and Dam 3	
	No.	No./lift (for 34 lifts)	No.	No./lift (for 20 lifts)	No.	No./lift (for 14 lifts)
Chestnut lamprey	1	0.03	0	0	1	0.07
Longnose gar	11	0.32	1	0.05	0	0
Shortnose gar	23	0.68	2	0.10	2	0.14
Bowfin	17	0.50	0	0	3	0.21
American eel	0	0	0	0	1	0.07
Gizzard shad	14	0.41	1	0.05	1	0.07
Mooneye	4	0.12	0	0	1	0.07
Northern pike	38	1.12	0	0	14	1.00
Carp	71	2.09	57	2.85	56	4.00
River carpsucker	2	0.06	1	0.05	2	0.14
Quillback carpsucker	3	0.09	0	0	1	0.07
White sucker	0	0	2	0.10	15	1.07
Smallmouth buffalo	4	0.12	3	0.15	1	0.07
Bigmouth buffalo	9	0.26	3	0.15	0	0
Silver redhorse	0	0	0	0	3	0.21
Shorthead redhorse	60	1.76	15	0.75	7	0.50
Black bullhead	2	0.06	15	0.75	0	0
Channel catfish	1	0.03	0	0	0	0
Flathead catfish	1	0.03	0	0	1	0.07
White bass	170	5.00	161	8.05	29	2.07
Rock bass	2	0.06	0	0	3	0.21
Hybrid sunfish	0	0	0	0	1	0.07
Pumpkinseed	0	0	0	0	1	0.07
Bluegill	27	0.79	57	2.85	94	6.71
Smallmouth bass	5	0.15	0	0	0	0
Largemouth bass	0	0	1	0.05	2	0.14
White crappie	40	1.18	71	3.55	54	3.86
Black crappie	226	6.65	132	6.60	109	7.79
Yellow perch	1	0.03	0	0	1	0.07
Sauger	7	0.21	4	0.20	2	0.14
Walleye	17	0.50	4	0.20	2	0.14
Freshwater drum	69	2.03	127	6.35	67	4.79
Total	825	24.26	657	32.85	474	33.86

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Table 2.4-5 Summary of trap net catches from the Mississippi River and connecting waters near the Prairie Island Nuclear Generating Plant, Red Wing, Minnesota, fall 1978.

Species	Above Plant		Plant Area (from plant intake to Lock and Dam 3)		Below Lock and Dam 3	
	No.	No./lift (for 34 lifts)	No.	No./lift (for 20 lifts)	No.	No./lift (for 15 lifts)
Longnose gar	2	0.06	0	0	0	0
Shortnose gar	37	1.09	4	0.20	0	0
Bowfin	13	0.38	0	0	5	0.33
American eel	0	0	0	0	2	0.13
Gizzard shad	8	0.24	2	0.10	0	0
Goldeye	1	0.03	0	0	0	0
Mooneye	4	0.12	1	0.05	1	0.07
Northern pike	43	1.26	1	0.05	5	0.33
Carp	53	1.56	6	0.30	73	4.87
River carpsucker	2	0.06	0	0	0	0
Quillback carpsucker	2	0.06	0	0	2	0.13
White sucker	1	0.03	1	0.05	1	0.07
Smallmouth buffalo	1	0.03	0	0	2	0.13
Bigmouth buffalo	4	0.12	1	0.05	3	0.20
Silver redhorse	5	0.15	0	0	0	0
Shorthead redhorse	44	1.29	10	0.50	14	0.93
Black bullhead	1	0.03	1	0.05	0	0
Brown bullhead	1	0.03	0	0	0	0
Channel catfish	1	0.03	2	0.10	0	0
Flathead catfish	2	0.06	0	0	0	0
White bass	286	8.41	187	9.35	111	7.40
Rock bass	0	0	0	0	1	0.07
Hybrid sunfish	1	0.03	2	0.10	0	0
Bluegill	52	1.53	53	2.65	10	0.67
Smallmouth bass	1	0.03	0	0	0	0
Largemouth bass	0	0	0	0	2	0.13
White crappie	57	1.68	106	5.30	37	2.47
Black crappie	435	12.79	74	3.70	381	25.40
Sauger	22	0.65	7	0.35	9	0.60
Walleye	12	0.35	3	0.15	12	0.80
Freshwater drum	83	2.44	71	3.55	92	6.13
Total	1174	34.53	532	26.60	763	50.87

277 062

Table 2.4-6. Length-frequencies of all fish caught in trap nets from the Mississippi River and connecting waters near the Prairie Island Nuclear Generating Plant, Red Wing, Minnesota, 1978. Sections 0, 1, 2, 3, and 4 combined, seasons separated. (Sheet 1 of 15)

Total Length in Centimeters	Chestnut lamprey Summer*	Longnose gar Spring	Longnose gar Summer	Longnose gar Fall	Longnose gar Total	Shortnose gar Spring	Shortnose gar Summer	Shortnose gar Fall	Shortnose gar Total
Y/Y not meas.									
0.1 - 1.9									
2.0 - 3.9									
4.0 - 5.9									
6.0 - 7.9									
8.0 - 9.9									
10.0 - 11.9									
12.0 - 13.9									
14.0 - 15.9									
16.0 - 17.9									
18.0 - 19.9									
20.0 - 21.9									
22.0 - 23.9									
24.0 - 25.9									
26.0 - 27.9									
28.0 - 29.9									
30.0 - 31.9									
32.0 - 33.9									
34.0 - 35.9									
36.0 - 37.9									
38.0 - 39.9									
40.0 - 44.9									
45.0 - 49.9									
50.0 - 54.9						6	3	3	12
55.0 - 59.9						19	13	16	48
60.0 - 64.9						13	6	17	36
65.0 - 69.9			3	1	4	5	3	3	11
70.0 - 74.9			4		4	1			1
75.0 - 79.9		1	3		5				
80.0 - 84.9		1	2		3				
85.0 - 89.9									
90.0 - 94.9									
95.0 - 99.9									
100.0 - +									
Others not meas.	2						2	2	4
Total unmeasured	2						2	2	4
Total measured		2	12	2	16	44	25	39	108
Grand Total	2	2	12	2	16	44	27	41	112

* This species was caught during only one season.

277 063

Table 2.4-6. Length-frequencies of all fish caught in trap nets from the Mississippi River and connecting waters near the Prairie Island Nuclear Generating Plant, Red Wing, Minnesota, 1978. Sections 0, 1, 2, 3, and 4 combined, seasons separated. (Sheet 2 of 15)

Total Length in Centimeters	Bowfin Spring	Bowfin Summer	Bowfin Fall	Bowfin Total	American eel Spring	American eel Summer	American eel Fall	American eel Total	Gizzard shad Spring
Y/Y not meas.									
0.1 - 1.9									
2.0 - 3.9									
4.0 - 5.9									
6.0 - 7.9									
8.0 - 9.9									
10.0 - 11.9									
12.0 - 13.9									
14.0 - 15.9									
16.0 - 17.9									
18.0 - 19.9									
20.0 - 21.9									2
22.0 - 23.9									
24.0 - 25.9									
26.0 - 27.9									
28.0 - 29.9									1
30.0 - 31.9									4
32.0 - 33.9									9
34.0 - 35.9									4
36.0 - 37.9									2
38.0 - 39.9		2		2					
40.0 - 44.9		1	1	2					2
45.0 - 49.9		2		2					
50.0 - 54.9	2	3	3	8					
55.0 - 59.9	3	5	3	11					
60.0 - 64.9	4	2	7	13					
65.0 - 69.9	1		2	3					
70.0 - 74.9		3	1	4					
75.0 - 79.9									
80.0 - 84.9							1	1	
85.0 - 89.9									
90.0 - 94.9									
95.0 - 99.9									
100.0 - +									
Others not meas.		2	1	3	1	1	1	3	1
Total unmeasured		2	1	3	1	1	1	3	1
Total measured	10	18	17	45			1	1	24
Grand Total	10	20	18	48	1	1	2	4	25

277 064

Table 2.4-6. Length-frequencies of all fish caught in trap nets from the Mississippi River and connecting waters near the Prairie Island Nuclear Generating Plant, Red Wing, Minnesota, 1978. Sections 0, 1, 2, 3, and 4 combined, seasons separated. (Sheet 3 of 15)

Total Length in Centimeters	Gizzard shad Summer	Gizzard shad Fall	Gizzard shad Total	Goldeye Spring	Goldeye Fall	Goldeye Total	Mooneye Spring	Mooneye Summer	Mooneye Fall
Y/Y not meas.									
0.1 - 1.9									
2.0 - 3.9									
4.0 - 5.9									
6.0 - 7.9									
8.0 - 9.9									
10.0 - 11.9									
12.0 - 13.9									
14.0 - 15.9		2	2						
16.0 - 17.9		4	4						
18.0 - 19.9									
20.0 - 21.9			2						
22.0 - 23.9									
24.0 - 25.9	1		1						
26.0 - 27.9	3		3						1
28.0 - 29.9			1				1		
30.0 - 31.9	1		5				7	3	
32.0 - 33.9	2		11				7	2	3
34.0 - 35.9	3	2	9						2
36.0 - 37.9	1		3						
38.0 - 39.9		1	1						
40.0 - 44.9			2	1	1	2			
45.0 - 49.9									
50.0 - 54.9									
55.0 - 59.9									
60.0 - 64.9									
65.0 - 69.9									
70.0 - 74.9									
75.0 - 79.9									
80.0 - 84.9									
85.0 - 89.9									
90.0 - 94.9									
95.0 - 99.9									
100.0 - +									
Others not meas.	5	1	7						
Total unmeasured	5	1	7						
Total measured	11	9	44	1	1	2	15	5	6
Grand Total	16	10	51	1	1	2	15	5	6

277 065

Table 2.4-6. Length-frequencies of all fish caught in trap nets from the Mississippi River and connecting waters near the Prairie Island Nuclear Generating Plant, Red Wing, Minnesota, 1978. Sections 0, 1, 2, 3, and 4 combined, seasons separated. (Sheet 4 of 15)

Total Length in Centimeters	Mooneye Total	Northern pike Spring	Northern pike Summer	Northern pike Fall	Northern pike Total	Carp Spring	Carp Summer	Carp Fall	Carp Total
Y/Y not meas.									
0.1 - 1.9									
2.0 - 3.9									
4.0 - 5.9									
6.0 - 7.9									
8.0 - 9.9									
10.0 - 11.9									
12.0 - 13.9									
14.0 - 15.9				1	1				
16.0 - 17.9									
18.0 - 19.9							1		1
20.0 - 21.9						1			1
22.0 - 23.9							2	1	3
24.0 - 25.9						1			1
26.0 - 27.9	1						3	1	4
28.0 - 29.9	1					2	6	1	9
30.0 - 31.9	10					1	5	3	9
32.0 - 33.9	12					1	4	2	7
34.0 - 35.9	2						2	2	4
36.0 - 37.9						1	3	1	5
38.0 - 39.9						4	2		6
40.0 - 44.9		1			1	21	15	9	45
45.0 - 49.9		1	1		2	55	29	19	103
50.0 - 54.9		2	2		4	74	49	18	141
55.0 - 59.9			3	1	4	29	29	31	89
60.0 - 64.9		6		10	16	39	20	13	72
65.0 - 69.9		7	6	5	18	11	13	23	47
70.0 - 74.9		7	5	10	22	14	1	6	21
75.0 - 79.9		4	6	8	18	2			2
80.0 - 84.9		2	13	7	22				
85.0 - 89.9		2	8	5	15				
90.0 - 94.9		3	4		7				
95.0 - 99.9		4	1	2	7				
100.0 - +			2		2				
Others not meas.			1		1	6		2	8
Total unmeasured			1		1	6		2	8
Total measured	26	39	51	49	139	256	184	130	570
Grand Total	26	39	52	49	140	262	184	132	578

Table 2.4-6. Length-frequencies of all fish caught in trap nets from the Mississippi River and connecting waters near the Prairie Island Nuclear Generating Plant, Red Wing, Minnesota, 1978. Sections 0, 1, 2, 3, and 4 combined, seasons separated. (Sheet 5 of 15)

Total Length in Centimeters	River carp-sucker Spring	River carp-sucker Summer	River carp-sucker Fall	River carp-sucker Total	Quillback carp-sucker Spring	Quillback carp-sucker Summer	Quillback carp-sucker Fall	Quillback carp-sucker Total	White sucker Spring
Y/Y not meas.									
0.1 - 1.9									
2.0 - 3.9									
4.0 - 5.9									
6.0 - 7.9									
8.0 - 9.9									
10.0 - 11.9									
12.0 - 13.9									
14.0 - 15.9									
16.0 - 17.9									
18.0 - 19.9									
20.0 - 21.9					1			1	
22.0 - 23.9									
24.0 - 25.9							1	1	
26.0 - 27.9	1			1					
28.0 - 29.9									
30.0 - 31.9					3	1	1	5	1
32.0 - 33.9	1			1	3			3	
34.0 - 35.9					1	1		2	1
36.0 - 37.9					2	1		3	1
38.0 - 39.9		2		2	1	1	1	3	1
40.0 - 44.9	2		2	4	2			2	
45.0 - 49.9	2	2		4			1	1	
50.0 - 54.9	1			1	1			1	
55.0 - 59.9									
60.0 - 64.9	1			1					
65.0 - 69.9									
70.0 - 74.9									
75.0 - 79.9									
80.0 - 84.9									
85.0 - 89.9									
90.0 - 94.9									
95.0 - 99.9									
100.0 - +									
Others not meas.	1	1		2					
Total unmeasured	1	1		2					
Total measured	8	4	2	14	14	4	4	22	4
Grand Total	9	5	2	16	14	4	4	22	4

277 067

Table 2.4-6. Length-frequencies of all fish caught in trap nets from the Mississippi River and connecting waters near the Prairie Island Nuclear Generating Plant, Red Wing, Minnesota, 1978. Sections 0, 1, 2, 3, and 4 combined, seasons separated. (Sheet 6 of 15)

Total Length in Centimeters	White sucker Summer	White sucker Fall	White sucker Total	Smallmouth buffalo Spring	Smallmouth buffalo Summer	Smallmouth buffalo Fall	Smallmouth buffalo Total	Bigmouth buffalo Spring	Bigmouth buffalo Summer
Y/Y not meas.									
0.1 - 1.9									
2.0 - 3.9									
4.0 - 5.9									
6.0 - 7.9									
8.0 - 9.9									
10.0 - 11.9									
12.0 - 13.9									
14.0 - 15.9									
16.0 - 17.9				1			1	1	
18.0 - 19.9									
20.0 - 21.9								1	
22.0 - 23.9								1	
24.0 - 25.9					1		1	1	1
26.0 - 27.9					2		2		1
28.0 - 29.9					1	1	2	2	
30.0 - 31.9	1		2		1		1		1
32.0 - 33.9									3
34.0 - 35.9			1		1		1	2	1
36.0 - 37.9	1	1	3						
38.0 - 39.9	1		2			2	2		1
40.0 - 44.9	7	1	8						
45.0 - 49.9	7	1	8		2		2		1
50.0 - 54.9								2	2
55.0 - 59.9								1	1
60.0 - 64.9								2	
65.0 - 69.9								1	
70.0 - 74.9									
75.0 - 79.9									
80.0 - 84.9									
85.0 - 89.9									
90.0 - 94.9									
95.0 - 99.9									
100.0 - +									
Others not meas.									
Total unmeasured									
Total measured	17	3	24	1	8	3	12	14	12
Grand Total	17	3	24	1	8	3	12	14	12

Table 2.4-6. Length-frequencies of all fish caught in trap nets from the Mississippi River and connecting waters near the Prairie Island Nuclear Generating Plant, Red Wing, Minnesota, 1978. Sections 0, 1, 2, 3, and 4 combined, seasons separated. (Sheet 7 of 15)

Total Length in Centimeters	Bigmouth buffalo Fall	Bigmouth buffalo Total	Spotted sucker Spring*	Silver redhorse Spring	Silver redhorse Summer	Silver redhorse Fall	Silver redhorse Total	Shorthead redhorse Spring	Shorthead redhorse Summer
Y/Y not meas.									
0.1 - 1.9									
2.0 - 3.9									
4.0 - 5.9									
6.0 - 7.9									
8.0 - 9.9									
10.0 - 11.9									
12.0 - 13.9									
14.0 - 15.9									
16.0 - 17.9		1							
18.0 - 19.9									
20.0 - 21.9		1							
22.0 - 23.9		1							
24.0 - 25.9		2						1	
26.0 - 27.9		1						1	
28.0 - 29.9		2						1	
30.0 - 31.9		1						1	
32.0 - 33.9	1	4						3	3
34.0 - 35.9	2	5						3	2
36.0 - 37.9								10	10
38.0 - 39.9	1	2						22	15
40.0 - 44.9	1	1	1	2	1		3	44	39
45.0 - 49.9	1	2		2		1	3	18	12
50.0 - 54.9	2	6		5	2	1	8	3	1
55.0 - 59.9		2		1		3	4		
60.0 - 64.9		2		1			1		
65.0 - 69.9		1							
70.0 - 74.9									
75.0 - 79.9									
80.0 - 84.9									
85.0 - 89.9									
90.0 - 94.9									
95.0 - 99.9									
100.0 - +									
Others not meas.				1			1		
Total unmeasured				1			1		
Total measured	8	34	1	11	3	5	19	107	82
Grand Total	8	34	1	12	3	5	20	107	82

* This species was caught during only one season.

277 069

Table 2.4-6. Length-frequencies of all fish caught in trap nets from the Mississippi River and connecting waters near the Prairie Island Nuclear Generating Plant, Red Wing, Minnesota, 1978. Sections 0, 1, 2, 3, and 4 combined, seasons separated. (Sheet 8 of 15)

Total Length in Centimeters	Shorthead redhorse Fall	Shorthead redhorse Total	Black bullhead Spring	Black bullhead Summer	Black bullhead Fall	Black bullhead Tot-	Yellow bullhead Spring*	Brown bullhead Spring	Brown bullhead Fall
Y/Y not meas.									
0.1 - 1.9									
2.0 - 3.9									
4.0 - 5.9									
6.0 - 7.9									
8.0 - 9.9									
10.0 - 11.9									
12.0 - 13.9									
14.0 - 15.9									
16.0 - 17.9									
18.0 - 19.9				2		2			
20.0 - 21.9				1		1			
22.0 - 23.9			2	6		8	1		
24.0 - 25.9		1		4		4			
26.0 - 27.9		1	2	1	1	4			
28.0 - 29.9		1		2		2			
30.0 - 31.9	2	3	1		1	2		1	
32.0 - 33.9	1	7	1			1			1
34.0 - 35.9	7	12							
36.0 - 37.9	4	24							
38.0 - 39.9	11	48							
40.0 - 44.9	30	113							
45.0 - 49.9	9	39							
50.0 - 54.9	2	6							
55.0 - 59.9									
60.0 - 64.9									
65.0 - 69.9									
70.0 - 74.9									
75.0 - 79.9									
80.0 - 84.9									
85.0 - 89.9									
90.0 - 94.9									
95.0 - 99.9									
100.0 - +									
Others not meas.	2	2		1		1			
Total unmeasured	2	2		1		1			
Total measured	66	255	6	16	2	24	1	1	1
Grand Total	68	257	6	17	2	25	1	1	1

* This species was caught during only one season.

277 070

Table 2.4-6. Length-frequencies of all fish caught in trap nets from the Mississippi River and connecting waters near the Prairie Island Nuclear Generating Plant, Red Wing, Minnesota, 1978. Sections 0, 1, 2, 3, and 4 combined, seasons separated. (Sheet 9 of 15)

Total Length in Centimeters	Brown bullhead Total	Channel catfish Spring	Channel catfish Summer	Channel catfish Fall	Channel catfish Total	Flathead catfish Spring	Flathead catfish Summer	Flathead catfish Fall	Flathead catfish Total
Y/Y not meas.									
0.1 - 1.9									
2.0 - 3.9									
4.0 - 5.9									
6.0 - 7.9									
8.0 - 9.9									
10.0 - 11.9									
12.0 - 13.9									
14.0 - 15.9									
16.0 - 17.9									
18.0 - 19.9									
20.0 - 21.9									
22.0 - 23.9									
24.0 - 25.9		1			1				
26.0 - 27.9									
28.0 - 29.9									
30.0 - 31.9	1		1		1				
32.0 - 33.9	1								
34.0 - 35.9								1	1
36.0 - 37.9						1			1
38.0 - 39.9									
40.0 - 44.9				1	1			1	1
45.0 - 49.9		2		2	4				
50.0 - 54.9									
55.0 - 59.9						2	1		3
60.0 - 64.9		1			1				
65.0 - 69.9							1		1
70.0 - 74.9									
75.0 - 79.9									
80.0 - 84.9									
85.0 - 89.9									
90.0 - 94.9									
95.0 - 99.9						1			1
100.0 - +									
Others not meas.									
Total unmeasured									
Total measured	2	4	1	3	8	4	2	2	8
Grand Total	2	4	1	3	8	4	2	2	8

Table 2.4-6. Length-frequencies of all fish caught in trap nets from the Mississippi River and connecting waters near the Prairie Island Nuclear Generating Plant, Red Wing, Minnesota, 1978. Sections 0, 1, 2, 3, and 4 combined, seasons separated. (Sheet 10 of 15)

Total Length in Centimeters	White bass Spring	White bass Summer	White bass Fall	White bass Total	Rock bass Spring	Rock bass Summer	Rock bass Fall	Rock bass Total	Hybrid sunfish Summer
Y/Y not meas.									
0.1 - 1.9									
2.0 - 3.9									
4.0 - 5.9									
6.0 - 7.9									
8.0 - 9.9									
10.0 - 11.9									1
12.0 - 13.9									
14.0 - 15.9	2	1	1	4	3	3		6	
16.0 - 17.9	4	10	1	15	1	1		2	
18.0 - 19.9	3	55	19	77		1	1	2	
20.0 - 21.9	5	39	59	103					
22.0 - 23.9	43	27	34	104					
24.0 - 25.9	54	76	93	223					
26.0 - 27.9	22	52	89	163					
28.0 - 29.9	9	16	80	105					
30.0 - 31.9	8	13	25	46					
32.0 - 33.9	17	15	46	78					
34.0 - 35.9	29	25	57	111					
36.0 - 37.9	29	20	57	106					
38.0 - 39.9	32	5	15	52					
40.0 - 44.9	5	3	6	14					
45.0 - 49.9									
50.0 - 54.9									
55.0 - 59.9									
60.0 - 64.9									
65.0 - 69.9									
70.0 - 74.9									
75.0 - 79.9									
80.0 - 84.9									
85.0 - 89.9									
90.0 - 94.9									
95.0 - 99.9									
100.0 - +									
Others not meas.		3	2	5					
Total unmeasured		3	2	5					
Total measured	262	357	582	1201	4	5	1	10	1
Grand Total	262	360	584	1206	4	5	1	10	1

Table 2.4-6. Length-frequencies of all fish caught in trap nets from the Mississippi River and connecting waters near the Prairie Island Nuclear Generating Plant, Red Wing, Minnesota, 1978. Sections 0, 1, 2, 3, and 4 combined, seasons separated. (Sheet 11 of 15)

Total Length in Centimeters	Hybrid sunfish Fall	Hybrid sunfish Total	Pumpkin-seed Summer*	Bluegill Spring	Bluegill Summer	Bluegill Fall	Bluegill Total	Smallmouth bass Summer	Smallmouth bass Fall
Y/Y not meas.									
0.1 - 1.9									
2.0 - 3.9									
4.0 - 5.9									
6.0 - 7.9									
8.0 - 9.9									
10.0 - 11.9		1		1	19	4	24		
12.0 - 13.9				18	46	12	76		
14.0 - 15.9	2	2	1	29	49	30	108		
16.0 - 17.9	1	1		31	43	43	117		
18.0 - 19.9				16	18	22	56		
20.0 - 21.9				6	2	3	11	1	
22.0 - 23.9						1	1	1	
24.0 - 25.9								1	
26.0 - 27.9								1	
28.0 - 29.9									
30.0 - 31.9									
32.0 - 33.9								1	
34.0 - 35.9									
36.0 - 37.9									
38.0 - 39.9									
40.0 - 44.9									1
45.0 - 49.9									
50.0 - 54.9									
55.0 - 59.9									
60.0 - 64.9									
65.0 - 69.9									
70.0 - 74.9									
75.0 - 79.9									
80.0 - 84.9									
85.0 - 89.9									
90.0 - 94.9									
95.0 - 99.9									
100.0 - +									
Others not meas.					1		1		
Total unmeasured					1		1		
Total measured	3	4	1	101	177	115	393	5	1
Grand Total	3	4	1	101	178	115	394	5	1

* This species was caught during only one season.

277 073

Table 2.4-6. Length-frequencies of all fish caught in trap nets from the Mississippi River and connecting waters near the Prairie Island Nuclear Generating Plant, Red Wing, Minnesota, 1978. Sections 0, 1, 2, 3, and 4 combined, seasons separated. (Sheet 12 of 15)

Total Length in Centimeters	Smallmouth bass	Largemouth bass	Largemouth bass	Largemouth bass	Largemouth bass	White crappie	White crappie	White crappie	White crappie
Total	Total	Spring	Summer	Fall	Total	Spring	Summer	Fall	Total
Y/Y not meas.									
0.1 - 1.9									
2.0 - 3.9									
4.0 - 5.9									
6.0 - 7.9									
8.0 - 9.9									
10.0 - 11.9									
12.0 - 13.9						1		1	2
14.0 - 15.9						1	15	7	23
16.0 - 17.9							16	41	57
18.0 - 19.9			1		1	22	8	18	48
20.0 - 21.9	1		1		1	54	44	22	120
22.0 - 23.9	1					28	58	67	153
24.0 - 25.9	1					18	15	29	62
26.0 - 27.9	1					11	3	10	24
28.0 - 29.9		1	1		2	7		4	11
30.0 - 31.9						2	1		3
32.0 - 33.9	1			1	1	2	1	1	4
34.0 - 35.9					1				
36.0 - 37.9									
38.0 - 39.9									
40.0 - 44.9	1								
45.0 - 49.9									
50.0 - 54.9									
55.0 - 59.9									
60.0 - 64.9									
65.0 - 69.9									
70.0 - 74.9									
75.0 - 79.9									
80.0 - 84.9									
85.0 - 89.9									
90.0 - 94.9									
95.0 - 99.9									
100.0 - +									
Others not meas.						1	4		5
Total unmeasured						1	4		5
Total measured	6	1	3	2	6	146	161	200	507
Grand Total	6	1	3	2	6	147	165	200	512

Table 2.4-6. Length-frequencies of all fish caught in trap nets from the Mississippi River and connecting waters near the Prairie Island Nuclear Generating Plant, Red Wing, Minnesota, 1978. Sections 0, 1, 2, 3, and 4 combined, seasons separated. (Sheet 13 of 15)

Total Length in Centimeters	Black crappie Spring	Black crappie Summer	Black crappie Fall	Black crappie Total	Yellow perch Spring	Yellow perch Summer	Yellow perch Total	Sauger Spring	Sauger Summer
Y'Y not meas.									
0.1 - 1.9									
2.0 - 3.9									
4.0 - 5.9									
6.0 - 7.9									
8.0 - 9.9									
10.0 - 11.9	1		1	2					
12.0 - 13.9	3	74	48	125					
14.0 - 15.9		109	138	247					
16.0 - 17.9	15	27	53	95					
18.0 - 19.9	72	40	38	150					
20.0 - 21.9	33	81	162	276					
22.0 - 23.9	41	91	282	414	1	1	2		
24.0 - 25.9	20	36	118	174		1	1		
26.0 - 27.9	7	5	33	45				1	
28.0 - 29.9	1	2	4	7					2
30.0 - 31.9			2	2				2	
32.0 - 33.9			1	1				1	1
34.0 - 35.9	1			1				5	3
36.0 - 37.9								5	3
38.0 - 39.9								4	2
40.0 - 44.9								6	
45.0 - 49.9								3	2
50.0 - 54.9								3	
55.0 - 59.9									
60.0 - 64.9									
65.0 - 69.9									
70.0 - 74.9									
75.0 - 79.9									
80.0 - 84.9									
85.0 - 89.9									
90.0 - 94.9									
95.0 - 99.9									
100.0 - +									
Others not meas.	1	2	10	13					
Total unmeasured	1	2	10	13					
Total measured	194	465	880	1539	1	2	3	30	13
Grand Total	195	467	890	1552	1	2	3	30	13

Table 2.4-6. Length-frequencies of all fish caught in trap nets from the Mississippi River and connecting waters near the Prairie Island Nuclear Generating Plant, Red Wing, Minnesota, 1978. Sections 0, 1, 2, 3, and 4 combined, seasons separated. (Sheet 14 of 15)

Total Length in Centimeters	Sauger Fall	Sauger Total	Walleye Spring	Walleye Summer	Walleye Fall	Walleye Total	Fresh-water drum Spring	Fresh-water drum Summer	Fresh-water drum Fall
Y/Y not meas.									
0.1 - 1.9									
2.0 - 3.9									
4.0 - 5.9									
6.0 - 7.9									
8.0 - 9.9									
10.0 - 11.9									
12.0 - 13.9									
14.0 - 15.9							2	1	1
16.0 - 17.9							12	24	12
18.0 - 19.9							10	29	36
20.0 - 21.9							49	22	24
22.0 - 23.9	1	1					63	27	19
24.0 - 25.9							35	24	23
26.0 - 27.9	1	2					64	32	22
28.0 - 29.9	2	4	1			1	98	34	38
30.0 - 31.9	2	4					101	32	33
32.0 - 33.9	5	7	3		1	4	46	17	23
34.0 - 35.9	7	15	1	1	3	5	24	8	11
36.0 - 37.9	2	10	3			3	16	7	1
38.0 - 39.9	7	13	1	1	3	5	6	1	
40.0 - 44.9	6	12	4		4	8	5	2	
45.0 - 49.9	5	10	5	2	4	11	1		
50.0 - 54.9		3	4	6	5	15	1		
55.0 - 59.9			11	7		18		1	
60.0 - 64.9			7	4	4	15			
65.0 - 69.9			2	1	3	6			
70.0 - 74.9			1			1			
75.0 - 79.9									
80.0 - 84.9									
85.0 - 89.9									
90.0 - 94.9									
95.0 - 99.9									
100.0 - +									
Others not meas.			1	1		2	2	2	3
Total unmeasured			1	1		2	2	2	3
Total measured	38	81	43	22	27	92	533	261	243
Grand Total	38	81	44	23	27	94	535	263	246

277 076

Table 2.4-6. Length-frequencies of all fish caught in trap nets from the Mississippi River and connecting waters near the Prairie Island Nuclear Generating Plant, Red Wing, Minnesota, 1978. Sections 0, 1, 2, 3, and 4 combined, seasons separated. (Sheet 15 of 15)

Total Length in Centimeters	Freshwater drum Total								
Y/Y not meas.									
0.1 - 1.9									
2.0 - 3.9									
4.0 - 5.9									
6.0 - 7.9									
8.0 - 9.9									
10.0 - 11.9									
12.0 - 13.9									
14.0 - 15.9	4								
16.0 - 17.9	48								
18.0 - 19.9	75								
20.0 - 21.9	95								
22.0 - 23.9	109								
24.0 - 25.9	82								
26.0 - 27.9	118								
28.0 - 29.9	170								
30.0 - 31.9	166								
32.0 - 33.9	86								
34.0 - 35.9	43								
36.0 - 37.9	24								
38.0 - 39.9	7								
40.0 - 44.9	7								
45.0 - 49.9	1								
50.0 - 54.9	1								
55.0 - 59.9	1								
60.0 - 64.9									
65.0 - 69.9									
70.0 - 74.9									
75.0 - 79.9									
80.0 - 84.9									
85.0 - 89.9									
90.0 - 94.9									
95.0 - 99.9									
100.0 - +									
Others not meas.	7								
Total unmeasured	7								
Total measured	1037								
Grand Total	1044								

Table 2.4-7 Summary of gill net catches from the Mississippi River and connecting waters near the Prairie Island Nuclear Generating Plant, Red Wing, Minnesota, spring and fall 1978. (Sheet 1 of 2)

Species	Spring				Fall			
	Above Plant		Plant Area		Above Plant		Plant Area	
	No./lift No. for 16 lifts		No./lift No. for 8 lifts		No./lift No. for 16 lifts		No./lift No. for 8 lifts	
Longnose gar	17	1.06	0	0	0	0	0	0
Shortnose gar	84	5.25	11	1.38	0	0	0	0
Bowfin	10	0.63	0	0	7	0.44	0	0
Gizzard shad	241	15.06	101	12.63	185	11.56	322	40.25
Goldeye	4	0.25	0	0	3	0.19	0	0
Mooneye	20	1.25	0	0	2	0.13	0	0
Northern pike	7	0.44	2	0.25	15	0.94	2	0.25
Carp	104	6.50	27	3.38	13	0.81	4	0.50
Quillback carpsucker	10	0.63	2	0.25	0	0	0	0
Highfin carpsucker	2	0.13	0	0	0	0	0	0
Smallmouth buffalo	14	0.88	4	0.50	0	0	7	0.88
Bigmouth buffalo	28	1.75	16	2.00	0	0	0	0
Shorthead redhorse	80	5.00	48	6.00	10	0.63	6	0.75
Black bullhead	14	0.88	12	1.50	4	0.25	9	1.13
Yellow bullhead	0	0	1	0.13	0	0	0	0
Channel catfish	17	1.06	5	0.63	15	0.94	5	0.63
Flathead catfish	0	0	1	0.13	0	0	0	0
White bass	235	14.69	50	6.25	37	2.31	19	2.38
Rock bass	6	0.38	0	0	4	0.25	0	0
Green sunfish	0	0	1	0.13	0	0	1	0.13
Bluegill	3	0.19	3	0.38	2	0.13	1	0.13
Largemouth bass	0	0	1	0.13	0	0	0	0
White crappie	43	2.69	47	5.88	8	0.50	15	1.88
Black crappie	68	4.25	14	1.75	17	1.06	2	0.25

Table 2.4-7 Summary of gill net catches from the Mississippi River and connecting waters near the Prairie Island Nuclear Generating Plant, Red Wing, Minnesota, spring and fall 1978. (Sheet 2 of 2)

Species	Spring				Fall			
	Above Plant		Plant Area		Above Plant		Plant Area	
	No./lift No. for 16 lifts		No./lift No. for 8 lifts		No./lift No. for 16 lifts		No./lift No. for 8 lifts	
Yellow perch	8	0.50	19	2.38	3	0.19	7	0.88
Sauger	62	3.88	43	5.38	72	4.50	32	4.00
Walleye	19	1.19	7	0.88	8	0.50	3	0.38
Freshwater drum	80	5.00	35	4.38	14	0.88	25	3.13
Total	1176	73.50	450	56.25	419	26.19	460	57.50

Table 2.4-8. Length-frequencies of all fish caught in gill nets from the Mississippi River and connecting waters near the Prairie Island Nuclear Generating Plant, Red Wing, Minnesota, 1978. Sections 0, 1, and 3 combined, seasons separated. (Sheet 1 of 8)

Total Length in Centimeters	Longnose gar Spring*	Shortnose gar Spring*	Bowfin Spring	Bowfin Fall	Bowfin Total	Gizzard shad Spring	Gizzard shad Fall	Gizzard shad Total	Goldeye Spring
Y/Y not meas.							262	262	
0.1 - 1.9									
2.0 - 3.9									
4.0 - 5.9									
6.0 - 7.9									
8.0 - 9.9							1	1	
10.0 - 11.9							1	1	
12.0 - 13.9							7	7	
14.0 - 15.9						2	17	19	
16.0 - 17.9						17	60	77	
18.0 - 19.9						16	9	25	
20.0 - 21.9						10	2	12	
22.0 - 23.9						2		2	
24.0 - 25.9						1	1	2	
26.0 - 27.9						2	3	5	
28.0 - 29.9						3	3	6	
30.0 - 31.9						58	31	29	
32.0 - 33.9						114	31	145	
34.0 - 35.9			1		1	78	26	104	
36.0 - 37.9				1	1	6	29	35	
38.0 - 39.9			1		1	3	17	20	
40.0 - 44.9		2		1	1	3	5	8	3
45.0 - 49.9				1	1				
50.0 - 54.9		7	3	1	4				
55.0 - 59.9	1	27	2	1	3				
60.0 - 64.9	1	34	2	1	3				
65.0 - 69.9	1	18	1	1	2				
70.0 - 74.9	5	3							
75.0 - 79.9	3	2							
80.0 - 84.9	4	1							
85.0 - 89.9									
90.0 - 94.9									
95.0 - 99.9									
100.0 - +	2	1							
Others not meas.						27	2	29	1
Total unmeasured						27	264	291	1
Total measured	17	95	10	7	17	315	243	558	3
Grand Total	17	95	10	7	17	342	507	849	4

* This species was caught during only one season.

277 080

Table 2.4-8. Length-frequencies of all fish caught in gill nets from the Mississippi River and connecting waters near the Prairie Island Nuclear Generating Plant, Red Wing, Minnesota, 1978. Sections 0, 1, and 3 combined, seasons separated. (Sheet 2 of 8)

Total Length in Centimeters	Goldeye Fall	Goldeye Total	Mooneye Spring	Mooneye Fall	Northern Total	Northern pike Spring	Northern pike Fall	Northern pike Total	Carp Spring
Y/Y not meas.									
0.1 - 1.9									
2.0 - 3.9									
4.0 - 5.9									
6.0 - 7.9									
8.0 - 9.9									
10.0 - 11.9									
12.0 - 13.9									
14.0 - 15.9									
16.0 - 17.9									
18.0 - 19.9									
20.0 - 21.9									
22.0 - 23.9			1		1				2
24.0 - 25.9									1
26.0 - 27.9									
28.0 - 29.9			3		3				1
30.0 - 31.9			4	1	5				1
32.0 - 33.9			10	1	11				1
34.0 - 35.9			1		1				
36.0 - 37.9									
38.0 - 39.9									3
40.0 - 44.9	3	6							21
45.0 - 49.9									37
50.0 - 54.9									40
55.0 - 59.9						2	1	3	12
60.0 - 64.9						3	3	6	6
65.0 - 69.9						2	4	6	4
70.0 - 74.9						1	3	4	
75.0 - 79.9							2	2	
80.0 - 84.9						1	1	2	
85.0 - 89.9									
90.0 - 94.9							3	3	
95.0 - 99.9									
100.0 - +									
Others not meas.		1	1		1				2
Total unmeasured		1	1		1				2
Total measured	3	6	19	2	21	9	17	26	129
Grand Total	3	7	20	2	22	9	17	26	131

Table 2.4-8. Length-frequencies of all fish caught in gill nets from the Mississippi River and connecting waters near the Prairie Island Nuclear Generating Plant, Red Wing, Minnesota, 1978. Sections 0, 1, and 3 combined, seasons separated. (Sheet 3 of 8)

Total Length in Centimeters	Carp Fall	Carp Total	Quillback carp-sucker Spring*	Highfin carp-sucker Spring*	Small-mouth buffalo Spring	Small-mouth buffalo Fall	Small-mouth buffalo Total	Bigmouth buffalo Spring*	Shorthead redhorse Spring
Y/Y not meas.									
0.1 - 1.9									
2.0 - 3.9									
4.0 - 5.9									
6.0 - 7.9									
8.0 - 9.9									
10.0 - 11.9									
12.0 - 13.9						1	1		
14.0 - 15.9					2	3	5	1	
16.0 - 17.9					2	2	4	1	
18.0 - 19.9					4		4	5	
20.0 - 21.9					2		2	9	
22.0 - 23.9		2			2	1	3	10	
24.0 - 25.9		1			1		1	3	
26.0 - 27.9					1		1	1	
28.0 - 29.9		1		1				8	
30.0 - 31.9		1	1						3
32.0 - 33.9	1	2	2		1		1		7
34.0 - 35.9	1	1	2						4
36.0 - 37.9	2	2	1						18
38.0 - 39.9		3							25
40.0 - 44.9		21	4	1	1		1	2	54
45.0 - 49.9	2	39	2						14
50.0 - 54.9	5	45						2	
55.0 - 59.9	4	16			1		1		
60.0 - 64.9	2	8							
65.0 - 69.9		4							
70.0 - 74.9									
75.0 - 79.9									
80.0 - 84.9									
85.0 - 89.9									
90.0 - 94.9									
95.0 - 99.9									
100.0 - +									
Others not meas.		2			1		1	2	3
Total unmeasured		2			1		1	2	3
Total measured	17	146	12	2	17	7	24	42	125
Grand total	17	148	12	2	18	7	25	44	128

* This species was caught during only one season.

277 082

Table 2.4-3. Length-frequencies of all fish caught in gill nets from the Mississippi River and connecting waters near the Prairie Island Nuclear Generating Plant, Red Wing, Minnesota, 1978. Sections 0, 1, and 3 combined, seasons separated. (Sheet 4 of 8)

Total Length in Centimeters	Shorthead redhorse Fall	Shorthead redhorse Total	Black bullhead Spring	Black bullhead Fall	Black bullhead Total	Yellow bullhead Spring*	Channel catfish Spring	Channel catfish Fall	Channel catfish Total
Y/Y not meas.									
0.1 - 1.9									
2.0 - 3.9									
4.0 - 5.9									
6.0 - 7.9									
8.0 - 9.9									
10.0 - 11.9									
12.0 - 13.9									
14.0 - 15.9									
16.0 - 17.9			5		5				
18.0 - 19.9			7		7		1		1
20.0 - 21.9			3		3		1		1
22.0 - 23.9			2	1	3	1			
24.0 - 25.9			3	4	7			1	1
26.0 - 27.9			2	4	6				
28.0 - 29.9			2	3	5		1	1	2
30.0 - 31.9		3		1	1		1		1
32.0 - 33.9		7	1		1				
34.0 - 35.9		4							
36.0 - 37.9		18						1	1
38.0 - 39.9	1	26					3	2	5
40.0 - 44.9	10	64					4	1	5
45.0 - 49.9	4	18					6	5	11
50.0 - 54.9							4	6	10
55.0 - 59.9								2	2
60.0 - 64.9									
65.0 - 69.9								1	1
70.0 - 74.9									
75.0 - 79.9									
80.0 - 84.9									
85.0 - 89.9									
90.0 - 94.9									
95.0 - 99.9									
100.0 - +									
Others not meas.	1	4	1		1		1		1
Total unmeasured	1	4	1		1		1		1
Total measured	15	140	25	13	38	1	21	20	41
Grand Total	16	144	26	13	39	1	22	20	42

* This species was caught during only one season.

277 083

Table 2.4-8. Length-frequencies of all fish caught in gill nets from the Mississippi River and connecting waters near the Prairie Island Nuclear Generating Plant, Red Wing, Minnesota, 1978. Sections 0, 1, and 3 combined, seasons separated. (Sheet 5 of 8)

Total Length in Centimeters	Flathead catfish Spring*	White bass Spring	White bass Fall	White bass Total	Rock bass Spring	Rock bass Full	Rock bass Total	Green sunfish Spring	Green sunfish Fall
Y/Y not meas.									
0.1 - 1.9									
2.0 - 3.9									
4.0 - 5.9									
6.0 - 7.9									
8.0 - 9.9									
10.0 - 11.9			1	1					
12.0 - 13.9		18	3	21	2		2	1	
14.0 - 15.9		35	1	36		1	1		1
16.0 - 17.9		3		3	4	1	5		
18.0 - 19.9		1	1	2		2	2		
20.0 - 21.9		7		7					
22.0 - 23.9		92		92					
24.0 - 25.9		52	10	62					
26.0 - 27.9		26	11	37					
28.0 - 29.9		2	7	9					
30.0 - 31.9		7	3	10					
32.0 - 33.9		8	6	14					
34.0 - 35.9		10	5	15					
36.0 - 37.9		10	3	13					
38.0 - 39.9		3	4	7					
40.0 - 44.9									
45.0 - 49.9									
50.0 - 54.9									
55.0 - 59.9									
60.0 - 64.9									
65.0 - 69.9	1								
70.0 - 74.9									
75.0 - 79.9									
80.0 - 84.9									
85.0 - 89.9									
90.0 - 94.9									
95.0 - 99.9									
100.0 - +									
Others not meas.		11	1	12					
Total unmeasured		11	1	12					
Total measured	1	274	55	329	6	4	10	1	1
Grand Total	1	285	56	341	6	4	10	1	1

* This species was caught during only one season.

277 084

Table 2.4-8. Length-frequencies of all fish caught in gill nets from the Mississippi River and connecting waters near the Prairie Island Nuclear Generating Plant, Red Wing, Minnesota, 1978. Sections 0, 1, and 3 combined, seasons separated. (Sheet 6 of 8)

Total Length in Centimeters	Green sunfish Total	Bluegill Spring	Bluegill Fall	Bluegill Total	Largemouth bass Spring*	White crappie Spring	White crappie Fall	White crappie Total	Black crappie Spring
Y/Y not meas.									
0.1 - 1.9									
2.0 - 3.9									
4.0 - 5.9									
6.0 - 7.9									
8.0 - 9.9									1
10.0 - 11.9						15		15	34
12.0 - 13.9	1					30		30	1
14.0 - 15.9	1	3		3			1	1	
16.0 - 17.9		2	1	3		2	3	5	5
18.0 - 19.9		1		1	1	14	3	17	14
20.0 - 21.9			1	1		12		12	11
22.0 - 23.9						8	9	17	9
24.0 - 25.9						1	2	3	3
26.0 - 27.9						3		3	2
28.0 - 29.9							1	1	
30.0 - 31.9							2	2	
32.0 - 33.9							2	2	
34.0 - 35.9									
36.0 - 37.9									
38.0 - 39.9									
40.0 - 44.9									
45.0 - 49.9									
50.0 - 54.9									
55.0 - 59.9									
60.0 - 64.9									
65.0 - 69.9									
70.0 - 74.9									
75.0 - 79.9									
80.0 - 84.9									
85.0 - 89.9									
90.0 - 94.9									
95.0 - 99.9									
100.0 - +									
Others not meas.			1	1		5		5	2
Total unmeasured			1	1		5		5	2
Total measured	2	6	2	8	1	85	23	108	80
Grand Total	2	6	3	9	1	90	23	113	82

* This species was caught during only one season.

277 085

Table 2.4-8. Length-frequencies of all fish caught in gill nets from the Mississippi River and connecting waters near the Prairie Island Nuclear Generating Plant, Red Wing, Minnesota, 1978. Sections 0, 1, and 3 combined, seasons separated. (Sheet 7 of 8)

Total Length in Centimeters	Black crappie Fall	Black crappie Total	Yellow perch Spring	Yellow perch Fall	Yellow perch Total	Sauger Spring	Sauger Fall	Sauger Total	Walleye Spring
Y/Y not meas.									
0.1 - 1.9									
2.0 - 3.9									
4.0 - 5.9									
6.0 - 7.9									
8.0 - 9.9		1							
10.0 - 11.9		34							
12.0 - 13.9	1	2	1		1				
14.0 - 15.9	11	11	2		2				
16.0 - 17.9	3	8	5	1	6				
18.0 - 19.9	2	16	15	4	19				
20.0 - 21.9		11	2	5	7	1		1	
22.0 - 23.9		9	1		1	11		11	
24.0 - 25.9		3	1		1	14	2	16	
26.0 - 27.9		2				4	7	11	2
28.0 - 29.9						3	9	12	1
30.0 - 31.9						6	4	10	1
32.0 - 33.9						6	10	16	5
34.0 - 35.9						10	10	20	4
36.0 - 37.9						14	12	26	2
38.0 - 39.9						5	10	15	1
40.0 - 44.9						16	13	29	2
45.0 - 49.9						10	22	32	3
50.0 - 54.9						4	3	7	3
55.0 - 59.9							2	2	2
60.0 - 64.9									
65.0 - 69.9									
70.0 - 74.9									
75.0 - 79.9									
80.0 - 84.9									
85.0 - 89.9									
90.0 - 94.9									
95.0 - 99.9									
100.0 - +									
Others not meas.	2	4				1		1	
Total unmeasured	2	4				1		1	
Total measured	17	97	27	10	37	104	104	208	26
Grand Total	19	101	27	10	37	105	104	209	26

Table 2.4-8. Length-frequencies of all fish caught in gill nets from the Mississippi River and connecting waters near the Prairie Island Nuclear Generating Plant, Red Wing, Minnesota, 1978. Sections 0, 1, and 3 combined, seasons separated. (Sheet 8 of 8)

Total Length in Centimeters	Walleye Fall	Walleye Total	Freshwater drum Spring	Freshwater drum Fall	Freshwater drum Total				
Y/Y not meas.				1	1				
0.1 - 1.9									
2.0 - 3.9									
4.0 - 5.9									
6.0 - 7.9									
8.0 - 9.9									
10.0 - 11.9									
12.0 - 13.9			7	11	18				
14.0 - 15.9			9	12	21				
16.0 - 17.9			10	1	11				
18.0 - 19.9			4	5	9				
20.0 - 21.9			16	3	19				
22.0 - 23.9			14		14				
24.0 - 25.9			10		10				
26.0 - 27.9		2	6		6				
28.0 - 29.9		1	9	2	11				
30.0 - 31.9	2	3	11	3	14				
32.0 - 33.9	1	6	9		9				
34.0 - 35.9	2	6	6	1	7				
36.0 - 37.9	2	4	1		1				
38.0 - 39.9	2	3							
40.0 - 44.9		2	1		1				
45.0 - 49.9	1	4							
50.0 - 54.9		3							
55.0 - 59.9		2							
60.0 - 64.9	1	1							
65.0 - 69.9									
70.0 - 74.9									
75.0 - 79.9									
80.0 - 84.9									
85.0 - 89.9									
90.0 - 94.9									
95.0 - 99.9									
100.0 - +									
Others not meas.			2		2				
Total unmeasured			2	1	3				
Total measured	11	37	113	38	151				
Grand Total	11	37	115	39	154				

Table 2.4-9 Summary of day electrofishing catches from the Mississippi River and connecting waters near the Prairie Island Nuclear Generating Plant, Red Wing, Minnesota, spring 1978.

Species	Above Plant		*Plant Area (from plant intake to Lock and Dam 3)		*Below Lock & Dam 3
	No.	(for 7.50 h)	No.	(for 1.25 h)	
Shortnose gar	2	0.27	1	0.80	
Bowfin	2	0.27	0	0	
Gizzard shad	55	7.33	4	3.20	
Mooneye	16	2.13	0	0	
Carp	76	10.13	12	9.60	
Silver chub	1	0.13	0	0	
Emerald shiner	18	2.40	5	4.00	
Pugnose minnow	1	0.13	0	0	
Spottail shiner	8	1.07	0	0	
Spotfin shiner	4	0.53	1	0.80	
Bullhead minnow	13	1.73	0	0	
Carpsucker spp.	6	0.80	1	0.80	
River carpsucker	3	0.40	0	0	
Quillback carpsucker	1	0.13	0	0	
White sucker	3	0.40	0	0	
Smallmouth buffalo	3	0.40	5	4.00	
Bigmouth buffalo	0	0	1	0.80	
Silver redhorse	0	0	1	0.80	
Shorthead redhorse	21	2.80	8	6.40	
Channel catfish	5	0.67	6	4.80	
Flathead catfish	0	0	2	1.60	
White bass	32	4.27	7	5.60	
Rock bass	9	1.20	1	0.80	
Hybrid sunfish	2	0.27	0	0	
Green sunfish	3	0.40	9	7.20	
Bluegill	71	9.47	9	7.20	
Smallmouth bass	51	6.80	10	8.00	
Black crappie	8	1.07	1	0.80	
Yellow perch	9	1.20	0	0	
Log perch	2	0.27	0	0	
Sauger	41	5.47	2	1.60	
Walleye	19	2.53	1	0.80	
Freshwater drum	343	45.73	3	2.40	
Total	828	110.40	90	72.00	

*Stations 3-5 to 3-9 (plant area) and Stations 4-0 to 4-9 (below dam) were not sampled during spring due to equipment problems.

Table 2.4-10 Summary of day electrofishing catches from the Mississippi River and connecting waters near the Prairie Island Nuclear Generating Plant, Red Wing, Minnesota, summer 1978.

Species	Above Plant		Plant Area (from plant intake to Lock and Dam 3		Below Lock & Dam 3	
	No.	No./hour (for 7.50 h)	No.	No./hour (for 2.50 h)	No.	No./hour (for 2.50 h)
Chestnut lamprey	0	0	0	0	1	0.40
Shortnose gar	2	0.27	1	0.40	0	0
Bowfin	1	0.13	0	0	0	0
Gizzard shad	396	52.80	97	38.80	9	3.60
Mooneye	0	0	1	0.40	0	0
Northern pike	2	0.27	0	0	0	0
Carp	150	20.00	42	16.80	50	20.00
Silver chub	3	0.40	0	0	1	0.40
Emerald shiner	207	27.60	9	3.60	174	69.60
Spottail shiner	11	1.47	9	3.60	0	0
Spotfin shiner	0	0	1	0.40	0	0
Bullhead minnow	4	0.53	6	2.40	0	0
Carpsucker spp.	7	0.93	1	0.40	1	0.40
River carpsucker	1	0.13	0	0	1	0.40
Quillback carpsucker	16	2.13	4	1.60	2	0.80
White sucker	1	0.13	0	0	1	0.40
Smallmouth buffalo	2	0.27	14	5.60	1	0.40
Bigmouth buffalo	0	0	3	1.20	2	0.80
Redhorse spp.	1	0.13	0	0	0	0
Silver redhorse	1	0.13	0	0	0	0
Shorthead redhorse	23	3.07	16	6.40	11	4.40
Channel catfish	8	1.07	6	2.40	2	0.80
Flathead catfish	1	0.13	0	0	0	0
White bass	67	8.93	29	11.60	88	35.20
Rock bass	6	0.80	1	0.40	11	4.40
Hybrid sunfish	0	0	5	2.00	1	0.40
Green sunfish	16	2.13	4	1.60	1	0.40
Bluegill	105	14.00	95	38.00	56	22.40
Smallmouth bass	48	6.40	11	4.40	23	9.20
Largemouth bass	2	0.27	4	1.60	0	0
White crappie	2	0.27	1	0.40	2	0.80
Black crappie	3	0.40	12	4.80	3	1.20
Johnny darter	0	0	1	0.40	0	0
Yellow perch	12	1.60	9	3.60	0	0
Log perch	9	1.20	2	0.80	3	1.20
Sauger	53	7.07	4	1.60	5	2.00
Walleye	8	1.07	1	0.40	5	2.00
Freshwater drum	440	58.67	74	29.60	9	3.60
Total	1608	214.40	463	185.20	463	185.20

Table 2.4-11 Summary of day electrofishing catches from the Mississippi River and connecting waters near the Prairie Island Nuclear Generating Plant, Red Wing, Minnesota, fall 1978.

Species	Above Plant		Plant Area (from plant intake to Lock and Dam 3)		Below Lock & Dam 3	
	No.	No./hour (for 7.50 h)	No.	No./hour (for 2.50 h)	No.	No./hour (for 2.50 h)
Silver lamprey	0	0	2	0.80	0	0
Bowfin	2	0.27	0	0	0	0
Gizzard shad	385	51.33	113	45.20	221	88.40
Mooneye	1	0.13	0	0	7	2.80
Carp	95	12.67	62	24.80	110	44.00
Silver chub	2	0.27	0	0	1	0.40
Emerald shiner	47	6.27	30	12.00	24	9.60
Spottail shiner	7	0.93	2	0.80	0	0
Spotfin shiner	1	0.13	0	0	0	0
Bullhead minnow	4	0.53	1	0.40	0	0
Carpsucker spp.	3	0.40	0	0	5	2.00
River carpsucker	2	0.27	0	0	2	0.80
Quillback carpsucker	2	0.27	2	0.80	3	1.20
White sucker	0	0	0	0	1	0.40
Smallmouth buffalo	2	0.27	5	2.00	0	0
Bigmouth buffalo	1	0.13	0	0	5	2.00
Silver redhorse	1	0.13	0	0	0	0
Shorthead redhorse	10	1.33	7	2.80	14	5.60
Channel catfish	1	0.13	7	2.80	1	0.40
Flathead catfish	0	0	5	2.00	0	0
White bass	37	4.93	29	11.60	59	23.60
Rock bass	14	1.87	5	2.00	16	6.40
Hybrid sunfish	2	0.27	20	8.00	1	0.40
Green sunfish	11	1.47	8	3.20	2	0.80
Orangespotted sunfish	0	0	1	0.40	0	0
Bluegill	40	5.33	157	62.80	162	64.80
Smallmouth bass	33	4.40	10	4.00	13	5.20
Largemouth bass	0	0	7	2.80	3	1.20
White crappie	4	0.53	20	8.00	3	1.20
Black crappie	18	2.40	13	5.20	15	6.00
Yellow perch	3	0.40	0	0	0	0
Log perch	1	0.13	0	0	0	0
Sauger	24	3.20	2	0.80	10	4.00
Walleye	9	1.20	13	5.20	7	2.80
Freshwater drum	46	6.13	6	2.40	28	11.20
Total	808	107.73	527	210.80	713	285.20

Table 2.4-12. Length-frequencies of all fish caught by electrofishing in the Mississippi River and connecting waters near the Prairie Island Nuclear Generating Plant, Red Wing, Minnesota, 1978. Sections 0, 1, 2, 3, and 4 combined, seasons separated. (Sheet 1 of 16)

Total Length in Centimeters	Chestnut lamprey Summer *	Silver lamprey Fall*	Shortnose gar Spring	Shortnose gar Summer	Shortnose gar Total	Bowfin Spring	Bowfin Summer	Bowfin Fall	Bowfin Total
Y/Y not meas.									
0.1 - 1.9									
2.0 - 3.9									
4.0 - 5.9									
6.0 - 7.9									
8.0 - 9.9									
10.0 - 11.9									
12.0 - 13.9									
14.0 - 15.9									
16.0 - 17.9									
18.0 - 19.9									
20.0 - 21.9									
22.0 - 23.9								1	1
24.0 - 25.9									
26.0 - 27.9									
28.0 - 29.9									
30.0 - 31.9									
32.0 - 33.9									
34.0 - 35.9									
36.0 - 37.9								1	
38.0 - 39.9									
40.0 - 44.9									
45.0 - 49.9						1			1
50.0 - 54.9			1	1	2	1	1		2
55.0 - 59.9				1	1				
60.0 - 64.9			2	1	3				
65.0 - 69.9									
70.0 - 74.9									
75.0 - 79.9									
80.0 - 84.9									
85.0 - 89.9									
90.0 - 94.9									
95.0 - 99.9									
100.0 - +									
Others not meas.	1	2							
Total unmeasured	1	2							
Total measured			3	3	6	2	1	2	5
Grand Total	1	2	3	3	6	2	1	2	5

* This species was caught during only one season.

277 091

Table 2.4-12. Length-frequencies of all fish caught by electrofishing in the Mississippi River and connecting waters near the Prairie Island Nuclear Generating Plant, Red Wing, Minnesota, 1978. Sections 0, 1, 2, 3, and 4 combined, seasons separated. (Sheet 2 of 16)

Total Length in Centimeters	Gizzard shad Spring	Gizzard shad Summer	Gizzard shad Fall	Gizzard shad Total	Mooneye Spring	Mooneye Summer	Mooneye Fall	Mooneye Total	Northern pike Summer*
Y/Y not meas.		112	270	382					
0.1 - 1.9									
2.0 - 3.9		39		39					
4.0 - 5.9		54		54					
6.0 - 7.9	6	14	3	23					
8.0 - 9.9		4	4	8					
10.0 - 11.9		17	15	32					
12.0 - 13.9		63	44	107					
14.0 - 15.9		106	185	291					
16.0 - 17.9		23	111	134					
18.0 - 19.9		2	19	21					
20.0 - 21.9	9		1	10					
22.0 - 23.9	5			5					
24.0 - 25.9	2	2		4					
26.0 - 27.9		3	5	8			1	1	
28.0 - 29.9	2	15	8	25			1	1	
30.0 - 31.9	9	3	13	25			5	5	
32.0 - 33.9	13	5	4	22	10	1		11	
34.0 - 35.9	13	9	8	30	6		1	7	
36.0 - 37.9		7	10	17					
38.0 - 39.9		1	6	7					
40.0 - 44.9			3	3					
45.0 - 49.9									
50.0 - 54.9									
55.0 - 59.9									
60.0 - 64.9									
65.0 - 69.9									
70.0 - 74.9									
75.0 - 79.9									1
80.0 - 84.9									1
85.0 - 89.9									
90.0 - 94.9									
95.0 - 99.9									
100.0 - +									
Others not meas.		23	10	33					
Total unmeasured		135	280	415					
Total measured	59	367	439	865	16	1	8	25	2
Grand Total	59	502	719	1280	16	1	8	25	2

* This species was caught during only one season.

277 092

Table 2.4-12. Length-frequencies of all fish caught by electrofishing in the Mississippi River and connecting waters near the Prairie Island Nuclear Generating Plant, Red Wing, Minnesota, 1978. Sections 0, 1, 2, 3, and 4 combined, seasons separated. (Sheet 3 of 16)

Total Length in Centimeters	Carp Spring	Carp Summer	Carp Fall	Carp Total	Silver chub Spring	Silver chub Summer	Silver chub Fall	Silver chub Total	Emerald shiner Spring
Y/Y not meas.									
0.1 - 1.9									
2.0 - 3.9		1		1					
4.0 - 5.9									
6.0 - 7.9									
8.0 - 9.9									
10.0 - 11.9									
12.0 - 13.9									
14.0 - 15.9						1		1	
16.0 - 17.9	1			1					
18.0 - 19.9	1	1		2			1	1	
20.0 - 21.9	2			2					
22.0 - 23.9	1			1					
24.0 - 25.9		1	1	2					
26.0 - 27.9									
28.0 - 29.9	1	1	2	4					
30.0 - 31.9	1	1	3	5					
32.0 - 33.9		5	3	8					
34.0 - 35.9		4	5	9					
36.0 - 37.9		3	5	8					
38.0 - 39.9	1	1	4	6					
40.0 - 44.9	3	19	16	38					
45.0 - 49.9	26	85	65	176					
50.0 - 54.9	29	67	85	181					
55.0 - 59.9	13	31	44	88					
60.0 - 64.9	5	13	22	41					
65.0 - 69.9	2	7	7	16					
70.0 - 74.9			3	3					
75.0 - 79.9			1	1					
80.0 - 84.9									
85.0 - 89.9									
90.0 - 94.9									
95.0 - 99.9									
100.0 - +									
Others not meas.	1	2	1	4	1	3	2	6	23
Total unmeasured	1	2	1	4	1	3	2	6	23
Total measured	87	240	266	593		1	1	2	
Grand Total	88	242	267	597	1	4	3	8	23

277 093

Table 2.4-12. Length-frequencies of all fish caught by electrofishing in the Mississippi River and connecting waters near the Prairie Island Nuclear Generating Plant, Red Wing, Minnesota, 1978. Sections 0, 1, 2, 3, and 4 combined, seasons separated. (Sheet 4 of 16)

Total Length in Centimeters	Emerald shiner Summer	Emerald shiner Fall	Emerald shiner Total	Spottail shiner Spring	Spottail shiner Summer	Spottail shiner Fall	Spottail shiner Total	Spotfin shiner Spring	Spotfin shiner Summer
Y/Y not meas.									
0.1 - 1.9									
2.0 - 3.9									
4.0 - 5.9									
6.0 - 7.9									
8.0 - 9.9									
10.0 - 11.9					1		1		
12.0 - 13.9									
14.0 - 15.9									
16.0 - 17.9									
18.0 - 19.9									
20.0 - 21.9									
22.0 - 23.9									
24.0 - 25.9									
26.0 - 27.9									
28.0 - 29.9									
30.0 - 31.9									
32.0 - 33.9									
34.0 - 35.9									
36.0 - 37.9									
38.0 - 39.9									
40.0 - 44.9									
45.0 - 49.9									
50.0 - 54.9									
55.0 - 59.9									
60.0 - 64.9									
65.0 - 69.9									
70.0 - 74.9									
75.0 - 79.9									
80.0 - 84.9									
85.0 - 89.9									
90.0 - 94.9									
95.0 - 99.9									
100.0 - +									
Others not meas.	390	101	514	8	19	9	36	5	1
Total unmeasured	390	101	514	8	19	9	36	5	1
Total measured					1		1		
Grand Total	390	101	514	8	20	9	37	5	1

277 094

Table 2.4-12. Length-frequencies of all fish caught by electrofishing in the Mississippi River and connecting waters near the Prairie Island Nuclear Generating Plant, Red Wing, Minnesota, 1978. Sections 0, 1, 2, 3, and 4 combined, seasons separated. (Sheet 5 of 16)

Total Length in Centimeters	Spotfin shiner Fall	Spotfin shiner Total	Pugnose minnow Spring*	Bullhead minnow Spring	Bullhead minnow Summer	Bullhead minnow Fall	Bullhead minnow Total	Carpsucker spp. Spring	Carpsucker spp. Summer
Y/Y not meas.									
0.1 - 1.9									
2.0 - 3.9									
4.0 - 5.9									
6.0 - 7.9									
8.0 - 9.9								1	1
10.0 - 11.9								1	1
12.0 - 13.9								1	4
14.0 - 15.9								1	1
16.0 - 17.9								1	1
18.0 - 19.9									
20.0 - 21.9									
22.0 - 23.9									1
24.0 - 25.9									
26.0 - 27.9									
28.0 - 29.9									
30.0 - 31.9									
32.0 - 33.9									
34.0 - 35.9									
36.0 - 37.9									
38.0 - 39.9									
40.0 - 44.9									
45.0 - 49.9									
50.0 - 54.9									
55.0 - 59.9									
60.0 - 64.9									
65.0 - 69.9									
70.0 - 74.9									
75.0 - 79.9									
80.0 - 84.9									
85.0 - 89.9									
90.0 - 94.9									
95.0 - 99.9									
100.0 - +									
Others not meas.	1	7	1	13	10	5	28		
Total unmeasured	1	7	1	13	10	5	28		
Total measured								7	9
Grand Total	1	7	1	13	10	5	28	7	9

* This species was caught during only one season.

277 095

Table 2.4-12. Length-frequencies of all fish caught by electrofishing in the Mississippi River and connecting waters near the Prairie Island Nuclear Generating Plant, Red Wing, Minnesota, 1978. Sections 0, 1, 2, 3, and 4 combined, seasons separated. (Sheet 6 of 16)

Total Length in Centimeters	Carpsucker spp. Fall	Carpsucker spp. Total	River carpsucker Spring	River carpsucker Summer	River carpsucker Fall	River carpsucker Total	Quillback carpsucker Spring	Quillback carpsucker Summer	Quillback carpsucker Fall
Y/Y not meas.									
0.1 - 1.9									
2.0 - 3.9									
4.0 - 5.9									
6.0 - 7.9									
8.0 - 9.9		2							
10.0 - 11.9		2	1			1			
12.0 - 13.9	1	6							
14.0 - 15.9	1	5							
16.0 - 17.9	2	4							
18.0 - 19.9	3	3						2	
20.0 - 21.9	1	1						1	
22.0 - 23.9		1						2	2
24.0 - 25.9								4	
26.0 - 27.9								1	
28.0 - 29.9									1
30.0 - 31.9							1		1
32.0 - 33.9								1	
34.0 - 35.9								3	
36.0 - 37.9								1	2
38.0 - 39.9								2	1
40.0 - 44.9				1	3	4		3	
45.0 - 49.9				1		1		1	
50.0 - 54.9			2		1	3		1	
55.0 - 59.9									
60.0 - 64.9									
65.0 - 69.9									
70.0 - 74.9									
75.0 - 79.9									
80.0 - 84.9									
85.0 - 89.9									
90.0 - 94.9									
95.0 - 99.9									
100.0 - +									
Others not meas.									
Total unmeasured									
Total measured	8	24	3	2	4	9	1	22	7
Grand Total	8	24	3	2	4	9	1	22	7

277 096

Table 2.4-12. Length-frequencies of all fish caught by electrofishing in the Mississippi River and connecting waters near the Prairie Island Nuclear Generating Plant, Red Wing, Minnesota, 1978. Sections 0, 1, 2, 3, and 4 combined, seasons separated. (Sheet 7 of 16)

Total Length in Centimeters	Quillback carpsucker Total	White sucker Spring	White sucker Summer	White sucker Fall	White sucker Total	Smallmouth buffalo Spring	Smallmouth buffalo Summer	Smallmouth buffalo Fall	Smallmouth buffalo Total
Y/Y not meas.									
0.1 - 1.9									
2.0 - 3.9									
4.0 - 5.9									
6.0 - 7.9									
8.0 - 9.9							1		1
10.0 - 11.9							2		2
12.0 - 13.9							3		3
14.0 - 15.9							1		1
16.0 - 17.9									
18.0 - 19.9	2					1			1
20.0 - 21.9	1					1			1
22.0 - 23.9	4								
24.0 - 25.9	4					3			3
26.0 - 27.9	1					1			1
28.0 - 29.9	1		1		1		1	2	3
30.0 - 31.9	2					1	2	1	4
32.0 - 33.9	1	2			2				
34.0 - 35.9	3						1		1
36.0 - 37.9	3					1		2	3
38.0 - 39.9	3								3
40.0 - 44.9	3	1		1	2			1	3
45.0 - 49.9	1		1		1			1	1
50.0 - 54.9	1								
55.0 - 59.9									
60.0 - 64.9							1		1
65.0 - 69.9									
70.0 - 74.9									
75.0 - 79.9									
80.0 - 84.9									
85.0 - 89.9									
90.0 - 94.9									
95.0 - 99.9									
100.0 - +									
Others not meas.									
Total unmeasured									
Total measured	30	3	2	1	6	8	17	7	32
Grand Total	30	3	2	1	6	8	17	7	32

Table 2.4-12. Length-frequencies of all fish caught by electrofishing in the Mississippi River and connecting waters near the Prairie Island Nuclear Generating Plant, Red Wing, Minnesota, 1978. Sections 0, 1, 2, 3, and 4 combined, seasons separated. (Sheet 8 of 16)

Total Length in Centimeters	Bigmouth buffalo Spring	Bigmouth buffalo Summer	Bigmouth buffalo Fall	Bigmouth buffalo Total	Redhorse sup. Summer*	Silver redhorse Spring	Silver redhorse Summer	Silver redhorse Fall	Silver redhorse Total
Y/Y not meas.									
0.1 - 1.9									
2.0 - [illegible].9									
4.0 - 5.9									
[illegible]0 - 7.9									
[illegible] - 9.9					1				
10.0 - 11.9									
12.0 - 13.9									
14.0 - 15.9									
16.0 - 17.9									
18.0 - 19.9									
20.0 - 21.9									
22.0 - 23.9									
24.0 - 25.9									
26.0 - 27.9									
28.0 - 29.9									
30.0 - 31.9	1			1					
32.0 - 33.9		2	1	3					
34.0 - 35.9		1	1	2			1		1
36.0 - 37.9		1	1	2					
38.0 - 39.9			1	1					
40.0 - 44.9			1	1					
45.0 - 49.9									
50.0 - 54.9									
55.0 - 59.9		1		1		1		1	2
60.0 - 64.9									
65.0 - 69.9			1	1					
70.0 - 74.9									
75.0 - 79.9									
80.0 - 84.9									
85.0 - 89.9									
90.0 - 94.9									
95.0 - 99.9									
100.0 - +									
Others not meas.									
Total unmeasured									
Total measured	1	5	6	12	1	1	1	1	3
Grand Total	1	5	6	12	1	1	1	1	3

* Caught during one season only.

Table 2.4-12. Length-frequencies of all fish caught by electrofishing in the Mississippi River and connecting waters near the Prairie Island Nuclear Generating Plant, Red Wing, Minnesota, 1978. Sections 0, 1, 2, 3, and 4 combined, seasons separated. (Sheet 9 of 16)

Total Length in Centimeters	Shorthead redhorse Spring	Shorthead redhorse Summer	Shorthead redhorse Fall	Shorthead redhorse Total	Channel catfish Spring	Channel catfish Summer	Channel catfish Fall	Channel catfish Total	Flathead catfish Spring
Y/Y n meas.									
0.1 - 1.9									
2.0 - 3.9									
4.0 - 5.9									
6.0 - 7.9									
8.0 - 9.9		5		5			1	1	
10.0 - 11.9		2	2	4					
12.0 - 13.9			1	1			1	1	
14.0 - 15.9					1			1	
16.0 - 17.9		1		1					
18.0 - 19.9			2	2			1	1	
20.0 - 21.9		2	1	3	1			1	
22.0 - 23.9			2	2					
24.0 - 25.9		1	1	2					
26.0 - 27.9		2	1	3					
28.0 - 29.9		1		1					
30.0 - 31.9	2		1	3		1		1	
32.0 - 33.9	1	1	1	3	1			1	1
34.0 - 35.9	1		3	4	1			1	
36.0 - 37.9	10	9	2	21		2		2	
38.0 - 39.9	4	9	3	16		2		2	
40.0 - 44.9	8	14	10	32	2	2	3	7	1
45.0 - 49.9	3	3		6	2	3	1	6	
50.0 - 54.9			1	1	1	3	1	5	
55.0 - 59.9					1	3		4	
60.0 - 64.9					1		1	2	
65.0 - 69.9									
70.0 - 74.9									
75.0 - 79.9									
80.0 - 84.9									
85.0 - 89.9									
90.0 - 94.9									
95.0 - 99.9									
100.0 - +									
Others not meas.									
Total unmeasured									
Total measured	29	50	31	110	11	16	9	36	2
Grand Total	29	50	31	110	11	16	9	36	2

Table 2.4-12. Length-frequencies of all fish caught by electrofishing in the Mississippi River and connecting waters near the Prairie Island Nuclear Generating Plant, Red Wing, Minnesota, 1978. Sections 0, 1, 2, 3, and 4 combined, seasons separated. (Sheet 10 of 16)

Total Length in Centimeters	Flathead catfish Summer	Flathead catfish Fall	Flathead catfish Total	White bass Spring	White bass Summer	White bass Fall	White bass Total	Rock bass Spring	Rock bass Summer
Y/Y not meas.									
0.1 - 1.9									
2.0 - 3.9				3			3		
4.0 - 5.9				1			1		
6.0 - 7.9								2	
8.0 - 9.9					17		17		1
10.0 - 11.9					28	8	36	1	2
12.0 - 13.9					8	27	35	3	2
14.0 - 15.9				9		5	14		4
16.0 - 17.9				11	2		13	4	7
18.0 - 19.9					11	6	17		
20.0 - 21.9					15	5	20		1
22.0 - 23.9				5	10	10	25		1
24.0 - 25.9				3	33	9	45		
26.0 - 27.9					23	20	43		
28.0 - 29.9					11	15	26		
30.0 - 31.9				1	4	2	7		
32.0 - 33.9			1	1	11	3	15		
34.0 - 35.9				1	4	3	8		
36.0 - 37.9					6	5	11		
38.0 - 39.9				2	1	5	8		
40.0 - 44.9		1	2	1		2	3		
45.0 - 49.9	1	1	2						
50.0 - 54.9		1	1						
55.0 - 59.9		1	1						
60.0 - 64.9									
65.0 - 69.9									
70.0 - 74.9									
75.0 - 79.9									
80.0 - 84.9		1	1						
85.0 - 89.9									
90.0 - 94.9									
95.0 - 99.9									
100.0 - +									
Others not meas.				1			1		
Total unmeasured				1			1		
Total measured	1	5	8	38	184	125	347	10	18
Grand Total	1	5	8	39	184	125	348	10	18

277 100

Table 2.4-12. Length-frequencies of all fish caught by electrofishing in the Mississippi River and connecting waters near the Prairie Island Nuclear Generating Plant, Red Wing, Minnesota, 1978. Sections 0, 1, 2, 3, and 4 combined, seasons separated. (Sheet 11 of 16)

Total Length in Centimeters	Rock bass Fall	Rock bass Total	Hybrid sunfish Spring	Hybrid sunfish Summer	Hybrid sunfish Fall	Hybrid sunfish Total	Green sunfish Spring	Green sunfish Summer	Green sunfish Fall
Y/Y not meas.									
0.1 - 1.9									
2.0 - 3.9									
4.0 - 5.9	7	7						2	
6.0 - 7.9		2						1	
8.0 - 9.9	4	5	1			1	3	5	6
10.0 - 11.9	6	9		1	3	4	5	9	8
12.0 - 13.9	4	9	1	2	13	16	1	2	6
14.0 - 15.9	8	12		2	7	9	3	2	1
16.0 - 17.9	5	16		1		1			
18.0 - 19.9	1	1							
20.0 - 21.9		1							
22.0 - 23.9		1							
24.0 - 25.9									
26.0 - 27.9									
28.0 - 29.9									
30.0 - 31.9									
32.0 - 33.9									
34.0 - 35.9									
36.0 - 37.9									
38.0 - 39.9									
40.0 - 44.9									
45.0 - 49.9									
50.0 - 54.9									
55.0 - 59.9									
60.0 - 64.9									
65.0 - 69.9									
70.0 - 74.9									
75.0 - 79.9									
80.0 - 84.9									
85.0 - 89.9									
90.0 - 94.9									
95.0 - 99.9									
100.0 - +									
Others not meas.									
Total unmeasured									
Total measured	35	63	2	6	23	31	12	21	21
Grand Total	35	63	2	6	23	31	12	21	21

277 101

Table 2.4-12. Length-frequencies of all fish caught by electrofishing in the Mississippi River and connecting waters near the Prairie Island Nuclear Generating Plant, Red Wing, Minnesota, 1978. Sections 0, 1, 2, 3, and 4 combined, seasons separated. (Sheet 12 of 16)

Total Length in Centimeters	Green sunfish Total	Orange-spotted sunfish Fall*	Bluegill Spring	Bluegill Summer	Bluegill Fall	Bluegill Total	Smallmouth bass Spring	Smallmouth bass Summer	Smallmouth bass Fall
Y/Y not meas.									
0.1 - 1.9									
2.0 - 3.9				21	9	30			
4.0 - 5.9	2			19	43	62			
6.0 - 7.9	1		5	3	13	21		2	
8.0 - 9.9	14		16	16	16	48		4	1
10.0 - 11.9	22		1	68	79	148	5	1	1
12.0 - 13.9	9		12	35	81	128	13	8	2
14.0 - 15.9	6		17	39	62	118	3	13	1
16.0 - 17.9			17	43	46	106	3	9	2
18.0 - 19.9			10	8	10	28	7	10	3
20.0 - 21.9			1	3		4	6	11	7
22.0 - 23.9							11	5	8
24.0 - 25.9							3	7	12
26.0 - 27.9			1			1	1	4	8
28.0 - 29.9							4	4	2
30.0 - 31.9							1		3
32.0 - 33.9								1	1
34.0 - 35.9							1		
36.0 - 37.9							1		1
38.0 - 39.9							1	2	
40.0 - 44.5							1	1	3
45.0 - 49.9									
50.0 - 54.9									1
55.0 - 59.9									
60.0 - 64.9									
65.0 - 69.9									
70.0 - 74.9									
75.0 - 79.9									
80.0 - 84.9									
85.0 - 89.9									
90.0 - 94.9									
95.0 - 99.9									
100.0 - +									
Others not meas.		1		1		1			
Total unmeasured		1		1		1			
Total measured	54		80	255	359	694	61	82	56
Grand Total	54	1	80	256	359	695	61	82	56

* This species was caught during only one season.

Table 2.4-12. Length-frequencies of all fish caught by electrofishing in the Mississippi River and connecting waters near the Prairie Island Nuclear Generating Plant, Red Wing, Minnesota, 1978. Sections 0, 1, 2, 3, and 4 combined, seasons separated. (Sheet 13 of 16)

Total Length in Centimeters	Smallmouth bass Total	Largemouth bass Summer	Largemouth bass Fall	Large-mouth bass Total	White crappie Summer	White crappie Fall	White crappie Total	Black crappie Spring	Black crappie Summer
Y/Y not meas.									
0.1 - 1.9									
2.0 - 3.9									
4.0 - 5.9									
6.0 - 7.9	2								2
8.0 - 9.9	5					1	1		
10.0 - 11.9	7							3	
12.0 - 13.9	23							5	1
14.0 - 15.9	17	1		1					4
16.0 - 17.9	14					6	6		2
18.0 - 19.9	20		1	1		2	2		2
20.0 - 21.9	24	3		3	1	6	7		4
22.0 - 23.9	24		2	2	3	4	7	1	2
24.0 - 25.9	22		5	5	1	4	5		1
26.0 - 27.9	13					2	2		
28.0 - 29.9	10		1	1		1	1		
30.0 - 31.9	4	1		1					
32.0 - 33.9	2	1		1		1	1		
34.0 - 35.9	1								
36.0 - 37.9	2								
38.0 - 39.9	3		1	1					
40.0 - 44.9	5								
45.0 - 49.9									
50.0 - 54.9	1								
55.0 - 59.9									
60.0 - 64.9									
65.0 - 69.9									
70.0 - 74.9									
75.0 - 79.9									
80.0 - 84.9									
85.0 - 89.9									
90.0 - 94.9									
95.0 - 99.9									
100.0 - +									
Others not meas.									
Total unmeasured									
Total measured	199	6	10	16	5	27	32	9	18
Grand Total	199	6	10	16	5	27	32	9	18

277 103

Table 2.4-12. Length-frequencies of all fish caught by electrofishing in the Mississippi River and connecting waters near the Prairie Island Nuclear Generating Plant, Red Wing, Minnesota, 1978. Sections 0, 1, 2, 3, and 4 combined, seasons separated. (Sheet 14 of 16)

Total Length in Centimeters	Black crappie Fall	Black crappie Total	Johnny darter Summer*	Yellow perch Spring	Yellow perch Summer	Yellow perch Fall	Yellow perch Total	Log perch Spring	Log perch Summer
Y/Y not meas.									
0.1 - 1.9									
2.0 - 3.9									
4.0 - 5.9	1	1		3			3		
6.0 - 7.9	1	3			2		2		1
8.0 - 9.9					17	1	18		6
10.0 - 11.9	1	4				2	2		
12.0 - 13.9	5	11		3			3		
14.0 - 15.9	11	15		3	1		4		
16.0 - 17.9	5	7							
18.0 - 19.9	2	4							
20.0 - 21.9	6	10			1		1		
22.0 - 23.9	9	12							
24.0 - 25.9	5	6							
26.0 - 27.9									
28.0 - 29.9									
30.0 - 31.9									
32.0 - 33.9									
34.0 - 35.9									
36.0 - 37.9									
38.0 - 39.9									
40.0 - 44.9									
45.0 - 49.9									
50.0 - 54.9									
55.0 - 59.9									
60.0 - 64.9									
65.0 - 69.9									
70.0 - 74.9									
75.0 - 79.9									
80.0 - 84.9									
85.0 - 89.9									
90.0 - 94.9									
95.0 - 99.9									
100.0 - +									
Others not meas.			1					2	7
Total unmeasured			1					2	7
Total measured	46	73		9	21	3	33		7
Grand Total	46	73	1	9	21	3	33	2	14

* This species was caught during only one season.

277 104

Table 2.4-12. Length-frequencies of all fish caught by electrofishing in the Mississippi River and connecting waters near the Prairie Island Nuclear Generating Plant, Red Wing, Minnesota, 1978. Sections 0, 1, 2, 3, and 4 combined, seasons separated. (Sheet 15 of 16)

Total Length in Centimeters	Log perch Fall	Log perch Total	Sauger Spring	Sauger Summer	Sauger Fall	Sauger Total	Walleye Spring	Walleye Summer	Walleye Fall
Y/Y not meas.									
0.1 - 1.9									
2.0 - 3.9									
4.0 - 5.9			2		1	3	1		
6.0 - 7.9		1	7			7	1		
8.0 - 9.9		6							
10.0 - 11.9				15	1	16		1	
12.0 - 13.9				20	7	27		4	1
14.0 - 15.9				1	7	8		1	2
16.0 - 17.9				2	3	5		1	
18.0 - 19.9			3			3	5		
20.0 - 21.9			9		1	10	7		1
22.0 - 23.9			6		1	7	2	1	
24.0 - 25.9			8	6	1	15		1	2
26.0 - 27.9			6	7	8	21			1
28.0 - 29.9				7	1	8	2		1
30.0 - 31.9					2	2		1	2
32.0 - 33.9			1			1		1	1
34.0 - 35.9				2		2		2	1
36.0 - 37.9			1	1		2			
38.0 - 39.9				1		1			
40.0 - 44.9					3	3			3
45.0 - 49.9							1	1	5
50.0 - 54.9							1		3
55.0 - 59.9									1
60.0 - 64.9									5
65.0 - 69.9									
70.0 - 74.9									
75.0 - 79.9									
80.0 - 84.9									
85.0 - 89.9									
90.0 - 94.9									
95.0 - 99.9									
100.0 - +									
Others not meas.	1	10							
Total unmeasured	1	10							
Total measured			43	62	36	141	20	14	29
Grand Total	1	17	43	62	36	141	20	14	29

277 105

Table 2.4-12. Length-frequencies of all fish caught by electrofishing in the Mississippi River and connecting waters near the Prairie Island Nuclear Generating Plant, Red Wing, Minnesota, 1978. Sections 0, 1, 2, 3, and 4 combined, seasons separated. (Sheet 16 of 16)

Total Length in Centimeters	Walleye Total	Freshwater drum Spring	Freshwater drum Summer	Freshwater drum Fall	Freshwater drum Total
Y/Y not meas.			90		90
0.1 - 1.9					
2.0 - 3.9			1		1
4.0 - 5.9	1				
6.0 - 7.9	1				
8.0 - 9.9			20	2	22
10.0 - 11.9	1	4	115	7	126
12.0 - 13.9	5	43	112	28	183
14.0 - 15.9	3	108	10	7	125
16.0 - 17.9	1	29	36	3	68
18.0 - 19.9	5	7	55	4	66
20.0 - 21.9	8	14	9	1	24
22.0 - 23.9	3	12	4	1	17
24.0 - 25.9	3	4	2	1	7
26.0 - 27.9	1	3		2	5
28.0 - 29.9	3	1	1	3	5
30.0 - 31.9	3	3	1	6	10
32.0 - 33.9	2	2	9	4	15
34.0 - 35.9	3		2	2	4
36.0 - 37.9		1	1	1	3
38.0 - 39.9		2	2	5	9
40.0 - 44.9	3	1	2	2	5
45.0 - 49.9	7	1		1	2
50.0 - 54.9	4				
55.0 - 59.9	1				
60.0 - 64.9	5				
65.0 - 69.9					
70.0 - 74.9					
75.0 - 79.9					
80.0 - 84.9					
85.0 - 89.9					
90.0 - 94.9					
95.0 - 99.9					
100.0 - +					
Others not meas.		111	51		162
Total unmeasured		111	141		252
Total measured	63	235	382	80	697
Grand Total	63	346	523	80	949

277 106

Table 2.4-13 Summary of trawling catches from the Mississippi River and connecting waters near the Prairie Island Nuclear Generating Plant, Red Wing, Minnesota, spring 1978.

Species	ve Plant		Plant Area	(from plant intake to Lock and Dam 3)
	No.	No./hour (for 0.500 h)	No.	No./hour (for 0.500 h)
Gizzard shad	9	18.00	1	2.00
Carp	0	0	2	4.00
Quillback carpsucker	0	0	2	4.00
Smallmouth buffalo	1	2.00	0	0
Bigmouth buffalo	1	2.00	1	2.00
Shorthead redhorse	0	0	1	2.00
Channel catfish	0	0	1	2.00
White bass	5	10.00	8	16.00
White crappie	5	10.00	4	8.00
Black crappie	12	24.00	2	4.00
Walleye	0	0	2	4.00
Freshwater drum	4	8.00	8	16.00
Total	37	74.00	32	64.00

Table 2.4-14 Summary of trawling catches from the Mississippi River and connecting waters near Prairie Island Nuclear Generating Plant, Red Wing, Minnesota, summer 1978.

Species	Above Plant		Plant Area (from plant intake to Lock and Dam 3)	
	No.	No./hour (for 0.500 h)	No.	No./hour (for 0.500 h)
Shortnose gar	2	4.00	0	0
Gizzard shad	3	6.00	0	0
Carp	0	0	2	4.00
Emerald shiner	1	2.00	0	0
Spottail shiner	1	2.00	0	0
Quillback carpsucker	0	0	4	8.00
Smallmouth buffalo	2	4.00	4	8.00
Channel catfish	0	0	2	4.00
White bass	2	4.00	0	0
Bluegill	10	20.00	0	0
White crappie	79	158.00	0	0
Black crappie	45	90.00	0	0
Freshwater drum	36	72.00	27	54.00
Total	181	362.00	39	78.00

Table 2.4-15 Summary of trawling catches from the Mississippi River and connecting waters near Prairie Island Nuclear Generating Plant, Red Wing, Minnesota, fall 1978.

Species	Above Plant		Plant Area (from plant intake to Lock and Dam 3)	
	No.	No./hour (for 0.500 h)	No.	No./hour (for 0.500 h)
Bowfin	1	2.00	0	0
Gizzard shad	4	8.00	26	52.00
Carp	2	4.00	1	2.00
Spottail shiner	6	12.00	1	2.00
Bigmouth buffalo	2	4.00	2	4.00
Yellow bullhead	1	2.00	0	0
Bluegill	23	46.00	0	0
White crappie	27	54.00	0	0
Black crappie	24	48.00	1	2.00
Sauger	0	0	1	2.00
Freshwater drum	13	26.00	3	6.00
Total	103	206.00	35	70.00

Table 2.4-16. Length-frequencies of all fish caught by trawling in the Mississippi River and connecting waters near the Prairie Island Nuclear Generating Plant, Red Wing, Minnesota, 1978. Sections 0 and 3 combined, seasons separated. (Sheet 1 of 6)

Total Length in Centimeters	Shortnose gar Summer*	Bowfin Fall*	Gizzard shad Spring	Gizzard shad Summer	Gizzard shad Fall	Gizzard shad Total	Carp Spring	Carp Summer	Carp Fall
Y/Y not meas.									
0.1 - 1.9									
2.0 - 3.9			1			1			
4.0 - 5.9			7			7			
6.0 - 7.9			2			2			
8.0 - 9.9				1	2	3			
10.0 - 11.9				1	2	3			
12.0 - 13.9				1	2	3			
14.0 - 15.9					11	11			
16.0 - 17.9					8	8			
18.0 - 19.9					4	4			
20.0 - 21.9							1		
22.0 - 23.9									
24.0 - 25.9									
26.0 - 27.9									
28.0 - 29.9									
30.0 - 31.9									1
32.0 - 33.9									
34.0 - 35.9									
36.0 - 37.9									
38.0 - 39.9					1	1			
40.0 - 44.9									
45.0 - 49.9		1							2
50.0 - 54.9								2	
55.0 - 59.9									
60.0 - 64.9	2						1		
65.0 - 69.9									
70.0 - 74.9									
75.0 - 79.9									
80.0 - 84.9									
85.0 - 89.9									
90.0 - 94.9									
95.0 - 99.9									
100.0 - +									
Others not meas.									
Total not meas.									
Total measured	2	1	10	3	30	43	2	2	3
Grand Total	2	1	10	3	30	43	2	2	3

* This species was caught during only one season.

277 110

Table 2.4-16. Length-frequencies of all fish caught by trawling in the Mississippi River and connecting waters near the Prairie Island Nuclear Generating Plant, Red Wing, Minnesota, 1978. Sections 0 and 3 combined, seasons separated. (Sheet 2 of 6)

Total Length in Centimeters	Carp	Emerald shiner	Spottail shiner	Spottail shiner	Spottail shiner	Quillback carp-sucker	Quillback carp-sucker	Quillback carp-sucker	Small-mouth buffalo
	Total	Summer*	Summer	Fall	Total	Spring	Summer	Total	Spring
Y/Y not meas.									
0.1 - 1.9									
2.0 - 3.9									
4.0 - 5.9		1							
6.0 - 7.9			1		1				
8.0 - 9.9									
10.0 - 11.9									
12.0 - 13.9									
14.0 - 15.9									
16.0 - 17.9									
18.0 - 19.9									
20.0 - 21.9	1								
22.0 - 23.9									1
24.0 - 25.9							1	1	
26.0 - 27.9									
28.0 - 29.9									
30.0 - 31.9	1								
32.0 - 33.9									
34.0 - 35.9							1	1	
36.0 - 37.9							1	1	
38.0 - 39.9									
40.0 - 44.9							1	1	
45.0 - 49.9	2					2		2	
50.0 - 54.9	2								
55.0 - 59.9									
60.0 - 64.9	1								
65.0 - 69.9									
70.0 - 74.9									
75.0 - 79.9									
80.0 - 84.9									
85.0 - 89.9									
90.0 - 94.9									
95.0 - 99.9									
100.0 - +									
Others not meas.				7	7				
Total unmeasured				7	7				
Total measured	7	1	1		1	2	4	6	1
Grand Total	7	1	1	7	8	2	4	6	1

* This species was caught during only one season.

277 111

Table 2.4-16. Length-frequencies of all fish caught by trawling in the Mississippi River and connecting waters near the Prairie Island Nuclear Generating Plant, Red Wing, Minnesota, 1978. Sections 0 and 3 combined, seasons separated. (Sheet 3 of 6)

Total Length in Centimeters	Smallmouth buffalo Summer	Smallmouth buffalo Total	Bigmouth buffalo Spring	Bigmouth buffalo Fall	Bigmouth buffalo Total	Shorthead redhorse Spring*	Yellow bullhead Fall*	Channel catfish Spring	Channel catfish Summer
Y/Y not meas.									
0.1 - 1.9									
2.0 - 3.9								1	
4.0 - 5.9									1
6.0 - 7.9									
8.0 - 9.9	2	2							
10.0 - 11.9									
12.0 - 13.9									
14.0 - 15.9									
16.0 - 17.9									
18.0 - 19.9									
20.0 - 21.9									
22.0 - 23.9		1							
24.0 - 25.9									
26.0 - 27.9									
28.0 - 29.9									1
30.0 - 31.9	1	1	1	1	2				
32.0 - 33.9									
34.0 - 35.9				2	2		1		
36.0 - 37.9				1	1				
38.0 - 39.9	1	1							
40.0 - 44.9	1	1				1			
45.0 - 49.9									
50.0 - 54.9	1	1							
55.0 - 59.9									
60.0 - 64.9									
65.0 - 69.9									
70.0 - 74.9									
75.0 - 79.9			1		1				
80.0 - 84.9									
85.0 - 89.9									
90.0 - 94.9									
95.0 - 99.9									
100.0 - +									
Others not meas.									
Total unmeasured									
Total measured	6	7	2	4	6	1	1	1	2
Grand Total	6	7	2	4	6	1	1	1	2

* This species was caught during only one season.

277 112

Table 2.4-16. Length-frequencies of all fish caught by trawling in the Mississippi River and connecting waters near the Prairie Island Nuclear Generating Plant, Red Wing, Minnesota, 1978. Sections 0 and 3 combined, seasons separated. (Sheet 4 of 6)

Total Length in Centimeters	Channel catfish Total	White bass Spring	White bass Summer	White bass Total	Bluegill Summer	Bluegill Fall	Bluegill Total	White crappie Spring	White crappie Summer
Y/Y not meas.									33
0.1 - 1.9					2		2		1
2.0 - 3.9	1				5		5		7
4.0 - 5.9	1								30
6.0 - 7.9									1
8.0 - 9.9					1		1		
10.0 - 11.9									
12.0 - 13.9						1	1	1	
14.0 - 15.9					2	3	5	2	2
16.0 - 17.9		1		1		9	9		3
18.0 - 19.9		1	1	2		8	8		
20.0 - 21.9						2	2		
22.0 - 23.9		2		2				4	2
24.0 - 25.9		5	1	6					
26.0 - 27.9		2		2				1	
28.0 - 29.9	1	1		1				1	
30.0 - 31.9									
32.0 - 33.9									
34.0 - 35.9		1		1					
36.0 - 37.9									
38.0 - 39.9									
40.0 - 44.9									
45.0 - 49.9									
50.0 - 54.9									
55.0 - 59.9									
60.0 - 64.9									
65.0 - 69.9									
70.0 - 74.9									
75.0 - 79.9									
80.0 - 84.9									
85.0 - 89.9									
90.0 - 94.9									
95.0 - 99.9									
100.0 - +									
Others not meas.									
Total unmeasured									33
Total measured	3	13	2	15	10	23	33	9	46
Grand Total	3	13	2	15	10	23	33	9	79

Table 2.4-16. Length-frequencies of all fish caught by trawling in the Mississippi River and connecting waters near the Prairie Island Nuclear Generating Plant, Red Wing, Minnesota, 1978. Sections 0 and 3 combined, seasons separated. (Sheet 5 of 6)

Total Length in Centimeters	White crappie Fall	White crappie Total	Black crappie Spring	Black crappie Summer	Black crappie Fall	Black crappie Total	Sauger Fall*	Walleye Spring*	Freshwater drum Spring
Y/Y not meas.		33							
0.1 - 1.9		1							
2.0 - 3.9		7							1
4.0 - 5.9		30		1		1			1
6.0 - 7.9	3	4		2		2			
8.0 - 9.9	4	4	1		1	2			
10.0 - 11.9			7	2		9			
12.0 - 13.9		1	2	30	6	38			
14.0 - 15.9		4		4	16	20			1
16.0 - 17.9	7	10							1
18.0 - 19.9			1	1		2			1
20.0 - 21.9	1	1	2	4	1	7		1	3
22.0 - 23.9	4	10	1	1	1	3			3
24.0 - 25.9	4	4							
26.0 - 27.9	2	3					1		
28.0 - 29.9	2	3							1
30.0 - 31.9								1	
32.0 - 33.9									
34.0 - 35.9									
36.0 - 37.9									
38.0 - 39.9									
40.0 - 44.9									
45.0 - 49.9									
50.0 - 54.9									
55.0 - 59.9									
60.0 - 64.9									
65.0 - 69.9									
70.0 - 74.9									
75.0 - 79.9									
80.0 - 84.9									
85.0 - 89.9									
90.0 - 94.9									
95.0 - 99.9									
100.0 - +									
Others not meas.									
Total unmeasured		33							
Total measured	27	82	14	45	25	84	1	2	12
Grand Total	27	115	14	45	25	84	1	2	12

277 114

* This species was caught during only one season.

Table 2.4-16. Length-frequencies of all fish caught by trawling in the Mississippi River and connecting waters near the Prairie Island Nuclear Generating Plant, Red Wing, Minnesota, 1978. Sections 0 and 3 combined, seasons separated. (Sheet 6 of 6)

Total Length in Centimeters	Freshwater drum Summer	Freshwater drum Fall	Freshwater drum Total						
Y/Y not meas.									
0.1 - 1.9									
2.0 - 3.9		1	2						
4.0 - 5.9		3	4						
6.0 - 7.9	5		5						
8.0 - 9.9	4	2	6						
10.0 - 11.9	5	1	6						
12.0 - 13.9		5	5						
14.0 - 15.9		4	5						
16.0 - 17.9	10		11						
18.0 - 19.9	10		11						
20.0 - 21.9	12		15						
22.0 - 23.9	9		12						
24.0 - 25.9	4		4						
26.0 - 27.9	1		1						
28.0 - 29.9			1						
30.0 - 31.9	2		2						
32.0 - 33.9	1		1						
34.0 - 35.9									
36.0 - 37.9									
38.0 - 39.9									
40.0 - 44.9									
45.0 - 49.9									
50.0 - 54.9									
55.0 - 59.9									
60.0 - 64.9									
65.0 - 69.9									
70.0 - 74.9									
75.0 - 79.9									
80.0 - 84.9									
85.0 - 89.9									
90.0 - 94.9									
95.0 - 99.9									
100.0 - +									
Others not meas.									
Total unmeasured									
Total measured	63	16	91						
Grand Total	63	16	91						

277 115

Table 2.4-17 Summary of seining catches from the Mississippi River and connecting waters near the Prairie Island Nuclear Generating Plant, Red Wing, Minnesota, spring 1978.

Estimated area seined:	Above Plant 0.27 ha		Plant Area (from plant intake to Lock & Dam 3) 0.08 ha		Below Lock and Dam 3 0.12 ha	
	No.	No./ha	No.	No./ha	No.	No./ha
Shortnose gar	0	0	4	50.00	0	0
Gizzard shad	101	374.07	198	2475.00	36	300.00
Carp	2	7.41	2	25.00	0	0
Emerald shiner	56	207.41	11	137.50	507	4225.00
River shiner	0	0	2	25.00	0	0
Spottail shiner	20	74.07	67	837.50	1	8.33
Spotfin shiner	14	51.85	9	112.50	20	166.67
Bullhead minnow	17	62.96	15	187.50	0	0
Quillback carpsucker	2	7.41	0	0	0	0
Carpsucker spp.	7	25.93	10	125.00	0	0
Smallmouth buffalo	7	25.93	33	412.50	0	0
Bigmouth buffalo	0	0	1	12.50	0	0
Shorthead redhorse	1	3.70	0	0	0	0
White bass	126	466.67	55	687.50	0	0
Bluegill	8	29.63	9	112.50	0	0
White crappie	0	0	0	0	2	16.67
Black crappie	4	14.81	6	75.00	2	16.67
Johnny darter	2	7.41	3	37.50	0	0
Yellow perch	5	18.52	1	12.50	0	0
Log perch	2	7.41	0	0	0	0
Sauger	0	0	1	12.50	0	0
Walleye	6	22.22	0	0	0	0
Freshwater drum	9	33.33	14	175.00	1	8.33
Total	389	1440.74	441	5512.50	569	4741.67

Table 2.4-18 Summary of seining catches from the Mississippi River and connecting waters near the Prairie Island Nuclear Generating Plant, Red Wing, Minnesota, summer 1978.

Estimated area seined:	Above Plant 0.25 ha		Plant Area (from plant intake to Lock & Dam 3) 0.06 ha		Below Lock and Dam 3 0.12 ha	
	No.	No./ha	No.	No./ha	No.	No./ha
Shortnose gar	0	0	1	16.67	0	0
Gizzard shad	10	40.00	7	116.67	55	458.33
Northern pike	1	4.00	0	0	0	0
Carp	2	8.00	1	16.67	1	8.33
Silver chub	1	4.00	1	16.67	1	8.33
Emerald shiner	9	36.00	3	50.00	42	350.00
Pugnose minnow	1	4.00	0	0	0	0
Spottail shiner	58	232.00	18	300.00	1	8.33
Spotfin shiner	4	16.00	13	216.67	0	0
Bullhead minnow	0	0	2	33.33	0	0
Carpsucker spp.	0	0	2	33.33	0	0
Quillback carpsucker	0	0	1	16.67	0	0
White sucker	1	4.00	0	0	0	0
Smallmouth buffalo	2	8.00	0	0	0	0
Channel catfish	0	0	23	383.33	1	8.33
White bass	7	28.00	3	50.00	12	100.00
Bluegill	6	24.00	17	282.33	1	8.33
Smallmouth bass	3	12.00	1	16.67	0	0
White crappie	2	8.00	1	16.67	0	0
Black crappie	1	4.00	0	0	0	0
Yellow perch	1	4.00	0	0	0	0
Log perch	9	36.00	1	16.67	7	58.33
Sauger	2	8.00	1	16.67	2	16.67
Walleye	1	4.00	0	0	0	0
Freshwater drum	10	40.00	25	416.67	18	150.00
Total	[illegible]	524.00	121	2016.67	141	1175.00

Table 2.4-19 Summary of seining catches from the Mississippi River and connecting waters near the Prairie Island Nuclear Generating Plant, Red Wing, Minnesota, fall 1978.

Estimated area seined:	Above Plant 0.29 ha		Plant Area (from plant intake to Lock & Dam 3) 0.07 ha		Below Lock and Dam 3 0.14 ha	
	No.	No./ha	No.	No./ha	No.	No./ha
Gizzard shad	8	27.59	28	400.00	6	42.86
Northern pike	0	0	0	0	1	7.14
Silver chub	2	6.90	4	57.14	4	28.57
Emerald shiner	42	144.83	15	214.29	68	485.71
River shiner	0	0	0	0	1	7.14
Spottail shiner	19	65.52	7	100.00	0	0
Spotfin shiner	7	24.14	3	42.86	0	0
Bullhead minnow	27	93.10	9	128.57	0	0
Channel catfish	0	0	1	14.29	0	0
Tadpole madtom	1	3.45	0	0	0	0
White bass	2	6.90	1	14.29	9	64.29
Bluegill	4	13.79	22	314.29	0	0
Smallmouth bass	1	3.45	1	14.29	0	0
White crappie	1	3.45	0	0	0	0
Black crappie	0	0	0	0	1	7.14
Johnny darter	0	0	1	14.29	0	0
Sauger	0	0	0	0	2	14.29
Walleye	0	0	1	14.29	0	0
Freshwater drum	0	0	1	14.29	1	7.14
Total	114	393.10	94	1342.86	93	664.29

Table 2.4-20. Length-frequencies of all fish caught by seining in the Mississippi River and connecting waters near the Prairie Island Nuclear Generating Plant, Red Wing, Minnesota, 1978. Sections 0, 1, 2, 3, and 4 combined, seasons separated. (Sheet 1 of 11)

Total Length in Centimeters	Shortnose gar Spring	Shortnose gar Summer	Shortnose gar Total	Gizzard shad Spring	Gizzard shad Summer	Gizzard shad Fall	Gizzard shad Total	Northern pike Summer	Northern pike Fall
Y/Y not meas.				214			214		
0.1 - 1.9									
2.0 - 3.9				33	3	1	37		
4.0 - 5.9				57	2	3	62		
6.0 - 7.9				2		22	24		
8.0 - 9.9					1	6	7		
10.0 - 11.9					10	1	11		
12.0 - 13.9					44	1	45		
14.0 - 15.9					10	2	12		
16.0 - 17.9						4	4		
18.0 - 19.9				1		2	3		
20.0 - 21.9									
22.0 - 23.9									
24.0 - 25.9									
26.0 - 27.9					2		2		
28.0 - 29.9									
30.0 - 31.9								1	
32.0 - 33.9									
34.0 - 35.9									
36.0 - 37.9									
38.0 - 39.9									
40.0 - 44.9									
45.0 - 49.9									1
50.0 - 54.9									
55.0 - 59.9	2		2						
60.0 - 64.9	2		2						
65.0 - 69.9									
70.0 - 74.9									
75.0 - 79.9									
80.0 - 84.9									
85.0 - 89.9									
90.0 - 94.9									
95.0 - 99.9									
100.0 - +									
Others not meas.		1	1	28			28		
Total unmeasurd		1	1	242			242		
Total measured	4		4	93	72	42	207	1	1
Grand Total	4	1	5	335	72	42	449	1	1

277 119

Table 2.4-20. Length-frequencies of all fish caught by seining in the Mississippi River and connecting waters near the Prairie Island Nuclear Generating Plant, Red Wing, Minnesota, 1978. Sections 0, 1, 2, 3, and 4 combined, seasons separated. (Sheet 2 of 11)

Total Length in Centimeters	Northern pike	Carp	Carp	Carp	Silver chub	Silver chub	Silver chub	Emerald shiner	Emerald shiner
	Total	Spring	Summer	Total	Summer	Fall	Total	Spring	Summer
Y/Y not meas.									
0.1 - 1.9									
2.0 - 3.9								3	5
4.0 - 5.9					2	1	3	4	32
6.0 - 7.9					1	7	8	60	13
8.0 - 9.9						1	1		4
10.0 - 11.9						1	1		
12.0 - 13.9									
14.0 - 15.9									
16.0 - 17.9									
18.0 - 19.9		1		1					
20.0 - 21.9									
22.0 - 23.9									
24.0 - 25.9									
26.0 - 27.9									
28.0 - 29.9			1	1					
30.0 - 31.9	1								
32.0 - 33.9									
34.0 - 35.9									
36.0 - 37.9									
38.0 - 39.9									
40.0 - 44.9									
45.0 - 49.9	1	1	1	2					
50.0 - 54.9			2	2					
55.0 - 59.9		2		2					
60.0 - 64.9									
65.0 - 69.9									
70.0 - 74.9									
75.0 - 79.9									
80.0 - 84.9									
85.0 - 89.9									
90.0 - 94.9									
95.0 - 99.9									
100.0 - +									
Others not meas.								507	
Total unmeasured								507	
Total measured	2	4	4	8	3	10	13	67	54
Grand Total	2	4	4	8	3	10	13	574	54

277 120

Table 2.4-20. Length-frequencies of all fish caught by seining in the Mississippi River and connecting waters near the Prairie Island Nuclear Generating Plant, Red Wing, Minnesota, 1978. Sections 0, 1, 2, 3, and 4 combined, seasons separated. (Sheet 3 of 11)

Total Length in Centimeters	Emerald shiner Fall	Emerald shiner Total	River shiner Spring	River shiner Fall	River shiner Total	Spottail shiner Spring	Spottail shiner Summer	Spottail Shiner Fall	Spottail shiner Total
Y/Y not meas.									
0.1 - 1.9									
2.0 - 3.9	10	18		1	1	72	3	3	78
4.0 - 5.9	34	70	1		1	9	34		43
6.0 - 7.9	72	145	1		1		40	18	58
8.0 - 9.9	6	10				7		4	11
10.0 - 11.9								1	1
12.0 - 13.9									
14.0 - 15.9									
16.0 - 17.9									
18.0 - 19.9									
20.0 - 21.9									
22.0 - 23.9									
24.0 - 25.9									
26.0 - 27.9									
28.0 - 29.9									
30.0 - 31.9									
32.0 - 33.9									
34.0 - 35.9									
36.0 - 37.9									
38.0 - 39.9									
40.0 - 44.9									
45.0 - 49.9									
50.0 - 54.9									
55.0 - 59.9									
60.0 - 64.9									
65.0 - 69.9									
70.0 - 74.9									
75.0 - 79.9									
80.0 - 84.9									
85.0 - 89.9									
90.0 - 94.9									
95.0 - 99.9									
100.0 - +									
Others not meas.	3	510							
Total unmeasured	3	510							
Total measured	122	243	2	1	3	88	77	26	191
Grand Total	125	753	2	1	3	88	77	26	191

277 121

Table 2.4-20. Length-frequencies of all fish caught by seining in the Mississippi River and connecting waters near the Prairie Island Nuclear Generating Plant, Red Wing, Minnesota, 1978. Sections 0, 1, 2, 3, and 4 combined, seasons separated. (Sheet 4 of 11)

Total Length in Centimeters	Spotfin shiner Spring	Spotfin shiner Summer	Spotfin shiner Fall	Spotfin shiner Total	Pugnose minnow Summer*	Bullhead minnow Spring	Bullhead minnow Summer	Bullhead minnow Fall	Bullhead minnow Total
Y/Y not meas.									
0.1 - 1.9									
2.0 - 3.9		1	7	8			1	16	17
4.0 - 5.9	33	10	3	46	1	28		19	47
6.0 - 7.9	8	6		14		4		1	5
8.0 - 9.9	2			2					
10.0 - 11.9									
12.0 - 13.9									
14.0 - 15.9									
16.0 - 17.9									
18.0 - 19.9									
20.0 - 21.9									
22.0 - 23.9									
24.0 - 25.9									
26.0 - 27.9									
28.0 - 29.9									
30.0 - 31.9									
32.0 - 33.9									
34.0 - 35.9									
36.0 - 37.9									
38.0 - 39.9									
40.0 - 44.9									
45.0 - 49.9									
50.0 - 54.9									
55.0 - 59.9									
60.0 - 64.9									
65.0 - 69.9									
70.0 - 74.9									
75.0 - 79.9									
80.0 - 84.9									
85.0 - 89.9									
90.0 - 94.9									
95.0 - 99.9									
100.0 - +									
Others not meas.							1		1
Total unmeasured							1		1
Total measured	43	17	10	70	1	32	1	36	69
Grand Total	43	17	10	70	1	32	2	36	70

* This species was caught during only one season.

277 122

Table 2.4-20. Length-frequencies of all fish caught by seining in the Mississippi River and connecting waters near the Prairie Island Nuclear Generating Plant, Red Wing, Minnesota, 1978. Sections 0, 1, 2, 3, and 4 combined, seasons separated. (Sheet 5 of 11)

Total Length in Centimeters	Carpsucker spp. Spring	Carpsucker spp. Summer	Carpsucker spp. Total	Quillback carpsucker Spring	Quillback carpsucker Summer	Quillback carpsucker Total	White sucker Summer*	Smallmouth buffalo Spring	Smallmouth buffalo Summer
Y/Y not meas.									
0.1 - 1.9									
2.0 - 3.9	5		5					11	
4.0 - 5.9	7	1	8					25	
6.0 - 7.9	3		3					3	1
8.0 - 9.9	2	1	3						1
10.0 - 11.9									
12.0 - 13.9									
14.0 - 15.9				1		1			
16.0 - 17.9									
18.0 - 19.9									
20.0 - 21.9				1		1			
22.0 - 23.9					1	1			
24.0 - 25.9									
26.0 - 27.9									
28.0 - 29.9							1		
30.0 - 31.9									
32.0 - 33.9									
34.0 - 35.9									
36.0 - 37.9									
38.0 - 39.9									
40.0 - 44.9								1	
45.0 - 49.9									
50.0 - 54.9									
55.0 - 59.9									
60.0 - 64.9									
65.0 - 69.9									
70.0 - 74.9									
75.0 - 79.9									
80.0 - 84.9									
85.0 - 89.9									
90.0 - 94.9									
95.0 - 99.9									
100.0 - +									
Others not meas.									
Total unmeasured									
Total measured	17	2	19	2	1	3	1	40	2
Grand Total	17	2	19	2	1	3	1	40	2

* This species was caught during only one season.

277 123

Table 2.4-20. Length-frequencies of all fish caught by seining in the Mississippi River and connecting waters near the Prairie Island Nuclear Generating Plant, Red Wing, Minnesota, 1978. Sections 0, 1, 2, 3, and 4 combined, seasons separated. (Sheet 6 of 11)

Total Length in Centimeters	Smallmouth buffalo	Bigmouth buffalo	Shortnose redhorse	Channel catfish	Channel catfish	Channel catfish	Tadpole madtom	White bass	White bass
	Total	Spring*	Spring*	Summer	Fall	Total	Fall*	Spring	Summer
Y/Y not meas.								105	
0.1 - 1.9									
2.0 - 3.9	11		1				1	12	
4.0 - 5.9	25	1		15		15		61	
6.0 - 7.9	4			9		9		1	3
8.0 - 9.9	1				1	1			6
10.0 - 11.9									3
12.0 - 13.9									
14.0 - 15.9								1	
16.0 - 17.9								1	
18.0 - 19.9									5
20.0 - 21.9									4
22.0 - 23.9									
24.0 - 25.9									1
26.0 - 27.9									
28.0 - 29.9									
30.0 - 31.9									
32.0 - 33.9									
34.0 - 35.9									
36.0 - 37.9									
38.0 - 39.9									
40.0 - 44.9	1								
45.0 - 49.9									
50.0 - 54.9									
55.0 - 59.9									
60.0 - 64.9									
65.0 - 69.9									
70.0 - 74.9									
75.0 - 79.9									
80.0 - 84.9									
85.0 - 89.9									
90.0 - 94.9									
95.0 - 99.9									
100.0 - +									
Others not meas.									
Total unmeasured								105	
Total measured	42	1	1	24	1	25	1	76	22
Grand Total	42	1	1	24	1	25	1	181	22

* this species was caught during only one season.

277 124

Table 2.4-20. Length-frequencies of all fish caught by seining in the Mississippi River and connecting waters near the Prairie Island Nuclear Generating Plant, Red Wing, Minnesota, 1978. Sections 0, 1, 2, 3, and 4 combined, seasons separated. (Sheet 7 of 11)

Total Length in Centimeters	White bass Fall	White bass Total	Bluegill Spring	Bluegill Summer	Bluegill Fall	Bluegill Total	Smallmouth bass Summer	Smallmouth bass Fall	Smallmouth bass Total
Y/Y not meas.		105							
0.1 - 1.9									
2.0 - 3.9		12		14	8	22			
4.0 - 5.9		61	2	4	17	23			
6.0 - 7.9		4	4		1	5	1		1
8.0 - 9.9		6	8			8	2	1	3
10.0 - 11.9	1	4	1	1		2			
12.0 - 13.9	5	5		2		2	1		1
14.0 - 15.9		1	2			2		1	1
16.0 - 17.9		1		2		2			
18.0 - 19.9	1	6							
20.0 - 21.9	2	6							
22.0 - 23.9									
24.0 - 25.9	2	3							
26.0 - 27.9	1	1							
28.0 - 29.9									
30.0 - 31.9									
32.0 - 33.9									
34.0 - 35.9									
36.0 - 37.9									
38.0 - 39.9									
40.0 - 44.9									
45.0 - 49.9									
50.0 - 54.9									
55.0 - 59.9									
60.0 - 64.9									
65.0 - 69.9									
70.0 - 74.9									
75.0 - 79.9									
80.0 - 84.9									
85.0 - 89.9									
90.0 - 94.9									
95.0 - 99.9									
100.0 - +									
Others not meas.				1		1			
Total unmeasured		105		1		1			
Total measured	12	110	17	23	26	66	4	2	6
Grand Total	12	215	17	24	26	67	4	2	6

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Table 2.4-20. Length-frequencies of all fish caught by seining in the Mississippi River and connecting waters near the Prairie Island Nuclear Generating Plant, Red Wing, Minnesota, 1978. Sections 0, 1, 2, 3, and 4 combined, seasons separated. (Sheet 8 of 11)

Total Length in Centimeters	White crappie Spring	White crappie Summer	White crappie Fall	White crappie Total	Black crappie Spring	Black crappie Summer	Black crappie Fall	Black crappie Total	Johnny darter Spring
Y/Y not meas.									
0.1 - 1.9									
2.0 - 3.9					3			3	4
4.0 - 5.9		3		3		1		1	1
6.0 - 7.9									
8.0 - 9.9			1	1			1	1	
10.0 - 11.9					6			6	
12.0 - 13.9	2			2	1			1	
14.0 - 15.9									
16.0 - 17.9									
18.0 - 19.9					1			1	
20.0 - 21.9					1			1	
22.0 - 23.9									
24.0 - 25.9									
26.0 - 27.9									
28.0 - 29.9									
30.0 - 31.9									
32.0 - 33.9									
34.0 - 35.9									
36.0 - 37.9									
38.0 - 39.9									
40.0 - 44.9									
45.0 - 49.9									
50.0 - 54.9									
55.0 - 59.9									
60.0 - 64.9									
65.0 - 69.9									
70.0 - 74.9									
75.0 - 79.9									
80.0 - 84.9									
85.0 - 89.9									
90.0 - 94.9									
95.0 - 99.9									
100.0 - +									
Others not meas.									
Total unmeasured									
Total measured	2	3	1	6	12	1	1	14	5
Grand total	2	3	1	6	12	1	1	14	5

Table 2.4-20. Length-frequencies of all fish caught by seining in the Mississippi River and connecting waters near the Prairie Island Nuclear Generating Plant, Red Wing, Minnesota, 1978. Sections 0, 1, 2, 3, and 4 combined, seasons separated. (Sheet 9 of 11)

Total Length in Centimeters	Johnny darter Fall	Johnny darter Total	Yellow perch Spring	Yellow perch Summer	Yellow perch Total	Log perch Spring	Log perch Summer	Log perch Total	Sauger Spring
Y/Y not meas.									
0.1 - 1.9									
2.0 - 3.9		4							
4.0 - 5.9		1	5		5	2	2	4	
6.0 - 7.9	1	1					7	7	
8.0 - 9.9				1	1		8	8	1
10.0 - 11.9									
12.0 - 13.9			1		1				
14.0 - 15.9									
16.0 - 17.9									
18.0 - 19.9									
20.0 - 21.9									
22.0 - 23.9									
24.0 - 25.9									
26.0 - 27.9									
28.0 - 29.9									
30.0 - 31.9									
32.0 - 33.9									
34.0 - 35.9									
36.0 - 37.9									
38.0 - 39.9									
40.0 - 44.9									
45.0 - 49.9									
50.0 - 54.9									
55.0 - 59.9									
60.0 - 64.9									
65.0 - 69.9									
70.0 - 74.9									
75.0 - 79.9									
80.0 - 84.9									
85.0 - 89.9									
90.0 - 94.9									
95.0 - 99.9									
100.0 - +									
Others not meas.									
Total unmeasured									
Total measured	1	6	6	1	7	2	17	19	1
Grand Total	1	6	6	1	7	2	17	19	1

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Table 2.4-20. Length-frequencies of all fish caught by seining in the Mississippi River and connecting waters near the Prairie Island Nuclear Generating Plant, Red Wing, Minnesota, 1978. Sections 0, 1, 2, 3, and 4 combined, seasons separated. (Sheet 10 of 11).

Total Length in Centimeters	Sauger Summer	Sauger Fall	Sauger Total	Walleye Spring	Walleye Summer	Walleye Fall	Walleye Total	Freshwater drum Spring	Freshwater drum Summer
Y/Y not meas.									
0.0 - 1.9									
2.0 - 3.9								7	
4.0 - 5.9								4	3
6.0 - 7.9				5			5		9
8.0 - 9.9			1	1			1		13
10.0 - 11.9	3		3		1		1		13
12.0 - 13.9	2		2					5	2
14.0 - 15.9		2	2			1	1	6	4
16.0 - 17.9								2	9
18.0 - 19.9									
20.0 - 21.9									
22.0 - 23.9									
24.0 - 25.9									
26.0 - 27.9									
28.0 - 29.9									
30.0 - 31.9									
32.0 - 33.9									
34.0 - 35.9									
36.0 - 37.9									
38.0 - 39.9									
40.0 - 44.9									
45.0 - 49.9									
50.0 - 54.9									
55.0 - 59.9									
60.0 - 64.9									
65.0 - 69.9									
70.0 - 74.9									
75.0 - 79.9									
80.0 - 84.9									
85.0 - 89.9									
90.0 - 94.9									
95.0 - 99.9									
100.0 - +									
Others not meas.									
Total unmeasured									
Total measured	5	2	8	6	1	1	8	24	53
Grand Total	5	2	8	6	1	1	8	24	53

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Table 2.4-20. Length-frequencies of all fish caught by seining in the Mississippi River and connecting waters near the Prairie Island Nuclear Generating Plant, Red Wing, Minnesota, 1978. Sections 0, 1, 2, 3, and 4 combined, seasons separated. (Sheet 11 of 11)

Total Length in Centimeters	Freshwater drum Fall	Freshwater drum Total							
Y/Y not meas.									
0.1 - 1.9									
2.0 - 3.9		7							
4.0 - 5.9		7							
6.0 - 7.9		9							
8.0 - 9.9	2	15							
10.0 - 11.9		13							
12.0 - 13.9		7							
14.0 - 15.9		10							
16.0 - 17.9		11							
18.0 - 19.9									
20.0 - 21.9									
22.0 - 23.9									
24.0 - 25.9									
26.0 - 27.9									
28.0 - 29.9									
30.0 - 31.9									
32.0 - 33.9									
34.0 - 35.9									
36.0 - 37.9									
38.0 - 39.9									
40.0 - 44.9									
45.0 - 49.9									
50.0 - 54.9									
55.0 - 59.9									
60.0 - 64.9									
65.0 - 69.9									
70.0 - 74.9									
75.0 - 79.9									
80.0 - 84.9									
85.0 - 89.9									
90.0 - 94.9									
95.0 - 99.9									
100.0 - +									
Others not meas.									
Total unmeasured									
Total measured	2	79							
Grand Total	2	79							

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Table 2.4-21 Total numbers of fish tagged and released in the Mississippi River and connecting waters near the Prairie Island Nuclear Generating Plant, Red Wing, Minnesota, April 9, 1974 through December 31, 1978, with numbers and percentages of tagged fish returned.

Species	Total No. tagged in 1978	Total No. tagged 1974 through 1978	Total No. of tags returned Apr. 9, 1974 through Dec. 31, 1978*	% returned of total tagged for each species
Northern pike	0	238	50 (2)**	21.00
Carp	0	15	0	0
Smallmouth buffalo	0	4	0	0
Channel catfish	66	216	9	4.13
Flathead catfish	17	31	1	3.22
White bass	35	3,053	347 (10)**	11.37
Smallmouth bass	4	110	11	10.00
Largemouth bass	0	22	5 (1)**	22.73
Sauger	7	1,130	131	11.59
Walleye	21	1,121	122	10.88
Total	150	5,940	676	11.38

* Tagged fish recaptured more than once are recorded as one in this table.

** Number of returns in parenthesis indicate the number of fish recaptured more than once.

Table 2.4-22 Recapture location of tagged fish relative to location released in the Mississippi River and connecting waters near the Prairie Island Nuclear Generating Plant, Red Wing, Minnesota, 1974 through 1978.*

Species	Upstream No.	Upstream Mean upstream movement (mi)	Upstream Range (mi)	Downstream No.	Downstream Mean downstream movement(mi)	Downstream Range (mi)	Stationary No.	Mean net movement ** Direction	Mean net movement ** Distance (mi)
Northern pike	18	2.7	0.3-16.7	29	8.8	0.3-28.5	5	Downstream	4.0
Channel catfish	2	69.5	11.0-128.0	6	59.8	2.0-120.7	1	Downstream	24.4
Flathead catfish	0	0.0	-----	0	0.0	-----	1	None	0.0
White bass	57	16.7	0.3-66.0	136	19.2	0.4-110.3	164***	Downstream	4.6
Smallmouth bass	4	9.6	1.0-17.0	2	7.4	1.0-13.7	5	Upstream	2.1
Largemouth bass	0	0.0	-----	3	3.1	0.1-5.7	3	Downstream	1.6
Sauger	15	16.9	2.7-32.3	82	20.8	0.3-40.5	28†	Downstream	11.6
Walleye	32	15.3	0.3-63.0	38	13.5	0.5-49.0	51††	Downstream	0.2

* For fish recaptured more than once, the location of the prior recapture was considered the release location for the following recapture.

** Difference between total upstream and total downstream distances divided by total number of fish (including stationary fish).

*** Location caught was not specified for one white bass, so this fish was not included in any of the calculations or figures on this table.

† Location caught was not specified for six sauger, so these fish were not included in any of the calculations or figures on this table.

†† Location caught was not specified for one walleye, so this fish was not included in any of the calculations or figures on this table.

Table 2.4-23 Length-weight relationships for selected species from the Mississippi River and connecting waters near the Prairie Island Nuclear Generating Plant, Red Wing, Minnesota, 1978. (All sampling sections combined, summer and fall data separated).

Species	Summer 1978 Equation	Correlation Coefficient	n	Fall 1978 Equation	Correlation Coefficient	n
Shortnose gar	log W = 3.2637 log L-6.1918	0.875	29	log W = 2.9789 log L-5.3816	0.922	29
Gizzard shad	log W = 3.0686 log L-5.0781	0.993	73	log W = 2.9906 log L-4.9245	0.994	230
Northern pike	log W = 3.1443 log L-5.5977	0.993	54	log W = 2.5571 log L-3.9272	0.983	48
Carp	log W = 3.0047 log L-4.8727	0.982	429	log W = 3.1149 log L-5.1766	0.987	324
Shorthead redhorse	log W = 2.9778 log L-4.9177	0.973	125	log W = 2.9558 log L-4.8598	0.986	94
Channel catfish	log W = 3.4614 log L-6.2568	0.994	18	log W = 3.3102 log L-5.8701	0.989	30
White bass	log W = 2.9566 log L-4.8130	0.991	369	log W = 3.0224 log L-4.9815	0.979	425
Bluegill	log W = 3.0316 log L-4.6607	0.955	278	log W = 3.2701 log L-5.2122	0.959	278
Smallmouth bass	log W = 2.9748 log L-4.8214	0.987	61	log W = 3.0377 log L-4.9825	0.990	49
White crappie	log W = 2.9191 log L-4.6494	0.970	159	log W = 3.0884 log L-5.0879	0.957	233
Black crappie	log W = 2.9173 log L-4.5986	0.980	295	log W = 3.1624 log L-5.1762	0.978	408
Sauger	log W = 3.1000 log L-5.3541	0.988	38	log W = 3.2298 log L-5.6764	0.991	153
Walleye	log W = 3.0562 log L-5.1974	0.996	28	log W = 3.2338 log L-5.6796	0.993	63
Freshwater drum	log W = 2.9113 log L-4.7104	0.987	422	log W = 3.1799 log L-5.3809	0.978	249

Table 2.4-24 Expected weights for fish of various lengths from the Mississippi River and connecting waters near the Prairie Island Nuclear Generating Plant, Red Wing, Minnesota, 1973-1978. Calculated from length-weight relationships for all stations combined. (Sheet 1 of 3)

Length		Weight (g)								
mm	in	1973	1974	1975	1976 Summer	1976 Fall	1977 Summer	1977 Fall	1978 Summer	1978 Fall
					Shortnose gar					
550		----	----	----	----	----	----	----	565	605
600		----	----	----	----	----	----	----	750	784
700		----	----	----	----	----	----	----	1241	1241
					Gizzard shad					
150	5.9	36	----	----	39	38	38	34	40	38
200	7.9	90	----	----	95	93	94	83	96	91
300	11.8	318	----	----	330	334	330	292	334	304
350	13.8	516	----	----	528	543	532	472	535	483
					Northern pike					
600	23.6	1424	----	----	1179	1440	1364	1400	1373	1502
700	27.6	2161	----	----	1948	2280	2123	2230	2229	2228
800	31.5	3102	----	----	3009	3418	3114	3335	3392	3135
900	35.4	4267	----	----	4415	4869	4365	4757	4913	4237
					Carp					
250	9.8	228	----	----	236	230	283	243	215	196
300	11.8	381	----	----	392	394	457	413	372	346
400	15.8	854	----	----	875	922	977	958	882	848
500	19.7	1598	----	----	1629	1783	1761	1838	1725	1700
600	23.6	2667	----	----	2708	3056	2850	3131	2984	3000
650	25.6	3339	----	----	3385	3872	3520	3956	3795	3849

Table 2.4-24 (cont'd) Expected weights for fish of various lengths from the Mississippi River and connecting waters near the Prairie Island Nuclear Generating Plant, Red Wing, Minnesota, 1973-1978. Calculated from length-weight relationships for all stations combined. (Sheet 2 of 3)

Length		Weight (g)								
mm	in	1973	1974	1975	1976 Summer	1976 Fall	1977 Summer	1977 Fall	1978 Summer	1978 Fall
					Shorthead redhorse					
300	11.8	305	----	----	343	334	315	307	208	290
400	15.8	704	----	----	688	797	725	733	677	678
450	17.7	1027	----	----	915	1138	1021	1048	962	961
					Channel catfish					
300	11.8	203	----	----	260	247	258	228	208	214
400	15.8	522	----	----	621	665	599	587	562	554
450	17.7	767	----	----	887	998	845	864	845	818
500	19.7	1084	----	----	1220	1434	1149	1221	1217	1159
					White bass					
200	7.9	131	----	110	116	99	123	99	98	94
250	9.8	240	----	211	208	200	212	200	189	185
300	11.8	394	----	359	334	353	330	355	324	320
380	15.0	747	----	714	617	742	589	747	652	654
					Bluegill					
100		----	----	----	----	----	----	----	25	21
150		----	----	----	----	----	----	----	86	80
200		----	----	----	----	----	----	----	207	205
					Smallmouth bass					
200	7.9	125	----	121	125	118	118	115	106	102
300	11.8	428	----	374	404	415	408	405	353	349

Table 2.4-24 (cont'd.) Expected weights for fish of various lengths from the Mississippi River and connecting waters near the Prairie Island Nuclear Generating Plant, Red Wing, Minnesota, 1973-1978. Calculated from length-weight relationships for all stations combined. (Sheet 3 of 3)

Length		Weight (g)								
mm	in	1973	1974	1975	1976 Summer	1976 Fall	1977 Summer	1977 Fall	1978 Summer	1978 Fall
					White crappie					
200		----	----	----	----	----	----	----	117	104
250		----	----	----	----	----	----	----	224	208
					Black crappie					
150	5.9	59	----	----	59	54	53	55	56	51
200	7.9	134	----	----	134	136	130	136	130	126
250	9.8	254	----	----	254	277	261	276	249	255
					Sauger					
300	11.8	250	----	241	208	225	252	228	211	211
400	15.8	611	----	600	544	583	595	613	516	534
500	19.7	1220	----	1220	1069	1143	1158	1319	1030	1098
					Walleye					
300	11.8	275	253	256	246	250	247	239	236	214
450	17.7	908	875	886	827	885	883	818	815	795
550	21.6	1640	1620	1640	1507	1656	1657	1505	1506	1521
					Freshwater drum					
150	5.9	41	----	----	47	45	45	38	42	35
200	7.9	98	----	----	106	107	106	91	97	86
300	11.8	333	----	----	330	358	350	314	317	313
400	15.8	793	----	----	743	846	817	758	733	782

Table 2.4-25 Summary of results from a multiple mark-recapture population estimate ending June 6, 1978 in the discharge area of the Prairie Island Nuclear Generating Plant, Red Wing, Minnesota (Station 3-2).

Species	Total Marked	Estimated Number (N)*	95% Confidence interval*@	Est. No. per hectare	Mean wt. (kg)	Est. Standing crop (kg/ha)
Carp	135	2,587	1,057-6,463	1,848	1.60	2,957
White bass	17	54	23-127	39	0.30	12
Walleye	21	81	34-216	58	1.20	70
Freshwater drum	317	3,682	2,202-6,483	2,630	0.26	684

*Unmarked mortalities have been added to N and to the confidence interval for N.

@Confidence intervals calculated using Appendix II in Ricker (1975).

Table 2.4-26 Abundance indices for 12 fish species using data from all seasons and all gears except seines, from the Mississippi River and connecting waters near the Prairie Island Nuclear Generating Plant, Red Wing, Minnesota, 1973 through 1978.

Species	1973	1974	1975	1976	1977	1978
Shortnose gar	0.87	1.32	0.91	0.90	1.96	0.95
Gizzard shad	1.99	0.78	1.10	0.63	3.89	0.70
Northern pike	1.32	1.11	0.99	0.82	0.57	0.71
Carp	0.90	1.25	0.70	1.14	0.87	0.65
Shorthead redhorse	0.84	1.05	0.54	1.48	1.12	0.84
White bass	0.79	1.18	0.68	1.24	1.26	0.99
Bluegill	0.85	1.74	0.51	0.86	2.54	1.51
White crappie	0.35	1.18	0.60	1.43	4.94	2.31
Black crappie	0.98	0.91	0.95	1.11	3.31	3.39
Sauger	1.79	1.08	0.97	0.65	0.40	0.78
Walleye	1.09	0.75	1.04	1.14	0.58	0.77
Freshwater drum	1.37	1.10	0.46	1.19	1.57	1.03

Table 2.4-27 Comparison of several population estimates made in the discharge area of the Prairie Island Nuclear Generating Plant, Red Wing, Minnesota, 1976 through 1978.

Species	Date of Estimate	Total no. of fish marked to date of estimate	Total no. of Recaptures	Estimated Number	95% Confidence interval	Source
Carp	Dec. 8, 1976	149	1	9,086	2,753-16,521	1
Carp	June 6, 1978	135	3	2,587	1,057- 6,463	3
White bass	Dec. 3, 1976	508	19	7,051	4,608-11,282	1
White bass	Dec. 30, 1977	727	49	4,632	3,370- 5,894	2
White bass	June 6, 1978	17	2	54	23- 127	3
Walleye	Dec. 8, 1976	218	23	1,053	714- 1,620	1
Walleye	Dec. 30, 1977	50	4	306	137- 766	4
Walleye	June 6, 1978	21	2	81	34- 216	3
Freshwater drum	June 6, 1978	317	13	3,682	2,202- 6,483	3

1 Gustafson and Geis, 1977

2 Gustafson, Fierstine, and Geis (1978)

3 This report

4 Calculated from unpublished 1977 data

PRAIRIE ISLAND NUCLEAR GENERATING PLANT
ENVIRONMENTAL MONITORING PROGRAM
1978 ANNUAL REPORT
ECOLOGICAL STUDIES

FISH CREEL SURVEY
(2.5)

Prepared for

Northern States Power Company
Minneapolis, Minnesota

by

Minnesota Department of Natural Resources
Division of Fish and Wildlife
Ecological Services Section

277 139

2.5 FISH CREEL SURVEY

No fish creel survey was conducted in 1978. This study will be continued in 1979.

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

PRAIRIE ISLAND NUCLEAR GENERATING PLANT
ENVIRONMENTAL MONITORING PROGRAM
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TERRESTRIAL PLANT COMMUNITY STUDIES
(2.6)

Prepared for
Northern States Power Company
Minneapolis, Minnesota

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River Falls, Wisconsin
April 1, 1979

2.6 TERRESTRIAL PLANT COMMUNITY STUDIES

2.6.1 INTRODUCTION

This report represents the continuing operational field and laboratory work conducted beyond the original five-year program completed and published in the 1976 Annual Report (Richardson 1976). The five-year terrestrial plant community study indicated that certain aspects of the study needed continued investigation and analysis. The 1977 Report (Richardson 1977) together with the following report constitutes a portion of these additional studies. The project, continued through the 1978 growing season, had the following primary objectives:

1. To estimate acorn production and conduct a variety of tests on the acorns to determine causal agent(s) involved in the inviability of acorns produced by the oaks adjacent to cooling towers.

2. To obtain data on the leaf canopy of the small oak forest located adjacent to the cooling towers, and identify any changes or alterations occurring in the canopy in response to the winter icing damage.

2.6.2 DESCRIPTION OF STUDY AREA

The study area included the areas designated as Transects 1, 2, and 16. A detailed description of the study and sampling transects can be found in the 1976 NSP Annual Report (Richardson 1976).

2.6.3 METHOD OF PROCEDURE

Detailed procedures involved in collection and analysis of data obtained from the acorn study are described in the 1976

Report. In an attempt to gain additional information on acorn viability and inviability, a variety of analytical techniques were to be employed. Because of the absence of acorns, however (see Section 2.6.4.2), these tests were not completed and must be postponed until subsequent studies are made.

Methods of procedure utilized in data collection and evaluation of the canopy are outlined in the 1977 NSP Annual Report (Richardson 1977).

2.6.4 RESULTS AND CONCLUSIONS

2.6.4.1 Acorn Production Studies

The study of production and viability of acorns produced in the small oak forest adjacent to the cooling towers has been a continuing project since its initiation in 1973. Cooling towers became fully operational in January, 1974. During winter months, the hot, moist air expelled from the towers becomes a dense cloud of steam. When steam contacts a cold surface, it freezes and forms an ever-thickening layer of crusty ice. If the cold surface is a tree branch or limb, ice accumulates on the surface facing the towers. The ice will either continue to accumulate,or existing weather conditions may melt the ice before it reaches the point where the increasing weight causes physical damage to the vegetation. Physical damage resulting from increased ice accumulation involves breaking of small branches and twigs or larger tree limbs. An investigation into this accumulation and its effects is being studied in more detail; results are scheduled for publication at a later date.

The small oak forest adjacent to the towers is dominated by large, well-developed red oak. This member of the black oak group generally produces flowers during the second or third

week of May. The pollen is produced in large quantities and is wind-borne. After pollination and fertilization, two growing seasons are required to produce mature acorns. The success of pollination and fertilization, therefore, cannot be determined in terms of an acorn crop until the end of the second growing season. Yearly fluctuations that occur in acorn production can be influenced by a number of environmental factors, i.e., late frost killing pollen or damaging pistillate flowers or heavy rains washing away pollen. The success of pollination and fertilization can lead to periods of high and low acorn production in any particular year. In general, studies indicate that there appears to be three to five years between heavy acorn production (Curtis 1959).

Tables 2.6-1 and 2.6-2 represent the tabulation of data and results obtained from the acorn collecting frames and ground quadrats since the initiation of the acorn study in 1973. Little information has been added to the acorn study as a result of this year's collection. The 1978 collections indicate an almost complete failure in acorn production. The ten collection frames located on Transect 1 averaged only three acorns per frame, with the entire collection consisting of only 30 empty acorn caps for the entire season. Ground samples yielded even poorer results, with an average of less than one (0.2) acorn per sample--represented by only one cap collected in the five ground samples. Results obtained from Transect 2 were comparable, with the frames and ground quadrats yielding on the average less than one acorn per sample site. Collection frames yielded only three acorn caps, with the ground quadrats containing only three acorns which, when opened, showed the cotyledons black and deteriorating.

A variety of organisms rely heavily on acorns as a major source of food and can be influenced directly by fluctuations in the yearly acorn crop. Curtis (1959) indicates

squirrels and chipmunks consume, store, or bury large quantities of acorns yearly. Many of the buried acorns germinate, providing the seedlings and future replacements in the oak forest. In addition, pheasants, deer, and a variety of small mice and other rodents rely on the acorns as a primary or secondary source of food. The acorn weevil, although considered destructive to the acorn, depends directly on acorns to complete its life cycle. The weevil, which may infest as much as 90 percent of the crop, is also a source of food for a variety of birds that inhabit the oak forest during the fall of the year.

Failure of the acorn crop did not appear to be a localized situation. The investigator's class in General Ecology at the University of Wisconsin-River Falls performed a similar study in a 40-acre oak woods seven miles northeast of the campus. Collections have been made from permanent ground quadrats on a yearly basis. Study results obtained from this area yielded data comparable with the study at Prairie Island. In general, these quadrats yielded only one or two acorns per square meter, none of which were viable; most of the "good" acorns had been eaten and all that remained were acorn caps or shell fragments.

Another aspect which can indicate generally poor acorn production was the unusual squirrel activity in areas apart from their usual forest habitat. Personal communication with several hunters, DNR field personnel, and other field workers indicated a very poor supply of acorns, not only in this geographical area but well into both Northern Wisconsin and Minnesota. Intensive feeding activity of squirrels in grain fields was considered to be above normal. Personal observation indicated an unusually high number of squirrels killed on the road; this would also lend support to an increase in squirrel feeding activity in areas outside the forest or woodlot. Although an unusually high squirrel

population could be another reason for this activity, several game wardens have indicated that, from a limited hunter check, the population and its harvest were about normal. The population, however, was considered somewhat lower than previous years.

Because of poor results obtained from this year's study, this portion of the study will be continued in hopes that the 1978 crop will provide sufficient material for further analysis of viability.

2.6.4.2 Canopy Evaluation

The small oak woods on Transect 2 adjacent to the cooling towers is subjected to winter icing. When conditions are such that steam from the cooling towers drifts into the woods, it contacts the trees and freezes on the branches. During periods of accumulation and melting, many small branches are broken from the trees. Many trees in the area exhibit major damage; the amount of damage appears to be in direct relationship to the distance of the trees from the towers. The most vulnerable branches appear to be the previous year's growth and are generally the first branches removed from the trees by ice accumulation. Growth for the following season is the result of lateral branch development. As a result, the canopy has a tendency to become more dense with almost a bushy type of appearance.

Studies utilizing photographs of the canopy have been completed yearly since 1973 (Richardson 1977). Examination of the photographs indicates that many small branches are gone, and subsequent expansion of the canopy has been limited. In general, the actual area of the canopy has not changed appreciably throughout the study period, however, the density of the canopy has steadily increased in areas subjected to heavy icing.

Tables 2.6-3 and 2.6-4 and Figures 2.6-1 and 2.6-2 represent analysis of canopy photographs taken through 1978. Stakes 1-11 indicate readings obtained from photographs of the canopy located in the oak forest. The remaining values are from photographs taken in the lowland forest portion of the transect.

Photographs of the canopy were taken with black and white film and evaluated as negatives. Vegetational regions of the canopy, therefore, show as white or gray areas, while the sky, visible through the canopy, is black or dark. Higher values indicate a more dense or complete canopy (Richardson 1977).

The amount of light penetrating the canopy on Transect 2 generally has remained relatively constant (Table 2.6-3 and Figure 2.6-1). The average value of 37 foot-candles, obtained in 1973, has remained relatively unchanged over the six-year study period. Internally, the canopy has changed in species composition and relationships, but the amount of light penetrating the canopy has been affected very little. Since light is one of the guiding principles behind the process of succession, it must be consistent in its quantity and quality if an area is to develop successionally. The value of 37 foot-candles--of a maximum of 50--would indicate a canopy that is approximately 75 percent complete.

Heaviest tree icing occurs within the area of Stakes 1-9. The trees within this area exhibit the greatest amount of physical damage. In general, the area coverage of the canopy has not expanded, while the density of the existing canopy has increased steadily. The lower values obtained for this area of the transect, when compared with actual photographs, reflect this aspect within the canopy.

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The remaining portion of Transect 2, as previously indicated, is that of the lowland forest that parallels a backwater marsh area. Major canopy trees in this area, primarily cottonwoods, are being successionally replaced by the elm-maple-ash species. Fluctuations in the values obtained in this portion of the transect reflect these changes. Many of the tall, dominant cottonwoods are dying, falling over, and leaving the canopy somewhat open. The additional light stimulates the understory, which quickly responds to fill the open canopy. For example, many elms in the area of the opened canopy grew as much as four to five feet during the last growing season.

Table 2.6-4 and Figure 2.6-2 represent values obtained from photographs taken along Transect 16. This transect was used primarily for a comparison of Transect 2. Major fluctuations are primarily due to loss and replacement of the canopy species. Fluctuation generally has been very slight; individual variations exhibited at the various stakes indicate a response by the vegetation to changes in the dominant canopy. The foot-candle reading of 40 would translate to approximately an 80 percent complete canopy.

2.6.5 SUMMARY

The evaluation of the canopy has provided limited information regarding physical effects of the winter icing on adjacent trees.

The primary purpose of the acorn study, as indicated in the introduction, was to gain information on the causal agents involved in the inviability of acorns produced by the oaks adjacent to the cooling towers. The lack of data for 1978 did not allow for any significant data to be added to previous studies. Therefore, work will continue in an attempt to gain more information as well as possible insights into acorn inviability.

2.6.6 LITERATURE CITED

Curtis, John T. 1959. The Vegetation of Wisconsin. The University of Wisconsin Press. 657 pp.

Richardson, J. W. 1976. Terrestrial Plant Community Studies. 1976 Annual Report for the Prairie Island Nuclear Generating Plant. Environmental Program. Northern States Power Company.

Richardson, J. W. 1977. Terrestrial Plant Community Studies. 1977 Annual Report for the Prairie Island Nuclear Generating Plant. Environmental Program. Northern States Power Company.

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Table 2.6-1

Yearly Analysis of Acorn Production from Transect 1

	Average values from Acorn Frames						Average values from Acorn Quadrats					
	1973	1974	1975	1976	1977	1978	1973	1974	1975	1976	1977	1978
Immature Acorns	-	*52.8	96.2	21.4	7.1	0.8	114.8	64.0	73.2	153.1	60.8	0.6
Mature Acorns												
Acorn Caps Only	-	30.8	190.2	96.8	57.0	3.0	162.4	58.4	150.7	209.5	83.2	0.2
Entire--undamaged	-	-	95.0	34.4	17.1	-	11.2	-	13.2	20.6	2.4	-
Tested Viable	-	0.4	4.8	0.6	4.7	-	8.0	-	9.5	4.2	0.4	-
Nonviable	-	32.4	-	33.6	11.8	-	40.2	48.0	-	16.1	2.0	-
Damaged (Herbivory, insect, fungus, etc.)	-	-	79.2	43.4	37.5	-	-	-	192.5	94.4	27.4	0.4
Production/hectare	-	308,000.0	1,902,000.0	968,000.0	570,000.0	30,000.0	1,624,000.0	584,000.0	1,507,500.0	2,095,000.0	832,000.0	2,000.0
Production/acre	-	124,696.0	770,040.0	391,902.0	230,770.0	12,145.8	657,490.0	236,437.0	610,323.0	848,178.0	336,842.0	809.7
Viable Acorns/hectare	-	[illegible]000.0	48,000.0	6,000.0	47,000.0	-	80,000.0	-	95,000.0	42,000.0	4,000.0	-
Viable Acorns/Acre	-	1,619.0	19,433.0	2,429.0	19,028.0	-	32,388.0	-	38,461.0	17,000.0	1,620.0	-
Percent Viable	-	1.3%	2.5%	0.6%	8.2%	-	5.0%	-	6.3%	2.0%	0.5%	-

*Values given represent an average/sq. meter obtained from the ten frames or five quadrats.

Table 2.6-2

Yearly Analysis of Acorn Production for Transect 2

	Average values from Acorn Frames						Average values from Acorn Quadrats					
	1973	1974	1975	1976	1977	1978	1973	1974	1975	1976	1977	1978
Immature Acorn	-	*11.2	41.2	19.5	11.4	2.0	111.0	64.0	94.0	120.1	85.4	0.4
Mature Acorns												
Acorn caps only	-	8.8	106.0	29.6	34.0	0.6	150.2	58.4	155.5	184.0	121.0	-
Entire--undamaged	-	-	3.0	3.4	2.9	-	6.8	-	1.5	0.6	3.6	0.6
Tested viable	-	4.0	-	-	-	-	3.2	-	-	-	-	-
Nonviable	-	7.4	-	3.6	2.7	-	39.2	48.0	-	0.6	3.6	0.6
Damaged (Herbivory, insect, fungus, etc.)	-	-	78.8	14.0	19.9	-	-	-	119.0	114.7	66.2	-
Production/hectare	-	88,000.0	1,060,000.0	296,000.0	340,000.0	6,000.0	1,502,000.0	584,000.0	1,555,000.0	1,840,000.0	1,210,000.0	6,000.0
Production/acre	-	35,627.0	429,150.0	119,838.0	137,650.0	2,429.0	608,097.0	236,437.0	629,554.0	744,940.0	489,879.0	2,429.0
Viable Acorns/hectare	-	40,000.0	-	-	-	-	32,000.0	-	-	-	-	-
Viable Acorns/acre	-	16,194.0	-	-	-	-	12,955.0	-	-	-	-	-
Percent Viable		45.5%	-	-	-	-	2.1%	-	-	-	-	-

*Values given represent an average/sq. meter obtained from the ten frames or five quadrats.

Table 2.6-3

Yearly Analysis of Canopy Photographs - Transect 2

Transect Position	1973	1974	1975	1976	1977	1978	Average
Stake #1	-	*37	31	31	24	24	29
3	39	37	42	-	33	32	37
5	39	35	42	36	38	36	38
7	35	29	37	35	34	38	35
9	41	37	42	40	36	34	38
11	37	35	44	39	40	38	39
13	34	37	-	38	39	43	38
15	37	40	42	38	35	44	39
17	34	35	26	40	43	34	35
19	39	41	39	25	38	40	37
29	39	41	-	38	41	44	41
39	30	31	34	41	42	29	35
49	41	30	38	38	43	25	36
Average	37	36	38	37	37	35	

Overall average = 37

*Values given in foot-candles based on maximum of 50 foot-candles

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Table 2.6-4

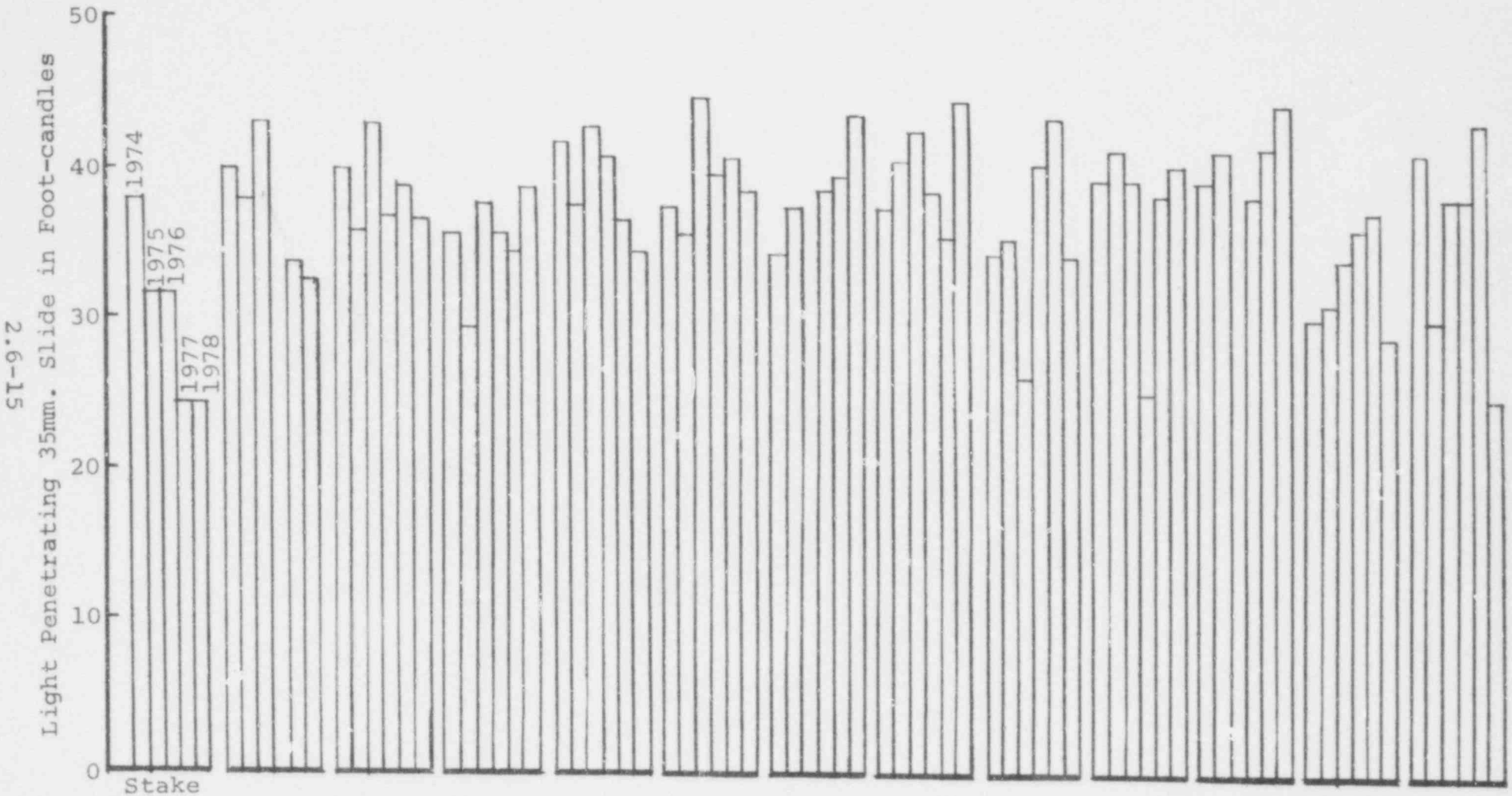
Yearly Analysis of Canopy Photographs - Transect 16

Transect Position	1973	1974	1975	1976	1977	1978	Average
Stake #1	*45	43	-	43	42	33	41
3	42	43	45	40	41	39	42
5	41	41	49	43	43	40	43
7	44	43	41	37	41	33	40
11	39	43	41	28	39	44	39
15	45	35	44	38	40	33	39
19	39	42	46	43	39	43	42
23	41	42	40	41	33	36	39
29	33	-	43	42	38	38	39
35	43	-	43	39	43	36	41
41	35	-	-	33	35	45	37
47	43	-	46	34	35	26	37
Average	41	42	44	38	40	37	

Overall average = 40

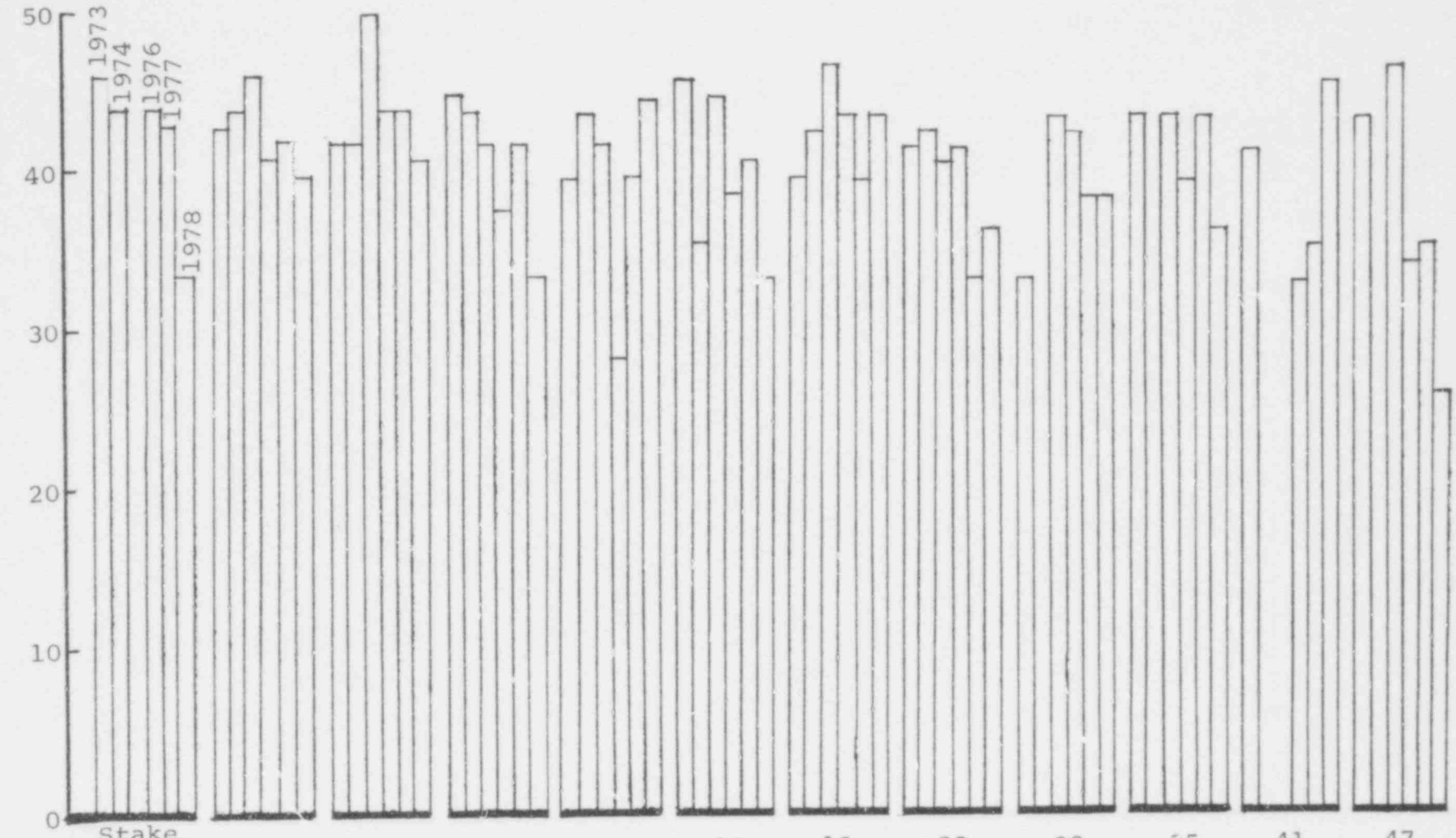
*Values given in foot-candles, based on a maximum of 50 foot-candles

Figure 2.6-1. Summary of Analysis of Canopy Photographs from Transect 2.



2.6-15

Figure 2.6-2. Summary of Analysis of Canopy Photographs from Transect 16.



PRAIRIE ISLAND NUCLEAR GENERATING PLANT

ENVIRONMENTAL MONITORING PROGRAM

1978 ANNUAL REPORT

ECOLOGICAL STUDIES

SMALL MAMMAL STUDY

(2.7)

Prepared for

Northern States Power Company
Minneapolis, Minnesota

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2.7 SMALL MAMMALS

2.7.1 INTRODUCTION

Small mammal populations were studied for the sixth consecutive year. The first two years of the study (1973 and 1974) were preoperational, with the last four years (1975, 1976, 1977, and 1978) operational. The 1978 study will conclude the general plant site small mammal studies for Prairie Island. Sampling has shown that small mammal populations are experiencing multiannual fluctuations with no significant influence from plant operations.

From 1973 to 1976, small mammals were sampled over a six-month period, May through October. In 1977 and 1978, sampling was reduced to twice per year during spring and fall. May and September sampling was considered adequate to determine change in populations within the various habitat types (in 1978, however, sampling carried over to the first part of October).

This report describes the results of the 1978 studies in comparison with data from previous years. Discussion will concern population trends of small mammal species in the vicinity of the Prairie Island Plant.

2.7.2 DESCRIPTION OF THE STUDY AREA

The study area included terrain within a one-and-one-half mile (2.4-kilometer) radius of the plant. This area was sampled for small mammals using nine transects within four habitat classifications. Transects 1 and 5 were classified as oak forest habitat; Transects 2, 12, and 16 as lowland forest habitat; Transects 7 and 11 as grassland-shrub habitat; and Transects 3 and 8 as sand terrace habitat. For a detailed description of the transects see Goddard and Richardson (1973 and 1974).

2.7.3 MATERIALS AND METHODS

Qualitative trapping of nine previously established transects, representing four habitats, was conducted in May and September. Traps used were standard 2" x 2" x 8" aluminum Sherman live traps. A mark-and-release program was carried out on each transect for a three-day period. Fifty stations approximately 25 feet apart were sampled along each transect. Captured mammals were toe-clipped, recorded, and released at the point of capture.

Population estimates were based on the Schnabel method as described by Giles (1969), where the population estimate is derived by:

$$Ni = \frac{Mi\ ni}{Xi},$$

where Ni = population estimate, Mi = total individuals marked up to last day, ni = total animals marked and recaptured on last day, Xi = recaptures on last day.

2.7.4 RESULTS

The total number of small mammals captured in 1978 dropped approximately 44 percent from 1977. Species diversity changed only slightly. In 1978 a total of 341 individuals of seven species were trapped (Table 2.7-1), whereas a total of 608 individuals of eight species were captured in 1977 (Zajicek 1978).

Two incidental species found in 1978 not found in 1977 were the eastern chipmunk and the southern flying squirrel (see Table 2.7-9 for list of scientific names). However, the western harvest mouse, house mouse, and meadow jumping mouse were not found in 1978. The single flying squirrel captured

in 1978 is an addition to the six-year species list at Prairie Island which now numbers sixteen.

The white-footed mouse was the most numerous small mammal captured, with the deer mouse second in abundance and the short-tailed shrew third. The 13-lined ground squirrel, eastern chipmunk, meadow vole, and southern flying squirrel comprise the remainder of species captured in 1978. Table 2.7-2 summarizes individual species population estimates for each transect.

2.7.4.1 Habitat Summary

Combined spring and fall small mammal population estimates showed a decrease from 1977 to 1978 in all habitat types except the grassland-shrub type. Grassland-shrub populations increased 25 percent over 1977. However, the greatest change took place in the oak forest habitat where a 64 percent decrease occurred. Sand terrace habitat decreased 51 percent from 1977 and lowland forest decreased 45 percent. Overall, the white-footed mouse and deer mouse (both of the genus Peromyscus) showed the greatest change.

The highest estimated small mammal density occurred in grassland-shrub habitat with a September-October total of 180.9 mammals/hectare. Oak forest populations were second highest with 119.0 mammals/hectare. Lowland forest habitat totaled 104.2 mammals/hectare and sand terrace habitat 58.7 mammals/hectare.

2.7.4.1.1 Oak Forest

Four small mammal species were trapped on oak forest transects in 1978 (Table 2.7-3). The most numerous species was the white-footed mouse with a combined spring and fall population of 136. The white-footed mouse comprised 92.0

percent of the oak forest population. The short-tailed shrew population estimate was six.

2.7.4.1.2 Lowland Forest

The white-footed mouse and short-tailed shrew were the only species captured on lowland forest habitat for 1978 (Table 2.7-4). In 1977 five species were found including the deer mouse, meadow vole, house mouse, and meadow jumping mouse. The white-footed mouse was the most numerous in 1978, with a combined spring and fall population of 119. The short-tailed shrew population estimate was six.

2.7.4.1.3 Grassland-Shrub

White-footed mouse was the most numerous species captured in grassland-shrub habitat comprising 46.3 percent of the total small mammal population (Table 2.7-5). In 1977 white-footed mice were 14.4 percent of the May and September totals. Deer mouse was the second most numerous species with 40.5 percent compared with 52.0 percent in 1977. Other species captured were the short-tailed shrew, the 13-lined ground squirrel, and meadow vole, which combined, comprised 13.2 percent of the small mammal population.

2.7.4.1.4 Sand Terrace

White-footed mice, deer mice, short-tailed shrews, and 13-lined ground squirrels were captured on sand terrace transects (Table 2.7-6). White-footed mice and 13-lined ground squirrels each comprised 34.4 percent of the sand terrace small mammal population. The deer mouse made up 21.8 percent of the population compared with 59.2 percent in 1977. Short-tailed shrews made up the remaining 9.3 percent of the sand terrace populations.

2.7.5 DISCUSSION

In the six years of studies carried out at Prairie Island, small mammal populations, particularly of the genus Peromyscus, have shown multiannual fluctuations which appear to be cyclical. Large population fluctuations are not unusual for small mammal populations (Goddard 1976). Population fluctuations have been documented on various species of small mammals throughout North America. Fluctuations of some populations are more regular than would be expected by chance and are commonly called cycles. Norling (1977) has reviewed some of the literature on this subject.

The best studied examples of small mammal cycles show a three-to four-year periodicity (Odum 1971). This is characteristic of many northern murids (lemmings, mice, and voles). Every three or four years, over large areas of the northern tundra, the lemmings (one species of the genus Lemmus and one species of Dicrostonyx) become extremely abundant only to "crash", often within a single season (Elton 1942). These cyclic fluctuations are generally confined to simpler ecosystems such as tundra and the desert. Similar fluctuations, although not as extreme, have occurred with two species of the genus Peromyscus at Prairie Island (Zajicek 1978). Other researchers studying small mammal populations in the midwest have observed these fluctuations (Goddard 1976).

Two species of Peromyscus are found in the Prairie Island vicinity, Peromyscus lencopus, the white-footed mouse, and Peromyscus maniculatus, the deer mouse (for further discussion of subspecies, habitat preferences, and identification problems of this genus, see Zajicek 1978). Data for these two species have been grouped for comparison purposes. This information negates any identification differences between researchers over the years, and provides the best index of

change in their populations at Prairie Island. Table 2.7-7 and Figure 2.7-1 represent the combined Schnabel population estimate of Peromyscus maniculatus and Peromyscus lencopus for all transects from 1975 to 1978. Populations in 1975 reached a September low of 100, peaked at 600 in 1977, and dropped to 260 in 1978.

Figures 2.7-2, 2.7-3, and Table 2.7-8 illustrate Peromyscus population fluctuations within the habitats studied. Oak forest apparently provided the most optimal habitat for Peromyscus populations in the Prairie Island area. It also showed the greatest fluctuations of populations. In oak forests, Peromyscus exhibits a three-year period between population peaks and valleys with an 83 percent variation between highs and lows. Oak forest September totals showed an increase in numbers from 1973 to 1974, then a "crash" to the 1975 low point of 58 with a two-year increase to 334 in 1977, followed by a decline in 1978 to 72 (Figure 2.7-2).

From previous data, grassland-shrub transects appeared to be following a similar three-year cycle, however, 1978 population estimates do not support this. Grassland-shrub September population totals increased from 1973 to 1974 with a drop in 1975 to nearly zero, then a gradual increase in 1976 to 25, followed by two more years of increase in 1977 and 1978 to a high of 98 (Figure 2.7-3).

Sand terrace populations are following a pattern similar to oak forests but with less variation between highs and lows. Peromyscus populations reached a low of one in September, 1975 and peaked in 1977 at 74, then declined in 1978 to 25 (Figure 2.7-3).

Lowland forest habitat does not appear to exhibit the three-year cycle. Lowland forest Peromyscus populations peaked in 1976 at 140. The following two years showed a

steady decline to a total of 92 in 1978 (Figure 2.7-2). A major reason for this pattern may be due to the periodic flooding the lowland forest transects experienced. Flooding would induce a major environmental stress that the other habitats studied would not have. Another difference is that the lowland forest habitat experiences cooling tower icing and fogging along Transect 2. In the winter months Transect 2 is transformed into a winter wonderland of heavy frost accumulations and artificial snow from the power plant cooling towers. However, the 1978 data indicate the small mammal population on Transect 2 is higher than other lowland forest transects.

There is no general agreement among mammalogists as to the causes of multiannual fluctuations of small mammal populations (Cockrum 1962). A number of theories have been proposed including food, predators, parasites and diseases, sunspots, weather, reproductive rate, diet, hormones, and randomness. The theory that population-wide exhaustion of certain hormone systems causes drastic decline of populations has a good deal of data to support it (Cockrum 1962). Christian and Davis (1956) found that "there is a density-dependent stimulus to the pituitary-adrenocortical system of wild Norway rats that operates independently of season or supplies of the usual environmental necessities." Other researchers have proposed that multiannual fluctuations are not cyclic, but are strictly random in the distribution of highs and lows. They state that these fluctuations are an expression of the fact that the influence of the environment is not simple (Cole 1951).

Direct negative impacts of the nuclear power plant on small mammals could result from habitat modifications including construction, landscaping, bulldozing, erosion, and possibly cooling tower frost damage. However, this study indicates that small mammal populations on non-modified habitats in

the plant vicinity are fluctuating normally with no measurable influence from the operation of the power plant. Perhaps the factor of greatest influence on the diversity and abundance of small mammal species in the Prairie Island vicinity has been community succession. Particularly in open habitats (grassland and sand terrace), the last six years have shown ecologically significant changes. Succession is proceeding from plowed fields, in some cases, to shrub woodland. Small mammal species have been changing accordingly, with harvest mice and prairie deer mice being replaced by the white-footed mouse in these communities (such as Transects 5, 7, 8, and 11).

2.7.6 SUMMARY

Small mammal populations in the Prairie Island vicinity showed an overall decline in numbers over the 1977 totals. The population of Peromyscus species dropped in all habitats except grassland-shrub, where it increased 53.0 percent over 1977. The white-footed mouse accounted for the increase in the grassland-shrub habitat.

Oak forest habitat supported the highest populations of small mammals. The most abundant species was the white-footed mouse followed by the eastern chipmunk and the short-tailed shrew. Lowland forest and grassland-shrub habitats supported nearly equal populations, with the white-footed mouse comprising the majority of mammals trapped in both. Deer mice showed an overall decrease in grassland-shrub habitat, but still comprised 40.5 percent of the population. Sand-terrace habitat ranked lowest in population, with the white-footed mouse most abundant.

Small mammal trapping in 1978 did not detect the presence of the western harvest mouse, meadow jumping mouse, or house mouse. However, the eastern chipmunk and southern flying squirrel were captured.

Peromyscus species data for 1978 indicate that multiannual population fluctuations are occurring in the Prairie Island vicinity. Oak forest habitat and sand terrace habitat appear to be fluctuating on a three-year cycle. No regular fluctuation is apparent for lowland forest and grassland-shrub habitats. Power plant operation does not appear to be significantly influencing population changes. Community succession in the open habitats is contributing to small mammal changes in diversity and abundance of species.

2.7.7 LITERATURE CITED

Christian, John J., and David E. Davis. 1956. The relationship between adrenal weight and population status of urban Norway rats. J. Mammal. 37(4):475-486.

Cockrum, E. Lendell. 1962. Introduction to Mammalogy. The Ronald Press Company, New York.

Cole, Lamont C. 1951. Population cycles and random oscillations. J. Wildl. Mgt. 15:233-252.

Elton, Charles. 1942. Voles, Mice, and Lemmings: Problems in Population Dynamics. Oxford University Press, London.

Giles, Robert H. 1969. Wildlife Management Techniques The Wildlife Society. 633 pp.

Goddard, Stephen V. and James W. Richardson. 1973. Environmental Monitoring and Ecological Studies Program. 1972 Annual Report for the Prairie Island Nuclear Generating Plant. Terrestrial Ecological Studies. Northern States Power Company. pp. C-429 - C464.

Goddard, Stephen V. and James W. Richardson. 1974. Environmental Monitoring and Ecological Studies Program. 1973 Annual Report for the Prairie Island Nuclear Generating Plant. Terrestrial Ecological Studies. Northern States Power Company. Vol. 2: pp. C-8.1 - C-8.212.

Goddard, Stephen V. 1976. Terrestrial Animal Population Studies Adjacent to the Prairie Island Generating Plant. Environmental Monitoring and Ecological Studies Program. 1975 Annual Report for the Prairie Island Nuclear Generating Plant. Northern States Power Company. Vol. 2: pp. 2.7.2-1 - 2.7.2.80.

Norling, Wayne. 1977. Small Mammal Study Four-year Report on Small Mammal Populations. 1976 Annual Report for the Prairie Island Nuclear Generating Plant. Northern States Power Company. Vol. 2: pp. 2.7.3-1 - 2.7.3-25.

Odum, Eugene P. 1971. Fundamentals of Ecology. W. B. Saunders Company, Philadelphia, London, Toronto.

Zajicek, Thomas E. 1978. Small Mammal Study. 1977 Annual Report for the Prairie Island Nuclear Generating Plant. Northern States Power Company. pp. 2.7-1 - 2.7-27.

277 166

Table 2.7-1 Total Individuals Trapped In All Transects for 1978

Species	May	Sept-Oct	Total
White-footed mouse	91	169	260
Deer mouse	14	17	31
Short-tailed shrew	0	28	28
13-Lined ground squirrel	9	6	15
Eastern chipmunk	0	5	5
Meadow vole	0	1	1
Southern flying squirrel	1	0	1
TOTAL	115	226	341

277 167

Table 2.7-2 Summary of Small Mammal Population Estimates For 1978

Species	May Pop.Est.*	May Min.Pop**	Sept - Oct Pop.Est.	Sept - Oct Min.Pop.
Transect 1				
White-footed mouse	49	45	41	34
Short-tailed shrew	-	-	-	2
Transect 2				
White-footed mouse	22	20	57	40
Short-tailed shrew	-	-	2	2
Transect 3				
White-footed mouse	-	2	20	18
Deer mouse	-	-	-	3
Short-tailed shrew	-	-	-	6
13-Lined ground squirrel	-	-	-	5
Transect 5				
White-footed mouse	23	19	23	31
Southern flying squirrel	-	1	-	-
Short-tailed shrew	-	-	-	1
Eastern chipmunk	-	-	8	5
Transect 7				
White-footed mouse	-	-	54	19
Deer mouse	1	1	-	-
Short-tailed shrew	-	-	-	11
Meadow vole	-	-	-	1
Transect 8				
Deer mouse	9	7	-	2
13-Lined ground squirrel	16	7	-	1
Transect 11				
White-footed mouse	-	-	2	2
Deer mouse	-	6	42	12
13-Lined ground squirrel	-	2	-	-
Short-tailed shrew	-	-	2	2
Transect 12				
White-footed mouse	-	-	3	3
Short-tailed shrew	-	-	-	3
Transect 16				
White-footed mouse	5	5	32	22
Short-tailed shrew	-	-	-	1

*Estimate based on the Schnabel Technique

**Number based on total individuals trapped

Table 2.7-3 Small Mammal Populations For Oak Forest Habitat In 1978*

Species	May	Sept-Oct	Total
White-footed mouse	72	64	136
Short-tailed shrew	0	3	3
Eastern chipmunk	0	8	8
Southern flying squirrel	1	0	1
TOTALS	73	75	148
Mammals/acre	45.6	46.9	92.5
Mammals/hectare	115.9	119.0	234.9

*Area trapped: 1.6 acres or 0.63 hectare

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Table 2.7-4 Small Mammal Populations For Lowland Forest Habitat In 1978*

Species	May	Sept-Oct	Total
White-footed mouse	27	92	119
Short-tailed shrew	0	6	6
TOTALS	27	98	125
Mammals/acre	11.3	40.8	52.1
Mammals/hectare	28.7	104.2	133.0

*Area trapped: 2.4 acres or 0.94 hectare.

277 170

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Table 2.7-5 Small Mammal Populations For Grassland-Shrub Habitat In 1978*

Species	May	Sept-Oct	Total
White-footed mouse	0	56	56
Deer mouse	7	42	49
Short-tailed shrew	0	13	13
13-Lined ground squirrel	0	2	2
Meadow vole	0	1	1
TOTALS	7	114	121
Mammals/acre	4.4	71.2	75.6
Mammals/hectare	11.1	180.9	192.1

*Area trapped: 1.6 acres or 0.63 hectare

277 171

Table 2.7-6 Small Mammal Populations For Sand Terrace Habitats In 1978*

Species	May	Sept-Oct	Total
White-footed mouse	2	20	22
Deer mouse	9	5	14
Short-tailed shrew	0	6	6
13-Lined ground squirrel	16	6	22
TOTALS	27	37	64
Mammals/acre	16.9	23.1	40.0
Mammals/hectare	42.8	58.7	101.6

*Area trapped: 1.6 acres or 0.63 hectare

277 172

Table 2.7-7 Annual Population Estimates For *Peromyscus* sp. (Combined White-footed mouse and Deer mouse)*

Transect	1975 May	1975 Sept	1976 May	1976 Sept	1977 May	1977 Sept	1978 May	1978 Sept-Oct
1	15	31	12	40	34	218	49	41
2	6	15	141	95	22	25	22	57
3	2	0	28	24	15	53	2	23
5	0	27	14	90	37	116	23	31
7	0	1	2	22	13	14	1	54
8	3	1	68	2	16	21	9	2
11	0	1	6	3	5	32	6	44
12	4	12	7	56	44	93	0	3
16	2	13	22	89	9	29	5	32
TOTALS	32	101	300	421	195	601	117	287

*Numbers are based on combined Schnabel population estimates, except when estimate is less than total individuals trapped, then minimum population was used.

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Table 2.7-8 Annual *Peromyscus* sp. Totals By Habitat

Habitat	1975 May	1975 Sept	1976 May	1976 Sept	1977 May	1977 Sept	1978 May	1978 Sept-Oct
Oak forest	15	58	26	130	71	334	72	72
Lowland forest	12	40	170	240	75	147	27	92
Grassland - shrub	0	2	9	25	18	46	7	98
Sand terrace	5	1	96	26	31	74	8	25

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Table 2.7-9 Common and Scientific Names of Small Mammals Trapped During the 1978 Study

Short-tailed shrew	*Blarina brevicauda*
13-Lined ground squirrel	*Citellus tridecemlineatus*
Southern flying squirrel	*Glaucomys volans*
Eastern chipmunk	*Tamias striatus*
Deer mouse	*Peromyscus maniculatus*
White-footed mouse	*Peromyscus leucopus*
Meadow vole	*Microtus pennsylvanicus*

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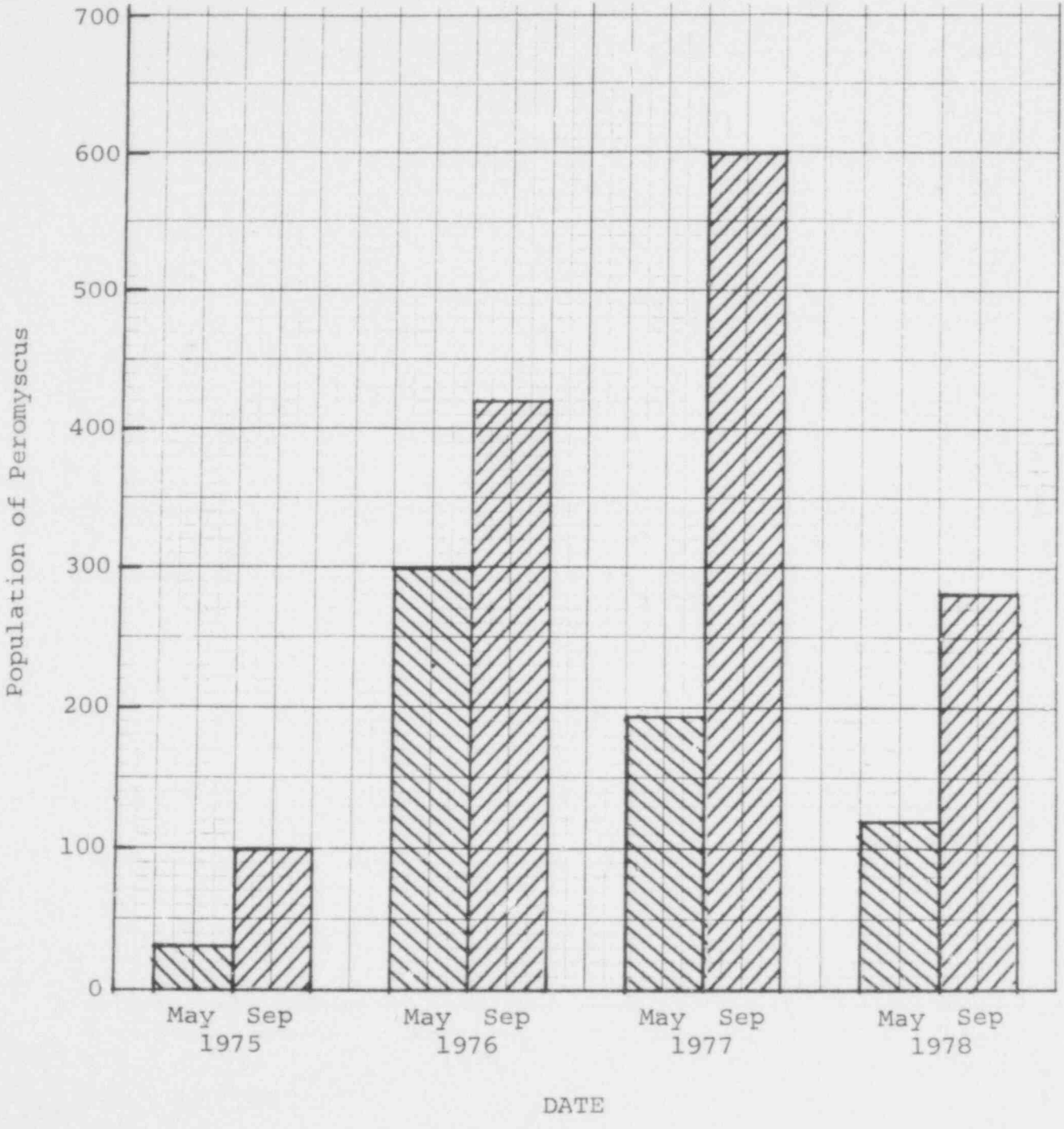
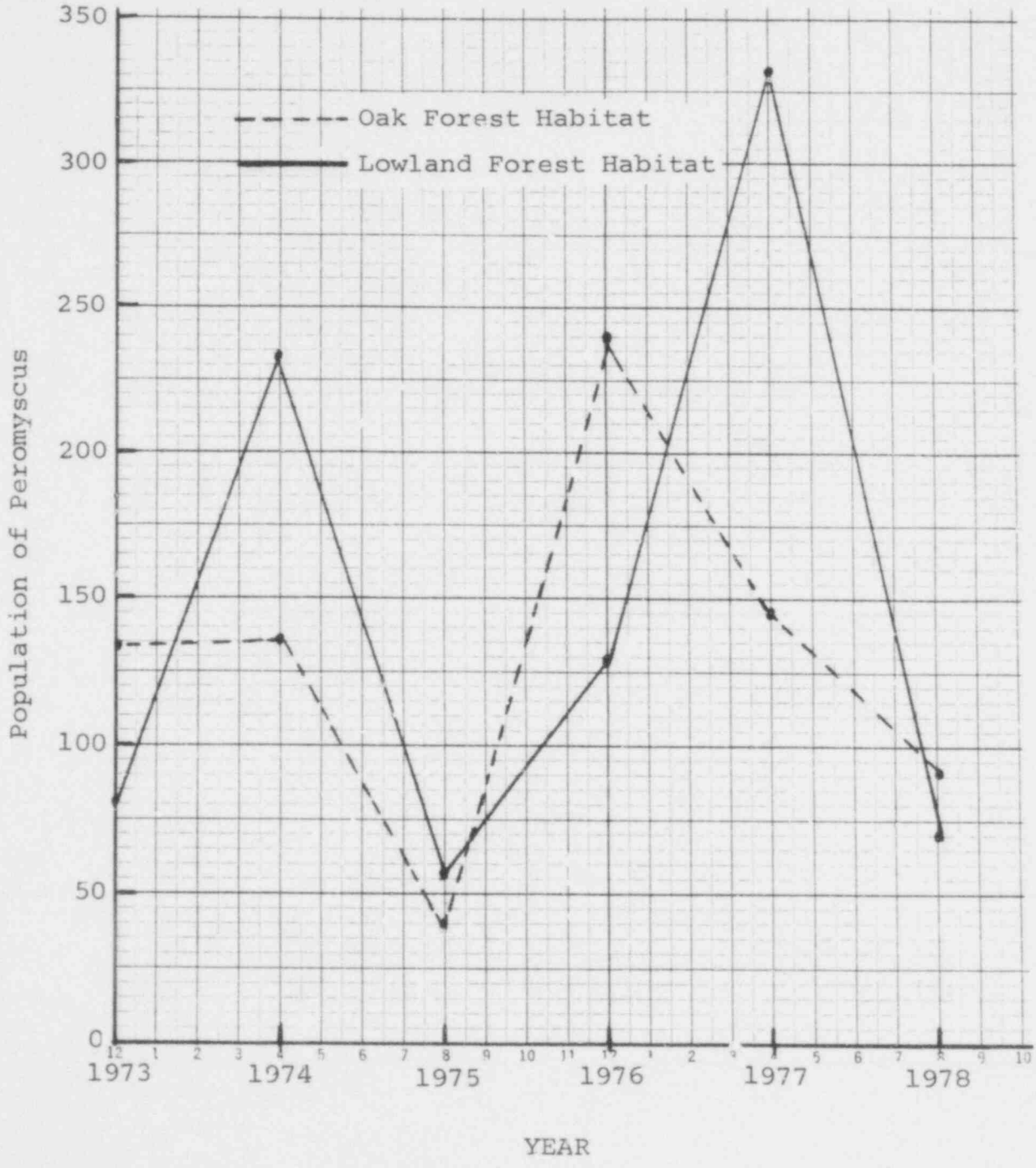
Figure 2.7-1. Annual Peromyscus sp. Population Totals for all Transects. May and September Schnabel Estimates.



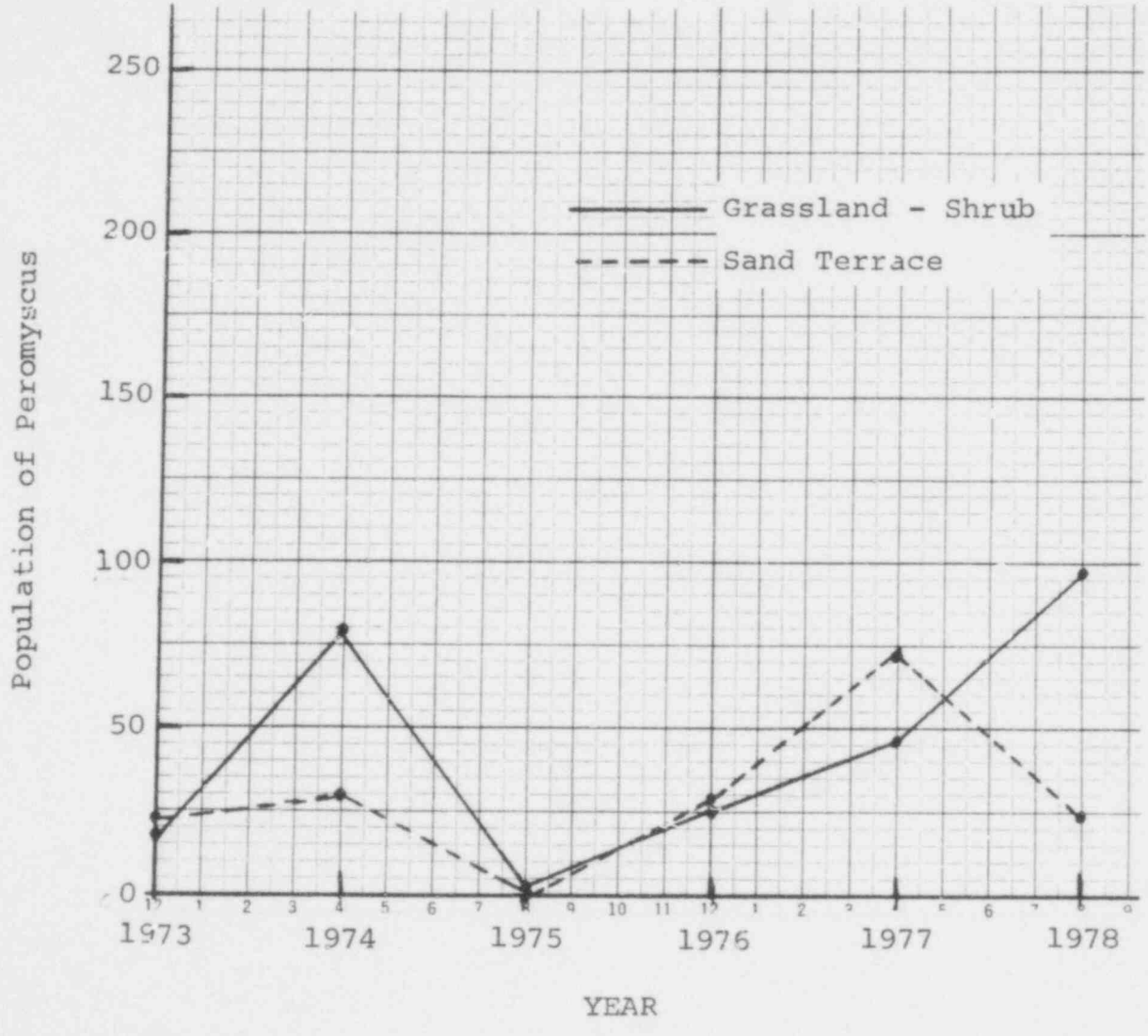
277 176

Figure 2.7-2. Annual September Peromyscus sp. Total (Based on Schnabel Method).



277 177

Figure 2.7-3. Annual September Peromyscus sp. Totals (Based on Schnabel Method).



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PRAIRIE ISLAND NUCLEAR GENERATING PLANT
ENVIRONMENTAL MONITORING PROGRAM
1978 ANNUAL REPORT
ECOLOGICAL STUDIES

SPECIAL STUDIES

NUMBER AND COMPOSITION OF BIRDS KILLED BY STRIKING TRANSMISSION LINES FROM THE PRAIRIE ISLAND NUCLEAR GENERATING PLANT

(3.1)

Prepared for

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3.1 BIRDS KILLED BY STRIKING ELECTRICAL TRANSMISSION LINES

3.1.1 INTRODUCTION

This is a final report on a five-year study on bird mortality caused by birds hitting the transmission lines from the Prairie Island Nuclear Generating Plant. The study was initiated in 1974 and continued through May 1978. The objectives of this study were to:

1. Obtain an index of the composition and magnitude of birds killed by striking the lines at different times of the year

2. Determine whether there was a relationship between the species and number of birds killed and the different study transects

3. Ascertain whether there was relationship between the number of birds killed and the orientation of the transmission lines to the Mississippi River

4. Obtain an estimate of the number of birds striking the transmission lines which were subsequently removed by predators.

3.1.2 DESCRIPTION OF THE STUDY AREA

The study area has been described in a previous report (Goddard 1977).

3.1.3 METHOD OF PROCEDURE

The method of procedure was similar to that described in earlier reports (Goddard 1977 and 1978). During 1978, walks

were again conducted on a weekly basis from April 22 to May 27. All fresh kills were marked with a pole topped by a yellow plastic flag which was located approximately 3-4 meters to the right of a dead bird. Subsequent observations were made to determine whether the bird had been eaten or removed by predators. Observations were recorded whether feathers or any other evidence remained if the bird was removed by a predator. The location and species were recorded for all the kills observed. A chi-square analysis (Steel and Torrie 1960) was conducted to determine if there was a dependent relationship between species killed and the transect in which the kill was observed.

3.1.4 RESULTS

During 1978 there were 68 birds representing 20 species found during the six walks. For the five years of the study, there were 453 birds representing 53 species and five unknowns found. The species, number, and percentage composition of the sample is shown in Table 3.1-1.

Eight species made up approximately 63 percent of the sample. These species were mourning dove (16.1 percent), starling (15.7 percent), red-winged blackbird (7.3 percent), common grackle (7.3 percent), brown-headed cowbird (5.7 percent), ring-necked pheasant (4.4 percent), American coot (3.7 percent), and sora rail (2.4 percent). Twenty-three species were represented by a single kill.

There was a statistically significant difference in the number of birds found dead by date and transect. About 64 percent of the dead birds were found in only four transects (Table 3.1-2). These were Transect 2 (20.8 percent), Transect 10 (15.5 percent), and Transects 3 and 11 (14.0 percent each). These four transects are all located perpendicular to the Mississippi River. Transects 6 and 7 were

located more or less perpendicular to the Vermillion River. However, only 7.3 percent of the dead birds were found in these two transects. The other six transects accounted for the remaining 28.4 percent of the sample.

During the last part of the study, 26 of the fresh kills were marked. On subsequent walks, 12 were still present as were feathers from three others. No trace remained of the other 11. Approximately 42 percent of the dead birds disappeared without a trace.

3.1.5 DISCUSSION AND CONCLUSIONS

The 53 species of dead birds recorded indicated that a wide variety of birds migrating through or living in the study area are killed by striking the transmission lines. However, the transmission lines result in a greater number of deaths in only a few species. This is indicated by the fact that 23 species were represented by a single kill.

The large number of mourning doves killed was undoubtedly attributable to their nesting in the area. Most mourning doves nested in a conifer plantation about 100 meters north of Areas 2 and 11 and about 200 meters northeast of Areas 3 and 10.

The relatively large number of starlings killed was probably because they are early migrants, and because they passed through the study area in large numbers during periods of inclement weather. The same reasons were probably true for grackles and red-winged blackbirds, but they were not killed in such great numbers. The low kill of grackles is also unusual, because they nested in the highest numbers of any species in the study area. In addition, many grackles nested in the same stand of conifers as the mourning doves.

The large number of ring-necked pheasants was not expected, since it was felt that few of them would fly high enough to strike the transmission lines. It is possible that some of them may have been killed by predators using the transmission towers as perches. The kills may have been simply a function of density, since 60 percent of the kills were found in Transects 2 and 11, which passed through some of the best pheasant habitat at Prairie Island.

The number of coots and sora rails killed was probably because they are nocturnal migrants, and most of them were found following a period when it rained at night, and there was a low ceiling that caused migrating birds to fly lower.

Since six of the eight species killed in the highest numbers nested in from high to very high numbers in the study area, it seems apparent that many nesting birds were killed. In many cases, the loss of a nesting parent would also result in a loss of its young.

The significant difference between the number of birds killed by date is not surprising, when considering the duration and tremendous variation in weather that occurred during the study. The largest kills were recorded when it had been raining, and/or there was a low ceiling on the nights preceding the walks. Few birds were found when the previous nights had been clear and mild.

Generally, larger numbers of dead birds were found in spring; this was because of several factors. First, the weather fluctuated to a greater degree. Second, the vegetation was just starting to grow and was not as dense as it would be later in the fall. Third, more counts were conducted in the spring, which increased the possibility of a walk taking place after a night when a large number of birds had been killed. Fourth, the fall walks were conducted

early in the migration period when the weather was more conducive to nocturnal migration. The clear nights would result in nocturnal migrants flying higher, thus passing over the transmission lines.

The significant difference between the number of birds killed in the four transects was due to the orientation of the transmission lines perpendicular to the migration corridor along the Mississippi River. There was an average of 16 percent of birds killed in each of these four transects. This was contrasted with an average of only 4.5 percent of the birds killed for each of the remaining eight transects.

However, low numbers of dead birds, an average of 3.7 percent, were recorded for two transects, which were oriented at an angle of about 50 degrees in relation to the Vermillion River. There are several possible explanations for this phenomenon. The length of the lines was the shortest because they crossed over the river. These were the only transects that ran through a forest area. For much of their length, the lines were at or below the tops of the trees. It is certainly possible that the trees caused birds to fly higher and thus avoid the lines. This would even be true when there was a low cloud ceiling. Birds moving through the tree tops would be flying slower and could more easily avoid the lines or even pass under the lines. In addition, there was an accumulated leaf litter and a heavy undergrowth which made it more difficult to locate dead birds.

The number of birds found was certainly a minimum estimate of the kill and would best be used as an index of the impact of the lines. Obviously there were dead birds that were not located. This number was probably not as great as would be true in other habitats because of the open nature of the

terrain and lack of dense vegetation on most of the ground under the transmission lines. The marked bird study indicated that about 42 percent of the birds were removed by predators. This figure does not include birds that were removed by predators before the transects were walked and birds were marked. The 42 percent may not be representative because of the small samples size (26) of marked birds. It is also possible that some birds could hit the wires and flutter away only to die later from their injuries. Based on these considerations, it would be safe to state that the actual number of birds killed is, at a minimum, double the number actually found.

Other studies have indicated that bird mortality results from striking transmission lines. A North Dakota study (McKenna and Allard 1976) reported finding 244 dead birds representing 18 species on 11 sample days between May 31 and August 24. These birds were killed by striking transmission lines perpendicular to a crossing between two lakes. The four species which made up approximately 80 percent of the kill were all low flying species.

In a California study prepared for Pacific Gas and Electric Company, Arend (1970) stated:

> "Electric power transmission lines mounted on steel towers cause very minor avian loss, and their adverse ecological impact on avian populations is negligible."

The transmission lines referred to are lines that carry over 60 kv. A major shortcoming of this study is that much of the information was based on written inquiries to individuals and agencies and pertained to instances where large numbers of birds were killed. The report did not deal with comprehensive studies, but instead was based more on casual

observations. In addition, many of the inquiries involved species that normally are found in heavily vegetated areas, where even large numbers of dead or injured birds could not easily be located.

The similarity in the number of dead birds found from year to year in the Prairie Island study area indicated that this technique is an accurate, low-cost method of obtaining an index of the number and composition of birds killed by striking transmission lines in that location. The study also provides base line data that can be used for comparison purposes if future studies are deemed necessary. However, I see no reason for the continuation of this study at the present time.

The study indicates that the best way to reduce birds kills resulting from striking transmission lines is to orient the lines parallel to bird migration corridors wherever possible. Locating transmission lines perpendicular to migration corridors will result in many more birds being killed. In a 1972 study Beer and Ogilvie stated:

> "Wires are particularly lethal when they run across rivers and channels, or pass close to sites holding large concentrations of birds."

The impact of transmission lines perpendicular to a migration corridor is further evidenced by a statement from the Environmental Assessment for a Proposed Crossing of the Mississippi River by a 161 kv Transmission Line. The assessment stated:

> Leigh H. Fredrickson, Gaylord Memorial Laboratory, who is presently conducting a study involving the effects of power lines on avian movements, stated that power lines running across the Mississippi

River at right angles to waterfowl flight paths, coupled with the timber-marsh funneling effect, would cause serious losses.

Other factors that should be considered in locating transmission lines are local terrain features such as forested areas and bluffs (which may make the lines more difficult to see) and the heights at which birds normally fly when passing over these areas. At Prairie Island it appears that birds strike the lines and are killed more often where vegetation below the lines is low than where it is high. Unfortunately, this was difficult to demonstrate because of the scarcity of forest habitat. Bird losses can be reduced in this situation by locating transmission lines so they are below the tops of trees whenever possible. The birds would then fly higher than the trees, or at least "flare up" to clear the trees and thus miss the wires.

3.1.6 LITERATURE CITED

Anonymous. 1976. Proposed Genoa-Lansing 161 KV Transmission Line Crossing Through the Upper Mississippi River Wildlife and Fish Refuge. Lansing District. U.S. Fish and Wildlife Service. Environmental Assessment.

Arend, Phillip H. 1970. The Ecological Impacts of Transmission Lines on the Wildlife of San Francisco Bay. Report prepared for Pacific Gas and Electric Company.

Beer, J. V. and M. A. Ogilvie. 1972. In The Swans: Scott, 1972: pp. 129-130. Michael Joseph, LTD. London.

Goddard, Stephen V. 1977. Number and Composition of Birds Killed by Striking Transmission Lines from the Prairie Island Nuclear Generating Plant. NSP 1976 Annual Report for the Prairie Island Nuclear Generating Plant Vol. 2 pp. 2.7.5.1-1 through 2.7.5.1-21.

McKenna, M. G. and G. E. Allard. 1976. Avian Mortality from Wire Collisions. North Dakota Outdoors. 39(5): pp. 16-18.

Steel, R. G. D. and James H. Torrie. 1960. Principles and Procedures of Statistics. McGraw-Hill Book Company.

Winer, B. J. 1962. Statistical Principles in Experimental Design. McGraw-Hill Book Company.

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Table 3.1-1 Summary of birds collected by species under the transmission lines from the Prairie Island Nuclear Generating Plant

Species	Number Found	Percent
Mourning dove	73	16.1
Starling	71	15.7
Red-winged blackbird	33	7.3
Common grackle	33	7.3
Brown-headed cowbird	26	5.7
Unknown unknown	21	4.6
Ring-necked pheasant	20	4.4
American coot	17	3.7
Sora rail	11	2.4
Robin	10	2.2
Vesper sparrow	9	2.0
Wood duck	8	1.8
Dark-eyed junco	8	1.8
Unknown sparrow	8	1.8
Western meadowlark	7	1.5
American goldfinch	7	1.5
Unknown warbler	6	1.3
Unknown thrush	5	1.1
Ovenbird	5	1.1
Eastern meadowlark	4	0.8
Killdeer	4	0.8
Catbird	3	0.7
Mallard	3	0.7
Rock dove	3	0.7
House wren	3	0.7
Common snipe	3	0.7
Northern oriole	3	0.7
Rose-breasted grosbeak	2	0.4
House sparrow	2	0.4
Black duck	2	0.4

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Table 3.1-1 (Continued)

Species	Number Found	Percent
Red-eyed vireo	2	0.4
Yellowthroat	2	0.4
Tree swallow	2	0.4
Savannah sparrow	2	0.4
Great blue heron	1	0.2
Hungarian partridge	1	0.2
Swamp sparrow	1	0.2
Chestnut-sided warbler	1	0.2
Tennessee warbler	1	0.2
Field sparrow	1	0.2
Ruddy duck	1	0.2
Green heron	1	0.2
Ruby-throated hummingbird	1	0.2
Yellow-shafted flicker	2	0.4
Short-billed dowitcher	1	0.2
Pectoral sandpiper	1	0.2
Spotted sandpiper	1	0.2
Semi-palmated sandpiper	1	0.2
Pied-billed grebe	1	0.2
Blue jay	1	0.2
White-throated sparrow	1	0.2
Tree sparrow	1	0.2
Blackpoll warbler	1	0.2
Hooded merganser	1	0.2
Unknown duck	1	0.2
Rusty blackbird	1	0.2
Song sparrow	1	0.2
Virginia rail	1	0.2
Total	443	96.9

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Table 3.1-2 Summary of the birds collected under the transmission lines from the Prairie Island Nuclear Generating Plant by date from 1974-1978

Transect No 1

Date	SPECIES												
	Starling	Unknown sparrow	Catbird	Robin	Red-winged blackbird	Dark-eyed junco	Unknown	Brown-hd. cowbird	Great blue heron	Mourning dove	Song sparrow	Ovenbird	Amer. coot
4/21/74	1	1	0	0	0		0	0	0	0	0	0	0
5/23/74	0	0	1	0	0	0	0	0	0	0	0	0	0
9/13/74	1	0	0	0	0	0	0	0	0	0	0	0	0
4/19/75	0	0	0	2	1	1	1	0	0	0	0	0	0
5/23/75	0	0	0	1	0	0	0	1	0	0	0	0	0
9/12/75	0	0	0	0	0	0	0	0	0	0	0	0	0
4/16/76	1	0	0	0	0	0	0	0	0	0	0	0	0
6/3/76	0	0	0	0	0	0	0	0	0	0	0	0	0
9/10/76	0	0	0	0	0	0	0	0	0	0	0	0	0
4/15/77	0	0	0	0	0	0	0	0	1	0	0	0	0
5/13/77	0	0	0	0	0	0	0	0	0	0	1	0	0
5/20/77	0	0	0	0	0	0	0	0	0	0	0	0	0
5/27/77	0	0	0	0	0	0	0	0	0	0	0	0	0
8/21/77	0	0	0	1	0	0	0	0	0	0	0	0	0
8/28/77	0	0	0	0	0	0	0	0	0	1	0	0	0
9/2/77	0	0	0	0	0	0	0	0	0	0	0	1	0
9/10/77	0	0	0	0	0	0	0	0	0	0	0	0	0
4/22/78	0	0	0	0	0	0	0	0	0	0	0	0	1
4/29/78	0	0	0	0	0	0	0	0	0	0	0	0	0
5/6/78	0	0	0	0	0	0	0	0	0	0	0	0	0
5/13/78	0	0	0	0	0	0	0	0	0	0	0	0	0
5/20/78	0	0	0	0	0	0	0	0	0	0	0	0	0
5/27/78	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	3	1	1	4	1	1	1	1	1	1	1	1	1

Table 3.1-2 (Continued)

Transect
No. 2

Date	SPECIES										
	Brown-hd. cowbird	Starling	Vesper sparrow	Unknown	Ring-nk. pheasant	Sora rail	Rose-brst. grosbeak	Mourning dove	Amer. coot	American goldfinch	Red-winged blackbird
4/21/74	1	3	1	1	1	1	0	0	0	0	0
5/23/74	1	0	0	0	0	1	2	1	0	0	0
9/13/74	0	1	0	0	1	2	0	1	0	0	0
4/29/75	0	2	0	3	1	0	0	0	1	1	4
5/23/75	0	1	0	0	1	0	0	1	0	0	4
9/12/75	0	0	0	0	0	1	0	1	0	0	0
4/16/76	1	4	0	0	1	0	0	1	0	0	3
6/3/76	1	1	0	1	1	0	0	3	0	0	1
9/10/76	1	0	2	0	0	2	0	1	0	0	0
4/15/77	0	1	0	0	1	0	0	1	0	0	0
5/13/77	0	0	0	0	0	0	0	2	0	0	0
5/20/77	0	4	0	0	0	0	0	1	0	0	0
5/27/77	0	0	0	0	0	0	0	0	0	0	0
8/21/77	0	0	0	0	0	0	0	0	0	0	0
8/28/77	0	0	0	0	0	0	0	0	0	0	0
9/2/77	0	0	0	0	0	0	0	0	0	0	0
9/10/77	0	0	0	0	0	0	0	1	0	0	0
4/22/78	0	0	0	0	0	0	0	0	0	0	0
4/29/78	0	0	0	0	0	0	0	0	0	0	0
5/6/78	0	0	0	0	0	0	0	0	0	0	0
5/13/78	0	0	0	1	1	0	0	0	0	0	0
5/20/78	0	0	0	0	0	0	0	0	0	0	0
5/27/78	0	0	0	0	0	0	0	0	0	0	0
Total	5	17	3	6	8	7	2	14	1	1	12

Table 3.1-2 (Continued)

Transect
No. 2

Date	SPECIES									
	Baltimore oriole	Common grackle	Slate-col. junco	Mallard	Common snipe	House sparrow	Wood duck	House wren	Unknown thrush	Unknown sparrow
4/21/74	0	0	0	0	0	0	0	0	0	0
5/23/74	0	0	0	0	0	0	0	0	0	0
9/13/74	0	0	0	0	0	0	0	0	0	0
4/19/75	0	0	0	0	0	1	1	0	0	0
5/23/75	0	0	0	0	0	0	0	1	0	0
9/12/75	0	0	0	0	0	0	0	0	0	0
4/16/76	0	1	0	0	0	0	0	0	0	0
6/3/76	0	0	0	0	0	0	0	0	1	1
9/10/76	0	0	0	0	0	0	0	0	0	0
4/15/77	0	1	2	0	0	0	0	0	0	0
5/13/77	1	0	0	0	0	0	0	0	0	0
5/20/77	0	0	0	0	0	0	0	0	0	0
5/27/77	0	0	0	0	0	0	0	0	0	0
8/21/77	0	0	0	0	0	0	0	0	0	0
8/28/77	0	0	0	0	0	0	0	0	0	0
9/2/77	0	0	0	0	0	0	0	0	0	0
9/10/77	0	0	0	0	0	0	0	0	0	0
4/22/78	0	1	0	1	1	0	0	0	0	0
4/29/78	0	2	0	0	0	0	0	0	0	0
5/6/78	0	1	0	0	0	0	0	0	0	0
5/13/78	0	1	0	0	0	0	0	0	0	0
5/20/78	0	0	0	0	0	0	0	1	0	0
5/27/78	0	0	0	0	0	0	0	0	0	0
Total	1	7	2	1	1	1	1	2	1	1

Table 3.1-2 (Continued)

Transect No. 3

Date	SPECIES										
	Unknown sparrow	Starling	Eastern meadowlark	Hungarian partridge	Swamp sparrow	Chestnut-sd. warbler	Mourning dove	Black duck	Sora rail	American coot	Unknown
4/21/74	1	1	1	1	0	0	0	0	0	0	0
5/23/74	0	0	0	0	1	1	1	1	0	0	0
9/13/74	0	0	0	0	0	0	2	0	2	0	0
4/19/75	0	1	2	0	0	0	1	0	1	1	1
5/23/75	0	1	0	0	0	0	0	0	0	0	0
9/12/75	0	0	0	0	0	0	0	0	0	0	0
4/16/76	0	4	0	0	0	0	1	0	0	0	1
6/3/76	0	1	0	0	0	0	0	0	0	0	0
9/10/76	0	0	0	0	0	0	0	0	0	0	0
4/15/77	0	0	0	0	0	0	0	0	0	0	0
5/13/77	0	0	0	0	0	0	1	0	0	0	0
5/20/77	0	1	0	0	0	0	0	0	0	0	0
5/27/77	0	1	0	0	0	0	0	0	0	0	0
8/21/77	0	0	0	0	0	0	0	0	0	0	0
8/28/77	0	0	0	0	0	0	0	0	1	0	0
9/2/77	0	0	0	0	0	0	0	0	0	0	0
9/10/77	0	0	0	0	0	0	1	0	0	0	0
4/22/78	0	1	0	0	0	0	2	0	0	0	0
4/29/78	0	1	0	0	0	0	2	0	0	1	0
5/6/78	0	0	0	0	0	0	0	0	0	0	0
5/13/78	0	0	0	0	0	0	0	0	0	0	1
5/20/78	0	0	0	0	0	0	0	0	0	0	0
5/27/78	0	0	0	0	0	0	1	0	0	0	0
Total	1	12	3	1	1	1	12	1	4	2	3

Table 3.1-2 (Continued)

Transect No. 3

Date	SPECIES										
	American goldfinch	Tennessee warbler	Ovenbird	Brown-hd. cowbird	Western meadowlark	Common grackle	Catbird	Field sparrow	Spotted sandpiper	Red-wing. blackbird	Tree swallow
4/21/74	0	0	0	0	0	0		0	0	0	0
5/23/74	0	0	0	0	0	0	0	0	0	0	0
9/13/74	0	0	0	0	0	0	0	0	0	0	0
4/19/75	1	0	0	0	0	0	0	0	0	0	0
5/23/75	0	0	0	0	0	0	0	0	0	0	0
9/12/75	0	1	1	0	0	0	0	0	0	0	0
4/16/76	1	0	0	2	1	5	1	1	0	0	0
6/3/76	0	0	0	1	0	1	0	0	0	0	0
9/10/76	0	0	0	0	0	0	0	0	0	0	0
4/15/77	0	0	0	0	0	0	0	0	0	0	0
5/13/77	0	0	0	0	0	0	0	0	0	0	0
5/20/77	0	0	0	0	0	0	0	0	0	0	0
5/27/77	0	0	0	0	0	0	0	0	0	0	0
8/21/77	0	0	0	0	0	0	0	0	0	0	0
8/28/77	0	0	0	0	0	0	0	0	0	0	0
9/2/77	0	0	0	0	0	0	0	0	0	0	0
9/10/77	0	0	0	0	0	0	0	0	0	0	0
4/22/78	0	0	0	0	0	0	0	0	0	0	0
4/29/78	0	0	0	0	0	0	0	0	0	0	1
5/6/78	0	0	0	0	0	0	0	0	0	1	0
5/13/78	0	0	0	0	0	0	0	0	0	1	0
5/20/78	0	0	0	0	0	0	0	0	0	0	0
5/27/78	0	0	0	0	0	1	0	0	1	0	0
Total	2	1	1		1	7	1	1	1	2	1

Table 3.1-2 (Continued)

Transect
No. 4

Date	SPECIES													
	Western meadow-lark	Unknown sparrow	Ruddy duck	Starling	Common grackle	Mourning dove	Rock dove	Red-eyed vireo	Unknown	Red-wg. black-bird	Ring-nk. pheasant	Brown-headed cowbird	Baltimore oriole	American goldfinch
4/21/74	1	1	1	1	0	0	0	0	0	0	0	0	0	0
5/23/74	1	0	0	0	2	1	1	1	0	0	0	0	0	0
9/13/74	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4/19/75	1	0	0	1	0	2	0	0	2	1	0	0	0	0
5/23/75	1	0	0	1	0	1	0	0	0	0	0	0	0	0
9/12/75	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4/16/76	0	0	0	1	2	0	0	0	0	1	1	0	0	0
6/3/76	0	1	0	0	0	0	0	0	0	0	0	0	0	0
9/10/76	1	0	0	0	0	1	0	0	0	0	0	0	0	0
4/15/77	0	0	0	0	0	0	0	0	0	0	1	0	0	0
5/13/77	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5/20/77	0	0	0	1	0	0	0	0	0	0	0	0	1	0
5/27/77	0	0	0	0	0	0	0	0	0	0	0	1	0	0
8/21/77	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8/28/77	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/2/77	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/10/77	0	0	0	0	0	1	0	0	0	0	0	0	0	0
4/22/78	0	0	0	1	0	1	0	0	1	0	0	0	0	1
4/29/78	0	0	0	0	1	0	0	0	0	0	0	0	0	0
5/6/78	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5/13/78	0	0	0	0	1	0	0	0	0	0	0	0	0	0
5/20/78	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5/27/78	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	5	2	1	6	6	7	1	1	3	2	2	1	1	1

Table 3.1-2 (Continued)

Transect
No. 5

Date	SPECIES										
	Eastern meadowlark	Yellow-th. warbler	Dark-eyed junco	Mourning dove	Starling	Robin	Common grackle	Red-winged blackbird	Ring-nk. pheasant	Unknown	American goldfinch
4/21/74	1	0	0	0	0	0	0	0	0	0	0
5/23/74	0	0	0	0	0	0	0	0	0	0	0
9/13/74	0	1	0	0	0	0	0	0	0	0	0
4/19/75	1	0	1	2	1	1	1	1	0	0	0
5/23/75	0	0	0	0	0	0	0	0	0	0	0
9/12/75	0	0	0	0	0	0	0	0	1	0	0
4/16/76	0	0	0	0	0	0	0	1	0	1	0
6/3/76	0	0	0	0	0	0	0	0	0	0	1
9/10/76	0	0	0	0	0	0	0	0	0	0	0
4/15/77	0	0	0	0	0	0	1	0	0	0	0
5/13/77	0	0	0	0	0	0	0	0	0	0	0
5/20/77	0	0	0	0	1	0	0	0	0	0	0
5/27/77	0	0	0	0	0	0	0	0	0	0	0
8/21/77	0	0	0	0	0	0	0	0	0	0	0
8/28/77	0	0	0	0	0	0	0	0	0	0	0
9/2/77	0	0	0	0	0	0	0	0	0	0	0
9/10/77	0	0	0	0	0	0	0	0	0	0	0
4/22/78	0	0	0	0	0	0	0	0	0	0	0
4/29/78	0	0	0	0	0	0	0	0	0	0	0
5/6/78	0	0	0	0	0	0	0	0	0	0	0
5/13/78	0	0	0	0	0	0	0	0	0	0	0
5/20/78	0	0	0	0	0	0	0	0	0	0	0
5/27/78	0	0	0	0	0	0	0	0	0	0	0
Total	2	1	1	2	2	1	2	2	1	1	1

Table 3.1-2 (Continued)

Transect No. 6

Date	SPECIES										
	Wood duck	Ovenbird	Red-eyed vireo	Ring-necked pheasant	Mourning dove	Unknown	Unknown warbler	Hooded merganser	American coot	Starling	House wren
4/21/74	1	0	0	0	0	0	0	0	0	0	0
5/23/74	0	0	0	0	0	0	0	0	0	0	0
9/13/74	1	1	1	0	0	0	0	0	0	0	0
4/19/75	1	0	0	2	0	0	0	0	0	0	0
5/23/75	0	0	0	0	0	0	0	0	0	0	0
9/12/75	0	0	0	0	1	0	0	0	0	0	0
4/16/76	0	0	0	0	0	0	0	0	0	0	0
6/3/76	0	0	0	0	1	1	1	0	0	0	0
9/10/76	0	0	0	0	0	0	1	0	0	0	0
4/15/77	0	0	0	0	0	0	0	0	1	0	0
5/13/77	0	0	0	0	0	0	0	0	0	0	0
5/20/77	0	0	0	0	0	1	0	0	0	1	0
5/27/77	0	0	0	0	0	0	0	0	0	0	0
8/21/77	0	0	0	0	1	0	0	1	0	0	0
8/28/77	0	0	0	0	0	0	0	0	0	0	0
9/2/77	0	0	0	0	0	0	0	0	0	0	0
9/10/77	0	0	0	0	0	0	0	0	0	0	0
4/22/78	0	0	0	1	0	0	0	0	0	0	0
4/29/78	0	0	0	0	0	0	0	0	0	0	0
5/6/78	1	0	0	0	1	0	0	0	0	0	0
5/13/78	0	0	0	0	0	0	0	0	0	0	0
5/20/78	0	0	0	0	0	0	0	0	0	0	1
5/27/78	0	0	0	0	0	0	0	0	0	0	0
Total	4	1	1	3	4	2	2	1	1	1	1

Table 3.1-2 (Continued)

Transect
No. 7

Date	SPECIES								
	Wood duck	Unknown	Unknown warbler	Sora rail	Ovenbird	American coot	Mourning dove	Starling	Brown-headed cowbird
4/21/74	0	0	0	0	0	0	0	0	0
5/23/74	0	0	0	0	0	0	0	0	0
9/13/74	1	0	0	0	0	0	0	0	0
4/19/75	0	0	0	0	0	0	0	0	0
5/23/75	0	0	0	0	0	0	0	0	0
9/12/75	0	0	0	0	0	0	0	0	0
4/16/76	0	0	0	0	0	0	0	0	0
6/3/76	0	1	1	1	0	0	0	0	0
9/10/76	0	0	0	0	1	0	0	0	0
4/15/77	0	0	0	0	0	0	0	0	0
5/13/77	0	0	0	0	0	0	1	1	0
5/20/77	0	0	0	0	0	1	0	0	0
5/27/77	0	0	0	0	0	0	1	0	0
8/21/77	0	0	0	0	0	0	1	0	0
8/28/77	0	0	0	0	0	0	0	0	0
9/2/77	0	0	0	0	0	0	0	0	0
9/10/77	0	0	0	0	0	0	1	0	0
4/22/78	0	0	0	0	0	0	0	0	0
4/29/78	0	0	0	0	0	0	0	0	0
5/6/78	0	0	0	0	0	0	0	0	0
5/13/78	0	0	0	0	0	0	0	0	0
5/20/78	0	0	0	0	0	0	0	0	1
5/27/78	0	0	0	0	0	0	0	0	0
Total	1	1	1	1	1	1	4	1	1

Table 3.1-2 (Continued)

Transect No. 8

Date	SPECIES									
	Brown-headed cowbird	Green heron	Common grackle	Starling	Robin	Vesper sparrow	Wood duck	Mourning dove	Red-winged blackbird	Unknown
4/21/74	1	1	1	0	0	0	0	0	0	0
5/23/74	0	0	0	0	0	0	0	0	0	0
9/13/74	0	0	0	0	0	0	0	0	0	0
4/19/75	0	0	0	2	2	1	1	0	0	0
5/23/75	0	0	0	0	0	0	0	0	0	0
9/12/75	0	0	0	0	0	0	0	1	0	0
4/16/76	0	0	0	0	0	0	0	0	0	0
6/3/76	0	0	1	0	0	0	0	1	1	0
9/10/76	0	0	0	0	0	0	0	0	0	0
4/15/77	0	0	1	0	0	0	0	1	1	0
5/13/77	0	0	0	0	0	0	0	0	0	0
5/20/77	0	0	0	0	0	0	0	0	0	1
5/27/77	0	0	0	0	0	0	0	0	0	0
8/21/77	0	0	0	0	0	0	0	0	0	0
8/28/77	0	0	0	0	0	0	0	0	0	0
9/2/77	0	0	0	0	0	0	0	0	0	0
9/10/77	0	0	0	0	0	0	0	0	0	0
4/22/78	0	0	0	0	0	0	0	1	0	0
4/29/78	0	0	0	0	0	0	0	0	0	0
5/6/78	0	0	0	0	0	0	0	0	0	0
5/13/78	0	0	0	0	0	0	0	0	0	0
5/20/78	0	0	0	0	0	0	0	0	0	0
5/27/78	0	0	0	0	0	0	0	0	0	0
Total	1	1	3	2	2	1	1	4	2	1

Table 3.1-2 (Continued)

Transect No. 9

Date	SPECIES												
	Common grackle	Unknown sparrow	Mourning dove	Black duck	Northern oriole	Ruby-th. hummingbird	Western meadowlark	Starling	Unknown	Red-winged blackbird	Tree sparrow	Dark-eyed junco	American coot
4/21/74	1	1	1	1	0	0	0	0	0	0	0	0	0
5/23/74	0	0	0	0	1	1	0	0	0	0	0	0	0
9/13/74	0	0	0	0	0	0	0	0	0	0	0	0	0
4/19/75	0	0	0	0	0	0	0	0	0	0	0	0	0
5/23/75	0	0	0	0	0	0	1	0	0	0	0	0	0
9/12/75	0	0	0	0	0	0	0	0	0	0	0	0	0
4/16/76	0	0	0	0	0	0	0	0	0	0	0	0	0
6/3/76	1	0	0	0	0	0	0	1	0	0	0	0	0
9/10/76	0	0	2	0	0	0	0	0	0	0	0	0	0
4/15/77	0	0	0	0	0	0	0	0	0	1	1	1	0
5/13/77	0	0	0	0	0	0	0	0	0	0	0	0	0
5/20/77	0	0	0	0	0	0	0	0	0	0	0	0	0
5/27/77	0	0	0	0	0	0	0	0	0	0	0	0	0
8/21/77	0	0	0	0	0	0	0	0	1	0	0	0	0
8/28/77	0	0	0	0	0	0	0	0	0	0	0	0	0
9/2/77	0	0	0	0	0	0	0	0	0	0	0	0	0
9/10/77	0	0	0	0	0	0	0	0	0	0	0	0	0
4/22/78	0	0	1	0	0	0	0	1	0	0	0	0	0
4/29/78	0	0	0	0	0	0	0	1	0	0	0	1	1
5/6/78	0	0	0	0	0	0	0	0	0	0	0	0	0
5/13/78	0	0	0	0	0	0	0	0	0	0	0	0	0
5/20/78	0	0	0	0	0	0	0	0	0	0	0	0	0
5/27/78	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	2	1	4	1	1	1	1	3	1	1	1	2	1

Table 3.1-2 (Continued)

Transect
No. 10

Date	SPECIES											
	Common grackle	Starling	Ring-necked pheasant	Unknown sparrow	Vesper sparrow	Savannah sparrow	Dark-eyed junco	Mourning dove	Brown-headed cowbird	Red-winged blackbird	House sparrow	Unknown warbler
4/21/74	1	1	1	1	1	1	1	1	1	1	0	0
5/23/74	0	0	0	0	0	0	0	1	1	1	1	0
9/13/74	1	0	0	0	0	0	0	0	0	0	0	1
4/19/75	0	2	0	0	0	0	0	1	1	1	0	0
5/23/75	0	1	0	0	0	0	0	0	0	1	0	0
9/12/75	0	0	0	0	0	0	0	0	0	0	0	0
4/16/76	0	0	0	0	0	0	0	0	0	0	0	0
6/3/76	1	2	0	0	0	0	0	0	0	0	0	0
9/10/76	0	0	0	1	0	0	0	1	1	0	0	0
4/15/77	0	2	0	0	0	0	1	0	2	1	0	0
5/13/77	0	0	1	0	0	0	0	1	1	0	0	0
5/20/77	1	1	0	0	0	0	0	0	0	0	0	0
5/27/77	0	0	0	0	0	0	0	0	0	0	0	0
8/21/77	0	0	0	0	0	0	0	1	0	0	0	1
8/28/77	0	0	0	0	0	0	0	0	0	0	0	0
9/2/77	0	0	0	0	0	0	0	1	0	0	0	0
9/10/77	0	0	0	0	0	0	0	0	0	0	0	0
4/22/78	0	1	0	0	1	0	0	1	0	0	0	0
4/29/78	0	0	0	0	0	0	0	0	0	0	0	0
5/6/78	0	0	0	0	0	0	0	0	1	0	0	0
5/13/78	0	1	0	0	0	0	0	1	0	0	0	0
5/20/78	0	1	0	0	0	0	0	0	0	0	0	0
5/27/78	0	0	0	0	0	0	0	0	0	0	0	0
Total	4	12	2	2	2	1	2	9	8	5	1	2

Table 3.1-2 (Continued)

Transect No. 10

Date	SPECIES												
	Yellow-shafted flicker	Short-billed dowitcher	Robin	American coot	Killdeer	White-throated sparrow	Unknown sparrow	Unknown	Pectoral sandpiper	Sora rail	Semi-palmated sandpiper	Wood duck	Virginia rail
4/21/74	0	0	0	0	0	0	0	0	0	0	0	0	0
5/23/74	0	0	0	0	0	0	0	0	0	0	0	0	0
9/13/74	1	0	0	0	0	0	0	0	0	0	0	0	0
4/19/75	0	1	1	2	1	0	0	0	0	0	0	0	0
5/23/75	0	0	0	1	0	0	0	0	0	0	0	0	0
9/12/75	0	0	0	0	0	1	0	0	0	0	0	0	0
4/16/76	0	0	0	0	0	0	0	0	0	0	0	0	0
6/3/76	0	0	0	0	0	0	1	2	1	0	0	0	0
9/10/76	0	0	0	0	0	0	0	2	0	1	1	0	0
4/15/77	0	0	0	0	0	0	0	0	0	0	0	0	0
5/13/77	0	0	0	0	0	0	0	0	0	0	0	0	0
5/20/77	0	0	0	0	1	0	0	0	0	0	0	0	0
5/27/77	0	0	0	0	0	0	0	0	0	0	0	0	0
8/21/77	0	0	0	0	0	0	0	0	0	0	0	1	0
8/28/77	0	0	0	0	0	0	0	0	0	0	0	0	0
9/2/77	0	0	0	0	0	0	0	0	1	0	0	0	0
9/10/77	0	0	0	0	0	0	0	0	0	0	0	0	0
4/22/78	0	0	0	0	0	0	0	0	0	0	0	0	0
4/29/78	0	0	0	0	0	0	0	0	0	0	0	0	0
5/6/78	0	0	0	0	0	0	0	0	0	0	0	0	0
5/13/78	0	0	0	1	0	0	0	0	0	0	0	0	1
5/20/78	0	0	0	0	0	0	0	0	0	0	0	0	0
5/27/78	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	1	1	1	4	2	1	1	4	1	1	1	1	1

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Table 3.1-2 (Continued)

Transect No. 11

Date	SPECIES									
	Ring-necked pheasant	Killdeer	Brown-hd. cowbird	Sora rail	Mourning dove	Common grackle	Blackpoll warbler	Red-winged blackbird	Unknown	American coot
4/21/74	1	0	0	0	0	0	0	0	0	0
5/23/74	1	1	4	1	1	1	1	1	1	0
9/13/74	0	0	0	1	0	0	0	1	0	0
4/19/75	0	0	0	0	2	0	0	1	1	2
5/23/75	0	0	0	0	1	0	0	0	0	0
9/12/75	0	0	0	0	0	0	0	0	0	0
4/16/76	0	0	0	0	1	0	0	2	0	0
6/3/76	0	0	0	0	0	0	0	0	0	0
9/10/76	0	0	0	1	0	0	0	0	0	0
4/15/77	0	0	0	1	1	0	0	0	0	1
5/13/77	0	0	0	0	0	0	0	0	0	0
5/20/77	0	0	1	0	2	0	0	0	0	0
5/27/77	0	0	0	0	0	0	0	0	0	0
8/21/77	2	1	0	0	0	0	0	0	0	0
8/28/77	0	0	0	0	0	0	0	0	0	0
9/2/77	0	0	0	0	0	0	0	0	0	0
9/10/77	0	0	0	0	1	0	0	0	0	0
4/22/78	0	0	0	0	0	0	0	0	0	1
4/29/78	0	0	0	0	0	1	0	0	0	0
5/6/78	0	0	1	0	0	0	0	0	0	0
5/13/78	0	0	0	0	0	0	0	0	0	0
5/20/78	0	0	0	0	0	0	0	0	0	0
5/27/78	0	0	0	0	0	0	0	0	0	0
Total	[illegible]	2	6	4	9	2	1	5	2	4

Table 3.1-2 (Continued)

Transect
No. 11

Date	SPECIES										
	Vesper sparrow	Rock dove	Starling	Robin	Unknown warbler	Common snipe	Pied-billed grebe	American goldfinch	Mallard	Ovenbird	Rusty blackbird
4/21/74	0	0	0	0	0	0	0	0	0	0	0
5/23/74	0	0	0	0	0	0	0	0	0	0	0
9/13/74	0	0	0	0	0	0	0	0	0	0	0
4/19/75	1	1	2	1	0	0	0	0	0	0	0
5/23/75	0	0	0	0	1	0	0	0	0	0	0
9/12/75	0	0	0	0	0	0	0	0	0	0	0
4/16/76	0	0	2	0	0	1	1	0	0	0	0
6/3/76	0	0	0	0	0	0	0	0	0	0	0
9/10/76	0	0	0	0	0	0	0	1	0	0	0
4/15/77	0	0	0	0	0	0	0	0	1	0	0
5/13/77	0	0	0	0	0	0	0	0	0	0	0
5/20/77	1	0	1	0	0	0	0	0	0	1	0
5/27/77	0	0	0	0	0	0	0	0	0	0	0
8/21/77	0	0	0	0	0	0	0	0	0	0	0
8/28/77	0	0	0	0	0	0	0	0	0	0	0
9/2/77	0	0	0	0	0	0	0	1	0	0	0
9/10/77	0	0	0	0	0	0	0	0	0	0	0
4/22/78	0	0	2	0	0	0	0	0	0	0	0
4/29/78	0	0	2	0	0	0	0	0	0	0	0
5/6/78	0	0	0	0	0	0	0	0	0	0	0
5/13/78	0	0	1	1	0	0	0	0	0	0	1
5/20/78	0	0	0	0	0	0	0	0	0	0	0
5/27/78	0	0	0	0	0	0	0	0	0	0	0
Total	2	1	10	2	1	1	1	2	1	1	1

Table 3.1-2 (Continued)

Transect
No. 12

Date	SPECIES														
	Starling	Yellow-throat warbler	American coot	Mallard	Rock dove	Yellow-shafted flicker	Blue jay	Red-winged blackbird	Catbird	Common snipe	Ring-necked pheasant	Mourning dove	Vesper sparrow	Savannah sparrow	Tree swallow
4/21/74	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5/23/74	0	0	0	[illegible]	0	0	0	0	0	0	0	0	0	0	0
9/13/74	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4/19/75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5/23/75	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
9/12/75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4/16/76	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
6/3/76	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/10/76	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4/15/77	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0
5/13/77	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5/20/77	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0
5/27/77	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8/21/77	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0
8/28/77	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
9/2/77	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/10/77	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4/22/78	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4/29/78	1	0	0	0	0	0	0	0	0	0	0	0	1	1	1
5/6/78	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
5/13/78	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5/20/78	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0
5/27/78	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	2	1	2	1	1	1	1	1	1	1	1	1	1	1	1

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PRAIRIE ISLAND NUCLEAR GENERATING PLANT

ENVIRONMENTAL MONITORING PROGRAM

1978 ANNUAL REPORT

ECOLOGICAL STUDIES

SPECIAL STUDIES

REPORT ON PRAIRIE ISLAND PRAIRIE ESTABLISHMENT OPERATIONS FOR 1978

(3.2)

Prepared for
Northern States Power Company
Minneapolis, Minnesota

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3.2 REPORT ON PRAIRIE ISLAND PRAIRIE ESTABLISHMENT OPERATIONS FOR 1978

3.2.1 INTRODUCTION

Efforts at restoration of prairie vegetation at the Prairie Island project began in 1974 when a small stand of remnant prairie grasses was burned. Burning of this, and additional areas, has continued intermittently since that time, the latest burns occurring in the spring of 1978. These areas include, besides the original stand, grassland vegetation characteristic of abandoned farmland, composed in large part of foreign, weedy grasses such as quack grass and brome grass, with a mixture of native species as well. Also, a large area of willow growth, interspersed with grassland, has been burned as part of the prairie restoration work. These "Prairie Restoration Areas" are referred to as "PRAs" throughout the remainder of this report.

A second aspect of prairie restoration began during late June and early July of 1975 when certain areas near the power plant were plowed and seeded with prairie grasses and forbs. The areas plowed and seeded were adjacent to, and originally part of, the weedy, old-field grasslands scheduled for burning during subsequent years. As such, they provided excellent comparative plots to study the efficiency of the two restoration methods, and to monitor the development of the two types of areas, side by side. These "Replowed and Planted Areas" will be referred to as "RAPAs" throughout the remainder of this report. One of the RAPAs was burned in the spring of 1978.

3.2.2 DESCRIPTION OF STUDY AREA

Three PRAs and two RAPAs were studied. Most of the areas occurred on fairly level, very sandy ground, recovering from

abandonment of farming practices. These areas were generally characterized by weedy grassland vegetation, with varying amounts of native species. Portions of some areas contained depressions, where the soil was wetter and of a heavier texture, and were occupied by dense growths of young willows. In addition, dredge deposits in certain locations created highly xeric conditions, with very sparse vegetation.

PRA 1 and RAPA 1 were located entirely on level, sandy ground, the vegetation of the RAPA being originally (i.e., pre-plowing) part of the grassland occurring on the PRA. PRA 2 and RAPA 2 were located in a similar situation, although between eight and ten percent of each area included a depression containing young willow growth. The third area studies, PRA 3, was divided into two sections. PRA 3A included grassland vegetation, approximately 27 percent dense willow growth, and 29 percent xeric sand deposit. PRA 3B was largely grassland, but included about 36 percent willow growth.

More complete descriptions of the study areas can be found in Dueholm 1976.

3.2.3 METHODS

During 1978 analyses were made of the vegetation, bird populations, and small mammal populations along transects through each of the six areas (PRAs 1, 2, 3A, and 3B, and RAPAs 1 and 2).

Descriptions of the transects and methods can be found in Dueholm 1978.

Briefly, vegetation was sampled using the point-frame method (Goddard and Richardson 1973). Each transect was sampled

once in 1978 in late August (transects were generally sampled twice in previous years). Nomenclature generally follows Gleason and Cronquist (1963). However, in choosing common names, reference was also frequently made to Britton and Brown (1913) for names of frequently unnamed species (e.g., sedges), and to Rock (1974), for more current names of many species. Plants will be referred to by common name throughout the text of this report. A list of common and scientific names for all plants is found in Appendices A3.2.1 to A3.2.6. All transects were sampled by the author.

Bird populations were sampled once a week during July and August in the early morning by Wayne Norling of the University of Wisconsin, River Falls Biology Department (in previous years the sampling was done largely by the author).

Small mammals were sampled in early October. Trapping was done by Mary Schmidt at the University of Wisconsin, River Falls Biology Department, who also tabulated the data. Population estimates were made using the Schnabel Method (Goddard and Richardson 1973). Small mammal trapping had been done in previous years by Wayne Norling.

The assistance of Mr. Norling and Ms. Schmidt is greatly appreciated. Also, Ms. Schmidt and Ms. Marianne Heiskell assisted in data recording during the point-frame sampling in August. Without the help of these people, many facets of the 1978 study would not have been possible because of my time limitations, and their contributions are hereby greatfully acknowledged.

3.2.4 RESULTS

For references to 1975, 1976, and 1977, please see Dueholm 1976, 1977, and 1978, respectively.

On May 3, 1978, PRAs 1 and 3 and RAPA 1 were burned. 277 210

3.2.4.1 Vegetation

Figures prepared for the previous report (Dueholm 1978) to help visualize behavior of major species through three years were amended to include 1978 data. In addition, graphs were prepared to illustrate behavior of certain groups of plants (such as annuals and planted species) and bare ground during the four years of the study. In these figures the first date represents the year before the first burn on the PRAs, or the year of the planting on the RAPAs. The 1976 dates represent summer and fall immediately after the burn on the PRAs, and the first full growing season on the RAPAs, the 1977 dates representing the second growing season following the burn, and the second full growing season on the RAPAs. The 1978 date represents late summer following the second burn on PRAs 1 and 3, the first burn on RAPA 1, the third full growing season on RAPA 2, and the third season following the initial burn on PRA 2. The 1978 date is approximately midway between the two sampling dates in 1976 and 1977.

PRA 1

The 1978 species list for PRA 1 (Appendix A3.2.1) contained 64 species. The 1977 list contained 77 species, the 1976 list 56, and the 1975 list 70 species. A summary of the occurrence of species during the four years of the study is presented in Appendix A3.2.7. It should be mentioned that the species list for 1978 was based on observations during a few days in August and is probably not complete.

The 1978 transect encountered 33 species (Table 3.2-1). The number of species encountered along the transect in previous years has ranged from 26 (late 1976) to 36 (1975).

The behavior of certain species is illustrated in Figure 3.2-1, and of annuals, biennials, and bare ground in Figure 3.2-7.

Fall witch-grass, the dominant species since 1976, remained the dominant species in 1978. Its percent composition in mid-August 1978 compares well with its composition in late September 1977 (Figure 3.2-1, between 45 and 48 percent), but is about 15 percent less than in late 1976, following the initial burn on PRA 1. Quack grass declined in 1978, from near 25 percent in 1977 to 18 percent in 1978. This species had also decreased following the 1976 burn and increased in 1977 (Figure 3.2-1).

Annuals and biennials, treated as a group, decreased following both the 1976 and 1978 burns (Figure 3.2-7), as exemplified by ragweed (Figure 3.2-1). Conversely, bare ground increased following each burn.

Five species in 1978 had composition values of two percent or greater. In 1977 seven species had such values on the early transect, five on the late; in 1976 four species on each date, and in 1975 ten species exceeded two percent.

RAPA 1

The 1978 RAPA 1 species list (which, as for the PRA, was based on limited observations) contained 40 species (Appendix A3.2.2), as opposed to 63 in 1977, 43 in 1976, and 39 in 1975. Species occurrence during four years is presented in Appendix A3.2.8.

The 1978 transect recorded 20 species (Table 3.2-2). The range in number of species has been from 18 (1975) to 32 (early 1977).

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The behavior of certian species is represented in Figure 3.2-2, and that of certain groups of species in Figure 3.2-10.

Quack grass, which had increased from a 1975 low of 8 percent to a 1977 high of 29 percent, decreased in 1978, following the first burn on RAPA 1, to 6 percent. Sweet clover also decreased in 1978, to 0.1 percent over the entire transect (it had been approximately 4 percent in 1977). This was especially apparent in the transect segment 41 through 60 where, in 1977, sweet clover had 20 percent composition. The composition in this segment in 1978 was only 0.5 percent (Table 3.2-2).

Six of the planted prairie species had values greater than two percent in 1978. Four of these (Indian grass, big and little bluestem, and switch-grass) had values greater than 10 percent, ranging to as high as 21 percent. These four, plus side-oats grama, were the dominating species in 1978 (Table 3.2-2). Also, all six species increased in composition (to varying degrees), compared with 1977 (Figure 3.2-2). Total composition of planted species has increased steadily since their first appearance, from 21 (5 species) and 25 percent (7 species) in 1976, early and late, to 46 (6 species) and 52 percent (same 6 species) in 1977. These same six species in 1978 increased to 79 percent total composition (Figure 3.2-10). Three planted species were not recorded at all in 1978: buffalo grass, gayfeather, and yellow or prairie coneflower. Gayfeather has never been found on the area and coneflower has never been represented by more than one or two individuals. Also, buffalo grass has never been common, not exceeding 0.2 percent on transect samples.

Commensurate with the increase in planted species has been a decrease in annuals and biennials (Figure 3.2-10). Annuals

and biennials, which contributed 83 percent in 1975, following planting, contributed only one percent in 1978. Bare ground, which increased in 1976 to near 15 percent, decreased in 1977 to near 10 percent, and was close to this figure in 1978 (Figure 3.2-10).

PRA 1 versus RAPA 1

In 1978, 31 species were found both among the 64 species on PRA 1 and the 40 on RAPA 1. In 1977, 51 species were in common (total of 77 on the PRA, and 63 on the RAPA). In 1976, 56 species were on the PRA species list, 43 were on the RAPA list, with 33 of these species in common. Finally, in 1975, 20 species were found among the 70 on PRA 1, and among the 39 on RAPA 1.

Quack grass in 1978 was approximately 12 percent less on the RAPA, compared with the PRA. In 1976 and 1977 percentage of quack grass was greater on the RAPA, by 3 to 9 percent. This species decreased on both areas in 1978, but the decline was much greater on the RAPA (cf. Figures 3.2-1 and -2). Fall witch-grass continued to be the major species on the PRA but, as in previous years, contributed very little to the RAPA vegetation. Bare ground followed somewhat similar trends on both areas, increasing from 1975 to 1976, then decreasing in 1977, followed by an increase in 1978. Percent composition of bare ground for the two areas was within 1.5 percent for 1978.

A steady decline in annuals and biennials has occurred on RAPA 1 (Figure 3.2-10), whereas a good deal of fluctuation has occurred on PRA 1 (Figure 3.2-7). Here annuals and biennials showed declines after burns in 1976 and 1978, but increases in 1977 when there was no burn.

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As in 1977, the RAPA had more species contributing two percent or greater composition than the PRA (7 versus 5). Included among those on the RAPA were many of the planted species, which did not occur on the PRA transect. However, as in 1977, four prairie species were on the 1978 species list for the PRA (Appendix A3.2.1). These four were Indian grass, big and little bluestem, and switch-grass. Switch-grass was present at the initiation of the study in 1975, while the others were not noted until 1977.

PRA 2

The 1978 species list for PRA 2 (based on limited observations) contained 51 species (Appendix A3.2.3). In 1977 there were 97 species on the list. In 1976 the first comprehensive species list for PRA 2 contained 82 species. The occurrence of species during these three years is presented in Appendix A3.2.9.

The transect for 1978 encountered 42 species (Table 3.2-3). The range in species has been from 34 (late 1977) to 46 (1975).

In 1975 nine points along the transect were located in an area of willow growth. Since there are 100 points along the transects, this indicates that nine percent of the transect was located in willow growth. Similarly, in 1976 seven percent (early sample) and eight percent (late sample) of the transect was in willow growth. In 1977 six percent of the early transect and seven percent of the late transect were among the willows. In the 1978 sample, eight percent of the transect was in willow growth.

The behavior of certain species for four years is depicted in Figure 3.2-3. The behavior of annuals and biennials, and the amount of bare ground is presented in Figure 3.2-13.

Percent composition of quack grass remained relatively unchanged from 1977 (near 36 percent) and was still the dominant species on PRA 2 in 1978 (Figure 3.2-3). Fall witch-grass increased from 6 percent in 1975 to a high of 13 percent in late 1976 (following a spring burn). In 1977 this species decreased to eight percent on the late sample. In 1978 fall witch-grass increased to 13 percent, essentially regaining its composition value after the single burn in 1976. Ragweed, following a decrease in 1976, increased to 10 percent in 1977, 7 percent higher than its original 1975 value. In 1978 ragweed decreased to only 0.3 percent (Figure 3.2-3). This was the trend observed in all annuals and biennials (Figure 3.2-13). After a decrease following the spring 1976 burn, a steady increase occurred through late 1977. The 1978 data show a decrease from late 1977, to near the early 1977 value (approximately 16 percent).

Kentucky bluegrass decreased following the burn in 1978, and has continually increased since then to a high of 9 percent in 1978 (original value was near 14 percent in 1975). Sweet clover also increased in 1978 as it did in 1977. Bare ground increased following the 1976 burn from 5 percent in 1975 to 17 percent in early 1976. Bare ground has steadily decreased from that point to a 1978 low of three percent.

species on the 1978 transect had composition values of t percent or greater. In 197 seven species had such values on the early transect and eight on the late transect. Nine species in early 1976, seven in late 1976, and ten in 1975 had such values.

RAPA 2

The 1978 species list for RAPA 2 (based on limited observations) contained 64 species (Appendix A3.2.4). The species list for 1977 contained 102 species, and that for 1976,

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the first comprehensive list for this area, contained 79 species. Appendix A3.2.10 presents the occurrence of species during the three years.

In 1978 the transect through RAPA 2 encountered 37 species (Table 3.2-4). The range in number of species for previous years has been from 27 (1975) to 48 (late 1976).

Seven percent of the transect occurred in an area of willow growth in 1975, nine percent in early and late 1976 and early 1977, eight percent in late 1977, and ten percent in 1978.

In Figure 3.2-4, selected species are presented graphically from 1975 through 1978. Also, certain groups of plants and bare ground are presented in Figure 3.2-16.

Quack grass, roughly equivalent in 1976 and 1977 (nearly seven percent on both late samples), exhibited a very slight decrease in 1976 (to six percent). Smooth or awnless brome grass increased slightly from 1976 to 1977 (four percent in early 1976 to eight percent in late 1977), and then dropped slightly in 1978 (to six percent). Annuals and biennials as a group declined continually from 1975 (72 percert) to 1978 (4 percent) (Figure 3.2-16). The behavior of the annual grass, green foxtail (Figure 3.2-4), is typical of this trend. Bare ground, between 10 and 15 percent in 1975 and 1976, was between 5 and 10 percent in 1977 and 1978.

The major species from 1976 through 1978 has been the planted prairie grass (side-oats grama, Figure 3.2-4). For most of the sample this species has consistently ranged between 20 and 22 percent composition. Total composition contributed by the planted species has continually increased from 1976 (Figure 3.2-16). In early 1976, 5 planted species contributed 27 percent composition, while in late 1976, 7

species contributed 36 percent, and in late 1977, 6 species had a total of 62 percent. In 1978 the same six species had a total of 70 percent composition. Each of these six species has had composition values of greater than two percent since early 1977 (cf. Figure 3.2.4). Eight of the nine planted species appeared in 1978 (Appendix A3.2.4), but two of these (buffalo grass and prairie coneflower) were very infrequent, not appearing in the transect data. Coneflower was represented by only two or three individuals. The ninth planted species, gayfeather, has only appeared once (in 1977), and was represented at that time by a single individual.

PRA 2 versus RAPA 2

The 1978 species list for PRA 2, with 51 species, had 36 in common with the 64 on the RAPA 2 list. In 1977, 77 species were found among the 97 on the PRA and the 102 on the RAPA. In 1976, 51 species were on both lists, the PRA having a total of 82 species and the RAPA 79. No comprehensive species lists were made for the areas in 1975.

Quack grass has consistently contributed approximately one-third of the composition on the PRA and less than one-tenth of the RAPA (with a slight decrease from 1976 to 1978). Fall witch-grass, generally fluctuating around ten percent on the PRA, has never been above one percent on the RAPA. Likewise, Kentucky bluegrass, which has had values between 5 and 15 percent on the PRA (except after the 1976 burn, when percent composition was less than one percent), has only once been above one percent on the RAPA (1.3 percent in 1975). A continual decrease in annuals has been apparent on the RAPA to less than four percent in 1978. The PRA has exhibited a year-to-year fluctuation in amounts of annuals (cf. Figure 3.2-13), with a total of 16 percent in 1978. Sweet clover in 1978 amounted to 8 percent of the PRA

(a slight increase over late 1977), but only 0.3 percent on the RAPA (a decrease from 1977). Bare ground has decreased on PRA 2 following an initial increase in early 1976. Bare ground has also decreased overall on the RAPA, but at a slower rate, and with greater fluctuation (cf. Figures 3.2-13 and 16).

The planted prairie grasses, which contributed 70 percent to the RAPA 2 vegetation (Figure 3.2-16), were not found along the PRA transect nor listed on the 1978 species list for PRA 2.

PRA 3A

The 1978 PRA 3A species list contained 88 species (Appendix A3.2.5), based on limited observations. The list for 1977 contained 85 species and the 1976 list (not entirely complete) 57 species. The occurrence of species during these three years is presented in Appendix A3.2.11.

In 1978 there were 46 species encountered along the transect through PRA 3A (Table 3.2-5). The range in previous years has been from 39 species (late 1977) to 54 (early 1977).

Twenty-six percent of the transect was located in willow growth in 1975, 27 percent in early 1976, 25 percent in late 1976, 28 percent in early 1977, 25 percent in late 1977, and 27 percent in 1978. In addition, approximately 29 percent of the transect through PRA 3A has been located in a highly xeric sand deposit, essentially the last 30 points of the transect.

Figure 3.2-5 illustrates the behavior of certain species during four years, and Figure 3.2-19 the behavior of select groups of species, as well as bare ground.

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Quack grass, which had remained fairly constant from 1975 through 1977 (ranging between 33 and 36 percent composition), decreased to 27 percent in 1978 following the second burn on this area, 9 percentage points less than in late 1977 (Figure 3.2-5). Reed canary grass has gradually increased since 1975, to 10.5 percent in 1978. Kentucky bluegrass decreased following the 1976 burn, increased in 1977, and decreased again following the 1978 burn (Figure 3.2-5). Bare ground, following an increase after the 1976 burn, decreased in 1977. The amount of bare ground in 1978 was intermediate between the two sample values in 1977 (Figure 3.2-19). Annuals and biennials decreased after the first burn, and have increased rather steadily ever since to a high of 41 percent in 1978 (Figure 3.2-19). Twenty-five of these percentage points were contributed by sweet clover, a biennial (Table 3.2-5). This species increased from 1976 through 1977, and again in 1978 to its current high point (sweet clover originally declined from 1975 to 1976, following the first spring burn, cf. Figure 3.2-5). The total composition of species associated with willow growth (e.g., mad-dog skullcap, rough hedge nettle, sneezeweed, reed canary grass, three-seeded mercury, and others) has fluctuated from year to year in a gradual increase, beginning with 8 percent in 1975, and reaching a high of 16 percent in 1978 (Figure 3.2-19). During years with two sample dates the early sample has been higher.

In 1978 seven species had values of two percent composition or greater. In early 1977 seven species had such values; in late 1977 seven species. Eight species were greater than two percent in early and late 1976, with seven exceeding this value in 1975.

PRA 3B

In 1978 the PRA 3B species list (based on limited observations) contained 83 species (Appendix A3.2.6); in 1977, 97

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species were on the list, and in 1976, 56 species (the 1976 list, as on PRA 3A, was incomplete). Occurrence of these species during the three years is presented in Appendix A3.2.12.

The 1978 transect through PRA 3B encountered 46 species (Table 3.2-6). In previous years the range has been from 41 species (late 1976 and late 1977) to 48 (early 1977).

In 1975, 21 percent of the transect was situated in willow growth; in early 1976, 35 percent (14 percent in denser growth), and in late 1976, 23 percent (11 percent in dense growth) was in willows. In early 1977, 30 percent of the transect was in willows (10 percent in dense growth), in late 1977, 33 percent was in willows (with 11 percent in dense growth), and in 1978, 36 percent was in willows (13 percent in dense growth). Also, five percent of the transect points in 1978 (60 to 64) were located in a weedy patch of thistles (primarily Canada thistle).

The behavior of select species is presented in Figure 3.2-6, while the reactions of certain groups of species during the four study years are presented in Figure 3.2-20.

Quack grass has fluctuated fairly consistently around 38 percent composition since the initiation of the study in 1975 (Figure 3.2-6). Nodding wild rye, which decreased following the 1976 burn, increased in 1977, and decreased again, following the 1978 burn (Figure 3.2-6). Kentucky bluegrass also decreased following each burn, with an increase during the interim (1977). The amount of sweet clover, which increased from 1976 to 1977, remained unchanged in 1978, near its 1977 value of nine percent. Percent composition of willows along the transect (primarily sandbar willow) has ranged from one in 1975, to three and 0.6 in 1976 (early and late samples, respectively), two and

one in 1977 (early and late) to a high of 5.5 percent in 1978. The trend in bare ground on PRA 3B parallels that on 3A (cf. Figures 3.2-19 and 20), as does that found in annuals and biennials, except that a slight decrease occurred from late 1977 to 1978 on PRA 3B (Figure 3.2-20), while a substantial increase occurred for this time period on 3A (Figure 3.2-19). Similar trends have also occurred in willow associates, as a group, on both areas, although total composition has been somewhat greater on 3B.

Certain species, although not contributing a large amount to the total composition, are abundant in localized segments of the transect. Indian hemp, for instance, had a transect-wide value of near two percent in 1978. However, all individuals of this species were found in the transect segment 41 - 50 (Table 3.2-6). The trend over four years of this species, in this particular segment, is of interest. In 1975 none were recorded. In early 1976 three percent of this segment was contributed by Indian hemp and in late 1976, one percent. In early 1977, 10 percent composition was reached on the early sample, and zero on the late sample. Finally, in 1978, 19 percent of this segment was contributed by this species. Similarly, in the segment 61 - 70, Canada thistle increased from zero in 1975, to a late 1976 high of 13 percent, and a late 1977 high of 26 percent. In 1978 the percentage dropped to 18 percent (Table 3.2-6). Canada thistle has been restricted to date to this ten-point segment.

Eight species had values of 2 percent composition or greater in 1978, whereas in early 1977, 10 species had such values, and in late 1977, 8 species were greater than 2 percent. In early 1976, 12 species were greater than 2 percent, in late 1976, 6 species, and in 1975, 9 species.

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PRA 3A versus PRA 3B

In 1978, 60 species were found among the 88 species on PRA 3A as well as among the 83 on PRA 3B. In 1977, 66 species were in common with 85 on 3A and 93 on 3B. In 1976, 34 species were included among the 57 on PRA 3A, and among the 56 on 3B.

As in previous years, PRAs 3A and 3B are quite similar, and both remain dominated by quack grass and sweet clover (Tables 3.2-5 and 6). Nevertheless, these species exhibited somewhat different reactions on the two areas in 1978. Quack grass, for instance, decreased on 3A, while remaining relatively unchanged on 3B. Conversely, sweet clover increased from 17 (late 1977) to 25 percent (1978) on 3A, while remaining constant on 3B (near 9 percent). Reed canary grass continued to increase on 3A to 10.5 percent in 1978. On 3B it contributed three percent, similar to the values for 1977. Nodding wild rye continued to be more abundant on 3B than on 3A and to be slightly more prevalent on 3B than reed canary grass (reed canary grass being more prevalent on 3A). The 1978 increase in willows in the transect data was more noticeable on 3B, where 5.5 percent composition occurred (versus one percent on 3A, which was approximately the early value in 1977). Twenty-seven percent of the 3A transect line is located in willow growth, whereas 36 percent of the 3B line is within willow growth. Although the pattern in response of willow-associated species was the same on each area, total composition of such species has been greater on 3B, and increases have been greater on 3B for comparable time periods (cf. Figures 3.2-19 and 20). Similar trends have also been observed in annuals and biennials for each area, until 1978, when this group increased to over 40 percent on 3A and decreased slightly on 3B (to near 16 percent). Trends in bare ground have also been the same for the two areas (Figures 3.2-19 and 20).

3.2.4.2 Birds

Table 3.2-7 presents results of the 1978 bird study. As in previous years, a weighted density for each area was calculated, taking into account the number of counts made of a transect and total area censused (see Dueholm 1976 for mechanics of this calculation), allowing better comparisons of populations of different areas and years. In addition, weighted densities for individual species on each area were determined for each of the four study years and are presented in Table 3.2-8. The areas in order of decreasing total density in 1978 were: combined PRA 3 transects, 5.11 birds per hectare; PRA 1, 3.31 birds per hectare; RAPA 2, 2.03 birds per hectare; PRA 2, 1.83 birds per hectare; and RAPA 1, 1.53 birds per hectare. The deviation of these densities from previous years can be seen in Table 3.2-8.

Graphs were prepared from the density data in Table 3.2-8 to help visualize fluctuations in densities of major bird species on each area during the four years of the study. In these figures certain species are grouped under one heading. For instance, "All Swallows" includes any species of swallow recorded, plus the purple martin, and "Grassland Sparrows" includes the savannah, vesper, and grasshopper sparrow.

On PRA 1 in 1975, 43 individuals of nine species were recorded from nine counts. In 1976 eight individuals of four species were recorded (four counts), whereas in 1977, 24 individuals of five species were recorded (eight counts). In 1978, from six counts, 35 individuals of seven species were recorded (Table 3.2-7). Total density decreased from 2.74 in 1975 to 1.15 in 1976, increased slightly in 1977 to 1.72, and increased still further in 1978 to 3.31 birds per hectare.

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Four-year densities of the major species are presented graphically in Figure 3.2-8. The most abundant species in 1978 was the mourning dove, with 51 percent of the total individuals (4 percent in 1977, zero in 1976, and 63 percent in 1975). The density of this species followed a similar pattern (Table 3.2-8 and Figure 3.2-8), being near 1.7 birds per hectare in 1975 and 1978. Western meadowlarks, which contributed 50 percent in 1977, 38 percent in 1976, and 14 percent in 1975, contributed 20 percent in 1978. Again, this pattern is reflected in the weighted densities of this species (Figure 3.2-8). As a group, swallows had greater densities in 1976 and 1977 and were not recorded in 1978 (Figure 3.2-8). Conversely, grassland sparrows, taken as a group, had higher densities in 1975 and 1978, not being recorded in either of the intervening years (Figure 3.2-8). Three-fourths of this density in 1978 was attributed to savannah sparrows, the remainder to vesper sparrows.

In 1975 on RAPA 1, 61 individuals of nine species were recorded (nine counts). In 1976 there were 20 individuals of five species (four counts), while in 1977 nine species totaled 37 individuals (eight counts). In 1978, 16 individuals of three species were recorded from six counts (Table 3.2-7). Total density for the area decreased from 3.88 in 1975 to 2.87 in 1976, 2.66 in 1977, to a low of 1.53 birds per hectare in 1978.

Four-year densities of the major species are presented graphically in Figure 3.2-11. Western meadowlarks increased from 1975 to 1977 (Table 3.2-8), both in terms of weighted density (0.254 to 0.861 to 1.08, for the three respective years), and in terms of percent contribution to the total birds censused in each year (7 to 30 to 41 percent, for the three years, respectively). In 1978 a decrease occurred in percentage (to 12.5 percent) and in density (to 0.191 birds per hectare). Ring-necked pheasants accounted for 15 percent

of the total individuals in 1975 and 22 percent in 1977. The density values for these two years are essentially identical (near 0.575). None were recorded during 1976 or 1978. The total density of swallows increased from 1975 to 1976, decreased to a 1977 low, and increased again in 1978 (Figure 3.2-11 and Table 3.2-8). Grassland sparrows were sparsely present in 1975 and 1977, but absent in 1976 and 1978. As evidenced in Figure 3.2-11, the mourning dove was the predominant species during 1975, 1976, and 1978, with densities greater than 1.0. The 1977 low was 0.144. Although mourning dove density in 1978 was less than in 1975 or 1976, its percentage value of total individuals was at its highest (68.8 percent, compared with a previous high of 46 percent in 1975).

PRA 2 in 1975 had 27 individuals of seven species recorded from four counts. Eight species with 41 individuals were recorded in 1976 from three counts. In 1977 from eight counts, 97 individuals of 15 species were present. In 1978, 10 species provided 68 individuals from six counts (Table 3.2-7). Total density increased from 1.09 in 1975 to a high of 2.27 in 1976. Since then it has declined slowly, first to 1.96 in 1977 then to 1.83 in 1978.

Densities of major species are graphed in Figure 3.2-14. As seen in this figure, the density of western meadowlarks increased from 1975 to a 1976 high of 0.861. During both 1976 and 1977, this was the predominant species on PRA 2, but declined in density in 1977, and again in 1978. Its percentage of total individuals followed a similar trend, with a high of 41 percent in 1976 and a low of 13 percent in 1978. Ring-necked pheasants contributed 4 percent in 1975, zero in 1976, 24 percent in 1977, and 3 percent of total individuals in 1978. Corresponding density values are 0.040, 0.0, 0.465, and 0.054. Thus, both percentage and density for this species in 1978 are equivalent to values in

1975. Mourning doves accounted for 37 percent of total individuals in 1975, 35 percent in 1978, and lesser values in the intervening years. The density data follow a slightly different pattern, increasing from 1975 (0.404) to 1976 (0.701), decreasing in 1977 (to 0.283), finally increasing in 1978 to 0.464, fairly close to its original 1975 value (Figure 3.2-14). Thus, three species (ring-necked pheasant, western meadowlark, and mourning dove) have similar densities in both 1975 and 1978, with different degrees of variation between these dates (cf. Table 3.2-8 and Figure 3.2-14). A steady increase in goldfinch density has occurred from 1976 onward (Figure 3.2-14).

RAPA 2 in 1975 had five individuals of two species from four counts, while in 1976, 19 individuals of four species were recorded from three counts. In 1977, 51 individuals representing 14 species were recorded from eight counts. Sixty-nine individuals of 8 species were recorded in 1978 from six counts (Table 3.2-7). Total densities have increased from 1975 to 1978, from 0.221 in 1975, to 1.12 in both 1976 and 1977, and 2.03 in 1978 (Table 3.2-8).

Densities of major species have been graphed in Figure 3.2-17. Ring-necked pheasants. the predominant species during sampling in 1977 (24 percent of total), have not been recorded for the remaining sample periods. American goldfinches had similar densities in 1976 and 1978, with a decrease in 1977 (Figure 3.2-17). Percentage for this species has ranged from 42 percent in 1976, to 26 percent in 1978, with 18 percent in 1977. None were recorded in 1975. Mourning doves, with 16 percent as a high from 1975 to 1977, accounted for 36 percent of total individuals in 1978, with a density, previously only as high as 0.177 (in 1976) increased to 0.736. Densities of western meadowlarks were low in 1975 and 1977 (0.088 for each year) and moderate in 1976 and 1978 (0.413 and 0.235, respectively) (cf. Figure

3.2-17). Grassland sparrows first appeared in 1977 and were present in 1978, but had low densities in both years.

PRA 3 (combined A and B Transects) has consistently had the highest numbers of individuals and species. In 1975, from 4 counts 190 individuals were recorded, from 22 species. In 1976, from 3 counts, 18 species had 137 individuals. And in 1977, 21 species provided 202 individuals (from 6 counts). Finally, in 1978, 169 individuals of ten species were recorded from 6 counts (Table 3.2-7). Total densities have also been consistently higher on this area, although generally declining through the four study years. In 1975 the density was 8.63 birds per hectare. In 1976 the density was 8.29, in 1977 6.11, and in 1978 it had dropped to 5.11 birds per hectare.

Densities of several species are presented in Figure 3.2-21 (note the change in key for this figure, compared with the previous four figures for bird densities). The density of American goldfinches declined following the 1976 burn on PRA 3, increased in 1977 (greater than full recovery), and decreased following the 1978 burn to a level conparable with that in 1976. While this was clearly the predominant species from 1975 to 1977, it was not so in 1978 (Figure 3.2-21), when it was exceeded in density by mourning doves. Mourning doves in 1978 were twice as dense as in any previous year, and had higher densities in years immediately following burns (Table 3.2-8). The ring-necked pheasant has never contributed over 8 percent (1975) of the total individuals, but has had moderate densities on this area. This amounted to 0.681 birds per hectare in 1975. Since then it has ranged to 0.242 in 1976, 0.393 in 1977, and 0.091 in 1978. Indigo buntings have steadily decreased from 1975 to 1978 (Figure 3.2-21). Certain species, e.g., the rose-breasted grosbeak and house wren, which were present in 1975 and 1977, were not recorded in either 1976 or 1978,

the years of burns on PRA 3. Also, song sparrows decreased after the 1976 burn, increased in 1977, and were not recorded in 1978. Birds such as these, commonly associated with the willow growth on PRA 3, have declined steadily as a group since 1975, even though various species may have experienced temporary increases (the yellow warbler, for instance) (Figure 3.2-21). The decline of species associated with the willows has been from a high of 2.727 total density in 1975, to 1.817 in 1976, 1.026 in 1977, and 0.695 in 1978.

Five species found on PRA 3 in 1978 were not recorded on any of the other areas (7 such species in 1977 and 12 in 1976). Four species found on at least one of the other four transects were not recorded on PRA 3 (10 in 1977 and 4 in 1976).

3.2.4.3 Small Mammals

Eighty-five small mammals were trapped in early October of 1978 (Table 3.2-9). One hundred-two were trapped in 1977, 91 in 1976, and 25 in 1975. Nine species were represented in 1978, only one of which had not appeared in previous years (the least weasel, with one individual captured). Seven species were captured in 1976 and 1977 and four in 1975. Only the Norway rat (one individual on PRA 3A in 1976) was not repeated in 1978. The deer mouse was the most common species over all the areas in 1978, with 49 individuals, a substantial increase over previous years (3 individuals in 1977, none in 1976, and one in 1975). The most common species in 1977 was the white-footed mouse with 70 individuals. This species had three individuals in 1978; in 1975 there were 21 (the most numerous species); in 1976 there were nine individuals. In 1976 the most numerous species was the western harvest mouse (69 individuals); in 1975 none were captured, in 1977 nine were caught, and

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in 1978 seven were trapped. One meadow vole was caught in 1975, two in 1976, eleven in 1977, and two in 1978. While no thirteen-lined ground squirrels were captured in 1975, seven were in 1976 and 1977, and ten in 1978. Eleven short-tailed shrews were trapped in 1978 (no more than two in any previous year).

The areas, listed in order of decreasing population densities in 1978, were: PRA 2, 90.90 per hectare; RAPA 2, 84.63 per hectare; PRA 3A, 65.81 per hectare; PRA 3B, 62.64 per hectare; RAPA 1, 47.01 per hectare; and PRA 1, 21.93 per hectare. Table 3.2-10 summarizes changes in density for each area, for each species caught. Deviations of total densities from previous years can also be found in this table. Graphs illustrating densities of major species for each area over four years were constructed from the density data in Table 3.2-10.

Total density on PRA 1 in 1975 was 22 small mammals per hectare, which increased to 75 in 1976, decreased to 38 in 1977, and 22 in 1978 (Table 3.2-10). Fluctuations in densities of major species on PRA 1 is presented in Figure 3.2-9. Total densities on RAPA 1 were an initial 28 per hectare, increasing to 38 in 1976, decreasing in 1977 to 19, and increasing in 1978 to 47 (Table 3.2-10). Figure 3.2-12 illustrates the densities of the major species during four years. The most abundant small mammal on each area in 1978 was the deer mouse, which had not been captured in previous years on either area (a density of 6 was reached on the PRA, 25 on the RAPA). The most abundant species on both areas in 1977 was the white-footed mouse. Densities on the PRA ranged from 19 in 1975, to 9 in 1976, to a 1977 high of 28 per hectare. None were captured in 1978 (Figure 3.2-9). On RAPA 1 densities for this species were at a high of 25 in 1975, decreased to 6 in 1976, and increased to 13 in 1977. None were captured in 1978 (Figure 3.2-12). In 1976 the

western harvest mouse was the predominant species on both areas, with a density of 47 on the PRA and 31 on the RAPA. None were caught in 1975, and densities were low in both 1977 and 1978 (cf. Figures 3.2-9 and 12). Thirteen-lined ground squirrels had a high density in 1976 of 19 per hectare on PRA 1 and low densities in all other years, and none were caught on the RAPA until 1976, when a density of 3 was attained (Table 3.2-10). Short-tailed shrews had a 1978 density on RAPA 1 of nine, while none were recorded on PRA 1.

On PRA 2 total density increased from 13 in 1975, to 84 in 1976, and 113 in 1977, decreasing in 1978 to 91 (Table 3.2-10). Four-year densities of major species are presented in Figure 3.2-15. RAPA 2 density decreased slightly from 25 in 1975 to 22 in 1976, but increased to 82 in 1977 and 85 in 1978 (Table 3.2-10). Figure 3.2-18 illustrates the four-year densities of major species for RAPA 2. As on PRA and RAPA 1, deer mice had the highest densities in 1978 for both PRA and RAPA 2 and were not recorded in previous years. The PRA density reached 75 per hectare, that of the RAPA 63. White-footed mice, with highs in 1976 for each area (94 on PRA 2 and 47 on RAPA 2), were not recorded in 1976; they had 1975 densities of 9 on the PRA and 25 on the RAPA. Densities were low in 1978, the species being represented only on the PRA, with a density of six (Figure 3.2-15 and 18 and Table 3.2-10). Western harvest mice had high peaks in 1976. None were caught on either area in 1975, and had high densities of 68 (PRA 2) and 22 (RAPA 2) in 1976, which declined to zero in 1977 on the PRA, and six on the RAPA. Densities of three for each area were obtained in 1978 (Figures 3.2-15 and 18). Meadow voles had densities of nine for each area in 1977, but were not recorded in 1978 or previous years. Thirteen-lined ground squirrels had densities of 13 in 1976, and 6 in 1977 and 1978 on the PRA, and a density of 19 in 1977 and 13 in 1978 on the RAPA

(Table 3.2-10). The short-tailed shrew had a density of six on the RAPA in 1978, zero in previous years, and was not captured on PRA 2.

PRAs 3A and 3B had the lowest total densities of all areas in 1975 and the highest in 1976 and 1977, with intermediate densities in 1978. Densities on 3A ranged from 3 in 1975, to 107 in 1976, 125 in 1977, and 66 in 1978, while those on 3B ranged from 9 (1975), to 187 (1976), to 119 (1977), to 63 (1978) (Table 3.2-10). Four-year densities of major species on PRA 3A and 3B are illustrated in Figures 3.2-22 and 23, respectively. As on all previous areas, the deer mouse was the predominant species in 1978, with a density of 31 on 3A and 50 on 3B. On 3A in 1975, this species had a density of three (zero in intervening years), while on 3B, in 1977, a density of nine was reached (Figures 3.2-22 and 23). The most abundant species in 1977 was the white-footed mouse (Figures 3.2-22 and 23). On 3A the density reached 110 per hectare and had been 6 in 1976. The density was zero in 1975 and 1978. On 3B the 1977 high density was 94, and ranged from three to nine in the remaining three years. The peak in 1976 was occupied by western harvest mice (Figures 3.2-22 and 23), at densities of 88 on 3A and 178 on 3B. None was recorded in 1975 (there were six fewer in 1977 and 1978). Meadow voles have been present on both areas during most years, but in low densities (Figures 3.2-22 and 23). Thirteen-lined ground squirrels have also had low or non-existent densities on these transects. Short-tailed shrews were not represented on PRA 3B until 1978, when one individual was caught. On 3A densities have ranged from zero in 1975, to 6 in 1976, 3 in 1977, to a high of 16 in 1978 (Table 3.2-10).

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3.2.5 DISCUSSION

3.2.5.1 Vegetation

The results from 1978 are especially interesting, because they illustrate the usefullness of fire as a management tool in prairie restoration at Prairie Island. As mentioned in previous reports, fire should cause decreases in cool-season, foreign, weedy grasses such as quack grass and Kentucky bluegrass, while stimulating desirable native species such as fall witch-grass and many prairie grasses (see Dueholm 1976 and 1977 for references). In 1978 quack grass decreased on all areas burned in May, with the exception of PRA 3B, where it remained near a constant 38 percent composition. Kentucky bluegrass also decreased on all burned areas in 1978. Conversely, quack grass did not decrease on PRA 2, which was not burned in 1978. Also, Kentucky bluegrass has continually increased on PRA 2 from a low in early 1976 (following the single burn on this area). Similar responses are reported elsewhere (Curtis and Partch 1948; Hill and Platt 1975). The influence of local site conditions in dampening some of the effects of fire (Zedler and Loucks 1969; Vogl 1974) are nonetheless still apparent on PRA 3B, for example, where 36 percent of the transect in 1978 was located in willow growth, and where quack grass has not decreased. Fall witch-grass, where it has occurred, has tended to increase following burns, especially on PRA1. Bare ground has increased here also following fire, while total composition of annuals and biennials has decreased. This trend has been generally mirrored on other areas, although bare ground actually decreased on the PRA 3 transects, again implying the influence of local site conditions.

Percentage of willows on the PRA 3 transects has tended to increase following burns to as much as 5.5 percent on 3B in

1978, and has been due in large part to increased sucker growth. In addition, total points of transects located within willow growth have exhibited a weak trend of increase following fire, especially on 3B, a trend also followed by willow associates (Figures 3.2-19 and 20). Although the point-frame method of vegetation sampling, as used in this study, appears to reveal relative changes in the willows, a more quantitative analysis for shrub vegetation would permit more accurate statements concerning them. Quadrat studies of density, for instance, would allow a clearer picture of year-to-year variability in willow growth. The original objective in 1975, however, was to quantitatively sample herbaceous vegetation, and, in addition, time limitations in 1975 prohibited any quadrat analyses. The relative changes revealed by current methods do, in all probability, reflect the actual situation.

The planted prairie grasses have increased steadily since their planting, contributing 70 percent or greater composition on the two study plots in 1978. This increase has occurred on each area, even though RAPA 2 was not burned in 1978. Quack grass on this area had not recovered to the same degree as on RAPA 1, never contributing more than 10 percent composition. On RAPA 1, however, quack grass had increased from a low following planting, to greater than 25 percent composition. Thus, competition from this species was considerably less on RAPA 2, and its influence less pronounced.

Fire on RAPA 1 in 1978 worked well to reduce quack grass. In addition to stimulating prairie grasses, resulting in increased competitiveness, fire should have caught quack grass at a time when its root reserves were low. Also, severe defoliation can prevent rhizome formation (Palmer and Sagar 1963), compounding the deleterious effects of fire on quack grass. Thus, this species was reduced from more

than 25 percent in 1977 (the dominant species) to near 5 percent in 1978. Stimulating effects of fire on prairie grasses may be evident in the fact that 80 percent of the vegetation on RAPA 1 was due to these species, representing an increase of near 27 percent over late 1977. On RAPA 2, 70 percent of the vegetation was contributed by the prairie grasses, representing an increase of only 8 percent over late 1977. As mentioned above, RAPA 2 was not burned in 1978. Also, as seen in Figure 3.2-2, all planted grasses present increased following the 1978 burn on RAPA 1, while on RAPA 2, several species remained unchanged, or exhibited slight decreases (e.g., big and little bluestem in Figure 3.2-4), again illustrating the importance of fire in stimulation of prairie species.

The planted species contributing the greatest compositions on the two areas (i.e., side-oats grama, little bluestem, Indian grass, and switch-grass) are species generally associated with drier site conditions (Curtis 1959), and their success reflects the dry, sandy soil found on the Prairie Island plots.

The stimulating effect of fire on prairie grasses and fall witch-grass, coupled with its deleterious effects on quack grass and Kentucky bluegrass,makes it an essential component of future management. This is especially important when the behavior of quack grass on PRA 1 is examined (Figure 3.2-1). This species decreased following each fire, but a partial recovery was apparent in 1977 when no burn occurred. Also, fire effectively reduced sweet clover on PRA 1, although this species increased on PRA 3A. One fire can cause an increase in sweet clover, but a series of annual, late spring fires can control it (Heitlinger 1975). At this point, annual burning is recommended on the PRAs, especially on PRA 3. Burning on the RAPAs may follow a similar schedule, since even one year of not burning can result in a

marked decrease in production by prairie grasses (Hadley and Kieckhefer 1963). An interim of two years may not be particularly harmful now that planted species are established, but not more than three years should pass to insure the vigor of the species concerned.

Although most of the planted species have done well and appear to be firmly established, several problems with the planting project, both practical and theoretical, should be pointed out. In terms of establishing stands of prairie grass, the project has been a success. Nevertheless, the areas are conspicuous in the lack of an integral component of prairies, i.e., prairie forbs. Even a seed mixture designed to produce "fast-grass" should include some of the more competitive prairie forbs (Schramm 1978) such as coneflower and goldenrod. Indeed, the strongest support for such projects from the lay public is most likely to come when forbs are successful and conspicuous (Kuchler 1973). Furthermore, once a stand of grass is established, it becomes increasingly difficult to introduce forbs or for volunteer establishment from surrounding seed sources (Schwarzmeier 1972, Zimmerman 1972, and Schramm 1978). Restorations, which begin with a high initial density of grasses, may require decades to attain many characteristics obtained by slower methods in five to ten years (Schwarzmeier 1972). Methods for introduction of forbs in a dense grass stand are given in Schramm (1978), but these are most effective with less-sensitive species, such as leadplant (Amorpha canescens) and the prairie clovers (Petalostemom spp.).

A key point in the choice of species for planting should be the geographical distribution of such species (Schramm 1978). Composition of local prairie remnants should be determined and recorded distributions consulted, with the objective of true restoration of the original vegetation

type in the area in mind. The inclusion of buffalo grass, sand love grass, and yellow or prairie coneflower in the Prairie Island seeding mixture reaffirms this point. None of these species is native in this region, and is characteristic of either the sandhills region of Nebraska or the western Great Plains region. Similarly, the species of gayfeather planted, although occasionally found in highly xeric situations in western Wisconsin, is also more characteristic of the western plains. Only one of these four planted species (sand love grass) has appeared consistently in transect sampling, while the other three are barely, if at all, represented on the entire area of planting. The choice of forbs for planting should have included other species in the same genera which are found in remnant tall-grass prairies in this region, are adapted to the local climate and soils, and are conspicuous bloomers once established. For instance, as opposed to the species of prairie coneflower planted (Ratibida columnifera), the related species R. pinnata is a native member of tall-grass prairie, and a competitive species suitable for inclusion in grass-dominated seed mixtures (Schramm 1978). Likewise, different species of gayfeather would have been more applicable than the one chosen. Lists of suitable species for midwestern restorations are available (Rock 1974 and Schramm 1978), and many of these species are present in the Prairie Island vicinity (cf. species lists in Richardson 1977).

Somewhat removed from the success of the prairie planting itself, but nonetheless important, is the problem of introducing non-local ecotypes into a region, a concern voiced by several authors (Schwarzmeier 1973 and Schramm 1978). The problem is one of possible genetic infection of species in naturally occurring prairie remnants, especially quality remnants containing a variety of subdominant species. It is not improbable that cross-pollinating of dominant species by introduced ecotypes could produce hybrid products of an

excessively aggressive character. Such an aggressive, dominant hybrid product in a natural remnant could expand greatly, resulting in little room available for lesser species, possibly resulting in their total exclusion, and decline in quality of the remnant (Schwarzmeier 197). It is conceivable that quality remnants could be degraded through prairie restoration involving non-local ecotypes. The problem may be especially acute, since introduced ecotypes may persist for two or three human generations or longer (Wilson 1972), allowing an excessively long period for possible deleterious hybrid products to form. Seed for the Prairie Island plantings was obtained from Nebraska, the ultimate source of the seed being unknown. The "Champ" variety of big bluestem used, however, is itself a hybrid of two species of bluestem (Wilson 1972). The most advised solution is to use local ecotypes. A frequently mentioned method of prairie establishment, applicable at Prairie Island, is the spreading of prairie hay on restoration areas (Schwarzmeier 1973 and Rock 1974).

To briefly summarize, success of prairie planting at Prairie Island should be evaluated contingent upon any future attempts to introduce native forbs, adapted locally, especially legumes and conspicuously blooming composites. In addition, such an attempt should include some early flowering species such as puccoon (Lithospermum sp.) and prairie phlox (Phlox pilosa). Finally, possible long-term effects upon local remnants should not be ignored.

3.2.5.2 Birds

Several facets of a particular habitat influence the bird community found there. One of these involves the amount of seed-producing plants, providing a food source for seed-eating birds, such as the mourning dove. In general, such plants are annuals (e.g., foxtails and crab grass), which

are used by a large number of species (Martin, Zim, and Nelson 1951). A second facet involves density of the vegetation, including litter accumulation, and the resultant ease of foraging. Density can also be involved in species' preferences for areas, regarding nesting, roosting, and loafing activities. In addition, with an accumulation of litter, an increase in insect populations takes place, especially in grasshoppers (Tester and Marshall 1961) to an optimum level, after which insects decline. This may provide an attraction to insect-eating birds such as meadowlarks and swallows. Many species which are primarily seed-eaters, also depend on insects, especially in rearing their young (Wiens 1969). Height, density, and structure of the vegetation of a habitat, as well as the distribution of these within the vegetation type, may be primary determinants of the bird community occupying the habitat, with actual composition of the vegetation of lesser importance (Wiens 1969 and Skinner 1975).

Since these factors are interrelated, it becomes somewhat difficult to correlate bird populations with a single factor. For instance, following fire on most plots, the total composition of annuals has decreased (Figures 3.2-7, 13, 19, and 20), lessening the food supply for seed-eating birds. However, this may be compensated for by easier access in foraging, due to removal of litter, resulting in an actual increase in seed-eating species. Another influence may be introduced by increased height and density of prairie grasses following fire, compounding the problem even further. Furthermore, fire may reduce insect populations, because of litter removal, the season immediately following a burn (Tester and Marshall 1961). The next season, however, may find litter restored to an optimal level for insects. In fact, insects are often most numerous in areas recovering from fire (Tester and Marshall 1961 and Daubenmire 1968). Finally, with increasing litter

accumulation in the absence of fire, species originally attracted to an "open" habitat of high light intensity may be replaced by species preferring dense litter layers with reduced light such as grasshopper and Henslow's sparrows (Wiens 1969). The relative interplay of these factors on different areas, or in different years, may result in increases on one particular area and decreases in another.

Total composition of annuals and biennials decreased following the 1976 burn on all burned plots (PRAs 1, 2, and 3). Mourning dove density (a seed-eater) increased on all areas except PRA 1, where a decrease occurred (Figure 3.2-8). It is interesting to note that the composition of annuals on PRAs 2 and 3 did not decrease below 12 percent and was generally greater than 15 percent in 1976. On PRA 1, however, annuals decreased below 6 percent. Apparently an increase in foraging ease on PRAs 2 and 3 compensated for a decrease in annuals, while on PRA 1 the decrease in annuals was too great for a similar compensation. Following the 1978 burn on PRA 1, annuals did not decrease below 10 percent, and an increase occurred in mourning dove densities. On the RAPAs, annuals have decreased continually since 1975, but mourning doves were at relatively high densities in 1978. One of the prevalent plant species on these areas in 1978 was Indian grass (Figures 3.2-2 and 4), which is a species apparently preferred by mourning doves for nesting (George 1978).

Higher densities of western meadowlarks occurred in 1977 on PRA 1, in 1976 and 1977 on PRA 2, in 1976 and 1977 on RAPA 1, and in 1976 on RAPA 2. On the PRAs, this represented either the season immediately following the 1976 burn, or the second year, when a year's accumulation of litter was present. Likewise, on the RAPAs, one or two year's litter accumulation was present. Western meadowlarks are reported to prefer open, grassy areas with dense, low vegetation and

high light intensity (Wiens 1969). Such conditions could be met by both vegetation recovery following fire, along with its initial increase in litter, as well as vegetation developing on the RAPAs. Accumulation of litter on each type of area would also favor an increase in insects (Tester and Marshall 1961). It is interesting to note in Figures 3.2-8, 11, 14, and 17 that highest densities of swallows, which are insect-eaters, occurred on all four areas in either 1976 or 1977 (or both), a possible reflection of an increase in insects.

Densities of grassland birds, taken as a group, have generally been fairly low (Table 3.2-8). However, some possible trends appear to have taken place among the species included in this group (i.e., vesper, savannah, and grasshopper sparrows). For instance, in 1975, on PRA 1, the vesper sparrow contributed the entire density figure (0.127 per hectare). In 1978 the major portion of grassland bird density was due to savannah sparrows (Table 3.2-8). Similarly, in 1975, vesper sparrows were present on RAPA 1 (at low density), while in 1977, grasshopper sparrows were present. In both these cases, the change has been from a species preferring xeric, sparsely vegetated sites (the vesper sparrow) to species preferring a vegetative cover that is fairly dense (Wiens 1969), either in terms of ground layer vegetation (savannah sparrow), or both a low cover of grasses as well as large tracts of tall prairie grasses (grasshopper sparrow). It may be conceivable that the increase in fall witch-grass, the dominant species on PRA 1, which occurs in the form of somewhat low and dense clumps, may have contributed to the change there, while the increase in planted prairie grasses and accumulation of litter on RAPA 1 may have served a similar purpose. Some possible support for the importance of fall witch-grass in this trend is suggested by trends on PRAs 2 and 3; here fall witch-grass has remained a fairly minor component of the

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vegetation, while quack grass has been the dominant feature. The structure of this species differs considerably from fall witch-grass, in that low-lying, dense clumps are not formed. Instead, a fairly open stand of grass is present. This difference may be reflected by the fact that only vesper sparrows have been found on PRA 2, and primarily vesper sparrows on PRA 3 (Table 3.2-10), the species preferring more open habitats (Wiens 1969). Densities of grassland sparrows on RAPA 2 have been consistently low, have appeared in 1977 and 1978 only, and seem to be pointing in the direction of vesper sparrows. The lack of grassland sparrows here until 1977 and 1978 may be consistent with a possible "lag" in the bird population on this area, mentioned in the previous report (Dueholm 1978). The primary vegetation here has been composed of side-oats grama (Figure 3.2-4), a relatively low, but open form of grass, resulting in an apparent favoring by vesper sparrows on RAPA 2 in 1978. With the continuing increase of taller planted species, as exhibited in Figure 3.2-4, and the apparent equilibrium reached by side-oats grama, birds preferring denser or taller vegetation may be expected to be attracted to this plot.

Ring-necked pheasants have had higher densities on all areas in 1975 and 1977, years during which no burns occurred. Densities of this species on PRA 3 decreased following both the 1976 and 1978 burn. The density also decreased following the 1976 burn on PRAs 1 and 2. Although the density increased on PRA 2 in 1977, it decreased in 1978, in the absence of fire on this area (a similar decrease from 1977 to 1978 occurred on RAPA 2, which has never been burned). It is obvious that factors other than fire alone were existing here, and natural fluctuations of populations from year to year cannot be entirely ruled out. Also, the effect of time of day of observations in 1976 may have a role in trends of pheasant densities for that year (Dueholm 1977).

In fact, the importance of fire in stimulating prairie grasses and affecting the PRA grassland vegetation structure and its possible influence on pheasant densities may be seen on PRA 2. Although the density decreased in 1976 following fire, 1977 density was ten times the initial 1975 density (0.465 versus 0.040 birds per hectare). Also, highest nest densities and greatest nesting success have been reported in areas of mixed native prairie grasses, especially areas with switch-grass (George 1978), illustrating the importance of the planted species on the RAPAs. The beneficial force of fire in altering habitat structure and in promoting prairie grasses should eventually produce ideal habitat for pheasants on Prairie Island.

No burn occurred on PRA 2 in 1978, allowing a third season for vegetation recovery following the initial burn in 1976. The continual recovery of this vegetation may be the cause for similar densities in three species in both 1975 and 1978. Densities were essentially equal for these two years for ring-necked pheasants, western meadowlarks, and mourning doves (Table 3.2-8). Thus, in slightly over two complete growing seasons following fire, densities of major species have returned to pre-burn levels, implying a similar recovery in structure of the habitat.

Although the percentage of transects located within willow growth on PRA 3 has remained relatively unchanged following two burns, species diversity of birds has decreased (from 18 to 20 species to only ten in 1978) as well as total density (from 8.63 in 1975 to 5.11 in 1978). This again illustrates the importance of vegetation structure. Kendeigh (1941), for instance, found that age and density of thickets were important factors in populations of yellow warblers, and that size of the thicket was not involved. On PRA 3 following the 1976 and 1978 burns, many willows were killed or severely damaged. Many of these remained standing but were

extremely brittle. In addition, much root sprouting occurred, resulting in relatively denser, but younger and shorter growth. It is the relative thickness of this resprouting which has resulted in increases in composition values in 1976 and 1978, especially on PRA 3B. Thus, with overall extent of willows remaining unchanged (at present), stand structure has been altered considerably, and its effect on bird populations can be seen in the continuous decrease in total density of birds associated with willow growth (from 2.727 in 1975 to 0.695 in 1978). Species such as the rose-breasted grosbeak and house wren, have not been present following either fire, and were sparingly present in 1977. The song sparrow decreased following the 1976 burn and was not recorded in 1978. A partial recovery may have been evident for these species in 1977. Conversely, indigo buntings have decreased continually since 1975. Yellow warblers actually increased following the 1976 burn, but have decreased since, while yellowthroats originally decreased in 1976 and increased in 1977 and 1978, although not reaching their original 1975 density. Within the dominant pattern of overall decrease of willow-associated species, occur temporary conditions partially favorable for some species, with small temporary recoveries in density as a result.

Goldfinches decreased following both burns on PRA 3 (Figure 3.2-21). In addition to changes in stand structure, as mentioned above, there was a decrease in percentage of thistles in 1978 in the transect segment 61 to 70 (from 26 to 18 percent). Thistles are primary foods of the American goldfinch (Martin, Zim, and Nelson 1951), and decreases here, coupled with structural change of the habitat may both be involved in decreases in goldfinches following fires.

3.2.5.3 Small Mammals

Since the initiation of this study in 1975, the prevalent small mammal in each of four years has been represented by a single species. In 1975 the white-footed mouse was most numerous, in 1976 the western harvest mouse was at a high, and in 1977 the white-footed mouse again was most prevalent. Finally in 1978, the deer mouse was the major species. The prevalence of a species in a particular year has been over all plots, whether burned, unburned, or planted. In fact, a particular species has been numerous not only on the six study plots here, but over appropriate habitat throughout the Prairie Island project area (cf. Norling 1977, prairie and sand terrace habitats). Populations of small mammals are subject to large fluctuations and are often cyclic (Goddard 1976). In a year of peak population size of a particular species, pressure caused by crowding is partially alleviated through emigration into adjoining areas. Such large-scale movement during population highs may account for the widespread prevalence of a species throughout the Prairie Island study area. Thus, the presence of population peaks on the six plots of the present study may simply represent peaks in a regular cycle of population highs and lows.

On the other hand, a fairly definite trend can be found in populations of small mammals on the six study plots. The importance of litter accumulation and vegetation density in small mammal populations was mentioned in the previous report (Dueholm 1978), and plays the major role in both numbers and species present in an area (Moreth and Schramm 1973). The western harvest mouse, for instance, prefers highly open habitats, such as early successional stages of abandoned fields, wherever little or no litter accumulation occurs. It may also have an irruption in population following fire (Cook 1959). Such seems to have been the case

following the 1976 burns. The increase occurred on the RAPA as well. It is interesting to note that percent of bare ground was highest on all areas in 1976. Bare ground generally approached or exceeded 15 percent on each area in 1976. Plots which had greatest percentages of bare ground included PRAs 2 and 3A and 3B (near 25 percent). These were also the plots which had greatest densities of western harvest mice in 1976. Thus, there appears to be a fairly good correlation of this species with amount of bare ground. In 1978 the amount of bare ground was generally less than 10 percent, even on burned plots, and no irruption of western harvest mice occurred. This species is also primarily a seed-eater, and the continuing decline of annuals and biennials on the RAPAs (to less than five percent in 1978) may have had an additional influence on their populations.

Both the white-footed mouse and deer mouse (members of the genus Peromyscus) have been reported to prefer vegetation recovering from fire (Tester and Marshall 1961, Daubenmire 1968, and Moreth and Schramm 1973). Litter accumulation is greater than that preferred by western harvest mice, but is not too dense. Four years of litter accumulation, for instance, has been reported to eliminate the white-footed mouse (Springer and Schramm 1972). The deer mouse is apparently not as sensitive to increasing vegetation density as the white-footed mouse (Moreth and Schramm 1973), and may even prefer areas of tall to mid-height grasses, such as big and little bluestem, and side-oats grama (Fleharty 1972). But with too great an accumulation of litter, this species too may decrease (Moreth and Schramm 1973). Areas of greatest litter and cover are then preferred by meadow voles (Schramm 1970, Moreth and Schramm 1973, Birney, and Grant and Baird 1976). With increased litter accumulation on the plots in 1977, the western harvest mouse was replaced by the white-footed mouse. In 1978 bare ground decreased even further on PRAs 2 and 3B, and was relatively unchanged

on RAPAs 1 and 2. Planted prairie species increased on both RAPAs providing denser vegetative cover. In addition, the 1978 season was very wet, whereas the 1976 season encompassed drought conditions. Increased moisture during 1978 may have encouraged greater regrowth of vegetation following the burns. The fact that bare ground did not increase as much following the 1978 burns as in 1976 would support this idea. The deer mouse being less sensitive to greater vegetation cover, replaced the white-footed mouse in 1978. Observers were not the same in 1978 as in previous years, so observer bias cannot be ruled out when identification of members of the rather difficult genus Peromyscus is concerned (Zajicek 1978). Nevertheless, identification is believed to be accurate, and the change in species densities would be consistent with the trend mentioned above.

A variety of interspecific relationships have been mentioned in the literature, and these too support the lack of observer bias in the small mammal data. It has been suggested than an element of interspecific competition exists between western harvest mice and deer mice (Fleharty 1972), where increases in deer mice are reflected by decreased in the western harvest mouse. Furthermore, increases in numbers of deer mice, through increased competition, may possibly contribute to decreases in white-footed mice (Moreth and Schramm 1973). This possibility, in conjunction with less sensitive response of deer mice to increased vegetation cover, supports the accuracy of present data. Finally, meadow voles have been reported to be dominant over white-footed mice (Bowker and Pearson 1975). The requirement of dense cover by this species has apparently held its densities at a low level on the study plots. Densities were generally higher in 1977, following one or two years of litter accumulation on the study plots, and decreased following both 1976 and 1978 burns. Conditions favorable for a particular species, a function of litter and cover,

resulting in a population increase in certain areas, may then cause emigration to peripheral areas. A large influx of a species may further cause interspecific competition. resulting in a decline in less dominant species. Habitat conditions may also be less favorable for the second species, compounding the decrease even further, so even if general cycles are present in the small mammal populations at Prairie Island, several factors (habitat development preference and interspecific competition) serve to confound the situation, possibly to remove any regularity in such cycles. Such is especially to be the case when habitat structure, density, and composition is altered by the occurrence of prescribed burns.

Densities of short-tailed shrews have been reported to decrease following burns (Springer and Schramm 1972), being dependent on a litter build-up of one and one half years. At Prairie Island, this species, when present, has generally had higher densities in 1976 and 1978, especially on PRA 3A in 1978 (Table 3.2-10), years following burns. No definite reason is known for this discrepency, but it may be that increased sucker growth of willows in these years has compensated for a decrease in litter cover.

At this point it is of great interest to sample the small mammal populations in 1979, when prescribed burns are planned for most study plots, to discover if the pattern of single species prevalence is repeated, and if so, what species predominates. It should be mentioned that very intensive burning cycles (annual fires over several years) may have been important in causing unexplained decreases in several species of small mammals in Illinois (Springer and Schramm 1972), although such should not be the case at Prairie Island under the present burning schedule.

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3.2.6 RECOMMENDATIONS

It is perhaps preferable to have two vegetation samples per year, as in 1976 and 1977. Should time be limiting, however, a single sample done during the middle of August may be appropriate, as in 1978. In addition, other areas burned at Prairie Island might also be sampled. Transects are already established in such areas, and include Transects 3, 4, 7, 8, and 11. Two of these are of special interest: Transect 7, located in a small remnant of prairie grasses, should be monitored; also, Transect 4 has never been burned, and might be included as a control plot for comparative purposes. This plot is also fairly similar to the PRA plots of the present study in terms of vegetation present. In 1976 Transect 4 consisted of between 25 and 30 percent quack grass, 22 percent Kentucky bluegrass,and between 21 and 34 percent fall witch-grass (Richardson 1977).

Bird populations should be censused for at least six weeks during the summer, from mid-June onward, providing a fair number of samples, and a time range consistent with previous years.

Finally, small mammals should continue to be sampled during late September and early October, as in previous years.

3.2.7 LITERATURE CITED

Birney, Elmer C., W. E. Grant, and Donna Day Baird. 1976. Importance of Vegetative Cover to Cycles of Microtus Populations. Ecol. 57(5): 1043 - 1051.

Bowker, Leslie S. and Paul G. Pearson. 1975. Habitat Orientation and Interspecific Interaction of Microtus pennsylvanicus and Peromyscus leucopus. Am. Midl. Nat. 94 (2): 491 - 496.

Britton, Nathaniel L. and Addison Brown. 1913. Illustrated Flora of the Northern United States and Canada (repr.). Peter Smith Publ., Inc. Magnolia, MA.

Cook, Sherburne F., Jr. 1959. The Effects of Fire on a Population of Small Rodents. Ecol. 40 (1): 102 - 108.

Curtis, John T. 1959. The Vegetation of Wisconsin. University of Wisconsin Press. Madison.

Curtis, John T. and Max L. Partch. 1948. Effect of Fire on the Competition Between Blue Grass and Certain Prairie Plants. Am. Midl. Nat. 39: 437 - 43.

Daubenmire, R. 1968. Ecology of fire in grasslands. Adv. Ecol. Res. 5: 209 - 266.

Dueholm, Keith H. 1978. Report on Prairie Island Prairie Establishment Operations for 1977. - in Environmental Monitoring and Ecological Studies Program. 1977 Annual Report for the Prairie Island Nuclear Generating Plant. Terrestrial Ecological Studies. Northern States Power. Vol. II: 3.2 - 1 - 3.2 - 71.

Dueholm, Keith H. 1977. Report on Prairie Island Prairie Establishment Operations for 1976. - in Environmental Monitoring and Ecological Studies Program. 1976 Annual Report for the Prairie Island Nuclear Generating Plant. Terrestrial Ecological Studies. Northern States Power. Vol. II: 2.7.5.2-1 - 2.7.5.2-66.

Dueholm, Keith H. 1976. Report on Prairie Island Prairie Establishment Operations for 1975. - in Environmental Monitoring and Ecological Studies Program. 1975 Annual Report for the Prairie Island Nuclear Generating Plant. Terrestrial Ecological Studies. Northern States Power. Vol. II: 2.7.3.6-1 - 2.7.3.6-57.

277 256

Fleharty, Eugene D. 1972. Some Aspects of Small Mammal Ecology in a Kansas Prairie. - in Zimmerman, J. H. (ed.), Proceedings of the Second Midwest Prairie Conference. Univ. of Wisconsin Arboretum, Madison. pp. 97 - 103.

George, Ronnie R. 1978. Native Prairie Grass Pastures as Nesting Habitat for Bobwhite Quail and Ring-necked Pheasant. - in Glenn-Lewin, D. C., and Roger Q. Landers, Jr. (eds.), Proceedings of the Fifth Midwest Prairie Conference. Iowa State University, Ames, pp. 104 - 106.

Gleason, H. A. and A. Cronquist. 1963. Manual of Vascular Plants of Northeastern United States and Adjacent Canada. D. Van Nostrand Co., Inc. Princeton, NJ.

Goddard, Stephen V. 1976. Terrestrial Animal Population Studies Adjacent to the Prairie Island Generating Plant. Environmental Monitoring and Ecological Studies Program. 1975 Annual Report for the Prairie Island Nuclear Generating Plant. Northern States Power Company. Vol. II: 2.7.2-1 - 2.7.2-80.

Goddard, Stephen V. and James W. Richardson. 1973. Environmental Monitoring and Ecological Studies Program. 1972 Annual Report for the Prairie Island Nuclear Generating Plant. Terrestrial Ecological Studies. Northern States Power Company, pp. C-429 - C-464.

Hadley, B. and B. J. Kieckhefer. 1963. Productivity of Two Prairie Grasses in Relation to Fire Frequency. Ecol. 44(2): 389 - 395.

Heitlinger, Mark E. 1975. Burning a Protected Tall Grass Prairie to Suppress Sweetclover, Melilotus alba Desc. - in Wali, Mohan K. (ed.), Prairie: A Multiple View. University of North Dakota Press. Grand Forks. pp. 123 - 132.

Hill, G. R. and W. J. Platt. 1975. Some Effects of Fire upon a Tall Grass Prairie Plant Community in Northwestern Iowa in Wali, Mohan K. (ed.), Prairie: A Multiple View. University of North Dakota Press. Grand Forks. pp. 102 - 113.

Kendeigh, S. Charles. 1941. Birds of a Prairie Community. The Condor 43 (4): 165 - 174.

Kuchler, A. W. 1973. The Prairie as an Aesthetic Experience and a tool for Public Enlightenment. - in Hulbert, Lloyd C. (ed.), Proceedings of the Third Midwest Prairie

277 251

Conference. Manhattan, Kansas. pp. 40 - 42.

Martin, A. C., H. S. Zim, and A. L. Nelson. 1951. American Wildlife and Plants. Dover Publ., Inc. New York.

Moreth, Louis H. and Peter Schramm. 1973. A Comparative Survey of Small Mammal Populations in Various Grassland Habitats with Emphasis on Restored Prairie. in - Hulbert, Lloyd C. (ed.), Proceedings of the Third Midwest Prairie Conference. Manhattan, Kansas. pp. 79 - 84.

Norling, Wayne. 1977. Small Mammal Study Four-year Report on Small Mammal Populations. 1976 Annual Report for the Prairie Island Nuclear Generating Plant. Northern States Power Company. Vol. II: 2.7.3-1 - 2.7.3-25.

Palmer, J. H. and G. R. Sagar. 1963. Agropyron repens (L.) Beauv. J. Ecol. 51: 783 - 794.

Richardson, James W. 1977. Terrestrial Plant Community Studies. - in Environmental Monitoring and Ecological Studies Program. 1976 Annual Report for the Prairie Island Nuclear Generating Plant. Terrestrial Ecological Studies. Northern States Power. Vol. II: 2.7.1-1 - 2.7.1-196.

Rock, Harold W. 1974. Prairie Propagation Handbook (3rd. ed.). Boerner Botanical Gardens. Milwaukee County Park System.

Schramm, Peter. 1978. The "Do's and Don'ts" of Prairie Restoration. - in Glenn-Lewin, D. C. and Roger Q. Landers, Jr. (eds.), Proceedings of the Fifth Midwest Prairie Conference. Iowa State University, Ames. pp. 139 - 150.

Schramm, Peter. 1970. Effects of Fire on Small Mammal Populations in a Restored Tall-grass Prairie. - in Schramm, Peter (ed.), Proceedings of a Symposium on Prairie and Prairie Restoration. Knox College. Galesburg, Illinois. pp. 39 - 41.

Schwarzmeier, Jerry. 1973. What Are Our Responsibilities in Prairie Restoration? - in Hulbert, Lloyd C. (ed.), Proceedings of the Third Midwest Prairie Conference. Manhattan, Kansas. pp. 37 - 40.

Schwarzmeier, Jerry. 1972. Competitional aspects of prairie restoration in the early stages. - in Zimmerman, J. H. (ed.), Proceedings of the Second Midwest Prairie Conference. Univ. of Wisconsin Arboretum, Madison. pp. 122 - 139.

Skinner, Robert M. 1975. Grassland Use Patterns and Prairie Bird Populations in Missouri. - in Wali, Mohan K. (ed.), Prairie: A Multiple View. University of North Dakota Press. Grand Forks. pp. 171 - 180.

Springer, J. Tucker and Peter Schramm. 1972. The Effects of Fire on Small Mammal Populations in a Restored Prairie with Special Reference to the Short-tailed Shrew, Blarina brevicauda. - in Zimmerman, J. H. (ed.), Proceedings of the Second Midwest Prairie Conference. Univ. of Wisconsin Arboretum, Madison. pp. 91 - 96.

Tester, J. R. and W. H. Marshall. 1961. A study of certain plant and animal interrelations on a native prairie in northwestern Minnesota. Univ. Minn. Mus. Nat. Hist. Occas. Papers 8: 1 - 51.

Vogl, Richard J. 1974. Effects of Fire on Grasslands. - in Kozlowski, T. T. and C. E. Ahlgren (eds.), Fire and Ecosystems. Academic Press, New York. pp. 139 - 194.

Wiens, John A. 1969. An approach to the Study of Ecological Relationships Among Grassland Birds. Ornithological Monographs No. 8. Am. Ornithologists Union. pp. 1 - 93.

Wilson, Jim. 1972. Effect of Variety Choice on Stand Establishment of Native Grasses in Prairie Restoration. - in Zimmerman, J. H. (ed.), Proceedings of the Second Midwest Prairie Conference. Univ. of Wisconsin Arboretum, Madison. pp. 140 - 150.

Zajicek, Thomas E. 1978. Small Mammal Study. - in Environmental Monitoring and Ecological Studies Program. 1977 Annual Report for the Prairie Island Nuclear Generating Plant. Terrestrial Ecological Studies. Northern States Power. Vol. II: 2.8-1 - 2.8-27.

Zedler, Joy and Orie L. Loucks. 1969. Differential Burning Response of Poa pratensis fields and Andropogon scoparius Prairies in Central Wisconsin. Am. Midl. Nat. 51(2): 341 - 352.

Zimmerman, James H. 1972. Propagation of Spring Prairie Plants. - in Zimmerman, James H. (ed.), Proceedings of the Second Midwest Prairie Conference. Univ. of Wisconsin Arboretum, Madison. pp. 153 - 161.

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Table 3.2-1
Point Frame Analysis of PRA 1. Completed 17 August 1978.

Species	Transect Segments 1-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	81-90	91-100	Total	% Comp.
Fall witch-grass(Leptoloma cognatum)	54	18	48	40	44	56	39	42	42	72	455	45.5
Quack-grass(Agropyron repens)	24	24	21	12	13	9	27	24	22	7	183	18.3
Bare Ground	7	18	4	7	8	3	10	7	13	12	89	8.9
Rough hair-grass(Agrostis scabra)	1	3	2	18	1	6	1	5	-	6	43	4.3
Schweinitz's cyperus(Cyperus schweinitzii)	3	10	6	3	1	5	-	10	2	-	40	4.0
Ragweed(Ambrosia artemisiifolia)	-	-	1	6	1	1	13	1	4	1	28	2.8
Green foxtail(Setaria viridis)	1	4	3	7	3	1	-	-	-	-	19	1.9
Purple love-grass(Eragrostis spectabilis)	-	-	-	-	16	-	-	-	-	-	16	1.6
Panic-grass sp.(Panicum sp.)	-	5	-	-	-	-	-	6	4	-	15	1.5
Kentucky blue-grass(Poa pratensis)	-	-	4	2	-	-	3	-	1	2	12	1.2
Horseweed(Conyza canadensis)	-	-	-	1	-	8	1	-	1	-	11	1.1
Cow vetch(Vicia villosa)	-	-	7	1	-	-	-	-	2	-	10	1.0
Narrow-leaved hawksbeard(Crepis tectorum)	-	3	-	-	-	-	-	1	5	-	9	0.9
Canada blue-grass(Poa compressa)	-	-	-	-	4	1	-	3	-	-	8	0.8
Sheep sorrel(Rumex acetosella)	3	4	-	-	-	-	-	1	-	-	8	0.8
Sand dropseed(Sporobolus cryptandrus)	1	2	3	1	-	-	-	-	-	-	7	0.7
Common milkweed(Asclepias syriaca)	5	-	-	-	-	-		-	-	-	5	0.5
Large crab-grass(Digitaria sanguinalis)	-	-	-	-	5	-	-	-	-	-	5	0.5
Flowering spurge(Euphorbia corollata)	-	-	-	1	-	4	-	-	-	-	5	0.5
Black bindweed(Polygonum convolvulus)	-	1	-	-	1	1	1	-	1	-	5	0.5
Daisy fleabane(Erigeron strigosus)	-	-	-	-	-	4	-	-	-	-	4	0.4
Yarrow(Achillea millefolium)	-	2	-	-	-	-	1	-	-	-	3	0.3
Missouri goldenrod(Solidago missouriensis)	-	-	-	-	-	1	-	-	2	-	3	0.3
Siberian elm(Ulmus pumila)	-	-	-	-	-	-	3	-	-	-	3	0.3
Ridge-seeded spurge(Chamaecyse glyptosperma)	-	2	-	-	-	-	-	-	-	-	2	0.2
Korean lespedeza(Lespedeza stipulacea)	-	2	-	-	-	-	-	-	-	-	2	0.2
Carpetweed(Mollugo verticillata)	-	-	1	1	-	-	-	-	-	-	2	0.2
Golden aster(Chrysopsis v[illo]sa)	1	-	-	-	-	-	-	-	-	-	1	0.1
Hedge bindweed(Convolv[ulus] [sep]ium)	-	-	-	-	-	-	-	-	1	-	1	0.1
Virginia strawberry(Fra[garia] virginiana)	-	-	-	-	1	-	-	-	-	-	1	0.1
Prairie froelichia(Froel[ichia] floridana)	-	-	-	-	1	-	-	-	-	-	1	0.1
Rough pennyroyal(Hedeoma hispida)	-	1	-	-	-	-	-	-	-	-	1	0.1
Wild four-o'clock(Oxybaphus nyctagineus)	-	-	-	-	1	-	-	-	-	-	1	0.1
Arkansas rose(Rosa suffulta)	-	-	-	-	-	-	1	-	-	-	1	0.1
Russian thistle(Salsola kali)	-	1	-	-	-	-	-	-	-	-	1	0.1
Totals	100	100	100	100	100	100	100	100	100	100	1000	100.0

Table 3.2-2
Point Frame Analysis of RAPA 1. Completed 17 August 1978.

Species	Transect Segments 1-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	81-90	91-100	Totals	% Comp.
Indian-grass(Sorghastrum nutans)	44	43	24	26	10	19	22	12	7	7	214	21.4
Little bluestem(Andropogon scoparius)	11	21	19	30	28	36	19	11	9	21	205	20.5
Switch-grass(Panicum virgatum)	8	8	13	22	13	19	17	11	27	13	151	15.1
Big bluestem(Andropogon gerardi)	9	9	9	3	6	8	12	24	22	20	122	12.2
Bare Ground	4	3	12	14	28	8	14	10	1	9	103	10.3
Side-oats gramma(Bouteloua curtipendula)	14	7	3	-	7	6	1	18	13	3	72	7.2
Quack-grass(A. opyron repens)	8	2	1	4	1	1	10	10	11	16	64	6.4
Sand love-grass(Eragrostis tricnoides)	-	-	3	-	-	2	1	4	5	9	24	2.4
Schweinitz's cyperus(Cyperus schweinitzii)	1	-	4	-	1	-	-	-	2	-	8	0.8
Rough hair-grass(Agrostis scabra)	-	7	-	-	-	-	-	-	-	-	7	0.7
Ragweed(Ambrosia artemisiifolia)	-	-	-	-	-	-	4	-	-	1	5	0.5
Flowering spurge(Euphorbia corollata)	-	-	3	-	2	-	-	-	-	-	5	0.5
Panic-grass sp.(Panicum sp.)	-	-	5	-	-	-	-	-	-	-	5	0.5
Fall witch-grass(Leptoloma cognatum)	-	-	2	1	-	-	-	-	1	-	4	0.4
Canada blue-grass(Poa compressa)	-	-	-	-	3	-	-	-	-	-	3	0.3
Sand primrose(Oenothera rhombipetala)	-	-	2	-	-	-	-	-	-	-	2	0.2
Cow vetch(Vicia villosa)	-	-	-	-	-	-	-	-	1	1	2	0.2
Common milkweed(Asclepias sy. iaca)	-	-	-	-	-	-	-	-	1	-	1	0.1
Sand-bur(Cenchrus longispinus)	1	-	-	-	-	-	-	-	-	-	1	0.1
Narrow-leaved hawksbeard(Crepis tectorum)	-	-	-	-	-	1	-	-	-	-	1	0.1
Sweet clover sp.(Melilotus sp.)	-	-	-	-	1	-	-	-	-	-	1	0.1
Totals	100	100	100	100	100	100	100	100	100	100	1000	100.0

Table 3.2-3
Point Frame Analysis of PRA 2. Completed 17, 18 August 1978.

Species	Transect Segments 1-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	81-90	91-100	Totals	% Comp.
Quack-grass(Agropyron repens)	-	40	74	65	11	50	42	47	19	10	358	35.8
Fall witch-grass(Leptoloma cognatum)	21	-	-	-	5	17	6	2	42	36	129	12.9
Kentucky blue-grass(Poa pratensis)	14	-	-	-	17	7	6	16	15	17	92	9.2
Smooth brome-grass(Bromus inermis)	-	-	-	-	-	-	32	30	13	15	90	9.0
Sweet clover sp.(Melilotus sp.)	26	28	8	-	9	-	-	-	-	-	71	7.1
Green foxtail(Setaria viridis)	8	19	-	1	2	-	-	-	2	7	34	3.4
Bare Ground	3	4	-	1	8	1-	1	1	1	-	29	2.9
Three-awn-grass(Aristida basiramea)	8	-	-	-	6	-	-	-	-	-	14	1.4
Golden aster(Chrysopsis villosa)	-	-	-	7	5	2	-	-	-	-	14	1.4
Siberian elm(Ulmus pumila)	-	-	-	-	-	7	7	-	-	-	14	1.4
Nodding wild rye(Elymus canadensis)	-	-	5	-	-	-	-	-	-	6	11	1.1
Russian thistle(Salsola kali)	-	-	-	-	-	-	5	2	4	-	11	1.1
White sweet clover(Melilotus alba)	10	-	-	-	-	-	-	-	-	-	10	1.0
Sand-bar willow(Salix interior)	-	-	8	2	-	-	-	-	-	-	10	1.0
Rough hair-grass(Agrostis scabra)	-	-	-	-	8	-	-	-	-	-	8	0.8
Korean lespedeza(Lespedeza stipulacea)	-	7	-	-	-	1	-	-	-	-	8	0.8
Ciliate-leaved paspalum(Paspalum ciliatifolium)	-	-	-	-	8	-	-	-	-	-	8	0.8
Silvery cinquefoil(Potentilla argentea)	5	-	-	2	-	-	-	-	-	1	8	0.8
Slender cyperus(Cyperus lupulinus)	-	-	-	-	7	-	-	-	-	-	7	0.7
Schweinitz's cyperus(Cyperus schweinitzii)	-	-	-	-	5	1	-	-	-	-	6	0.6
Rough pennyroyal(Hedeoma hispida)	1	-	-	5	-	-	-	-	-	-	6	0.6
Sand dropseed(Sporobolus cryptandrus)	-	-	-	-	5	1	-	-	-	-	6	0.6
Hoary vervain(Verbena stricta)	5	-	-	-	-	-	-	-	-	1	6	0.6
Large crab-grass(Digitaria sanguinalis)	2	-	-	-	1	-	-	-	2	-	5	0.5
Reed canary-grass(Phalaris arundinacea)	-	-	-	5	-	-	-	-	-	-	5	0.5
Rough hedge nettle(Stachys hispida)	-	-	-	5	-	-	-	-	-	-	5	0.5
Cottonwood(Populus deltoides)	-	-	4	-	-	-	-	-	-	-	4	0.4
Common milkweed(Asclepias syriaca)	-	-	-	-	-	-	-	-	-	3	3	0.3
Ragweed(Ambrosia artemisiifolia)	-	-	-	3	-	-	-	-	-	-	3	0.3
Canadian wild lettuce(Lactuca canadensis)	-	2	1	-	-	-	-	-	-	-	3	0.3
Panic-grass sp.(Panicum sp.)	-	-	-	-	-	-	-	-	-	3	3	0.3
Narrow-leaved hawksbeard(Crepis tectorum)	-	-	-	-	1	-	-	-	-	1	2	0.2
Daisy fleabane(Erigeron strigosus)	-	-	-	-	-	2	-	-	-	-	2	0.2
Sand primrose(Oenothera rhombipetala)	-	-	-	-	1	1	-	-	-	-	2	0.2

continued ---

Table 3.2-3 -- continued.

Species	Transect Segments 1-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	81-90	91-100	Totals	% Comp.
Obedient plant(Physostegia virginiana)	-	-	-	2	-	-	-	-	-	-	2	0.2
Canada blue-grass(Poa compressa)	2	-	-	-	-	-	-	-	-	-	2	0.2
Yellow foxtail(Setaria glauca)	-	-	-	-	-	-	-	2	-	-	2	0.2
American germander(Teucrium canadense)	-	-	-	-	-	-	-	-	2	-	2	0.2
Downy brome-grass(Bromus tectorum)	-	-	-	-	1	-	-	-	-	-	1	0.1
Spotted spurge(Chamaecyse maculata)	-	-	-	-	-	1	-	-	-	-	1	0.1
Cut-leaved water hoarhound(Lycopus americanus)	-	-	-	1	-	-	-	-	-	-	1	0.1
Carpetweed(Mollugo verticillata)	-	-	-	1	-	-	-	-	-	-	1	0.1
Black Bindweed(Polygonum convolvulus)	-	-	-	-	-	-	1	-	-	-	1	0.1
Totals	100	100	100	100	100	100	100	100	100	100	1000	100.0

Table 3.2-4
Point Frame Analysis of RAPA 2. Completed 18 August 1976.

Species	Transect Segments 1-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	81-90	91-100	Totals	% Comp.
Side-oats gramma(Bouteloua curtipendula)	52	73	53	2	10	5	2	2	6	2	207	20.7
Switch-grass(Panicum virgatum)	1	3	1	10	23	8	38	42	26	29	181	18.1
Indian-grass(Sorghastrum nutans)	4	1	-	9	25	16	22	31	27	27	162	16.2
Little bluestem(Andropogon scoparius)	4	3	-	7	13	23	9	13	14	8	94	9.4
Bare Ground	22	8	-	7	13	13	-	-	1	1	65	6.5
Quack-grass(Agropyron repens)	-	2	20	20	5	6	5	-	2	2	62	6.2
Smooth brome-grass(Bromus inermis)	-	-	4	-	-	-	12	10	7	27	60	6.0
Sand love-grass(Eragrostis trichoides)	5	-	-	-	2	6	10	-	5	-	28	2.8
Big bluestem(Andropogon gerardi)	1	-	-	-	2	17	-	2	4	-	26	2.6
Nodding wild rye(Elymus canadensis)	-	-	9	12	-	-	-	-	-	-	21	2.1
Reed canary-grass(Phalaris arundinacea)	-	-	-	11	-	-	-	-	-	-	11	1.1
Alfalfa(Medicago sativa)	-	-	9	-	-	-	-	-	-	-	9	0.9
Kentucky blue-grass(Poa pratensis)	-	-	-	7	1	-	-	-	1	-	9	0.9
Korean lespedeza(Lespedeza stipulacea)	-	7	-	-	-	-	-	-	-	-	7	0.7
Russian thistle(Salsola kali)	-	-	-	-	-	3	-	-	3	-	6	0.6
Wild lettuce(Lactuca serriola)	-	-	1	4	-	-	-	-	-	-	5	0.5
Fall witch-grass(Leptoloma cognatum)	5	-	-	-	-	-	-	-	-	-	5	0.5
Schweinitz's cyperus(Cyperus schweinitzii)	-	-	-	-	1	3	-	-	-	-	4	0.4
Sedge sp.(Carex sp.)	-	-	-	3	-	-	-	-	-	-	3	0.3
Slender cyperus(Cyperus lupulinus)	3	-	-	-	-	-	-	-	-	-	3	0.3
Daisy fleabane(Erigeron strigosus)	-	-	-	2	-	-	-	-	-	1	3	0.3
Sweet clover sp.(Melilotus sp.)	-	1	2	-	-	-	-	-	-	-	3	0.3
Stinging nettle(Urtica dioica)	-	-	-	3	-	-	-	-	-	-	3	0.3
Three-seeded mercury(Acalypha rhomboidea)	-	-	-	2	-	-	-	-	-	-	2	0.2
Rough hair-grass(Agrostis scabra)	-	-	-	-	2	-	-	-	-	-	2	0.2
Rough pennyroyal(Hedeoma hispida)	1	1	-	-	-	-	-	-	-	-	2	0.2
Panic-grass sp.(Panicum sp.)	-	-	-	-	-	-	-	-	-	2	2	0.2
Black bindweed(Polygonum convolvulus)	-	-	-	-	-	-	2	-	-	-	2	0.2
Silvery cinquefoil(Potentilla argentea)	1	-	-	-	-	-	-	-	1	-	2	0.2
Sheep sorrel(Rumex acetosella)	-	-	-	-	2	-	-	-	-	-	2	0.2
Green foxtail(Setaria viridis)	-	-	-	-	-	-	-	-	1	1	2	0.2
Downy brome-grass(Bromus tectorum)	-	-	-	-	-	-	-	-	1	-	1	0.1
Lamb's quarters(Chenopodium album)	-	-	-	-	-	-	-	-	1	-	1	0.1
Horseweed(Conyza canadensis)	-	-	-	1	-	-	-	-	-	-	1	0.1

continued ---

Table 3.2-4 -- continued.

Species	Transect Segments 1-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	81-90	91-100	Totals	% Comp.
Narrow-leaved hawksbeard(Crepis tectorum)	1	-	-	-	-	-	-	-	-	-	1	0.1
Avens sp.(Geum sp.)	-	-	1	-	-	-	-	-	-	-	1	0.1
Canada blue-grass(Poa compressa)	-	1	-	-	-	-	-	-	-	-	1	0.1
Sand dropseed(Sporobolus cryptandrus)	-	-	-	-	1	-	-	-	-	-	1	0.1
Totals	100	100	100	100	100	100	100	100	100	100	1000	100.0

Table 3.2-5
Point Frame Analysis of PRA 3A. Completed 18 August 1978.

Species	Transect Segments 1-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	81-90	91-100	Totals	% Comp.
Quack-grass(Agropyron repens)	21	34	38	29	23	47	3	41	32	-	268	26.8
Sweet clover sp.(Melilotus sp.)	21	17	42	51	48	-	-	30	18	22	249	24.9
Reed canary-grass(Phalaris arundinacea)	-	-	-	-	-	25	79	1	-	-	105	10.5
Bare Ground	6	-	4	-	5	5	2	4	23	30	79	7.9
Kentucky blue-grass(Poa pratensis)	12	13	9	-	-	-	-	-	1	1	36	3.6
Green foxtail(Setaria viridis)	2	-	2	-	-	-	2	3	-	15	24	2.4
Round-headed bush clover(Lespedeza capitata)	-	-	-	-	-	-	-	-	7	14	21	2.1
Sand-reed(Calamovilfa longifolia)	-	16	1	-	3	-	-	-	-	-	20	2.0
Showy sunflower(Helianthus laetiflorus)	19	-	-	-	-	-	-	-	-	-	19	1.9
Smooth brome-grass(Bromus inermis)	3	6	-	7	-	-	-	-	-	-	16	1.6
Panic-grass sp.(Panicum sp.)	2	7	1	-	-	-	-	-	3	3	16	1.6
Horseweed(Conyza canadensis)	-	-	-	-	-	-	-	6	6	3	13	1.3
Ragweed(Ambrosia artemisiifolia)	3	-	-	-	2	3	-	-	1	2	11	1.1
Sand-bar willow(Salix interior)	-	-	-	-	7	-	4	-	-	-	11	1.1
Russian thistle(Salsola kali)	-	-	-	-	-	-	-	10	1	-	11	1.1
Nodding wild rye(Elymus canadensis)	-	-	-	-	10	-	-	-	-	-	10	1.0
Cut-leaved water hoarhound(Lycopus americanus)	-	-	-	-	-	8	2	-	-	-	10	1.0
Jerusalem artichoke(Helianthus tuberosus)	-	-	-	9	-	-	-	-	-	-	9	0.9
Stickseed sp.(Hackelia sp.)	-	-	-	-	-	-	8	-	-	-	8	0.8
Canada blue-grass(Poa compressa)	3	-	-	-	-	-	-	-	-	4	7	0.7
Cottonwood(Populus deltoides)	-	-	-	1	-	5	-	-	-	-	6	0.6
Rough hedge nettle(Stachys hispida)	-	-	-	-	1	-	-	5	-	-	6	0.6
Three-awn-grass(Aristida basiramea)	-	4	-	-	-	-	-	-	-	-	4	0.4
Lamb's quarters(Chenopodium album)	-	-	-	3	-	-	-	-	-	-	3	0.3
Narrow-leaved hawksbeard(Crepis tectorum)	-	-	-	-	-	-	-	-	2	1	3	0.3
Virginia strawberry(Fragaria virginiana)	3	-	-	-	-	-	-	-	-	-	3	0.3
Sheathed dropseed(Sporobolus vaginiflorus)	-	-	-	-	-	-	-	-	3	-	3	0.3
Hoary vervain(Verbena stricta)	-	2	1	-	-	-	-	-	-	-	3	0.3
Sage(Artemisa ludoviciana)	-	-	2	-	-	-	-	-	-	-	2	0.2
Sedge sp.(Carex sp.)	-	-	-	-	-	1	-	-	-	1	2	0.2
Spotted spurge(Chamaecyse maculata)	-	-	-	-	-	-	-	-	2	-	2	0.2
Virginia wild rye(Elymus virginicus)	-	-	-	-	-	2	-	-	-	-	2	0.2
White cockle(Lychnis alba)	-	-	-	-	-	-	-	-	-	2	2	0.2

continued --

Table 3.2-5 -- continued

Species	Transect Segments 1-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	81-90	91-100	Totals	% Comp.
Clammy ground cherry(Physalis heterophylla)	-	-	-	-	-	2	-	-	-	-	2	0.2
Silvery cinquefoil(Potentilla argentea)	2	-	-	-	-	-	-	-	-	-	2	0.2
Rough hair-grass(Agrostis scabra)	-	1	-	-	-	-	-	-	-	-	1	0.1
Biennial wormwood(Artemisia biennis)	-	-	-	-	-	1	-	-	-	-	1	0.1
White field aster(Aster simplex)	1	-	-	-	-	-	-	-	-	-	1	0.1
Sand-bur(Cenchrus longispinus)	-	-	-	-	-	-	-	-	-	1	1	0.1
Slender cyperus(Cyperus lupulinus)		-	-	-	-	-	-	1	-	-	1	0.1
Philadelphia fleabane(Erigeron philadelphicus)		-	-	-	-	-	-	-	-	1	1	0.1
Daisy fleabane(Erigeron strigosus)	-	-	-	-	-	-	-	-	1	-	1	0.1
Rough pennyroyal(Hedeoma hispida)	-	-	-	-	-	-	-	1	-	-	1	0.1
Canadian wild lettuce(Lactuca canadensis)	-	-	-	-	-	1	-	-	-	-	1	0.1
Evening primrose(Oenothera biennis)	-	-	-	-	1	-	-	-	-	-	1	0.1
Rough cinquefoil(Potentilla norvegica)	1	-	-	-	-	-	-	-	-	-	1	0.1
Stiff goldenrod(Solidago rigida)	1	-	-	-	-	-	-	-	-	-	1	0.1
Totals	100	100	100	100	100	100	100	100	100	100	1000	100.0

Table 3.2-6
Point Frame Analysis of PRA 3B. Completed 19 August 1978.

Species	Transect Segments 1-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	81-90	91-100	Totals	% Comp.
Quack-grass(Agropyron repens)	60	80	51	11	28	29	17	1	47	45	369	36.9
Sweet clover sp.(Melilotus sp.)	11	1	25	8	1	37	5	-	-	-	88	8.8
Sand-bar willow(Salix interior)	-	-	-	10	18	6	7	13	1	-	55	5.5
Fall witch-grass(Leptoloma cognatum)	1	-	-	10	-	-	-	-	20	18	49	4.9
Nodding wild rye(Elymus canadensis)	-	-	-	23	9	-	-	6	-	1	39	3.9
Bare Ground	2	3	4	-	2	5	6	8	1	3	34	3.4
Reed canary-grass(Phalaris arundinacea)	-	-	-	10	-	-	16	4	-	-	30	3.0
Cottonwood(Populus deltoides)	-	-	-	6	16	-	-	-	7	-	29	2.9
Smooth brome-grass(Bromus inermis)	-	-	-	2	-	-	-	7	11	7	27	2.7
Indian hemp(Apocynum sibiricum)	-	-	-	-	19	-	-	-	-	-	19	1.9
Showy sunflower(Helianthus laetiflorus)	7	-	-	12	-	-	-	-	-	-	19	1.9
Canada thistle(Cirsium arvense)	-	-	-	-	-	-	18	-	-	-	18	1.8
Kentucky blue-grass(Po[illegible]ensis)	5	4	7	2	-	-	-	-	-	-	18	1.8
Canada goldenrod(Solid[illegible]adensis)	-	-	-	-	-	-	-	17	-	-	17	1.7
Missouri goldenrod(Solic[illegible]issouriensis)	-	-	-	1	-	-	-	14	-	-	15	1.5
Cut-leaved water hoarhound([illegible]copus americanus)	-	-	-	-	-	-	-	14	-	-	14	1.4
Panic-grass sp.(Panicum sp.)	1	10	3	-	-	-	-	-	-	-	14	1.4
Rough hair-grass(Agrostis scabra)	-	-	-	-	-	4	-	-	-	7	11	1.1
Hoary vervain(Verbena stricta)	5	-	4	-	-	2	-	-	-	-	11	1.1
Wild lettuce(Lactuca serriola)	-	-	-	-	-	1	9	-	-	-	10	1.0
Ragweed(Ambrosia artemisiifolia)	-	-	-	-	1	-	-	-	4	4	9	0.9
Three-seeded mercury(Acalypha rhomboidea)	-	-	-	-	-	-	-	8	-	-	8	0.8
Common milkweed(Asclepias syriaca)	-	-	-	-	6	-	-	2	-	-	8	0.8
Horseweed(Conyza canadensis)	-	-	-	-	-	8	-	-	-	-	8	0.8
Bull thistle(Cirsium vulgare)	-	-	-	-	-	-	7	-	-	-	7	0.7
Canada blue-grass(Poa compressa)	6	-	1	-	-	-	-	-	-	-	7	0.7
Green foxtail(Setaria viridis)	-	-	-	-	-	-	7	-	-	-	7	0.7
Large crab-grass(Digitaria sanguinalis)	-	-	-	-	-	5	-	-	-	1	6	0.6
Wild four-o'clock(Oxybaphus nyctagineus)	-	-	-	-	-	-	-	-	5	1	6	0.6
Russian thistle(Salsola kali)	-	-	-	-	-	-	-	-	-	6	6	0.6
Daisy fleabane(Erigeron strigosus)	-	-	-	-	-	3	2	-	-	-	5	0.5
Sneezeweed(Helenium autumnale)	-	-	-	-	-	-	3	2	-	-	5	0.5
Sedge sp.(Carex sp.)	2	-	-	-	-	-	2	-	-	-	4	0.4

continued ---

Table 3.2-6 -- continued.

Species	Transect Segments 1-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	81-90	91-100	Totals	% Comp.
Sand-bur(Cenchrus longispinus)	-	-	-	-	-	-	-	-	-	4	4	0.4
Canadian wild lettuce(Lactuca canadensis)	-	-	-	-	-	-	-	3	-	-	3	0.3
Sand dropseed(Sporobolus cryptandrus)	-	2	-	1	-	-	-	-	-	-	3	0.3
Ridge-seeded spurge(Chamaecyse glyptosperma)	-	-	2	-	-	-	-	-	-	-	2	0.2
Slender cyperus(Cyperus lupulinus)	-	-	2	-	-	-	-	-	-	-	2	0.2
Virginia strawberry(Fragaria virginiana)	-	-	-	-	-	-	2	-	-	-	2	0.2
Jerusalem artichoke(Helianthus tuberosus)	-	-	1	1	-	-	-	-	-	-	2	0.2
Yellow foxtail(Setaria glauca)	-	-	-	-	-	-	-	-	1	1	2	0.2
Bladder-campion(Silene cucubalus)	-	-	-	-	-	-	2	-	-	-	2	0.2
Stinging nettle(Urtica dioica)	-	-	-	-	-	-	2	-	-	-	2	0.2
Lamb's quarters(Chenopodium album)	-	-	-	-	-	-	-	-	1	-	1	0.1
Obedient plant(Physostegia virginiana)	-	-	-	-	-	-	-	1	-	-	1	0.1
Black bindweed(Polygonum convolvulus)	-	-	-	-	-	-	1	-	-	-	1	0.1
Poison ivy(Rhus radicans)	-	-	-	1	-	-	-	-	-	-	1	0.1
Totals	100	100	100	100	100	100	100	100	100	100	1000	100.0

Table 3.2 - 7 Summary of Bird Censusing Data (1971)

Species	FRA 1							FRA 1							FRA 2							FRA 2							FRA 3 (A & B combined)						
	4 July	15 July	29 July	29 July	6 Aug.	12 Aug.	Totals	4 July	15 July	29 July	29 July	6 Aug.	12 Aug.	Totals	4 July	15 July	29 July	29 July	6 Aug.	12 Aug.	Totals	4 July	15 July	29 July	29 July	6 Aug.	12 Aug.	Totals	4 July	15 July	29 July	29 July	6 Aug.	12 Aug.	Totals
R.N. Pheasant			1				1											2			2										3				3
Hung. Partridge																		1			1														
Killdeer																		1			1														
Mourning Dove	2		2	3	4	7	18			2	2	4	2	12		2	2	4	6	3	24	2		4	8	6	4	28	14	7	6	14	13	9	63
Eastern Kingbird	1	2					3																						1	2					3
Barn Swallow												1		1																					
Brown Thrasher																													4	1	3				8
Yellowthroat																																2			2
House Sparrow																																			
Western Meadowlark	2	1	2	1		1	7			1	1			2		2	2	2	1	1	8		2		4	1		7				1		2	3
R.W. Blackbird																																			
Grackle		2					2											3		5	10											1			1
Am. Goldfinch															2			3	3	1	9	2	2	2	2	2	1	19	12	15	10	5	7	11	60
Indigo Bunting																													2						2
Savannah Sparrow	1	1		1			3										1			1	2														
Vesper Sparrow			1				1																	1		1		2							
Field Sparrow																																1	2	2	7
Totals	6	6	6	5	4	8	35	0	0	3	3	4	2	12	2	4	5	23	14	10	68	6	6	7	21	9	10	69	33	34	23	28	24	22	169
Weighted population density	3.33 per hectare							1.50 per hectare							1.92 per hectare							2.70 per hectare							5.11 per hectare						

*See Dueholm, 1974 for mechanics of computation.

Table 3.2 - 8
Four-Year Summary of Bird Densities (Weighted Densities in Birds per Hectare)

Species	FRA 1				RAFA 1				FRA 2				RAFA 2				FRA 3			
	1975	1976	1977	1978	1975	1976	1977	1978	1975	1976	1977	1978	1975	1976	1977	1978	1975	1976	1977	1978
American Kestrel																		0.061		
Ring-necked Pheasant	0.191			0.095	0.572		0.575		0.040		0.465	0.054			0.264		0.681	0.242	0.393	0.091
Hungarian Partridge												0.027								
Killdeer					0.318							0.027						0.061		
Rock Dove											0.040									
Mourning Dove	1.72		0.072	1.702	1.78	1.29	0.144	1.052	0.404	0.701	0.283	0.464		0.177	0.132	0.736	0.772	0.908	0.575	1.905
Common Flicker	0.064				0.318						0.040						0.182		0.030	
Downy Woodpecker										0.108					0.022				0.030	
Eastern Kingbird			0.358	0.284		0.144	0.460					0.027					0.091	0.182		0.302
Rough-winged Swallow			0.143								0.020									
Barn Swallow	0.064	0.288	0.287		0.318		0.072	0.287		0.054	0.040				0.132	0.029				
Cliff Swallow		0.288				0.287				0.108	0.020			0.059						
Bank Swallow						0.287														
Purple Martin							0.072								0.022				0.151	
Blue Jay											0.020							0.061		
House Wren																	0.273		0.121	
Brown Thrasher																	0.500	0.666		0.272
Gray Catbird																			0.030	
Robin					0.191						0.061						0.045			
Eastern Bluebird																		0.242		
Blue-gray Gnatcatcher																			0.060	
Cedar Waxwing																	0.045			
Yellow Warbler																	0.182	0.545	0.151	
Yellowthroat																	0.500		0.181	0.332
House Sparrow									0.202			0.087				0.388	0.454		0.030	
Eastern Meadowlark																		0.061		
Western Meadowlark	0.382	0.431	0.860	0.662	0.254	0.061	1.08	0.191	0.323	0.916	0.606	0.242	0.088	0.413	0.088	0.235	0.363	0.363	0.030	0.060
Orchard Oriole															0.022				0.030	
Baltimore Oriole											0.040								0.091	
Red-wing Blackbird											0.141	0.350			0.110	0.088	0.045	0.906	0.665	0.030

Four-Year Summary of Bird Densities - continued

Species	FRA 1				RAFA 1				FRA 2				RAFA 2				FRA 3			
	1975	1976	1977	1978	1975	1976	1977	1978	1975	1976	1977	1978	1975	1976	1977	1978	1975	1976	1977	1978
Common Grackle	0.0			0.190					0.040				0.133		0.044	0.235	0.227	1.39		
Cowbird									0.040									0.182	0.030	
Rose-breasted Grosbeak															0.022		0.273		0.060	
American Goldfinch	0.064	0.144					0.144			0.108	0.141	0.350		0.472	0.198	0.530	2.59	1.82	2.96	1.81
Indigo Bunting											0.020						0.636	0.182	0.151	0.091
Savannah Sparrow				0.284													0.091			
Vesper Sparrow	0.127			0.095	0.064				0.040	0.108		0.027			0.022	0.088		0.242	0.060	
Grasshopper Sparrow							0.144								0.022					
Chipping Sparrow	0.064				0.064		0.072										0.182			
Field Sparrow																	0.136			0.212
Swamp Sparrow																	0.045			
Song Sparrow										0.105	0.020				0.022		0.318	0.182	0.272	
Totals	2.74	1.15	1.72	3.31	3.88	2.87	2.66	1.53	1.09	2.21	1.96	1.89	0.221	1.12	1.12	2.03	8.63	8.29	6.11	5.11

Table 3.2 - 9 Summary of Small Mammal Populations (1979)

Species	FRA 1[1] Pop. est.[2]	FRA 1 Min. pop.[3]	FRA 1 Density[4]	RAFA 1 Pop. est.	RAFA 1 Min. pop.	RAFA 1 Density	FRA 2 Pop. est.	FRA 2 Min. pop.	FRA 2 Density	RAFA 2 Pop. est.	RAFA 2 Min. pop.	RAFA 2 Density	FRA 2A Pop. est.	FRA 2A Min. pop.	FRA 2A Density	FRA 2B Pop. est.	FRA 2B Min. pop.	FRA 2B Density
White-footed mouse							2		6.27								1	3.13
Deer mouse	2.0	5	15.65	4.0	9	25.00	24.0	9	75.23	20.0	10	60.69	10.0	19	21.25	16.0	8	50.12
Western harvest mouse		1	3.13		2	6.27		1	3.13		1	3.13		2	6.27			
Meadow vole														1	3.13		1	3.13
Meadow jumping mouse														1	3.13			
House mouse					1	3.13												
Short-tailed shrew					3	9.40					2	6.27	5.0	5	15.67		1	3.13
Thirteen-lined ground squirrel		1	3.13		1	3.13		2	6.27		4	12.54		1	3.13		1	3.13
Least weasel														1	3.13			
Totals		7	21.93		15	47.01		13	90.90		17	84.63		21	65.81		12	62.64

[1] All transects trapped within first two weeks in October.
[2] Population estimate for transect, using Schnabel Method. Area trapped equal to 0.32 hectare.
[3] Minimum population, the actual number of animals trapped.
[4] Animals per hectare, determined using population estimate, if higher than minimum population, or minimum population if number animals caught too low for adequate results using Schnabel Method.

Table 3.2 - 10
Four Year Summary of Small Mammal Densities (in mammals per hectare)

Species	PRA 1				RAPA 1				PRA 2				RAPA 2				PRA 3A				PRA 3B			
	1975	1976	1977	1978	1975	1976	1977	1978	1975	1976	1977	1978	1975	1976	1977	1978	1975	1976	1977	1978	1975	1976	1977	1978
White-footed mouse	18.80	9.40	28.21		25.08	6.27	12.54		9.40		94.04	6.27	25.08		47.02			6.27	109.71		9.40	6.27	94.04	3.13
Deer mouse				15.67				25.00				75.13				62.69	3.13			31.35			9.40	50.12
Western harvest mouse		47.02	3.13	3.13		31.35	6.27	6.27		68.02		3.13		21.94	6.27	3.13		87.77	6.27	6.27		177.73	6.27	
Meadow vole	3.13		3.13								9.40				9.40			3.13	6.27	3.13		3.13	6.27	3.13
Meadow jumping mouse										3.13										3.13				
House mouse					3.13			3.13	3.13		3.13													
Short-tailed shrew								9.40								6.27		6.27	3.13	15.67			3.13	
Thirteen-lined ground squirrel		18.81	3.13	3.13				3.13		12.54	6.27	6.27			18.81	12.54				3.13			3.13	3.13
Norway rat																		3.13						
Least weasel																				3.13				
Totals	21.93	75.23	37.60	21.93	28.21	37.62	18.81	47.01	12.53	83.69	112.84	90.00	25.08	21.94	81.50	84.63	3.13	106.54	125.38	65.81	9.40	187.13	119.11	62.64

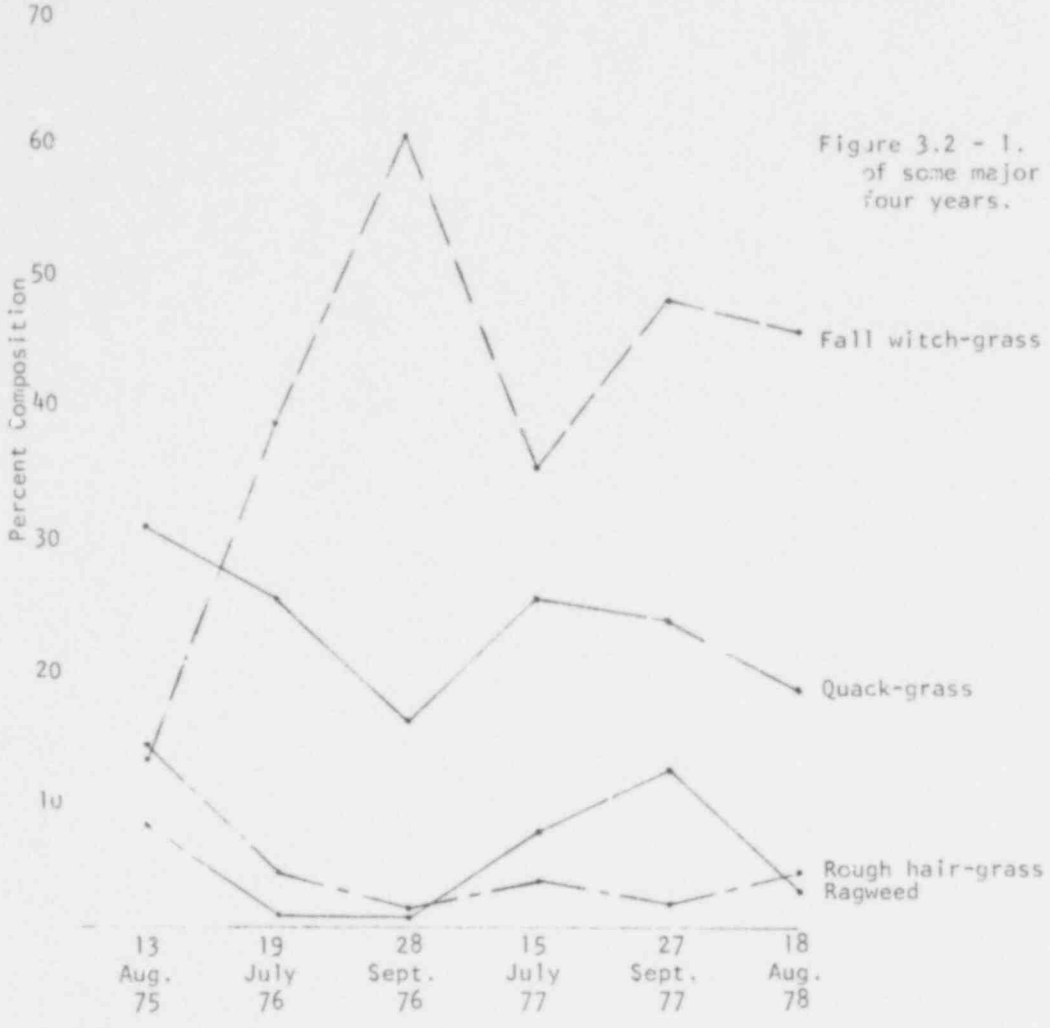

Figure 3.2 - 1. PRA 1. Behavior of some major species over four years.

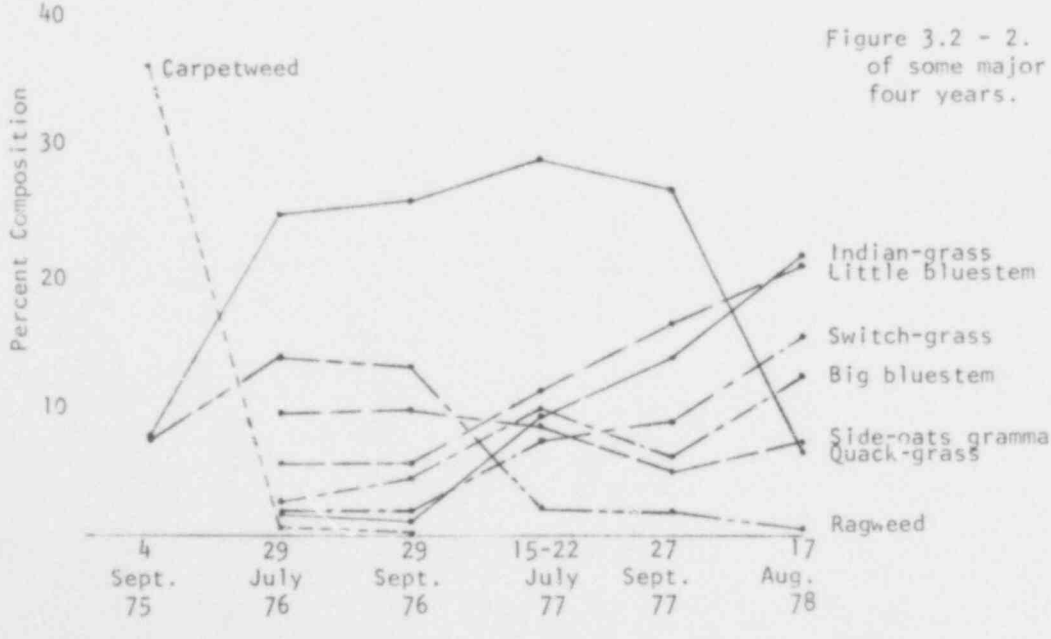

Figure 3.2 - 2. RAPA 1. Behavior of some major species over four years.

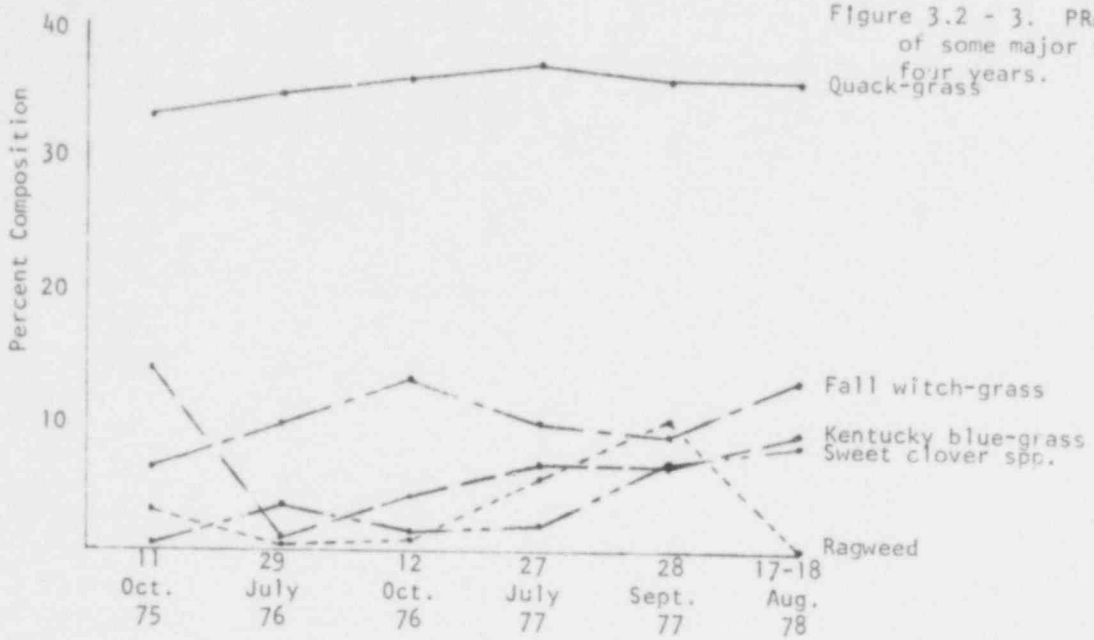

Figure 3.2 - 3. PRA 2. Behavior of some major species over four years.

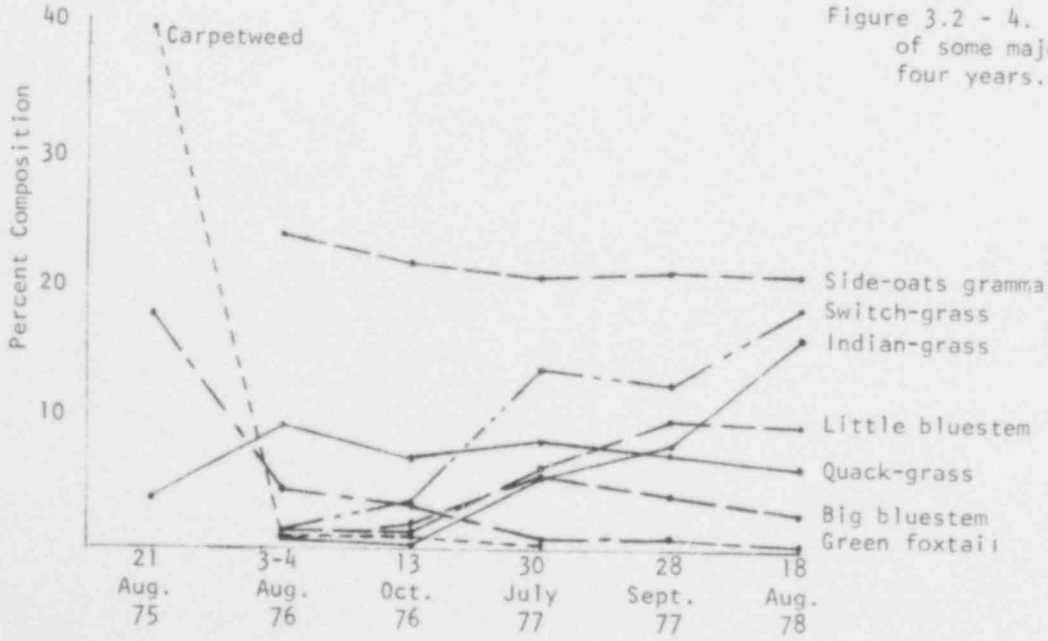

Figure 3.2 - 4. RAPA 2. Behavior of some major species over four years.

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270

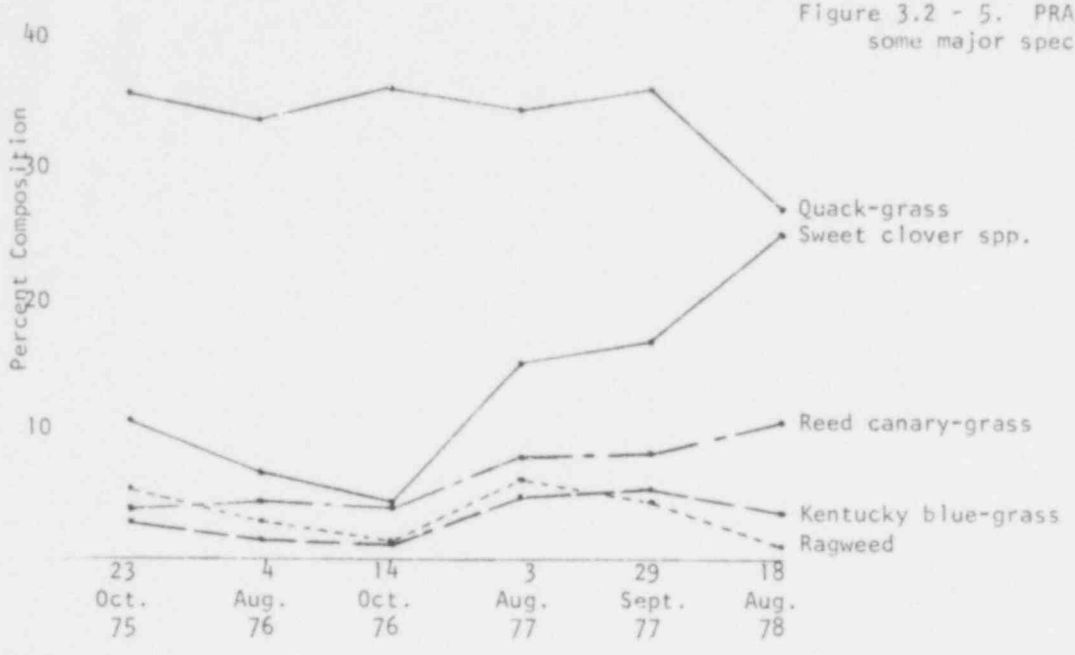

Figure 3.2 - 5. PRA 3A. Behavior of some major species over four years.

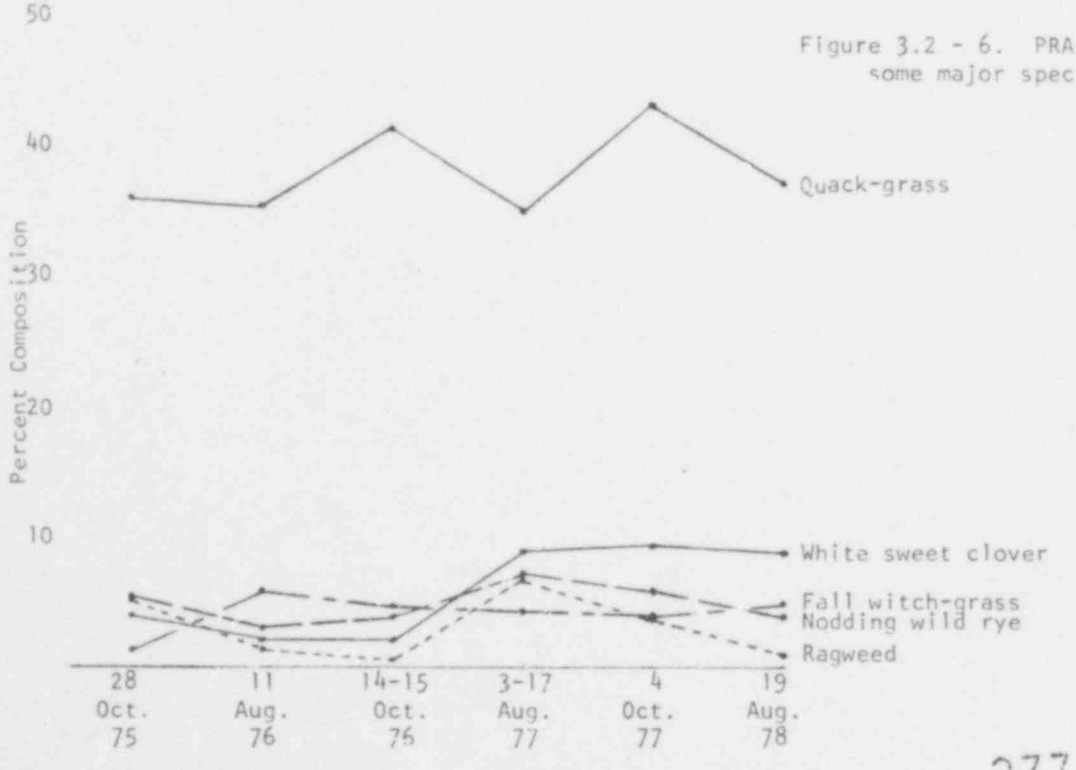

Figure 3.2 - 6. PRA 3B. Behavior of some major species over four years.

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Figure 3.2-7. PRA 1 - Behavior of Select Species Groups.

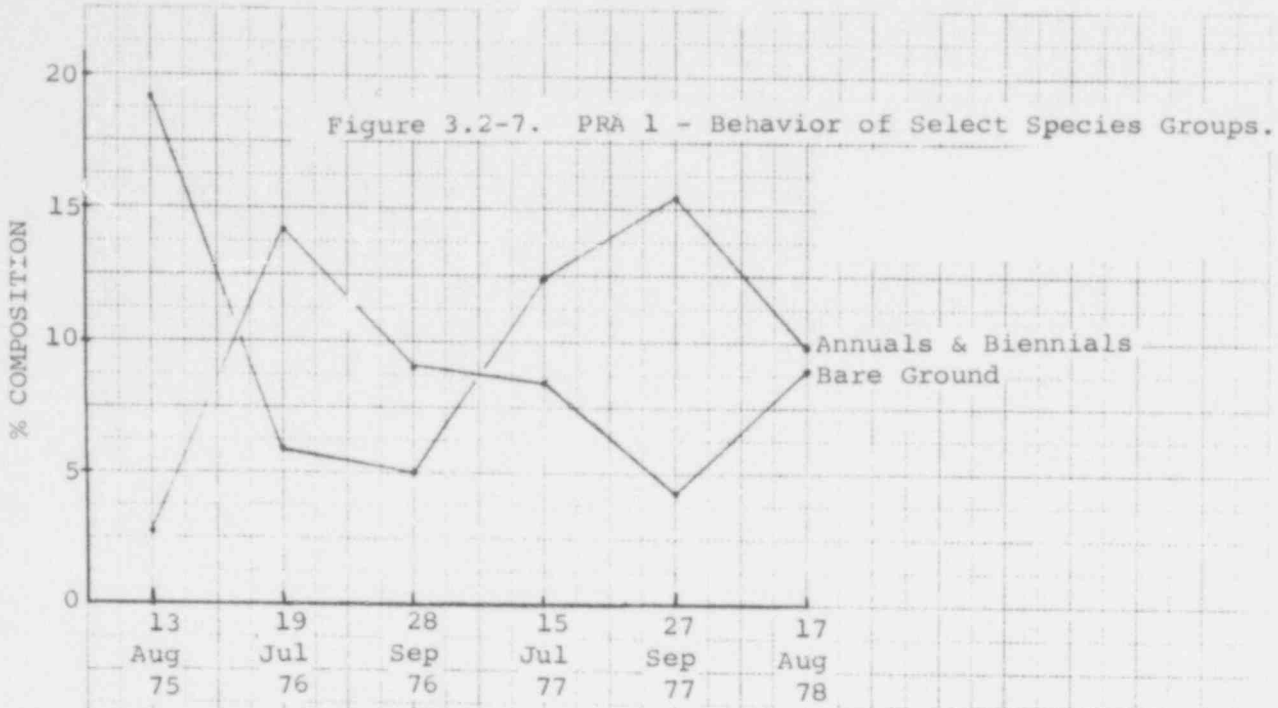


Figure 3.2-8.

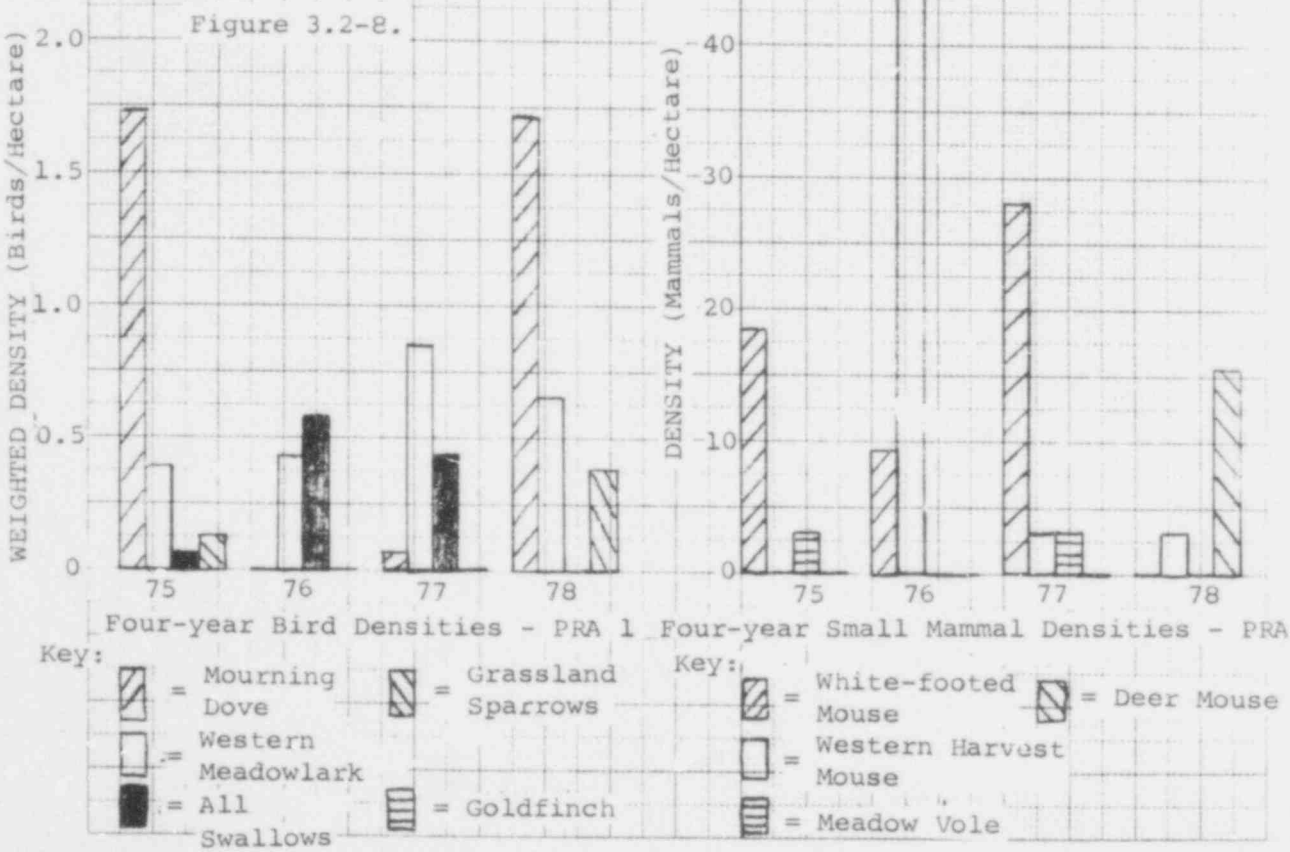


Figure 3.2-9.

277 272

Figure 3.2-10.

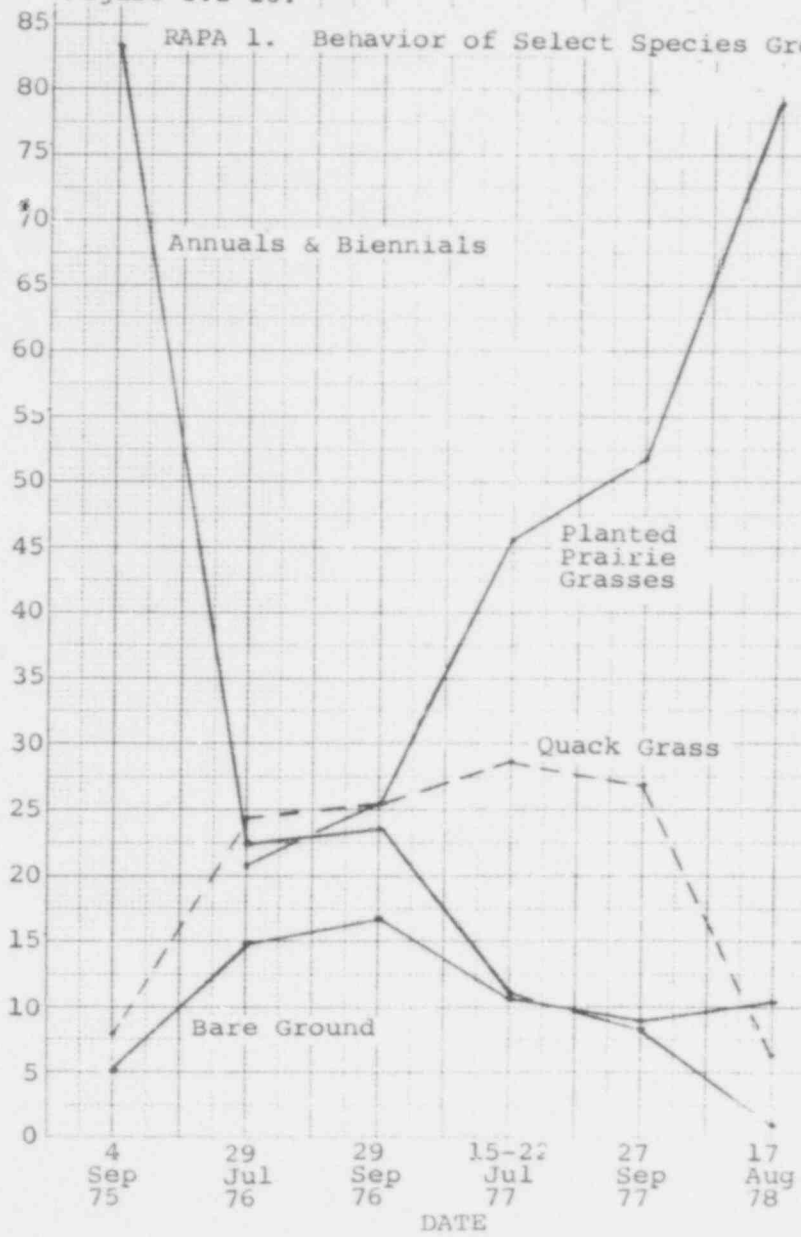
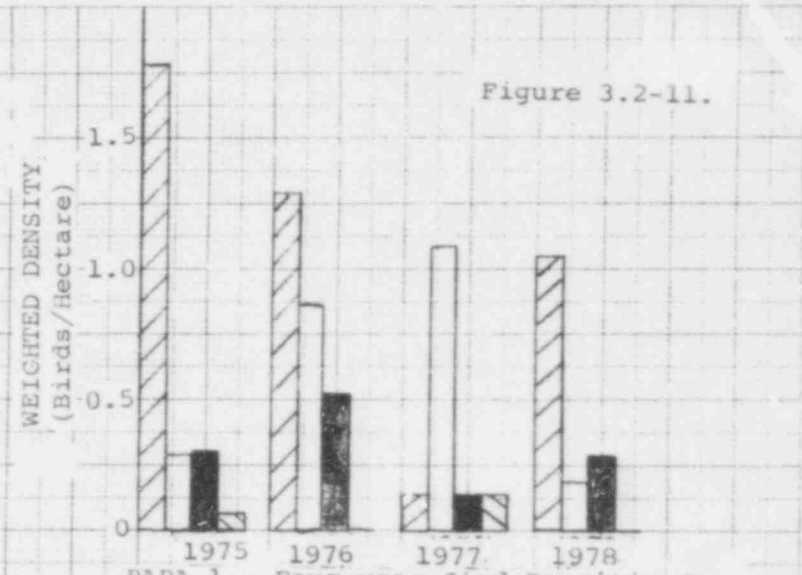
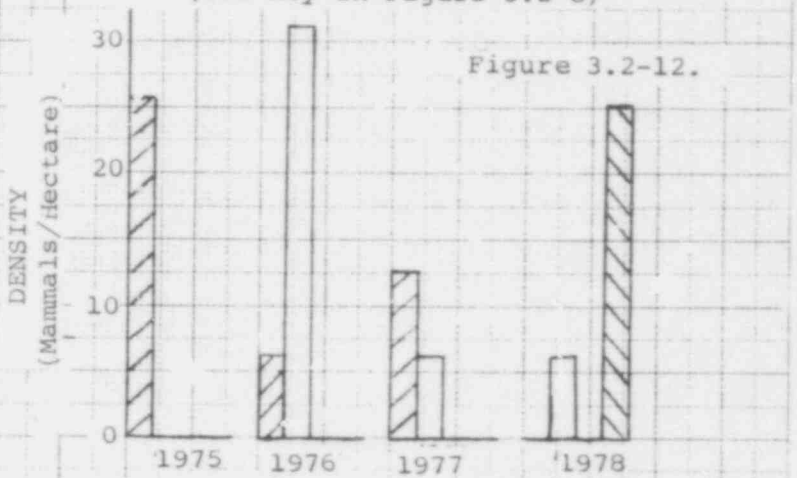


Figure 3.2-11.



RAPA 1 - Four-year Bird Densities (See Key in Figure 3.2-8)

Figure 3.2-12.



RAPA 1 - Four-year Small Mammal Densities (See Key in Figure 3.2-9)

277 273

Figure 3.2-13. PRA 2. Behavior of Select Species Groups.

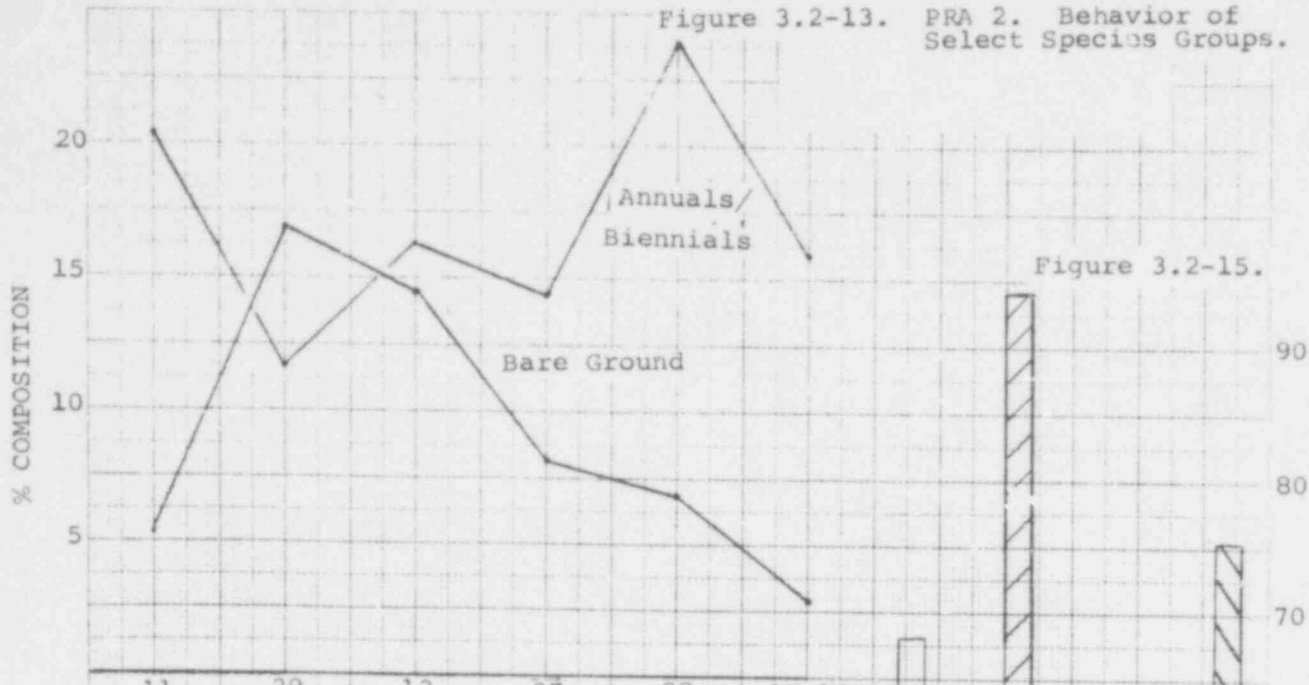
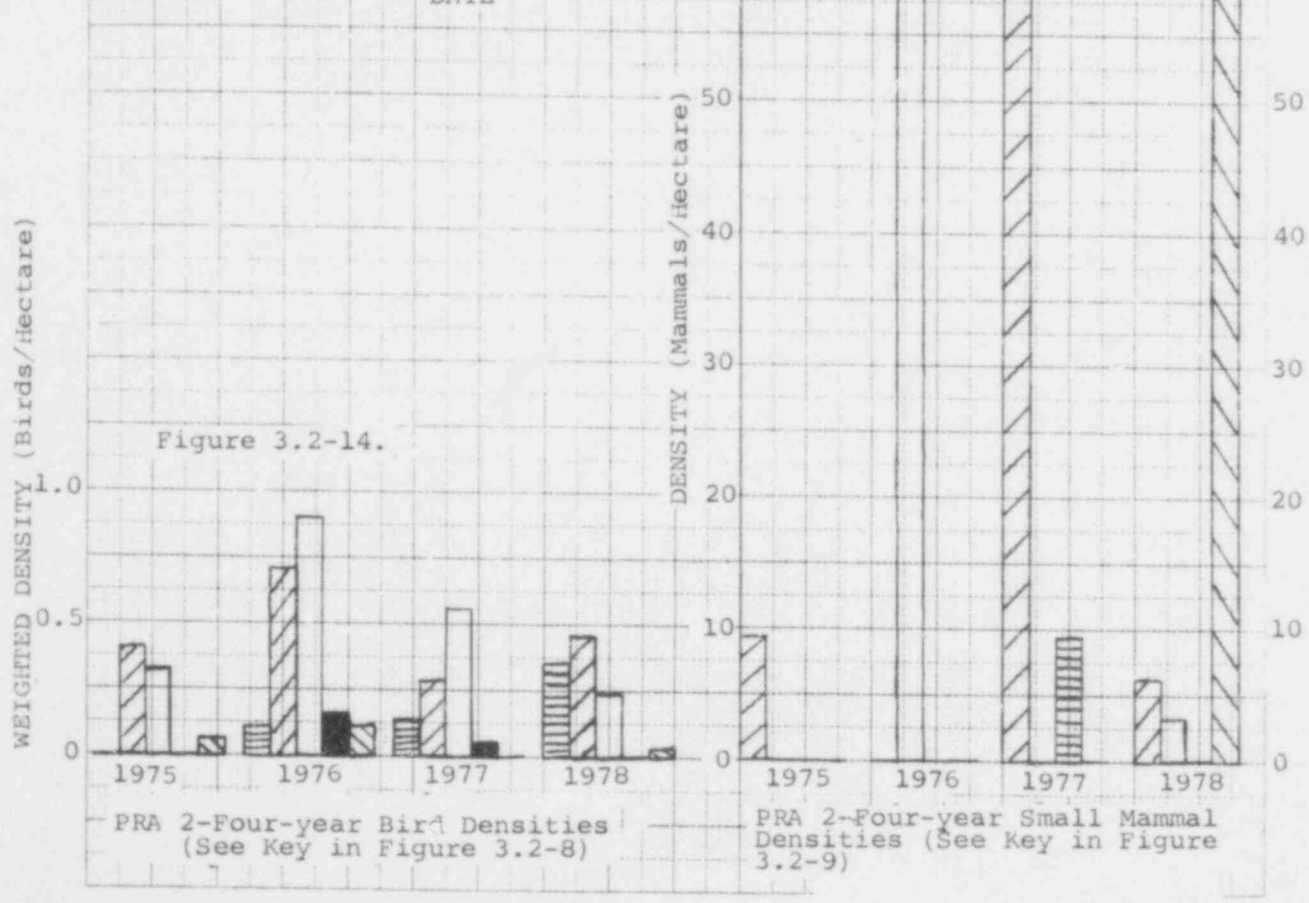


Figure 3.2-15.

Figure 3.2-14.



277 274

Figure 3.2-16. RAPA 2. Behavior of Select Species Groups.

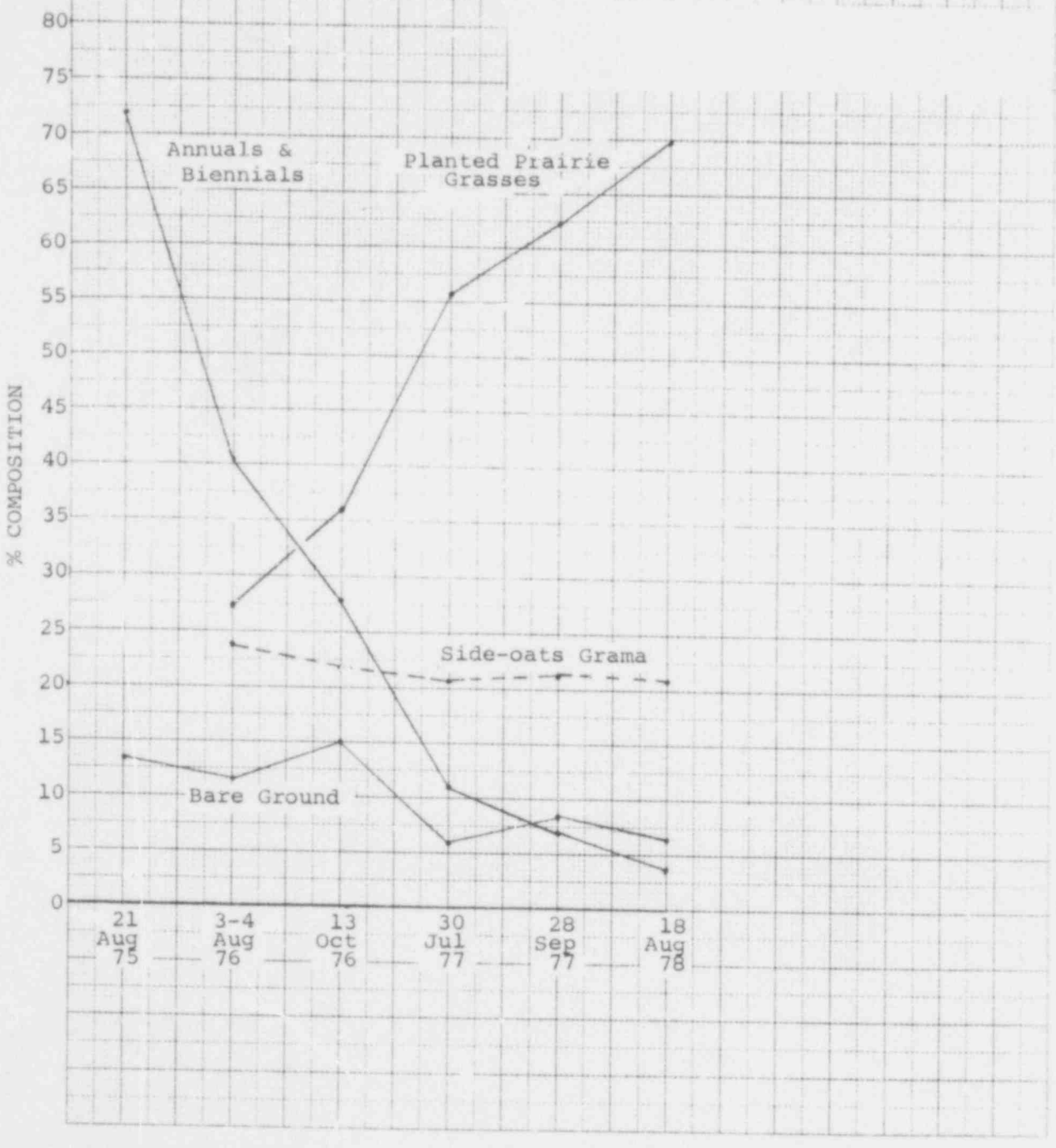
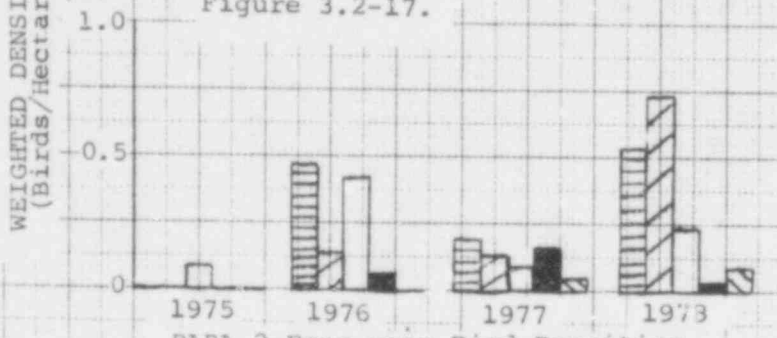
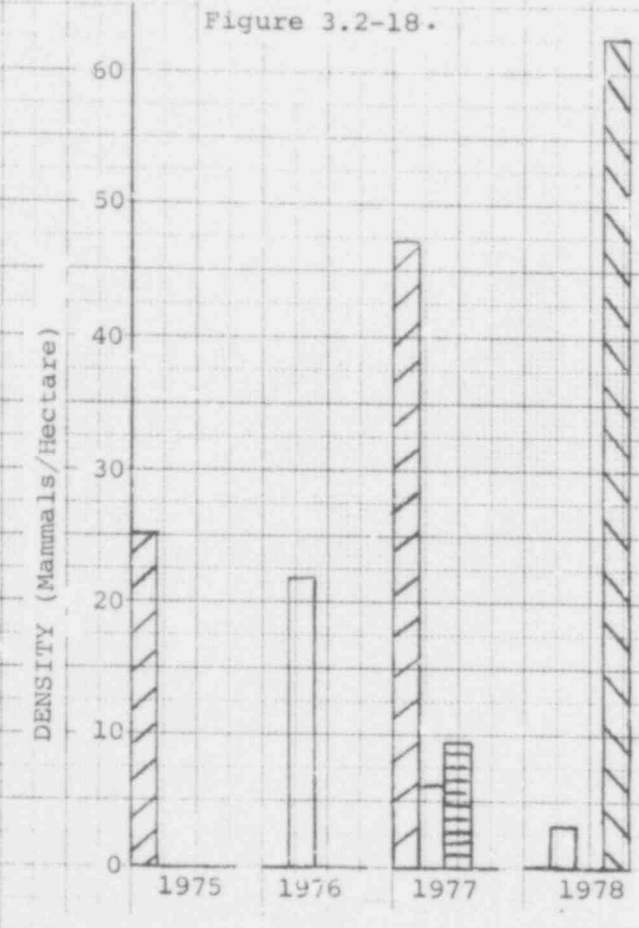


Figure 3.2-17.



RAPA 2-Four-year Bird Densities
(See Key in Figure 3.2-8)

Figure 3.2-18.



RAPA 2-Four-year Small Mammal Densities
(See Key in Figure 3.2-9)

277 276

Figure 3.2-19. PRA 3A. Behavior of Select Species groups.

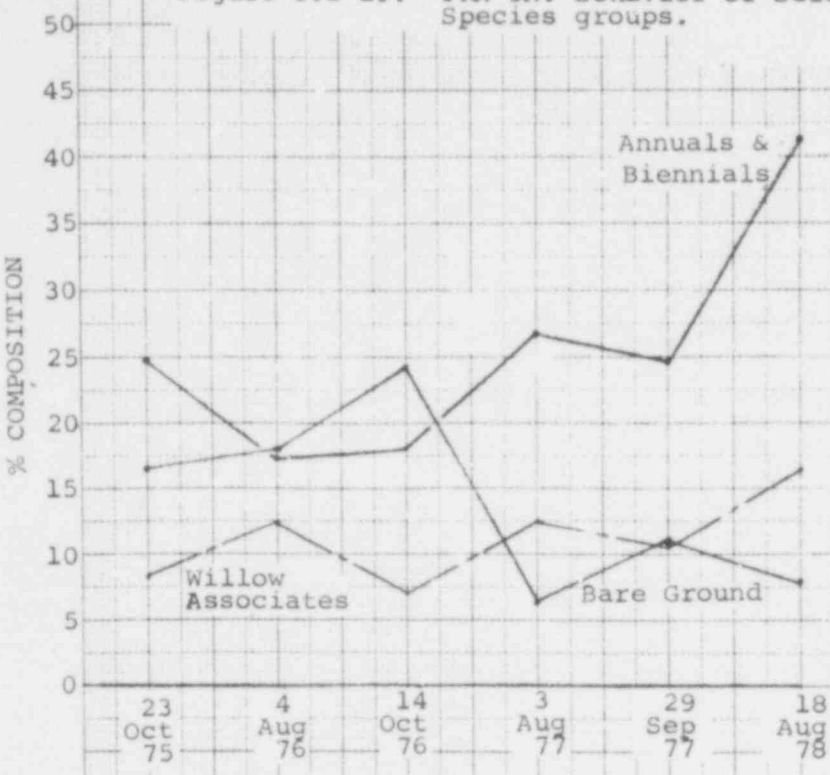


Figure 3.2-20. PRA 3B. Behavior of Select Species Groups.

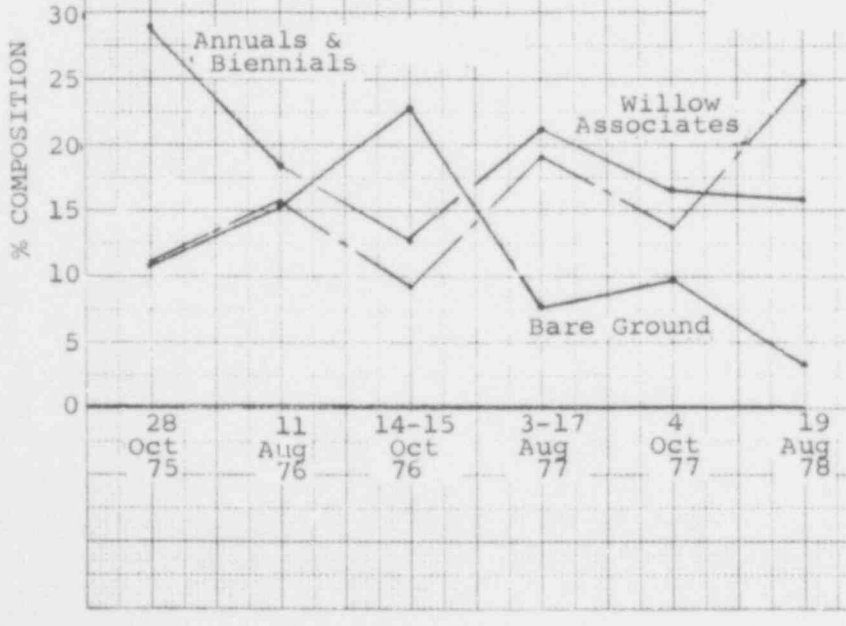


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Figure 3.2-21.

Key for PRA 3 - Bird Species.

= Mourning Dove

= Western Meadowlark

= Grassland Sparrows

= Ring-necked Pheasant

= Goldfinch

= Rose-breasted Grosbeak

= House Wren

= Yellow Warbler

= Indigo Bunting

= Song Sparrow

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Figure 3.2-21. PRA 3 - Four-year Bird Densities. (Continued)

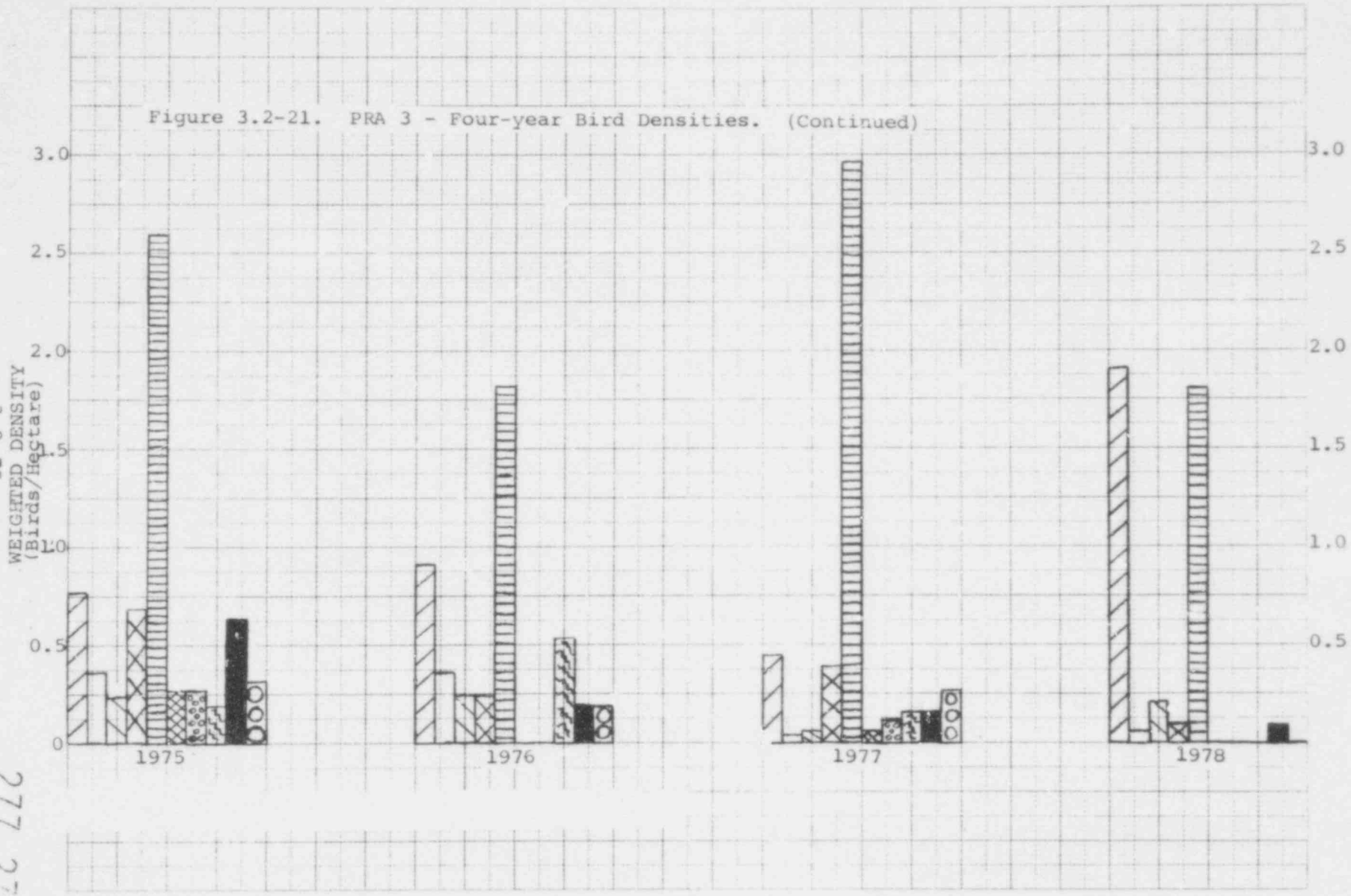
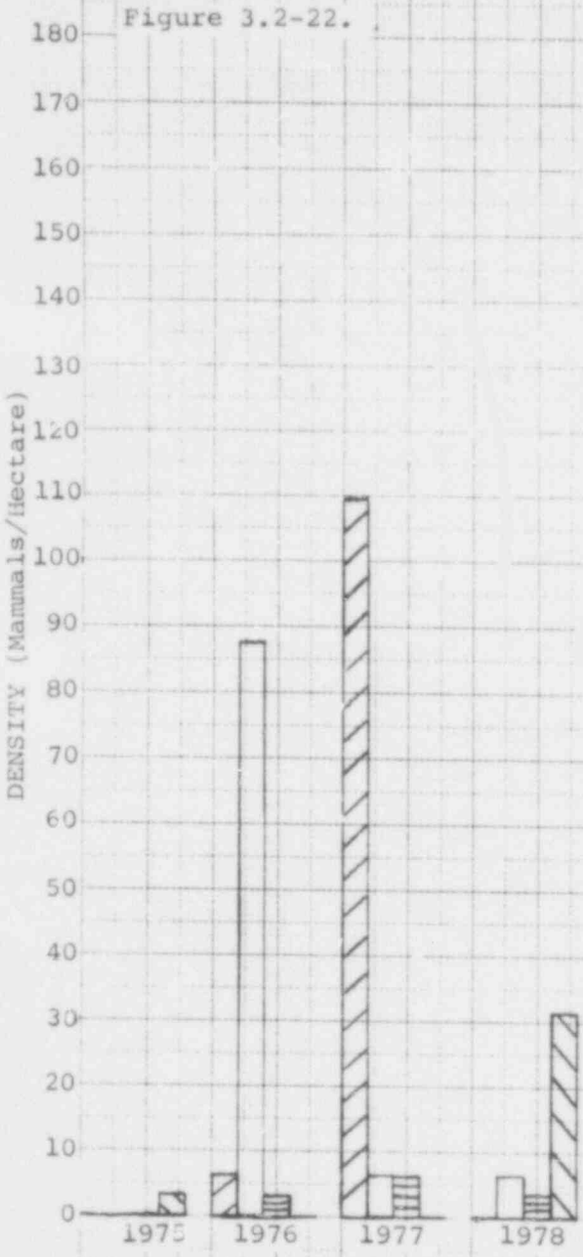
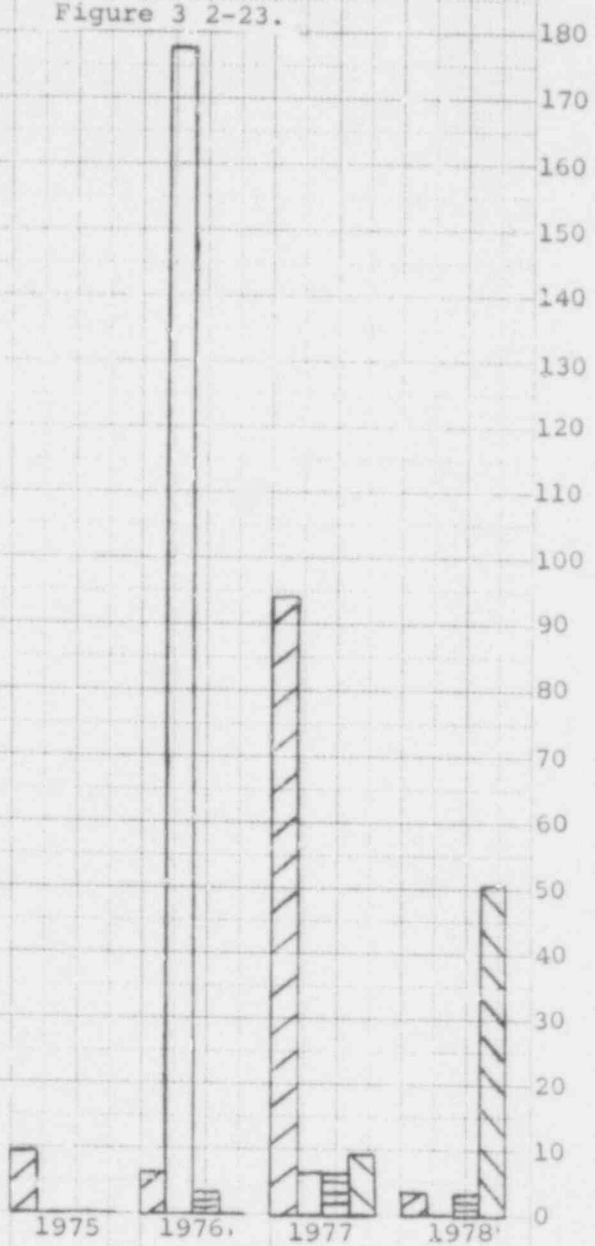


Figure 3.2-22.



PRA 3A - Four-year Summary of Small Mammal Densities (See Key in Figure 3.2-9)

Figure 3 2-23.



PRA 3B - Four-year Summary of Small Mammal Densities (See Key in Figure 3.2-9)

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Appendix A3.2.1
Species List for PRA 1 - 1978

Acer negundo	Box Elder
Achillea millefolium	Yarrow
Agropyron repens	Quack-grass
Agrostis scabra	Rough Hair-grass
Ambrosia artemisiifolia	Ragweed
Andropogon gerardi	Big Bluestem
Andropogon scoparius	Little Bluestem
Anemone cylindrica	Prairie Thimbleweed
Artemisia ludoviciana	Sage
Asclepias syriaca	Common Milkweed
Bromus inermis	Smooth or Awnless Brome-grass
Cenchrus longispinus	Sand-bur
Chamaecyse glyptosperma	Ridge-seeded Spurge
Chrysopsis villosa	Golden Aster
Convolvulus sepium	Hedge Bindweed
Conyza canadensis	Horseweed
Crepis tectorum	Narrow-leaved Hawksbeard
Cyperus lupulinus	Slender Cyperus
Cyperus schweinitzii	Schweinitz's Cyperus
Digitaria sanguinalis	Large Crab-grass
Elymus canadensis	Nodding Wild Rye
Eragrostis spectabilis	Purple Love-grass
Erigeron strigosus	Daisy Fleabane
Euphorbia corollata	Flowering Spurge
Fragaria virginiana	Virginia Strawberry
Froelichia floridana	Prairie Froelichia
Hedeoma hispida	Rough Pennyroyal
Helianthus petiolaris	Prairie Sunflower
Juniperus virginiana	Red Cedar
Lepidium densiflorum	Pepper-grass
Leptoloma cognatum	Fall Witch-grass
Lespedeza stipulacea	Korean Lespedeza
Lithospermum croceum	Puccoon
Lychnis alba	White Cockle
Medicago sativa	Alfalfa
Melilotus alba	White Sweet Clover
Mollugo verticillata	Carpetweed
Oenothera biennis	Common Evening-primrose
Oxybaphus nyctagineus	Wild Four-O'clock
Panicum sp.	Panic-grass sp.
Panicum virgatum	Switch-grass
Parthenocissus vitacea	Woodbine
Physalis heterophylla	Clammy Ground Cherry
Poa compressa	Canada Blue-grass
Poa pratensis	Kentucky Blue-grass
Polygonum convolvulus	Black Bindweed
Prunus americana	Wild Plum
Rhus glabra	Smooth Sumac
Rosa suffulta	Arkansaw Rose
Rumex acetosella	Sheep Sorrel
Salsola kali	Russian Thistle

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Setaria glauca	Yellow Foxtail
Setaria viridis	Green Foxtail
Silene cucubalus	Bladder-campion
Solidago missouriensis	Missouri Goldenrod
Solidago rigida	Stiff Goldenrod
Sorghastrum nutans	Indian-grass
Sporobolus cryptandrus	Sand Dropseed
Strophostyles helvola	Trailing Wild Bean
Ulmus pumila	Siberian Elm
Ulmus rubra	Slippery Elm
Verbena stricta	Hoary Vervain
Vicia villosa	Cow Vetch
Vitis riparia	Winter Grape

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Appendix A3.2.2
Species List for RAPA 1 - 1978

Agropyron repens	Quack-grass
Agrostis scabra	Rough Hair-grass
Ambrosia artemisiifolia	Ragweed
Andropogon gerardi	Big Bluestem
Andropogon scoparius	Little Bluestem
Asclepias syriaca	Common Milkweed
Bouteloua curtipendula	Side-oats Gramma
Cenchrus longispinus	Sand-bur
Chamaecyse glyptosperma	Ridge-seeded Spurge
Chenopodium album	Lamb's Quarters
Convolvulus sepium	Hedge Bindweed
Conyza canadensis	Horseweed
Crepis tectorum	Narrow-leaved Hawksbeard
Cyperus schweinitzii	Schweinitz's Cyperus
Eragrostis trichoides	Sand Love-grass
Erigeron strigosus	Daisy Fleabane
Euphorbia corollata	Flowering Spurge
Froelichia floridana	Prairie Froelichia
Helianthus petiolaris	Prairie Sunflower
Leptoloma cognatum	Fall Witch-grass
Lespedeza capitata	Round-headed Bush Clover
Medicago sativa	Alfalfa
Melilotus alba	White Sweet Clover
Melilotus officinalis	Yellow Sweet Clover
Oenothera biennis	Common Evening-primrose
Oenothera rhombipetala	Sand Primrose
Panicum sp.	Panic-grass sp.
Panicum virgatum	Switch-grass
Physalis heterophylla	Clammy Ground Cherry
Poa compressa	Canada Blue-grass
Polygonum convolvulus	Black Bindweed
Populus deltoides	Cottonwood
Potentilla norvegica	Rough Cinquefoil
Rumex acetosella	Sheep Sorrel
Salsola kali	Russian Thistle
Silene cucubalus	Bladder-campion
Solidago canadensis	Canada Goldenrod
Sorghastrum nutans	Indian-grass
Strophostyles helveola	Trailing Wild Bean
Vicia villosa	Cow Vetch

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Appendix A3.2.3
Species List for PRA 2 - 1978

Acalypha rhomboidea	Three-seeded Mercury
Agropyron repens	Quack-grass
Agrostis scabra	Rough Hair-grass
Ambrosia artemisiifolia	Ragweed
Ambrosia trifida	Great Ragweed
Aristida basiramea	Three-awn-grass
Asclepias syriaca	Common Milkweed
Bromus inermis	Smooth or Awnless Brome-grass
Bromus tectorum	Downy Brome-grass
Chamaecyse maculata	Spotted Spurge
Chrysopsis villosa	Golden Aster
Crepis tectorum	Narrow-leaved Hawksbeard
Cyperus lupulinus	Slender Cyperus
Cyperus schweinitzii	Schweinitz's Cyperus
Digitaria sanguinalis	Large Crab-grass
Elymus canadensis	Nodding Wild Rye
Erigeron annuus	(Annual) Daisy Fleabane
Erigeron strigosus	Daisy Fleabane
Hedeoma hispida	Rough Pennyroyal
Helenium autumnale	Sneezeweed
Lactuca canadensis	Canadian Wild Lettuce
Leptoloma cognatum	Fall Witch-grass
Lespedeza stipulacea	Korean Lespedeza
Lycopus americanus	Cut-leaved Water Hoarhound
Melilotus sp.	Sweet Clover sp.
Melilotus alba	White Sweet Clover
Mollugo verticillata	Carpetweed
Oenothera rhombipetala	Sand Primrose
Panicum sp.	Panic-grass sp.
Paspalum ciliatifolium	Ciliate-leaved Paspalum
Phalaris arundinacea	Reed Canary-grass
Physostegia virginiana	Obedient Plant
Poa compressa	Canada Blue-grass
Poa pratensis	Kentucky Blue-grass
Polygonum convolvulus	Black Bindweed
Populus deltoides	Cottonwood
Potentilla argentea	Silvery Cinquefoil
Ranunculus pensylvanicus	Pennsylvania Buttercup
Rubus occidentalis	Black Raspberry
Salix interior	Sand-bar Willow
Salsola kali	Russian Thistle
Setaria glauca	Yellow Foxtail
Setaria viridis	Green Foxtail
Sporobolus cryptandrus	Sand Dropseed
Stachys hispida	Rough Hedge Nettle
Teucrium canadense	American Germander
Ulmus pumila	Siberian Elm
Urtica dioica	Stinging Nettle
Verbascum thapsus	Great Mullein
Verbena hastata	Blue Vervain
Verbena stricta	Hoary Vervain

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Appendix A3.2.4
Species List for RAPA 2 - 1978

Acalypha rhomboidea	Three-seeded Mercury
Agropyron repens	Quack-grass
Agrostis scabra	Rough Hair-grass
Ambrosia trifida	Great Ragweed
Andropogon gerardi	Big Bluestem
Andropogon scoparius	Little Bluestem
Asclepias incarnata	Swamp Milkweed
Aster ericoides	White Heath Aster
Aster simplex	White Field Aster
Astragalus canadensis	Canadian Milk Vetch
Bouteloua curtipendula	Side-oats Gramma
Bromus inermis	Smooth or Awnless Brome-grass
Bromus tectorum	Downy Brome-grass
Buchloe dactyloides	Buffalo-grass
Carex sp.	Sedge sp.
Chenopodium album	Lamb's Quarters
Cirsium discolor	Prairie Thistle
Cirsium vulgare	Bull Thistle
Conyza canadensis	Horseweed
Crepis tectorum	Narrow-leaved Hawksbeard
Cyperus lupulinus	Slender Cyperus
Cyperus schweinitzii	Schweinitz's Cyperus
Elymus canadensis	Nodding Wild Rye
Eragrostis trichoides	Sand L grass
Erigeron annuus	(Annua isy Fleabane
Erigeron philadelphicus	Philade a Fleabane
Erigeron strigosus	Daisy l ne
Geum sp.	Avens sp.
Hedeoma hispida	Rough Pennyroyal
Helenium autumnale	Sneezeweed
Lactuca canadensis	Canadian Wild Lettuce
Lactuca serriola	Wild Lettuce
Leptoloma cognatum	Fall Witch-grass
Lespedeza stipulacea	Korean Lespedeza
Lycopus americanus	Cut-leaved Water Hoarhound
Medicago sativa	Alfalfa
Melilotus sp.	Sweet Clover sp.
Melilotus alba	White Sweet Clover
Oenothera biennis	Common Evening-primrose
Panicum sp.	Panic-grass sp.
Panicum virgatum	Switch-grass
Phalaris arundinacea	Reed Canary-grass
Physostegia virginiana	Obedient Plant
Poa compressa	Canada Blue-grass
Poa pratensis	Kentucky Blue-grass
Polygonum convolvulus	Black Bindweed
Potentilla argentea	Silvery Cinquefoil
Ratibida columnifera	Prairie or Yellow Coneflower
Rubus occidentalis	Black Raspberry
Rumex acetosella	Sheep Sorrel
Salix interior	Sand-bar Willow
Salsola kali	Russian Thistle

Setaria viridis	Green Foxtail
Sicyos angulatus	Bur-cucumber
Silene cucubalus	Bladder-campion
Solidago canadensis	Canada Goldenrod
Sorghastrum nutans	Indian-grass
Sporobolus cryptandrus	Sand Dropseed
Stachys hispida	Rough Hedge Nettle
Strophostyles helveola	Trailing Wild Bean
Urtica dioica	Stinging Nettle
Verbascum thapsus	Great Mullein
Verbena stricta	Hoary Vervain
Viola sp.	Violet sp.

Appendix A3.2.5
Species List for PRA 3A - 1978

Acalypha rhomboidea	Three-seeded Mercury
Acer negundo	Box Elder
Achillea millefolium	Yarrow
Agropyron repens	Quack-grass
Agrostis scabra	Rough Hair-grass
Ambrosia artemisiifolia	Ragweed
Ambrosia psilostachya	Western Ragweed
Ambrosia trifida	Great Ragweed
Amorpha fruticosa	Wild Indigo
Andropogon gerardi	Big Bluestem
Anemone canadensis	Canada Anemone
Apocynum sibiricum	Indian Hemp
Aristida basiramea	Three-awn-grass
Artemisia biennis	Biennial Wormwood
Artemisia ludoviciana	Sage
Asclepias incarnata	Swamp Milkweed
Asclepias syriaca	Common Milkweed
Asclepias verticillata	Whorled Milkweed
Aster ericoides	White Heath Aster
Aster simplex	White Field Aster
Bromus inermis	Smooth or Awnless Brome-grass
Calamovilfa longifolia	Sand-reed
Carex sp.	Sedge sp.
Cenchrus longispinus	Sand-bur
Chamaecyse maculata	Spotted Spurge
Chamaecyse nutans	Spurge
Chenopodium album	Lamb's Quarters
Cirsium vulgare	Bull Thistle
Conyza canadensis	Horseweed
Crepis tectorum	Narrow-leaved Hawksbeard
Cyperus lupulinus	Slender Cyperus
Cyperus schweinitzii	Schweinitz's Cyperus
Elymus canadensis	Nodding Wild Rye
Elymus virginicus	Virginia Wild Rye
Eragrostis spectabilis	Purple Love-grass
Erigeron philadelphicus	Philadelphia Fleabane
Erigeron strigosus	Daisy Fleabane
Erysimum (inconspicuum)	Wallflower
Eupatorium rugosum	[illegible]e Snakeroot
Euphorbia corollata	[illegible]ering Spurge
Fragaria virginiana	Virginia Strawberry
Gnaphalium (obtusifolium)	Cudweed
Hackelia sp.	Stickseed sp.
Hedeoma hispida	Rough Pennyroyal
Helenium autumnale	Sneezeweed
Helianthus laetiflorus	Showy Sunflower
Helianthus tuberosus	Jerusalem Artichoke
Lactuca canadensis	Canadian Wild Lettuce
Leptoloma cognatum	Fall Witch-grass
Lespedeza capitata	Round-headed Bush Clover
Lychnis alba	White Cockle
Lycopus americanus	Cut-leaved Water Hoarhound

Melilotus sp.	Sweet Clover sp.
Melilotus alba	White Sweet Clover
Oenothera biennis	Common Evening-primrose
Oxybaphus nyctagineus	Wild Four-O'clock
Panicum sp.	Panic-grass sp.
Panicum virgatum	Switch-grass
Paspalum ciliatifolium	Ciliate-leaved Paspalum
Phalaris arundinacea	Reed Canary-grass
Physalis heterophylla	Clammy Ground Cherry
Physostegia virginiana	Obedient Plant
Poa compressa	Canada Blue-grass
Poa pratensis	Kentucky Blue-grass
Polygonum ramosissimum	Bushy Knotweed
Populus deltoides	Cottonwood
Potentilla argentea	Silvery Cinquefoil
Potentilla norvegica	Rough Cinquefoil
Rumex altissimus	Tall Dock
Salix interior	Sand-bar Willow
Salix nigra	Black Willow
Salsola kali	Russian Thistle
Scutellaria lateriflora	Mad Dog Skullcap
Setaria viridis	Green Foxtail
Sicyos angulata	Bur-cucumber
Solidago canadensis	Canada Goldenrod
Solidago rigida	Stiff Goldenrod
Spartina pectinata	Prairie Cord-grass
Sporobolus cryptandrus	Sand Dropseed
Sporobolus vaginiflorus	Sheathed Dropseed
Stachys hispida	Rough Hedge Nettle
Taraxacum officinale	Dandelion
Ulmus rubra	Slippery Elm
Verbascum thapsus	Great Mullein
Verbena stricta	Hoary Vervain
Verbena urticifolia	White Vervain
Vitis riparia	Winter Grape
Xanthium strumarium	Cocklebur

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Appendix A3.2.6
Species List for PRA 3B - 1978

Acalypha rhomboidea	Three-seeded Mercury
Acer negundo	Box Elder
Agropyron repens	Quack-grass
Agrostis scabra	Rough Hair-grass
Ambrosia artemisiifolia	Ragweed
Ambrosia trifida	Great Ragweed
Andropogon gerardi	Big Bluestem
Anemone canadensis	Canada Anemone
Apocynum sibiricum	Indian Hemp
Asclepias syriaca	Common Milkweed
Aster ericoides	White Heath Aster
Bromus inermis	Smooth or Awnless Brome-grass
Bromus tectorum	Downy Bromw-grass
Calamovilfa longifolia	Sand-reed
Carex sp.	Sedge sp.
Cenchrus longispinus	Sand-bur
Chamaecyse glyptosperma	Ridge-seeded Spurge
Chamaecyse maculata	Spotted Spurge
Chamaecyse nutans	Spurge
Chenopodium album	Lamb's Quarters
Cirsium arvense	Canada Thistle
Cirsium vulgare	Bull Thistle
Convolvulus sepium	Hedge Bindweed
Conyza canadensis	Horseweed
Cyperus lupulinus	Slender Cyperus
Digitaria sanguinalis	Large Crab-grass
Elymus canadensis	Nodding Wild Rye
Elymus virginicus	Virginia Wild Rye
Eragrostis spectabilis	Purple Love-grass
Erigeron strigosus	Daisy Fleabane
Erysimum inconspicuum	Wallflower
Euphorbia corollata	Flowering Spurge
Fragaria virginiana	Virginia Strawberry
Hackelia sp.	Stickseed sp.
Helenium autumnale	Sneezeweed
Helianthus laetiflorus	Showy Sunflower
Helianthus tuberosus	Jerusalem Artichoke
Lactuca canadensis	Canadian Wild Lettuce
Lactuca serriola	Wild Lettuce
Leptoloma cognatum	Fall Witch-grass
Lespedeza capitata	Round-headed Bush Clover
Lycopus americanus	Cut-leaved Water Hoarhound
Melilotus sp.	Sweet Clover sp.
Mimulus ringens	Monkey Flower
Mollugo verticillata	Carpetweed
Oenothera biennis	Common Evening-primrose
Oxybaphus nyctagineus	Wild Four-O'clock
Panicum sp.	Panic-grass sp.
Panicum virgatum	Switch-grass
Phalaris arundinacea	Reed Canary-grass

Physalis heterophylla	Clammy Ground Cherry
Physalis virginiana	Virginia Ground Cherry
Physostegia virginiana	Obedient Plant
Poa compressa	Canada Blue-grass
Poa pratensis	Kentucky Blue-grass
Polanisia graveolens	Clammyweed
Polygonum convolvulus	Black Bindweed
Populus deltoides	Cottonwood
Potentilla arguta	Tall Cinquefoil
Ranunculus pensylvanicus	Pennsylvania Buttercup
Rhus radicans	Poison Ivy
Rosa suffulta	Arkansaw Rose
Rubus occidentalis	Black Raspberry
Rumex acetosella	Sheep Sorrel
Rumex altissimus	Tall Dock
Salix interior	Sand-bar Willow
Salix nigra	Black Willow
Salsola kali	Russian Thistle
Setaria glauca	Yellow Foxtail
Setaria viridis	Green Foxtail
Silene cucubalus	Bladder-campion
Solidago canadensis	Canada Goldenrod
Solidago missouriensis	Missouri Goldenrod
Solidago rigida	Stiff Goldenrod
Sporobolus cryptandrus	Sand Dropseed
Ulmus pumila	Siberian Elm
Urtica dioica	Stinging Nettle
Verbascum thapsus	Great Mullein
Verbena stricta	Hoary Vervain
Verbena urticifolia	White Vervain
Vernonia fasciculata	Western Iron-weed
Vitis riparia	Winter Grape
Xanthium strumarium	Cocklebur

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Appendix A3.2.7
PRA 1 - Four Year Species List (1975 - 1978)

	1975	1976	1977	1978
Acer negundo	x		x	x
Achillea millefolium	x	x	x	x
Agropyron repens	x	x	x	x
Agrostis scabra	x	x	x	x
Ambrosia artemisiifolia	x	x	x	x
A. trifida			x	
Andropogon gerardi			x	x
A. scoparius			x	x
Anemone cylindrica				x
Artemisia campestris			x	
A. ludoviciana			x	x
Asclepias syriaca	x	x	x	x
A. verticillata	x	x	x	
(Aster ontarionis)	x			
A. simplex		x	x	
Bromus inermis	x	x	x	x
B. tectorum	x	x	x	
Carex sp.	x		x	
Cenchrus longispinus	x	x	x	x
Chamaecyse glyptosperma	x	x		x
Chenopodium album	x	x	x	
Chrysopsis villosa	x	x	x	x
Convolvulus sepium	x	x	x	x
Conyza canadensis		x	x	x
Crepis tectorum	x	x	x	x
Cyperus lupulinus			x	x
C. schweinitzii	x	x	x	x
Cirsium discolor		x		
Digitaria sanguinalis	x	x	x	x
Elymus canadensis	x	x	x	x
Eragrostis spectabilis	x		x	x
Erigeron strigosus	x	x	x	x
Euphorbia corollata	x	x	x	x
Fragaria vesca			x	
F. virginiana		x	x	x
Froelichia floridana	x	x	x	x
Hedeoma hispida	x	x	x	x
Helianthus laetiflorus	x		x	
H. petiolaris	x	x	x	x
H. tuberosus	x	x		
Hordeum jubatum	x			
Juniperus virginiana	x		x	x
Lactuca sp.	x			
Lepidium densiflorum	x	x	x	x
Leptoloma cognatum	x	x	x	x

FRA 1 - Four Year Species List - continued

	1975	1976	1977	1978
Lespedeza stipulacea	x	x	x	x
Lithospermum croceum	x	x	x	x
Lychnis alba	x	x	x	x
Medicago sativa		x	x	x
Melilotus alba	x	x	x	x
M. officinalis	x			
Mollugo verticillata	x	x	x	x
Monarda fistulosa	x			
Oenothera biennis	x	x	x	x
O. rhombipetala	x	x	x	
Oxybaphus nyctagineus		x	x	x
Panicum sp.	x	x	x	x
P. virgatum	x	x	x	x
Parthenocissus vitacea			x	x
Physalis heterophylla				x
Plantago purshii	x			
Poa compressa	x	x	x	x
P. pratensis	x	x	x	x
Polanisia graveolens		x	x	
Polygonum convolvulus	x	x	x	x
P. pensylvanicum			x	
P. ramosissimum	x		x	
Potentilla argentea	x	x	x	
P. norvegica			x	
Prunus sp.	x			
P. americana		x		x
(P. pensylvanica)			x	
Rhus glabra			x	x
(Rosa blanda)	x			
R. suffulta		x	x	x
Rumex acetosella	x		x	x
R. altissimus	x		x	
R. verticillata (?)	x			
Salsola kali	x	x	x	x
Setaria glauca	x	x	x	x
S. viridis		x	x	x
Silene antirrhina	x	x	x	
S. cucubalus	x	x		x
Sisyrinchium campestre	x			
Solidago canadensis			x	
S. missouriensis			x	x
S. rigida	x			x
Sorghastrum nutans			x	x
Sporobolus cryptandrus	x	x	x	x
Solidago sp.	x			
(Stipa spartea) (Calamovilfa!)	x			

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PRA 1 - Four Year Species List - continued

	1975	1976	1977	1978
Strophostyles helveola			x	x
Taraxacum officinale	x			
Tragopogon major	x			
Ulmus americana			x	
U. pumila			x	x
U. rubra				x
Verbascum thapsus	x			
Verbena stricta	x		x	x
Vicia villosa	x		x	x
Vitis riparia	x		x	x

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Appendix A3.2.8
RAPA 1 - Four Year Species List (1975 - 1978)

	1975	1976	1977	1978
Achillea millefolium			x	
Agropyron repens	x	x	x	x
Agrostis scabra			x	x
Amaranthus retroflexus	x			
Ambrosia artemisiifolia	x	x	x	x
A. trifida	x			
Andropogon gerardi		x	x	
A. scoparius		x	x	x
Artemisia ludoviciana			x	
Asclepias syriaca	x	x	x	x
A. verticillata	x			
Aster azureus		x		
Bouteloua curtipendula		x	x	x
Bromus inermis			x	
B. tectorum		x		
Buchloe dactyloides		x	x	
Calamovilfa longifolia			x	
Cenchrus longispinus	x	x	x	x
Chamaecyse glyptosperma				x
Chamaecyse maculata	x			
Chenopodium album	x	x	x	x
Convolvulus sepium	x	x		x
Conyza canadensis		x	x	x
Crepis tectorum		x	x	x
Cycloloma atriplicifolium	x			
Cyperus esculentus	x			
C. lupulinus	x		x	
C. schweinitzii	x	x	x	x
Digitaria sanguinalis	x	x	x	
Echinochloa crus-galli	x			
Elymus canadensis		x	x	
Eragrostis cilianensis	x			
E. trichoides		x	x	x
Erigeron strigosus		x	x	x
Euphorbia corollata	x	x	x	x
Froelichia floridana	x	x	x	x
Hedeoma hispida			x	
Helianthus laetiflorus			x	
H. petiolaris	x	x	x	x
Hibiscus trionum	x			
Lepidium densiflorum		x	x	
Leptoloma cognatum	x	x	x	x
Lespedeza capitata				x
L. stipulacea			x	
Lithospermum croceum			x	

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RAPA 1 - Four Year Species List - continued

	1975	1976	1977	1978
Medicago sativa			x	x
Melilotus alba		x	x	x
M. officinalis		x	x	x
Mollugo verticillata	x	x	x	
Oenothera biennis	x	x	x	x
O. rhombipetala		x	x	x
Oxybaphus nyctagineus	x		x	
Panicum sp.	x		x	x
P. capillare	x			
P. virgatum		x	x	x
Paspalum ciliatifolium			x	
Physalis heterophylla			x	x
Plantago purshii			x	
Poa compressa			x	x
P. pratensis		x	x	
Poinsettia dentata	x			
Polanisia graveolens	x	x		
Polygonum convolvulus	x	x		x
P. pensylvanicum	x			
P. ramosissimum		x	x	
Populus deltoides	x			x
Potentilla argentea			x	
P. norvegica			x	x
Ratibida columnifera		x	x	
Rosa suffulta			x	
Rumex acetosella			x	x
Salsola kali		x	x	x
Setaria glauca	x	x	x	
S. viridis	x	x		
Silene antirrhina		x	x	
S. cucubalus	x	x	x	x
Solidago canadensis				x
Sorghastrum nutans		x	x	x
Sorghum halapense	x			
Sporobolus cryptandrus		x	x	
Strophostyles helveola	x		x	x
Taraxacum officinale	x			
Tragopogon major			x	
Tribulus terrestris	x			
Ulmus pumila			x	
Verbena stricta			x	
Vicia villosa		x	x	x
Viola sororia			x	

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Appendix A3.2.9
PRA 2 - Three Year Species List (1976 - 1978)

	1976	1977	1978
Acalypha rhomboidea		x	x
Acer negundo	x	x	
Achillea millefolium	x	x	
Agropyron repens	x	x	x
Agrostis scabra	x	x	x
Ambrosia artemisiifolia	x	x	x
A. trifida		x	x
Aristida basiramea	x	x	x
Artemisia biennis		x	
A. campestris	x		
A. ludoviciana	x		
Asclepias incarnata		x	
A. syriaca	x	x	x
A. verticillata	x	x	
Asparagus officinalis	x		
Aster ericoides	x	x	
A. simplex	x	x	
Berteroa incana		x	
Boltonia asteroides	x	x	
Bromus inermis	x	x	x
B. tectorum	x	x	x
Carex sp.	x	x	
Ceanothus ovatus	x		
Cenchrus longispinus	x	x	
Chamaecyse glyptosperma	x	x	
C. maculata	x	x	x
Chenopodium album	x	x	
Chrysopsis villosa	x	x	x
Convolvulus sepium	x		
Conyza canadensis	x	x	
Crepis tectorum	x	x	x
Cyperus lupulinus	x	x	x
C. schweinitzii	x	x	x
Digitaria sanguinalis	x	x	x
Elymus canadensis	x	x	x
Eragrostis spectabilis	x	x	
Erigeron annuus			x
E. philadelphicus	x	x	
E. strigosus	x	x	x
Euphorbia corollata	x	x	
Fragaria virginiana	x	x	
Froelichia floridana	x	x	
Hedeoma hispida	x	x	x
Helenium autumnale		x	x

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PRA 2 - Three Year Species List - continued

	1976	1977	1978
Helianthus petiolaris	x	x	
H. tuberosus	x	x	
Lactuca canadensis	x	x	x
L. serriola	x	x	
Lepidium densiflorum		x	
Leptoloma cognatum	x	x	x
Lespedeza capitata	x	x	
L. stipulacea		x	x
Lithospermum croceum		x	
Lychnis alba	x	x	
Lycopus americanus	x	x	x
Medicago sativa	x	x	
Melilotus sp.			x
M. alba	x	x	x
M. officinalis	x	x	
Mollugo verticillata	x	x	x
Muhlenbergia (racemosa)		x	
Oenothera biennis	x	x	
O. rhombipetala	x	x	x
Oxalis stricta	x		
Oxybaphus nyctagineus	x	x	
Panicum sp.	x	x	x
Paspalum ciliatifolium	x	x	x
Phalaris arundinacea	x		x
Physalis heterophylla		x	
P. longifolius		x	
Physostegia virginiana		x	x
Plantago purshii	x	x	
Poa compressa	x	x	x
P. pratensis	x	x	x
Polanisia graveolens	x	x	
Polygonum convolvulus	x	x	x
P. lapathifolium		x	
Populus deltoides	x	x	x
Potentilla argentea	x	x	x
Ranunculus pensylvanicus			x
Rhus glabra		x	
Rosa suffulta	x	x	
Rubus occidentalis	x	x	x
Rumex altissimus		x	
Salix sp.	x		
S. interior		x	x
Salsola kali	x	x	x
Setaria glauca	x		x
S. viridis	x	x	x

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PRA 2 - Three Year Species List - continued

	1976	1977	1978
Silene antirrhina		x	
S. cucubalus	x		
Solidago canadensis	x	x	
S. missouriensis		x	
S. rigida	x	x	
Sporobolus cryptandrus	x	x	x
Stachys hispida		x	x
Stipa spartea	x		
Taraxacum officinale	x	x	
Teucrium canadense	x	x	x
Tragopogon major	x	x	
Trifolium pratense	x	x	
Ulmus americana		x	
U. pumila	x	x	x
Urtica dioica		x	x
Verbascum thapsus	x	x	x
Verbena bracteata		x	
V. hastata			x
V. stricta	x	x	x
V. urticifolia		x	
Vicia villosa	x	x	
Viola sororia		x	
Vitis riparia		x	

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Appendix A 3.2.10
RAPA 2 - Three Year Species List (1976 - 1978)

	1976	1977	1978
Acalypha rhomboidea		x	x
Acer negundo		x	
Achillea millefolium		x	
Agropyron repens	x	x	x
Agrostis scabra	x	x	x
Ambrosia artemisiifolia	x	x	
A. trifida		x	x
Andropogon gerardi	x	x	x
A. scoparius	x	x	x
Apocynum sibiricum		x	
Arctium minus		x	
Artemisia ludoviciana	x		
Asclepias hirtella		x	
A. incarnata	x	x	x
A. syriaca	x	x	
Aster azureus	x		
A. ericoides		x	x
A. simplex		x	x
Astragalus canadensis		x	x
Bouteloua curtipendula	x	x	x
Bromus inermis	x	x	x
B. tectorum	x	x	x
Buchloe dactyloides	x	x	x
Carex sp.	x	x	x
Cenchrus longispinus	x	x	
Chamaecyse glyptosperma	x	x	
C. maculata		x	
Chenopodium album	x	x	x
Chrysopsis villosa	x	x	
Cirsium arvense	x		
C. discolor		x	x
C. vulgare	x	x	x
Conyza canadensis	x	x	x
Crepis tectorum	x	x	x
Cycloloma atriplicifolia	x		
Cyperus lupulinus		x	x
C. schweinitzii	x	x	x
Descurainia pinnata	x		
Digitaria sanguinalis		x	
Elymus canadensis	x	x	x
E. virginicus	x		
Eragrostis spectabilis	x		
E. trichoides	x	x	x
Erigeron annuus			x
E. philadelphicus		x	x
E. strigosus	x	x	x

RAPA 2 - Three Year Species List - continued

	1976	1977	1978
Euphorbia corollata	x		
Fragaria virginiana		x	
Froelichia floridana		x	
Geum sp.			x
Hedeoma hispida	x	x	x
Helenium autumnale	x	x	x
Helianthus laetiflorus		x	
H. petiolaris	x	x	
H. tuberosus	x		
Lactuca canadensis	x	x	x
L. serriola	x	x	x
Leersia oryzoides	x		
Lepidium densiflorum	x	x	
Leptoloma cognatum	x	x	x
Lespedeza stipulacea		x	x
Liatris punctata		x	
Lithospermum croceum	x	x	
Lycopus americanus	x	x	x
Medicago sativa	x	x	x
Melilotus sp.			x
M. alba	x	x	x
M. officinalis		x	
Menispermum canadense		x	
Mentha arvensis	x	x	
Mollugo verticillata	x	x	
Muhlenbergia (racemosa)	x	x	
Najas cataria		x	
Oenothera biennis	x	x	x
O. rhombipetala	x	x	
Oxybaphus nyctagineus	x	x	
Panicum sp.	x	x	x
P. capillare		x	
P. virgatum	x	x	x
Phalaris arundinacea	x	x	x
Physalis heterophylla	x	x	
Physostegia virginiana			x
Pinus resinosa		x	
Plantago purshii	x	x	
Poa compressa	x	x	x
P. pratensis	x	x	x
Polanisia graveolens	x	x	
Polygonum convolvulus	x	x	x
P. ramosissimum		x	
Populus deltoides	x		
Potentilla argentea	x	x	x
P. norvegica	x	x	

RAPA 2 - Three Year Species List - continued

	1976	1977	1978
Ratibida columnifera	x	x	x
Rhus glabra		x	
R. typhina	x		
Rosa suffulta		x	
Rubus occidentalis		x	x
Rumex acetosella	x		x
R. altissimus		x	
Salix interior	x	x	x
Salsola kali	x	x	x
Setaria glauca	x	x	
S. viridis	x	x	x
Sicyos angulatus			x
Silene antirrhina	x	x	
S. cucubalus	x	x	x
Solidago canadensis	x	x	x
S. gigantea		x	
S. nemoralis		x	
S. rigida		x	
Sorghastrum nutans	x	x	x
Sporobolus cryptandrus	x	x	x
Stachys hispida			x
Strophostyles helveola			x
Taraxacum officinale		x	
Teucrium canadense		x	
Ulmus pumila	x		
U. rubra		x	
Urtica dioica		x	x
Verbascum thapsus		x	x
Verbena hastata	x		
V. stricta	x	x	x
V. urticifolia		x	
Vernonia fasciculata	x		
Viola sp.			x
V. sororia		x	
Vicia villosa	x		

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Appendix A3.2.11
PRA 3A - Three Year Species List (1976 - 1978)

	1976	1977	1978
Acalypha rhomboidea	x	x	x
Acer negundo		x	x
Achillea millefolium	x	x	x
Agropyron repens	x	x	x
Agrostis scabra	x	x	x
Ambrosia artemisiifolia	x	x	x
A. psilostachya	x		x
A. trifida		x	x
Amorpha fruticosa		x	x
Andropogon gerardi	x		x
Anemone canadensis		x	x
Apocynum sibiricum		x	x
Arabis sp.		x	
Arctium minus		x	
Aristida basiramea	x	x	x
Artemisia biennis		x	x
A. ludoviciana		x	x
Asclepias incarnata			x
A. syriaca	x		x
A. verticillata		x	x
Aster ericoides		x	x
A. simplex		x	x
Astragalus canadensis	x		
Bidens (coronata?)		x	
Bromus inermis	x	x	x
Calamovilfa longifolia	x	x	x
Carex sp.	x	x	x
Cenchrus longispinus		x	x
Chamaecyse maculata		x	x
C. nutans			x
Chenopodium album	x	x	x
Cirsium vulgare	x	x	x
Conyza canadensis	x	x	x
Crepis tectorum	x	x	x
Cyperus lupulinus	x	x	x
C. schweinitzii	x	x	x
Digitaria sanguinalis	x		
Elymus canadensis	x	x	x
E. virginicus	x	x	x
Eragrostis spectabilis	x	x	x
Erigeron philadelphicus			x
E. strigosus			x
Erysimum (inconspicuum)			x
Eupatorium rugosum			x
Euphorbia corollata	x	x	x

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PRA 3A - Three Years Species List - continued

	1976	1977	1978
Fragaria virginiana		x	x
Gnaphalium (obtusifolium)			x
Hackelia sp.			x
Hedeoma hispida	x	x	x
Helenium autumnale	x	x	x
Helianthus laetiflorus		x	x
H. tuberosus	x	x	x
Lactuca canadensis			x
L. serriola		x	
Leersia oryzoides	x	x	
Lepidium densiflorum		x	
Leptoloma cognatum	x	x	x
Lespedeza capitata	x	x	x
Lychnis alba			x
Lycopus americanus	x	x	x
Medicago lupulina		x	
M. sativa	x	x	
Melilotus sp.			x
M. alba	x	x	x
M. officinalis	x		
Oenothera biennis		x	x
Oxalis dillenii	x		
O. stricta		x	
Oxybaphus nyctagineus		x	x
Panicum sp.	x	x	x
P. capillare	x	x	
P. depauperatum		x	
P. virgatum	x	x	x
Paspalum ciliatifolium	x	x	x
Phalaris arundinacea	x	x	x
Physalis heterophylla			x
Physostegia virginiana	x	x	x
Poa compressa	x	x	x
P. pratensis	x	x	x
Polygonum convolvulus		x	
P. lapathifolium		x	
P. ramosissimum		x	x
Populus deltoides	x	x	x
Potentilla argentea	x	x	x
P. arguta		x	
P. norvegica	x	x	x
Rumex altissimus		x	x
Salix interior	x	x	x
S. nigra			x
S. petiolaris		x	
Salsola kali	x	x	x

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PRA 3A - Three Years Species List - continued

	1976	1977	1978
Scutellaria lateriflora		x	x
Setaria glauca	x		
S. viridis	x	x	x
Sicyos angulata			x
Silene antirrhina	x		
S. cucubalus	x	x	
Solidago canadensis		x	x
S. missouriensis(?)	x		
S. nemoralis		x	
S. rigida		x	x
Spartina pectinata			x
Sporobolus cryptandrus	x	x	x
S. vaginiflorus		x	x
Stachys hispida	x	x	x
Taraxacum officinale			x
Ulmus rubra			x
Urtica dioica	x	x	
Verbascum thapsus		x	x
Verbena stricta	x	x	x
V. urticifolia		x	x
Vitis riparia			x
Xanthium strumarium		x	x

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Appendix A3.2.12
PRA 33 - Three Years Species List (1976 - 1978)

	1976	1977	1978
Acalypha rhomboidea	x	x	x
Acer negundo	x	x	x
Achillea millefolium	x	x	
Agropyron repens	x	x	x
Agrostis scabra	x	x	x
Ambrosia artemisiifolia	x	x	x
A. trifida		x	x
Andropogon gerardi			x
Anemone canadensis			x
A. cylindrica		x	
Apocynum sibiricum	x	x	x
Arabis sp.		x	
Arctium minus		x	
Aristida basiramea	x	x	
Artemisia biennis	x	x	
A. ludoviciana		x	
Asclepias incarnata		x	
A. syriaca	x	x	x
Aster ericoides		x	x
A. ontarionis		x	
Astragalus canadensis		x	
Bromus inermis	x	x	x
B. tectorum		x	x
Calamovilfa longifolia		x	x
Carex sp.	x	x	x
Cenchrus longispinus			x
Chamaecyse glyptosperma			x
C. maculata		x	x
C. nutans			x
Chenopodium album	x	x	x
Chrysopsis villosa		x	
Cirsium arvense	x	x	x
C. vulgare	x	x	x
Convolvulus sepium	x	x	x
Conyza canadensis	x	x	x
Crepis tectorum	x	x	
Cyperus lupulinus			x
C. schweinitzii	x	x	
Digitaria sanguinalis	x	x	x
Echinochloa crus-galli		x	
Elymus canadensis	x	x	x
E. virginicus		x	x
Eragrostis spectabilis		x	x
Erigeron annuus	x		
E. philadelphicus	x		
E. strigosus	x	x	x

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PRA 3B - Three Years Species List - continued

	1976	1977	1978
Erysimum inconspicuum			x
Euphorbia corollata		x	x
Fragaria vesca		x	
F. virginiana		x	x
Hackelia sp.			x
Hedeoma hispida		x	
Helenium autumnale	x	x	x
Helianthus laetiflorus		x	x
H. petiolaris		x	
H. tuberosus	x	x	x
Lactuca canadensis	x	x	x
L. serriola	x	x	x
Leersia oryzoides		x	
Lepidium densiflorum		x	
Lepiloma cognatum	x	x	x
Lespedeza capitata	x		x
Lycopus americanus	x	x	x
L. virginicus	x		
Melilotus sp.			x
M. alba	x	x	
Mimulus ringens		x	x
Mollugo verticillata	x	x	x
Oenothera biennis	x	x	x
O. rhombipetala		x	
Oxalis dillenii		x	
Oxybaphus nyctagineus	x	x	x
Panicum sp.	x	x	x
P. capillare		x	
P. virgatum		x	x
Phalaris arundinacea	x	x	x
Physalis heterophylla			x
P. longifolia		x	
P. virginiana	x		x
Physostegia virginiana		x	x
Poa compressa	x		x
P. pratensis	x	x	x
Polanisia graveolens		x	x
Polygonum convolvulus	x	x	x
Populus deltoides	x	x	x
Potentilla argentea		x	
P. arguta		x	x
P. norvegica	x		
Ranunculus pensylvanicus			x
Rhus radicans	x	x	x
Rosa suffulta			x
Rubus occidentalis		x	x

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PRA 3B - Three Years Species List - continued

	1976	1977	1978
Rumex acetosella		x	x
R. altissimus			x
R. mexicanus		x	
Salix interior	x	x	x
S. petiolaris	x	x	
S. nigra		x	x
Salsola kali	x	x	x
Scutellaria lateriflora		x	
Setaria glauca	x		x
S. viridis	x	x	x
Silene cucubalus		x	x
Solidago canadensis		x	x
S. juncea	x	x	
S. missouriensis	?		x
S. nemoralis		x	
S. rigida	x	x	x
Sporobolus cryptandrus		x	x
Stachys hispida		x	
Taraxacum officinale	x		
Teucrium canadense		x	
Ulmus pumila			x
U. rubra		x	
Urtica dioica		x	x
Verbascum thapsus		x	x
Verbena stricta	x	x	x
V. urticifolia		x	x
Vernonia fasciculata			x
Vicia villosa	x	x	
Vitis riparia		x	x
Xanthium strumarium		x	x

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PRAIRIE ISLAND NUCLEAR GENERATING PLANT

ENVIRONMENTAL MONITORING PROGRAM

1978 ANNUAL REPORT

PHYSICAL STUDIES

EROSION STUDY
SOIL AND INTAKE AND DISCHARGE CANALS

(4.1)

by

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and

Prairie Island Plant Engineering Staff

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4.1 EROSION STUDIES

4.1.1 INTRODUCTION

An erosion survey of the Prairie Island site was conducted in 1978 to monitor soil erosion associated with construction activities, general soil loss, and changes in the intake and discharge channels' bottom configurations. Inspections were similar to 1977 studies, including examinations of corrective measures taken on problem areas.

4.1.2 MATERIALS AND METHODS

Methods used in 1977 were continued in the 1978 study. Photographs and descriptive field notes were taken of erosion areas on June 2 and October 19, 1978. Photos were taken of actual erosion sites, potential erosion sites, and sites that had received corrective measures to control erosion. All photos were noted on a map sketch of the plant site, with each photo viewpoint noted.

To measure channel erosion, depths were measured laterally approximately 15 feet from shore and in the centers of the channels when possible. Readings were recorded at 30-to-50-foot intervals using a depth finder. Soundings were taken on July 19, 1978.

4.1.3 RESULTS

June and October observations identified nine erosion sites within the plant site boundary. Two sites were classified as severe , four as moderate, and two as low (Figure 4.1-1). In addition, one site identified as moderate in June was corrected with grading and rock riprap fill prior to the October survey.

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4.1.3.1 Erosion Site Descriptions

Site 1. Bubbler pump house access road. Moderate erosion problem. Some erosion has occurred between existing riprap piles on intake canal embankment. Control measures should be implemented to stabilize this situation. Two photos taken.

Site 2. East side substation exclusion fence. Moderate erosion problem. Runoff from gravel substation pad is causing some gravel movement into adjacent oak forest, but more important is the associated leaching of herbicides from the substation to the vegetation. A small adjacent area is completely denuded of vegetation due to runoff. Control measures needed. Three photos taken.

Site 3. Recirculation canal embankment near intake bar rack. During the June survey the embankment had begun to erode due to construction activities. However, control measures, including riprap rock and grading, have prevented any further problems. One photo taken.

Site 4. West end of plant parking lot. Moderate erosion problem. Runoff from parking lot has created a gully on the west end that is washing sand and gravel into an open field. Control measures are needed to prevent this gully from causing additional erosion. Three photos taken.

Site 5. Drainage ditch between first cooling tower and Lock and Dam Road. Severe erosion problem. East side of ditch has a large gully forming; severity increased from June to October surveys. Control measures needed to stabilized movement of loose soil. Three photos taken.

Site 6. Base of dredge spoils mound south of cooling towers. Moderate erosion problem on far east end of this loose soil area. Heavy summer rains have created some gullying that is washing soil into adjacent wooded area. Any control measures undertaken should not include heavy equipment in order to minimize further disturbance of the area. Two photos taken.

Site 7. South side of intake canal at bubbler pipe. Low erosion problem. Some erosion occurring at the point where the bubbler pipe meets the water. Soil is loose, consisting of mostly sand, and erosion is difficult to control. Two photos taken.

Site 8. Path to Sturgeon Lake boat dock at environmental lab. Severe erosion problem. Heavy summer rains have cut back the river bank where a foot path exists. A large gully has formed in the loose sand embankment. Future rains will continue to erode the access path. Control measures necessary. Three photos taken.

Site 9. East side of the discharge canal, directly across from discharge gates. Low erosion problem. A "cut" has formed in the island that separates the main channel from the discharge canal. It appears that undercuttings by beaver have caved in to create this opening. This area will be watched to monitor further erosion. Two photos taken.

4.1.3.2 Canal Depth Survey

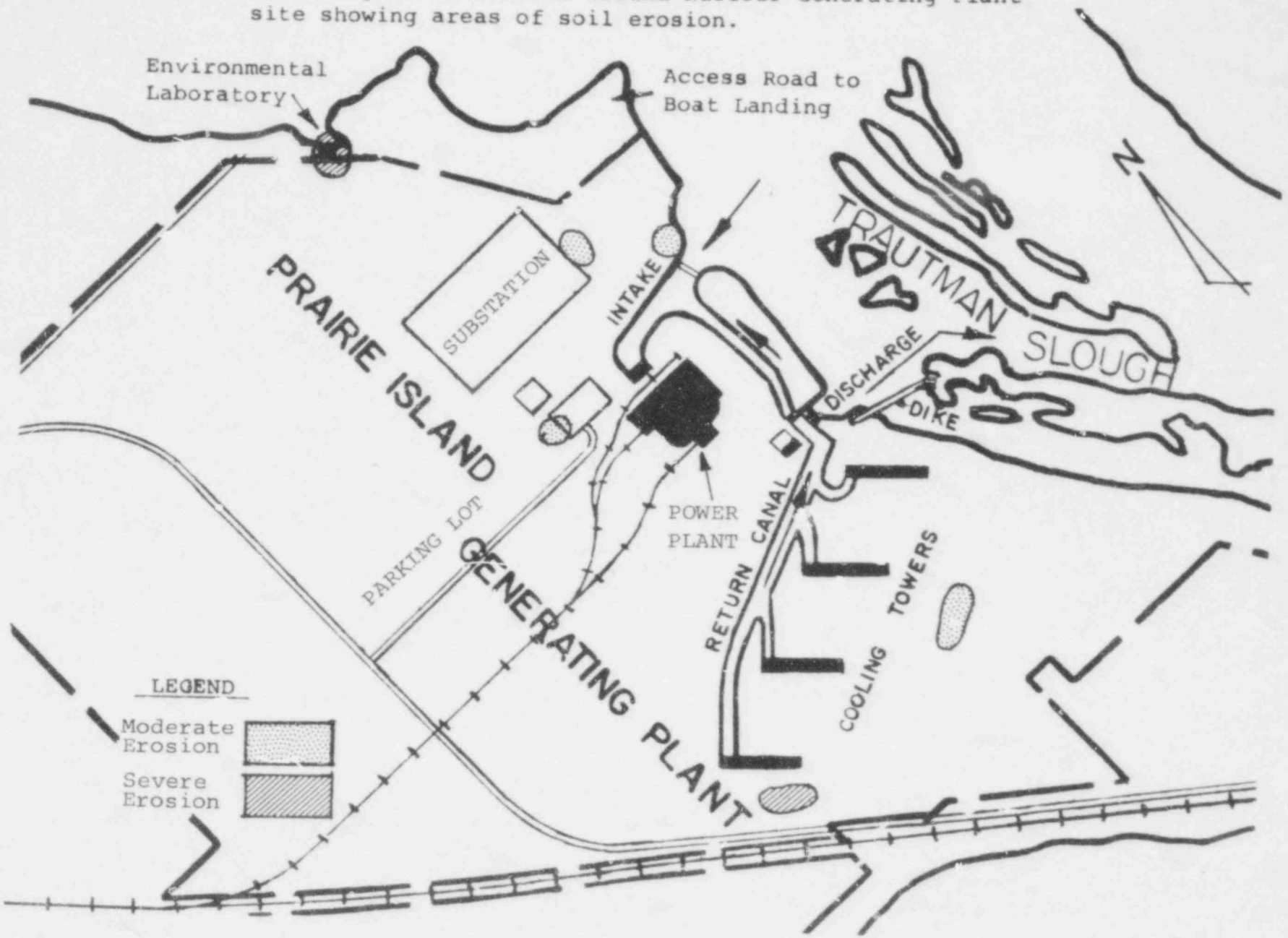
Intake and discharge canal depths changed little from 1977 to 1978. Variation in canal depth measurements from 1977

can be explained by differences in pool levels at the date of the survey, differences in measurement location, and shifting of bottom sediment. Soundings taken in 1978 indicate no significant erosion or deposition that would necessitate channel dredging (Figure 4.1-2).

4.1.4 SUMMARY

Plant site erosion increased in 1978 compared with 1977. Nine sites were identified and inspected. Two sites (5 and 8) were classified as severe, and four sites (1, 2, 4, and 6) were classified as moderate problem areas. All of these sites need some degree of erosion control. Increased soil erosion this year can be explained by heavy rains experienced in the spring and early summer. July in particular had record downpours that caused flooding and erosion in much of the surrounding area. In the plant vicinity, however, erosion control measures and natural soil stabilization minimized what could have been a greater problem. Areas such as the dredge spoils mound south of the cooling towers that was once a severe erosion site, did not degrade to any great extent. The majority of areas identified in 1978 were new sites not previously described. Intake and discharge canal depths showed no significant changes with no corrective action deemed necessary.

Figure 4.1-1. Partial plan of Prairie Island Nuclear Generating Plant site showing areas of soil erosion.



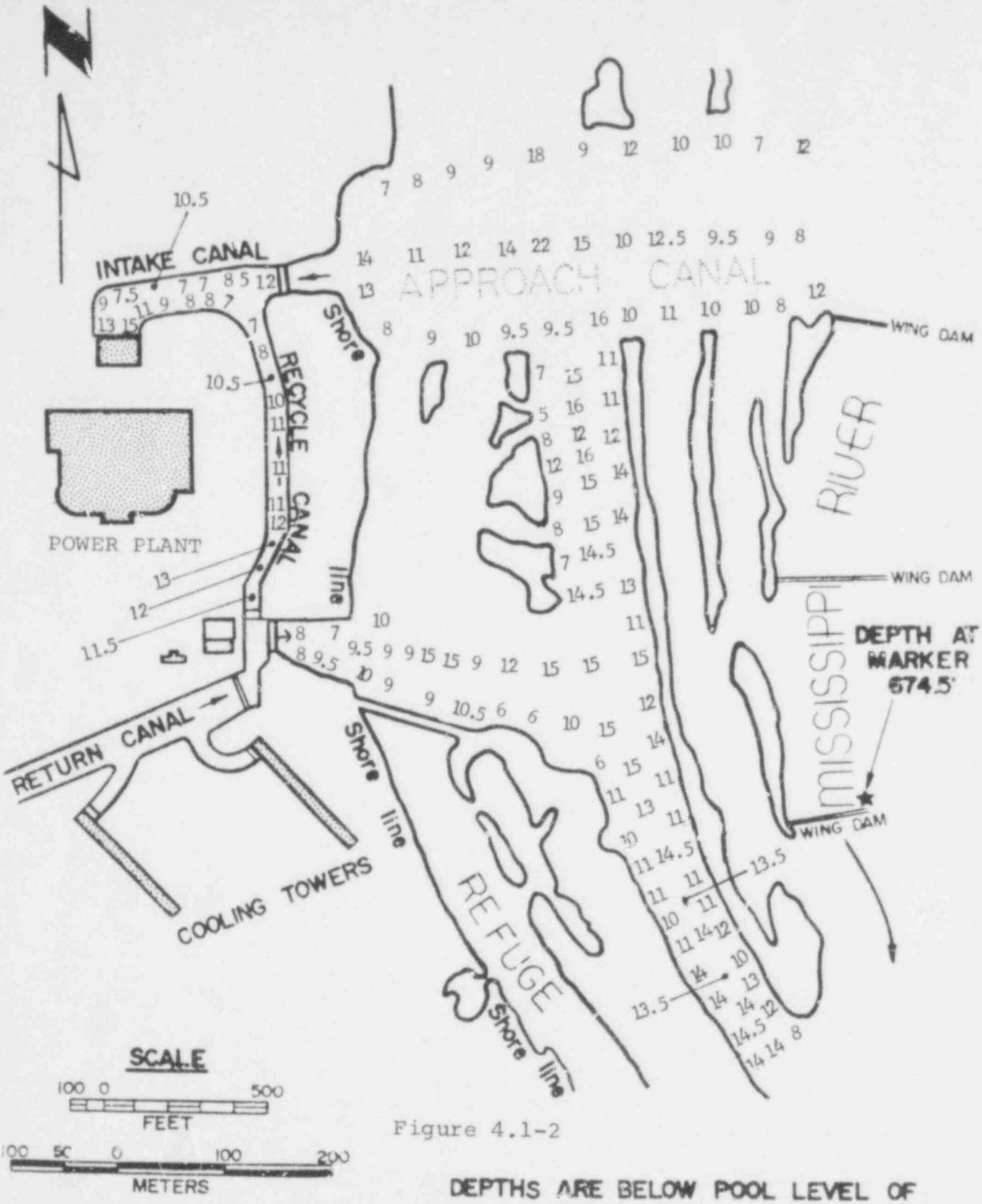


Figure 4.1-2

DEPTHS ARE BELOW POOL LEVEL OF 674.5 (msl) MEASURED AT MARKER

PRAIRIE ISLAND

MAP OF CANAL DEPTH SURVEY

(Sounding Data Taken on July 19, 1978)

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PRAIRIE ISLAND NUCLEAR GENERATING PLANT
ENVIRONMENTAL MONITORING PROGRAM
1978 ANNUAL REPORT
PHYSICAL STUDIES

DREDGING STUDY
(4.2)

Prepared by

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

4.2 DREDGING STUDY

No maintenance dredging has occurred in the five years since construction of the river facilities was completed. Without any periodic (maintenance) dredging work, there has been no opportunity to study the effects on water quality and aquatic biota.

Any maintenance dredging work would be in full compliance with state and federal specific permits and regulations designed to minimize the environmental impact. The total area affected would be small, and after dredging, the benthic community would regenerate naturally and recover to a level normal to the new bottom conditions.

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