PROGRESS REPORT

JANUARY 1, 1979 - JUNE 30, 1979

ECOLOGICAL MONITORING
FORT ST. VRAIN GENERATING STATION

FOR
PUBLIC SERVICE COMPANY
OF
COLORADO

POOR ORIGINAL

THORNE ECOLOGICAL INSTITUTE
2336 PEARL
BOULDER, COLORADO 80302

2013

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FORT ST. VRAIN NUCLEAR GENERATING STATION

ECOLOGICAL MONITORING PROGRAM

Progress Report
for the Period

January 1, 1979 to June 30, 1979

Prepared by:/s/ ______________________ 7-16-79
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2013 003

Progress Report

January 1, 1979 to June 30, 1979

ECOLOGICAL MONITORING

FORT ST. VRAIN NUCLEAR GENERATING STATION

for

Public Service Company

of

Colorado

by

Thorne Ecological Institute

2336 Pearl

Boulder, Colorado

Dr. Fred A. Glover

Project Director

2013 004

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2013 005

SUMMARY

2013 006

General Summary

The non-radiation, environmental monitoring data presented in this report continue to indicate only minor variations in the ecosystems and trophic levels of the Fort St. Vrain environs. Background monitoring data are available and analyzed for most environmental components for a period of eight years. Generally, environmental quality remains about the same through the years. To date, no discernible nor harmful measurable effects on the environment have become evident from operation of the Nuclear Station.

Aquatic Section

Invertebrates

Macroinvertebrate taxa were comparable to the same period in 1978 but a greater diversity was found. Most of the taxa change was the result of a few specimens. Ice and high water apparently affected macroinvertebrate numbers.

Fish

Fish are collected annually only in the fall; hence, no data on species, numbers, status, and foods are available for this reporting period.

Algae

Algal populations and number of species were lower in 1979 as compared to the corresponding period in 1978. The greatest species diversity occurred in the diatoms but all sample sites showed low species diversity. Spring runoff (scouring) and ice were greater in both rivers this year, either eliminating or greatly reducing algal numbers.

2013 007

Avian Section

There has been a general decline in the bird populations for the reporting period but the diversity of species for comparable past periods has remained about the same over the past eight years. Flooding, a cold, wet spring and heavy livestock grazing might be factors affecting avian numbers.

Terrestrial Section

Vegetation

Data from plant species occurring within exclosures (1972-1979) indicate no significant changes in species dominance. Outside the exclosures, the extent and intensity of cattle grazing appear to be the controlling influence on species dominance and vegetation characteristics.

Ecophysiological Characteristics

Elemental concentrations among the three monitored species over the years (1973-1978) have been quite similar. However, mercury concentrations in kochia and pinto beans have increased over this period. There is a possibility that cooling tower drift might be responsible for increased concentrations of phosphorus, magnesium, and sulfate in foliage samples from near the cooling towers.

Mammals, Amphibians and Reptiles

The same species of mammals, amphibians, and reptiles noted in the 1972 inventory were believed to be present on the Fort St. Vrain site during the report period. However, some of the uncommon species were not observed because of their unusual habits. Climatological and agricultural factors have had significant effects on the population status of most mammals. On the other hand, there appeared to be no cause and effect relationship from the Station's operations.

2013 009

FORT ST. VRAIN

Generation Summary - January-June 1979

Month	Dates With Electric Generation	Number of Days Without Generation	Gross Generation (MWH)
January	1-19, 23-31	3	109,306
February*	1	27	546
March*	0	31	0
April*	0	30	0
May*	0	31	0
June*	0	30	0

* Refueling outage from February 1, 1979 through end of reporting period.

2013 010

INTRODUCTION

2013 011

<u>Introduction</u>

This progress report presents non-radiological, environmental monitoring information and activities concerned with the period January 1, 1979 to June 30, 1979. Environmental studies have been conducted on the St. Vrain Site environs since 19. th monitoring data available and analyzed for most of the environmental components for eight years.

In an effort to control muskrat and beaver activities in the peripheral dike of Goosequill Pond, the water level was dropped significantly in April and May. As a result, monitoring information from some of the environmental components reflects the changes that occurred temporarily in the microenvironments of Goosequill Pond.

2013 012

INVESTIGATOR REPORTS

2013 013

AQUATIC SECTION

2013 014

AQUATIC INVERTEBRATE MONITORING

by

Clarence A. Carlson

David L. Propst

2013 015

INTRODUCTION

Monitoring of the aquatic biota in the area of the Fort St. Vrain Nuclear Generating Station in the first half of 1979 was conducted similar to the past. Data resulting from analyses of timed collections of macroinvertebrates from natural substrates are the primary components of this report. Extremely high water levels in June precluded macroinvertebrate collections at all stations. Extensive ice coverage in January prevented complete macroinvertebrate collections (only the pick portion of the collection was completed at SP4A, SP4U, and SP4B) on 9 January.

STUDY AREA DESCRIPTION

Stations SP4B and C1 were described by Cressey, Carlson and Fronk (1974). Station SP4U was described by Stacey, Carlson and Fronk (1975). Station SP4A was described by Carlson et al. (1977). Sampling stations for aquatic macroinvertebrates are illustrated in Figure 1.

The severe cold and resultant extensive ice cover during the winter months and subsequent high discharge during the spring caused a marked and continuous alteration of the channel bed at all sampling sites. The lower outlet of Goosequill Ditch had a discharge on every sampling date until 26 April. Discharge did not resume until the latter part of May. However, the flow was low after resumption of discharge. High water in the South Platte in June backed water a considerable distance up Goosequill Ditch.

For undetermined reasons, aquatic macroinvertebrate collections have not been made at SV2 and SV5 on the St. Vrain River. Sampling at these sites will resume July, 1979, and continue on a biweekly basis. Macroinvertebrates have not been sampled in Goosequill Pond since 1977 because there are no means to determine what stresses might affect the macroinvertebrates. The resultant data from 5 years of sampling were found not to be comparable with similar data from either of the rivers and there was no "control pond" available for comparison.

2013 016

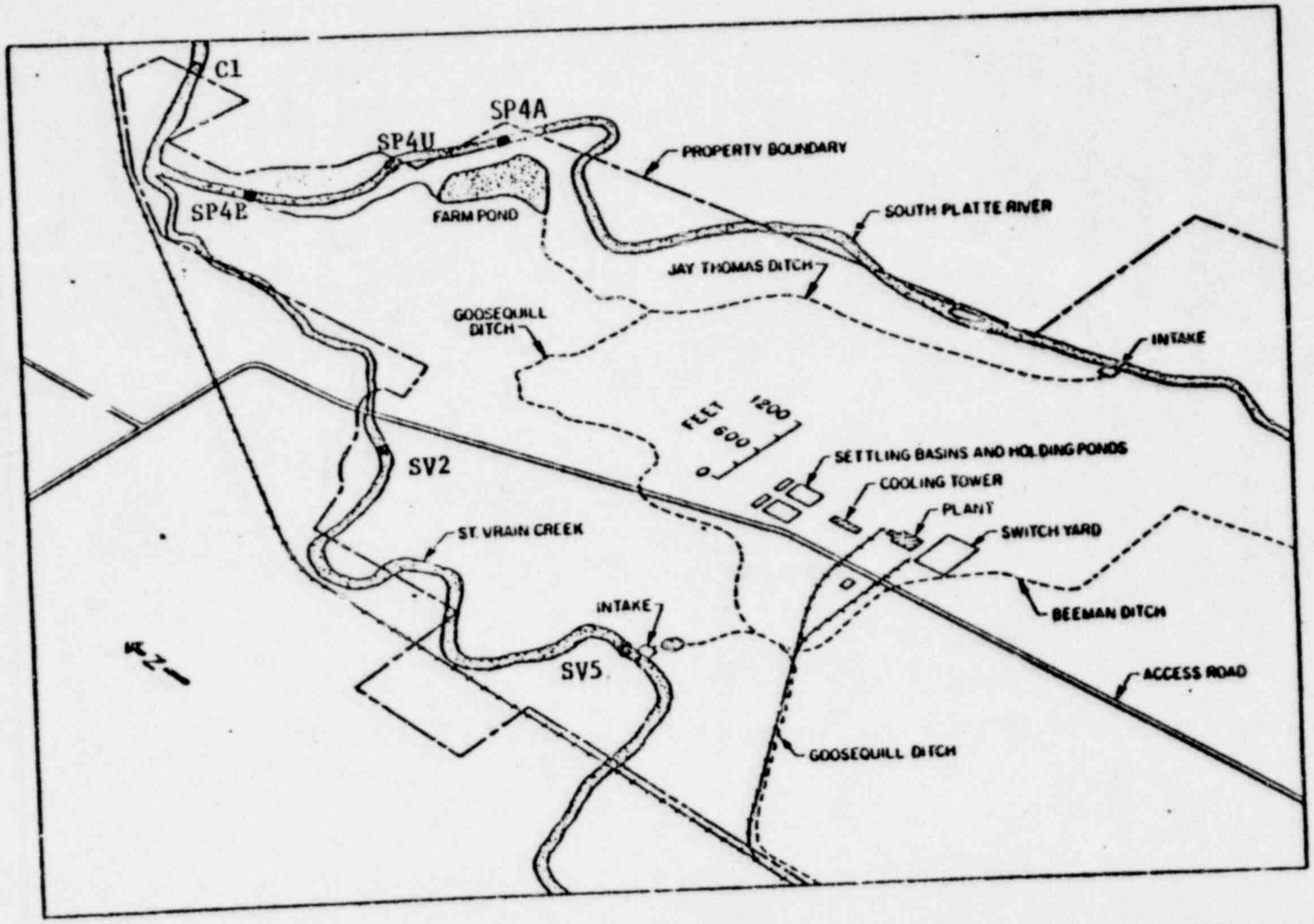

Figure 1. Macroinvertebrate sampling stations on the South Platte and St. Vrain Rivers as of 30 June 1979.

2013 017

METHODS

Macroinvertebrate samples were collected by methods described by Eder, Carlson and Fronk (1974). The samples were composed of macro-invertebrates collected in 10-min samples (with a triangular dipnet) combined with 5-min of debris picking.

Physical and chemical parameters were determined according to methods described by the American Public Health Association (1971), with the exception of total hardness. Total hardness determinations were made by use of a Hach Water Chemistry kit (Model AL-36B). Mal-functioning of the Corning pH meter prevented measurement of pH in March and April. In May pH was determined with a Hach Water Chemistry kit (Model AL-36B). Malfunctioning of the Hach Turbidimeter since April has prevented determination of turbidity. Other equipment used included a mercury thermometer and a Beckman conductivity bridge. The malfunctioning equipment has been replaced or repaired to operate satisfactorily.

RESULTS

<u>SP4A</u>

A total of twenty-six macroinvertebrate taxa were collected from Station SP4A from January through June 1979 (Table 1). This value is comparable to the same period in 1978. However, there was a marked decrease in total number of organisms collected in the two sampling periods, i.e. 5886 in 1978 but only 2917 in 1979. Oligochaetes were the most common organism comprising 37.9 percent of all macroinverte-brates collected at SP4A. <u>Simulium</u> sp. (Diptera: Simuliidae) were the

2013 018

Table 1. Total organisms collected at Stations SP4A, SP4U, SP4B, and C1 from January through June 1979.

Organism	Station				
	SP4A	SP4U	SP4B	C1	Total
Isotomurus palustris	0	0	8	0	8
Heptagenia sp.	0	0	1	1	2
Coenagridae	0	0	1	0	1
Argia sp.	0	10	1	3	14
Dytiscidae	0	0	1	0	1
Dytiscidae larvae	0	0	1	0	1
Dytiscus sp.	0	0	2	0	2
Laccophilus sp.	0	0	1	0	1
Laccobius sp.	0	0	1	0	1
Hydroporus sp.	0	0	1	0	1
Noteridae	0	0	1	0	1
Hydropsyche sp.	28	98	71	27	224
Ochrotrichia sp.	0	8	0	0	8
Ceratopogonidae	8	0	0	0	8
Tipulidae	25	88	96	64	273
Tipulidae pupae	16	8	8	8	40
Hexatoma sp.	24	0	0	0	24
Pedicia sp.	0	0	0	1	1
Psychoda sp.	1	0	0	0	1
Simuliidae pupae	17	33	16	1	67
Simulium sp.	654	617	366	303	1940
Chironomidae	0	0	8	0	8
Chironomidae pupae	92	161	120	56	429
Cricotopus sp.	640	995	1308	482	3425
Dicrotendipes sp.	23	41	10	13	87
Conchapelopia sp.	25	29	35	11	100
Paralauterborniella sp.	8	18	24	24	74
Chironomus sp.	17	288	8	18	331
Polypedilum sp.	1	10	2	1	14
Diamesa sp.	0	0	0	9	9
Cryptochironomus sp.	8	0	0	1	9
Thienemanniella sp.	0	0	0	8	8
Trichocladius sp.	0	0	16	9	25
Glyptotendipes sp.	2	2	9	0	13
Smittia sp.	0	2	0	1	3
Goeldichironomus sp.	16	8	0	0	24
Nematomorpha	16	0	0	0	16
Oligochaeta	1107	1203	899	866	4075
Hirudinea	0	0	8	0	8
Planaridae	1	1	0	8	10
Daphnidae	88	232	152	120	592
Daphnia sp.	8	0	16	0	24

2013 019

Table 1. Continued.

Organism	Station				
	SP4A	SP4U	SP4B	C1	Total
Cyclopidae	0	0	8	0	8
Hyalella azteca	73	115	62	138	388
Asellus sp.	3	19	25	18	65
Crangonyx sp.	16	1	8	3	28
Physa sp.	0	0	11	2	13
Lymnaea sp	0	0	1	0	1
Total # individuals	2917	3987	3306	2195	12406
Total # taxa	26	23	36	27	48

2013 020

second-most common macroinvertebrate, comprising 22.4 percent of the macroinvertebrates collected. Cricotopus sp. (Diptera: Chironomidae) was only slightly less abundant than Simulium sp., comprising 21.9 percent of the organisms. Hydropsyche sp. (Trichoptera: Hydropsychidae) was the only non-dipteran insect collected at SP4A and generally declined in abundance through the sampling period (Figure 2). Daphnidae (Cladocera) were moderately abundant in May. Hyalella azteca (Amphipoda: Talitridae), though never particularly common, was generally found throughout the sampling period (Figure 3). Nine taxa were represented by 10 or fewer individuals (Table 1). Simulium sp. was most common in early 1979 and declined markedly in abundance by the spring months (Figure 4). Cricotopus sp. was most common from January through March (Figure 5). Oligochaetes fluctuated in abundance (Figure 6). Several uncommon or previously unreported macroinvertebrates were collected at SP4A, i.e. Hexatoma sp. (Diptera: Tipulidae), Goeldichironomus sp. (Diptera: Chironomidae), Psychoda sp. (Diptera: Psychodidae), and Nematomorpha.

SP4U

Twenty-three macroinvertebrate taxa were collected from Station SP4U from January through June 1979. Although SP4U had the greatest number of organisms, it had the fewest taxa of any station. The number of taxa found at SP4U in the first half of 1979 is comparable to the number found in the same period in 1978, but the total number of organisms was significantly less in 1979. Oligochaetes were the most abundant organism, comprising 30.2 percent of all macroinvertebrates collected. Simulium sp. (15.5 percent) and Cricotopus sp. (25.0 percent),

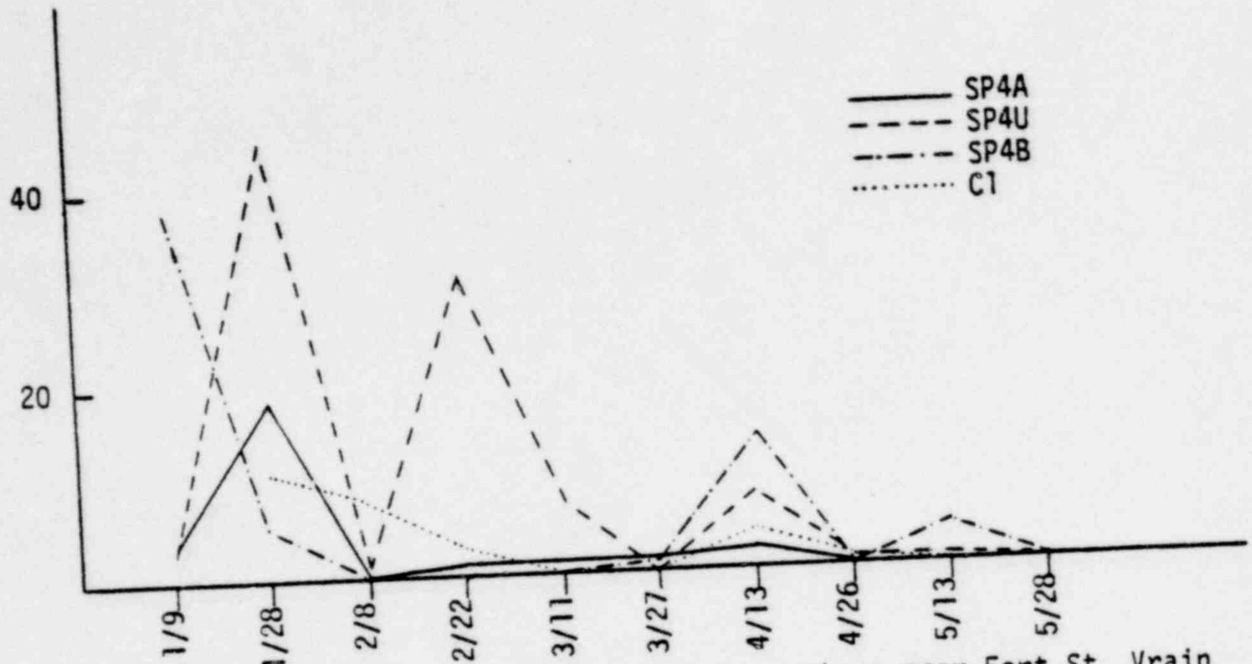

Figure 2. Fluctuations in <u>Hydrophyche</u> sp. numbers near Fort St. Vrain Nuclear Generating Station, January through June 1979.

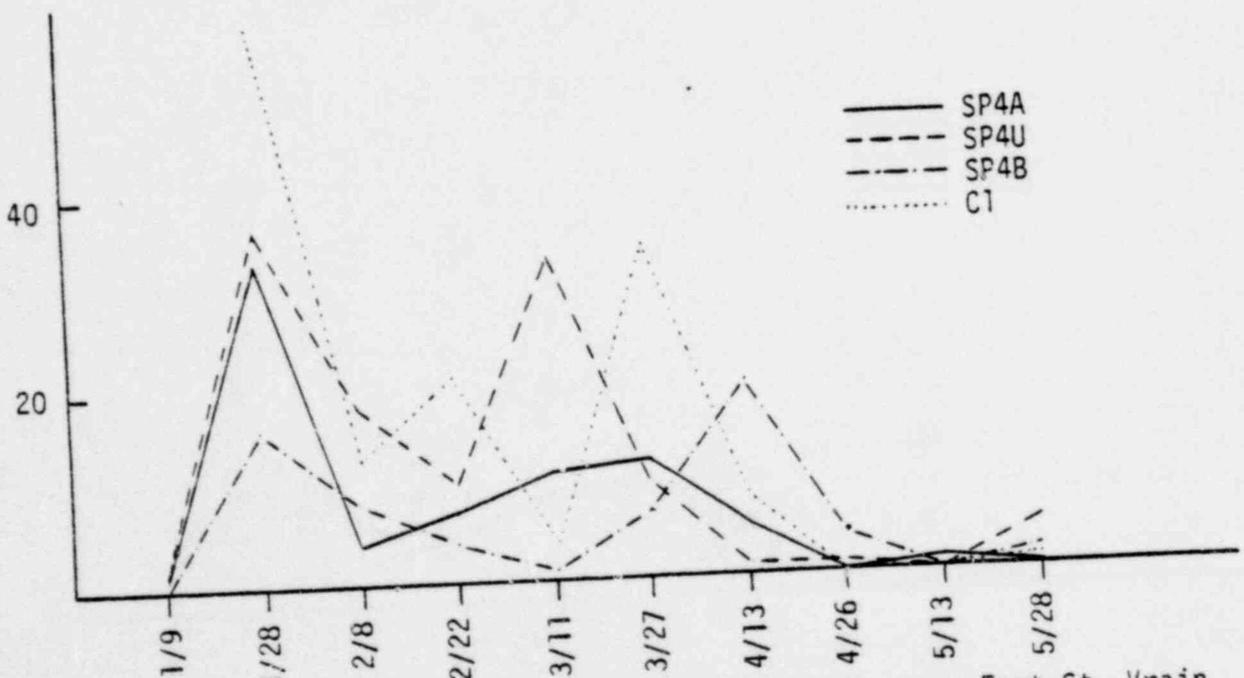

Figure 3. Fluctuations in <u>Hyalella azteca</u> numbers near Fort St. Vrain Nuclear Generating Station, January through June 1979.

2013 022

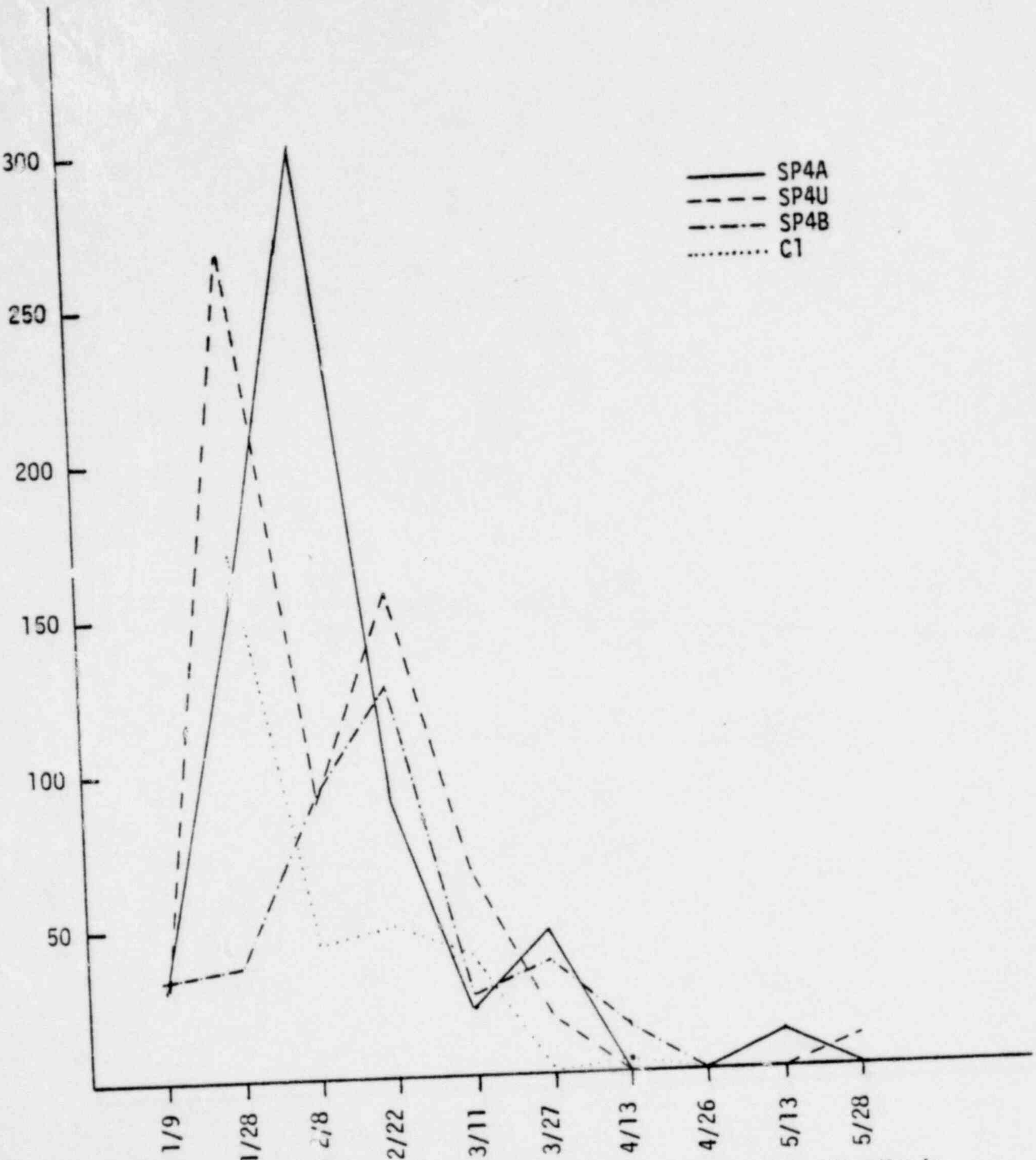

Figure 4. Fluctuations in Simulium sp. numbers near Fort St. Vrain Nuclear Generating Station, January through June 1979.

2013 023

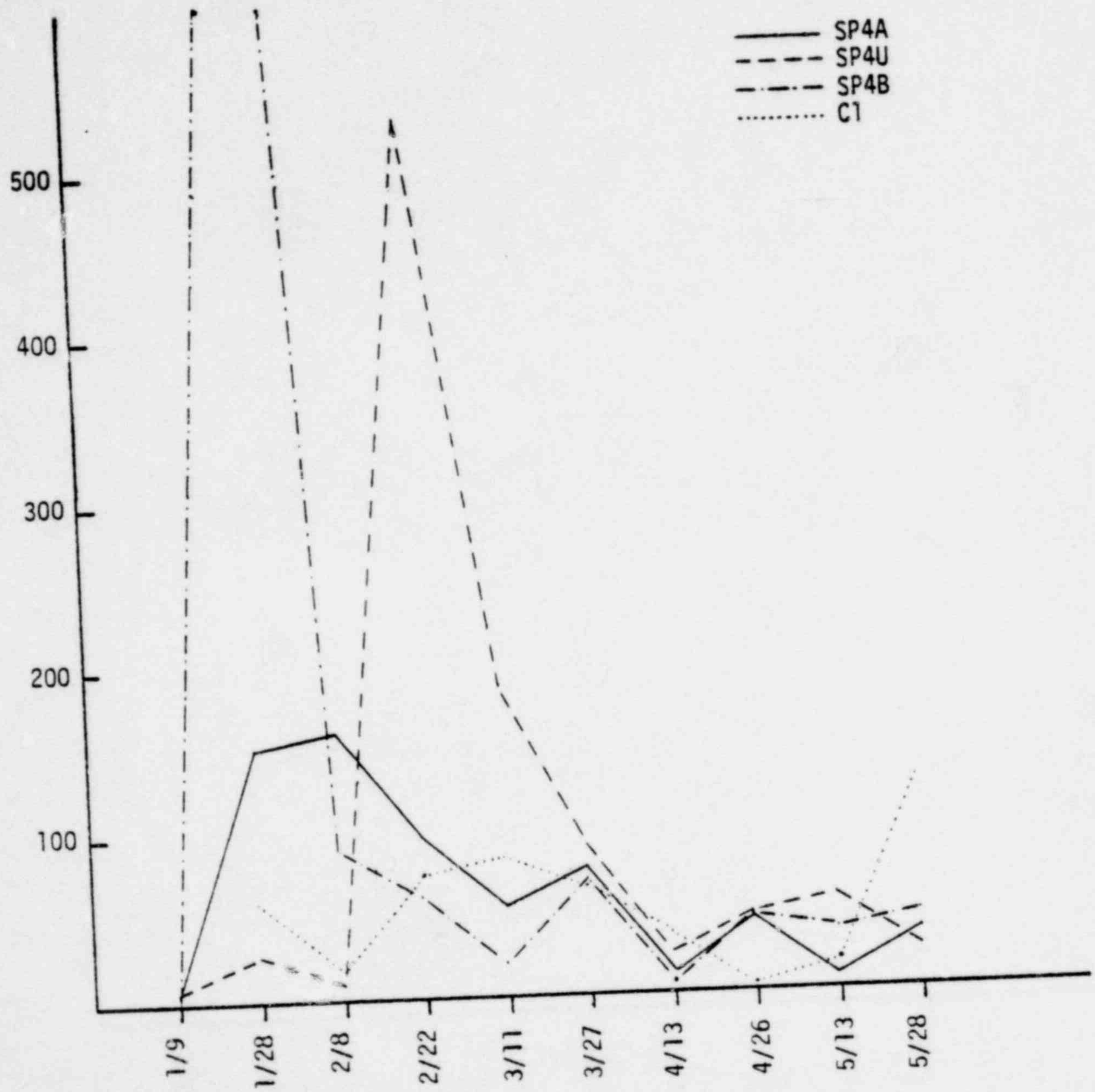

Figure 5. Fluctuations in <u>Cricotopus</u> sp. numbers near Fort St. Vrain Nuclear Generating Station, January through June 1979.

2013 024

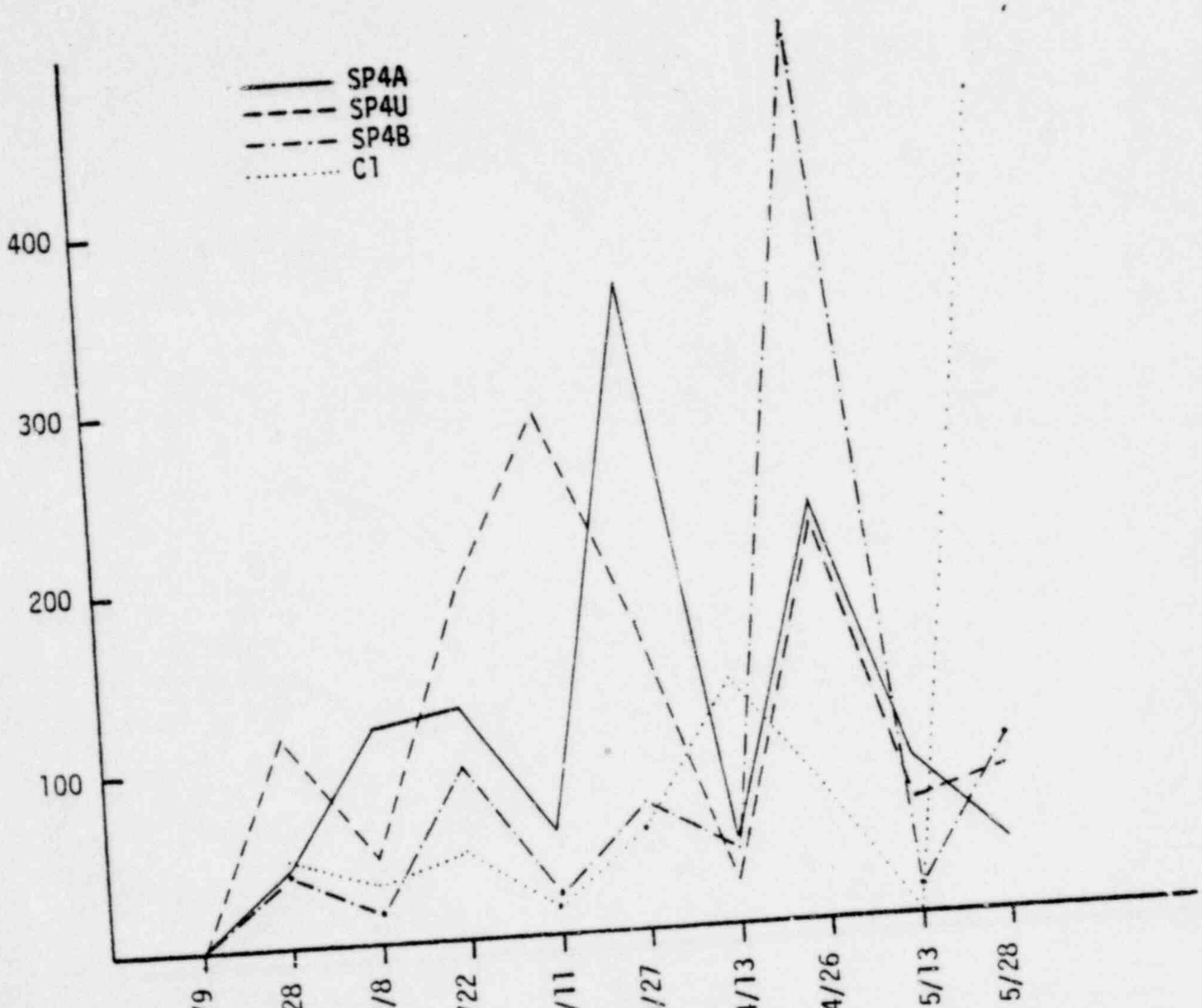

Figure 6. Fluctuations in Oligochaeta numbers near Fort St. Vrain Nuclear Generating Station, January through June 1979.

2013 025

were rather common. Only three non-dipteran insects were collected at SP4U in the first half of 1979, i.e. Argia sp. (Odonata: Coenagrionidae), Hydropsyche sp and Ochrotrichia sp. (Trichoptera: Hydroptilidae). Nine taxa were represented by 10 or fewer specimens at SP4U (Table 1). Hyalella azteca occurred throughout the sampling period, but was generally more common from January through March (Figure 3). Daphnidae was collected in March through May, but was most common in May. Simulium sp. was most common from January through March (Figure 4). Cricotopus sp. was present in relatively constant numbers throughout the sampling period except for 22 February and 11 March when it was present in rather high numbers (Figure 5). Smittia sp. (Diptera: Chironomidae) and Goeldichironomus sp. were the only unusual organisms collected at SP4U in the first half of 1979.

SP4B

Thirty-six macroinvertebrate taxa were collected from Station SP4B from January through June 1979, the most collected at any station during this sampling period and a significant increase over the number collected during the first half of 1978. However, 21 of the taxa were represented by 10 or fewer individuals and 10 were represented by a single specimen (Table 1). Like the other sampling sites, a few taxa dominated the macroinvertebrate community at SP4B. Cricotopus sp. was the most abundant organism, comprising 11.1 percent of the specimens collected. Hyalella azteca was generally present, but in relatively low numbers throughout the sampling period (Figure 3). Hydropsyche sp. occurred intermittently during the sampling period (Figure 1). Simulium sp. were most common in February and subsequently declined in abundance (Figure 4).

Cricotopus sp. were extremely common on 28 January but numbers subsequently decreased and remained at approximately the same level for the remainder of the sampling period (Figure 5). Oligochaetes occurred at approximately constant levels throughout the sampling period except on 26 April when they were extremely abundant (Figure 6).

C1

Twenty-seven macroinvertebrate taxa were collected at Station C1 from January through June 1979. Although C1 had the second-most taxa, it had the fewest specimens. Three taxa dominated the macroinvertebrate community of C1. Oligochaetes were the most common organism at C1, comprising 39.5 percent of the organisms collected at C1. However, the majority (52.7 percent) of Ologichaetes were collected on 28 May. Cricotopus sp. was the second-most common macroinvertebrate, comprising 22.0 percent of the specimens collected. Simulium sp. represented 13.8 percent of the organisms collected at C1. Fourteen taxa were represented by 10 or fewer individuals at C1 (Table 1). Hyalella azteca was more common from January through 13 April than in the remainder of the sampling period (Figure 3). Hydropsyche sp. occurred intermittently during the sampling period (Figure 2). Simulium sp. was quite common during the winter but diminished drastically in occurrence after 11 March (Figure 4). Cricotopus sp. occurred with slight fluctuations in abundance throughout the sampling period (Figure 5). Ologochaetes varied moderately in abundance during most of the sampling period and present in very high numbers on 28 May (Figure 6). Pecticia sp. (Diptera: Tipulidae), Cryptochironomus sp. (Diptera: Chironomidae), and Smittia sp. were uncommon organisms collected at C1.

2013 027

Chemical and Physical Data

Chemical and physical data for January through June 1979 are presented in Tables 2, 3, 4 and 5. Equipment breakdown resulted in incomplete chemical data for the sampling period.

Statistical Analysis

A FORTRAN IV program (ECODIV) developed by Galat, Keefe and Bergersen (1974) was used to analyze aquatic macroinvertebrate data for the first half of 1979. Three diversity indices were computed for this analysis: Equitability (EQUIT), the Trophic Condition Index (TCI) and the Shannon Diversity Index (DBAR). Data are reported for the first half of 1979 (Table 6).

Three indices are used to evaluate the aquatic macroinvertebrate communities in the South Platte River in the vicinity of the Fort St. Vrain Nuclear Generating Station. Two indices, EQUIT and DBAR, are assessments based upon the two components of diversity (evenness and richness). Evenness is the distribution of individuals among the species collected and richness is the number of species in each community.

Formally DBAR is referred to as the Shannon Index of General Diversity and is based upon the information theory of Margalef (1958). Values of DBAR of 3.0 or higher indicate communities rich in species and with the individuals apportioned rather equitably among the species. Conversely, DBAR values near 1.0 indicate depauperate communities in which a few taxa contain the bulk of the individuals. Communities of low DBAR values are typically stressed in some manner so that only the more tolerate organisms can survive.

2013 028

Table 2. Summary of chemical and physical data for Station SP4A, January through June 1979.≠

Parameter	1979 Date									
	1/9	1/27	2/8	2/22	3/11	3/27	4/13	4/26	5/13	5/28
Air Temp. (C)	-1.0	-6.5	1.0	13.5	17.0	13.0	18.5	18.0	25.0	*--
Water Temp. (C)	0.0	1.0	3.0	5.5	9.0	9.0	8.5	13.0	18.0	*--
Dissolved O_2 (mg/l)	8.0	8.1	9.5	8.7	6.9	7.1	7.0	5.3	4.4	4.9
Dissolved CO_2 (mg/l)	17.5	14.0	30.0	33.0	**--	--	--	--	4.5	****--
pH	7.8	8.0	7.5	7.5	***--	--	--	--	8.0	7.8
Total Alkalinity (mg/l)	388	488	358	474	354	330	260	216	247	252
Filtrable Solids (mg/l)	608	696	672	776	656	632	880	480	720	80
Dissolved Solids (mg/l)	798	872	892	854	864	802	1040	1040	820	500
Total Hardness (mg/l)	308	325	308	325	325	325	222	310	360	257
Conductivity (micromhos/cm)	420	370	450	380	390	375	200	230	220	340
Turbidity (JTU)	14.0	15.5	23.0	13.5	20.5	26.0	*****--	--	--	--

*Thermometer broken.
**Dissolved CO_2 cannot be calculated without pH
***pH meter malfunctioning.
****Dissolved CO_2 cannot be calculated without water temperature.
*****Turbidimeter malfunctioning.
≠June samples not made because of high water level.

2013 129

Table 3. Summary of chemical and physical data for Station SP4U, January through June 1979.≠

Parameter	1979 Date									
	1/9	1/27	2/8	2/22	3/11	3/27	4/13	4/26	5/13	5/28
Air Temp. (C)	-1.0	-7.5	8.0	13.0	23.0	11.5	18.5	18.0	26.0	22.0
Water Temp. (C)	0.0	0.5	3.0	6.0	10.0	8.0	8.5	12.5	19.0	24.0
Dissolved O_2 (mg/l)	7.7	8.0	9.3	8.7	7.0	7.1	6.9	5.2	4.6	4.2
Dissolved CO_2 (mg/l)	45.0	4.0	28.0	36.0	*--	--	--	--	4.5	5.5
pH	7.3	8.4	7.5	7.4	**--	--	--	--	8.0	7.9
Total Alkalinity (mg/l)	306	372	342	372	314	294	276	212	245	250
Filtrable Solids (mg/l)	592	728	640	712	656	624	480	640	640	480
Dissolved Solids (mg/l)	762	868	864	842	876	826	680	740	800	700
Total Hardness (mg/l)	308	325	308	308	325	325	240	310	360	291
Conducitvity (micromhos/cm)	380	355	435	320	500	480	210	260	215	290
Turbidity (JTU)	11.0	12.5	24.5	15.0	20.0	26.0	***--	--	--	--

*Dissolved CO_2 cannot be calculated without pH.
**pH meter malfunctioning.
***Turbidimeter malfunctioning
≠June samples not made because of high water level.

2013 030

Table 4. Summary of chemical and physical data for Station SP4B, January through June 1979.≠

Parameter	1979 Date									
	1/9	1/27	2/8	2/22	3/11	3/27	4/13	4/26	5/13	5/28
Air Temp. (C)	-2.0	-8.5	7.5	10.5	21.0	9.0	11.0	18.0	23.0	26.0
Water Temp. (C)	0.5	0.0	2.5	4.5	8.0	5.5	7.5	13.0	16.0	20.5
Dissolved O_2 (mg/l)	8.0	7.8	9.6	9.5	7.2	7.3	7.0	4.5	4.4	4.9
Dissolved CO_2 (mg/l)	12.0	4.5	17.5	40.8	*--	--	--	--	5.0	7.4
pH	7.9	8.4	7.8	7.5	**--	--	--	--	8.0	7.8
Total Alkalinity (mg/l)	338	400	402	528	414	296	264	222	255	254
Filtrable Solids (mg/l)	600	752	664	760	744	648	720	640	720	560
Dissolved Solids (mg/l)	840	722	892	862	858	840	760	1760	840	580
Total Hardness (mg/l)	342	342	308	325	325	342	257	325	360	291
Conductivity (micromhos/cm)	390	480	390	350	365	465	260	230	215	360
Turbidity (JTU)	10.0	9.5	22.5	10.0	16.0	25.0	***--	--	--	--

*Dissolved CO_2 cannot be calculated without pH.
**pH meter malfunctioning.
***Turbidimeter malfunctioning.
≠June water samples not made because of high water levels.

2013 331

Table 5. Summary of chemical and physical data for Station C1, January through June 1979.≠

Parameter	1979 Date									
	1/9	1/27	2/8	2/22	3/11	3/27	4/13	4/26	5/13	5/28
Air Temp. (C)	-4.0	-8.5	1.0	14.0	21.0	10.0	12.5	18.0	24.0	28.5
Water Temp. (C)	0.0	0.0	2.0	4.5	9.5	7.0	7.5	15.0	16.5	19.0
Dissolved O_2 (mg/l)	7.8	8.0	9.4	9.0	*--	7.6	6.8	4.7	4.7	4.7
Dissolved CO_2 (mg/l)	15.0	14.0	28.0	34.0	**--	--	--	--	4.5	7.5
pH	7.8	8.4	7.6	7.5	***--	--	--	--	8.0	7.8
Total Alkalinity (mg/l)	328	396	404	430	344	298	266	206	245	256
Filtrable Solids (mg/l)	656	744	720	704	784	672	480	740	160	320
Dissolved Solids (mg/l)	840	912	834	854	872	826	760	1440	900	600
Total Hardness (mg/l)	325	325	308	325	342	342	240	257	342	257
Conductivity (micromhos/cm)	340	375	385	350	405	440	250	245	210	330
Turbidity (JTU)	9.5	10.5	22.0	12.0	16.0	27.5	****--	--	--	--

*Dissolved O_2 bottle broken in transit.
**Dissolved CO_2 cannot be calculated without pH.
***pH meter malfunctioning.
****Turbidimeter malfunctioning.
≠June samples not made because of high water levels.

Table 6. Quarterly summary of ECODIV indices for four stations on the South Platte River, January through June 1979.

January through March, 1979

	SP4A	SP4U	SP4B	C1
TCI	.6683	.6239	.8666	.8190
DBAR	2.5035	2.6533	2.3774	2.0933
EQUIT	.388	.457	.293	.499

April through June, 1979

	SP4A	SP4U	SP4B	C1
TCI	.3896	.4488	.4331	.3281
DBAR	2.2259	2.3502	2.5463	1.9460
EQUIT	.349	.460	.308	.280

2013 033

Equitability (EQUIT) is based upon the "broken stick" theory of MacArthur (1957). Very simply, EQUIT is a more sophisticated measurement of community diversity that assumes (and correctly) that individuals are never evenly distributed among the species. Rather, some taxa are naturally more common than others, and some, under natural conditions, are always rare and represented by only a few individuals. Thus, EQUIT is an attempt to account for this phenomena. Values for EQUIT are found by searching Lloyd and Gherland's (1964) table. The values in the table are derived from MacArthur's (1957) formula for equitability. EQUIT values approaching zero suggest a stressed community in which there are very few species and almost all or all individuals are in the few taxa. In contrast, values approaching one are indicative of rather large, diverse communities that have not been subjected to any unnatural disturbances.

The Trophic Condition Index (TCI) (Brinkhurst et al. 1968) is an evaluation of a community that assigns each taxon to a tolerance classification. For calculation each taxon is placed in one of three tolerance classifications: (1) tolerant to pollution (organic or inorganic); (2) facultative or able to survive moderate levels of pollution; and (3) intolerant to any form of pollution. Placement of each taxon in a particular classification is based upon a review of the pertinent literature, i.e., Weber 1973. TCI considers the number of individuals in each tolerance classification rather than the number of species per tolerance classification. TCI values range from zero, indicating oligotrophic conditions to two, indicating eutrophic conditions.

2013 034

DISCUSSION

Station SP4B had a significantly greater number (36) of taxa than any other sampling site in the first half of 1979. In the same sampling period in 1978 SP4B had only 22 taxa. All other sampling stations had approximately the same number of taxa for both sampling periods. Although eight more taxa were collected in the first half of 1979 than for the same period in 1978, the more noteworthy change was in the particular taxa. Seventeen taxa collected in the first half of 1978 were not collected in the comparable period of 1979. Twenty-one taxa collected in the first half of 1979 were not collected in the same period in 1978. Thus, except for SP4B there has not been a change in the diversity of the macroinvertebrate communities but there has been a significant change in the particular components of the aquatic macro-invertebrate community of the South Platte River in the vicinity of the Fort St. Vrain Nuclear Generating Station. However, in assessing this change attention should be directed to the nature of the change. Taxa absent in 1979 collections but present in 1978 and taxa present in 1979 but absent in 1978 were generally represented by relatively few specimens and these were collected only on one or a few sampling dates. Notable exceptions are <u>Baetis</u> sp. (Ephemeroptera: Baetidae) (1978), Daphnidae (1979) and <u>Asellus</u> sp. (Isopoda: Asellidae) (1979). In addition, many of the taxa present in 1979 but not 1978 were found at SP4B. Interestingly, taxa changes were common in all major groups, i.e. non-dipteran insects, dipterans and non-insect macroinvertebrates.

Several classical explanations are possible for the increased diversity of SP4B. Certainly the most apparent is the marked change in flow regimes between the two sampling periods. Discharge in the South

Platte was lower in 1978 than 1979, particularly during the spring runoff phase. In 1978 there were several rather high spates but these were of short duration. In 1979 water levels began to increase with the melting of the ice in February and continued to increase at a constant rate through June. In addition, the severe and prolonged winter of 1979 resulted in extensive ice coverage which produced significant scouring of the substrate. Less apparent, but probably as important, is the influence of the effluent from Goosequill Ditch at SP4B. Goosequill Ditch had a constant flow until Goosequill Pond was dried in April 1979. Throughout the period it was flowing, Goosequill Ditch had some phytoplankton. Such a nutrient input would naturally enhance conditions supporting a more varied fauna, particularly during the colder months, but only so long as the nutrient input did not "overload" the system and create aneorobic conditions. Another possibility is the difference in amount of organic debris among the stations. However, the importance of this difference is obfuscated as Stations SP4A generally has the greatest amount and Station C1 has the least. SP4B always has a moderate amount but never more than SP4A. A final possible explanation is the differences in the composition of the substrate among the stations. SP4A has the most varied substrate, ranging from large gravel and cobble to sand-silt bottom areas. However, SP4B has the same range although the gravel-cobble component is generally not as extensive at SP4B as it is at SP4A. Stations SP4U and C1 have rather monotonous substrates, composed primarily of sand and silt. The data do not support acceptance of any one hypothesis as an adequate explanation for the replacement of some taxa by others between sampling periods or for the rather diverse macroinvertebrate community of SP4B in 1979. Rather, a reasonable explanation probably involves the fortuitous combination of a varied substrate, moderate amount of organic debris, and less scouring by ice with the enrichment of the area by the influent from Goosequill Pond. The importance of the influent is difficult to assess accurately because of the limited data collected. However, the early warming in the spring and prolonged warm water of Goosequill Pond in the fall permits a more extended season for phytoplankton growth than for the South Platte or St. Vrain Rivers. Thus, the effluent from Goosequill serves to moderate the thermal properties of the South Platte and additionally introduce nutrients in the form of phytoplankton during portions of the year when autochthonous production is low in the South Platte. Such a scenario, in addition to the above indicated properties, may provide at least a partial explanation for the greater aquatic macroinvertebrate diversity of Station SP4B.

Generally, the same taxa dominate the aquatic macroinvertebrate communities at all stations. Simulium sp., Cricotopus sp. and oligochaetes are almost always the most abundant organisms. Other forms (e.g. Chironomus sp. and Daphnidae) are occasionally abundant. Several groups (e.g. Hydropsyche sp. Tipulidae, and Hyalella azteca) occur relatively constantly, but never in very great numbers. Thus the changes in community structure are primarily among the relatively uncommon taxa. Little importance can be attached to the general decrease in numbers of macroinvertebrates collected as incomplete samples were taken in January and none were taken in June.

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2013 039

ALGAL MONITORING

by

Paul Kugrens

2013 040

INTRODUCTION

The data in this 1979 semi-annual report includes a comprehensive species list (Table I); a comparative table that provides monthly dominants, relative abundances, population sizes, and general water conditions at the time of collection (Table II); a list indicating the percentage of a population comprised of various algae (table III); a table of species diversity at each site (Table IV); and a table listing species ratios of the four most prominent algal divisions (Table V). Sampling techniques have remained the same, although during low or high water conditions, alternate substrates had to be chosen but these should not alter the results significantly since previous observations indicate little difference in algal growth on the samplers vs. other substrates. As in the past, only living cells are included in actual counts to represent actual site conditons. If dead cells are included the numbers would be greatly inflated and inaccurate. Figure 1 presents the algae sampling sites.

OBSERVATIONS

1. Species Diversity

Tables I and IV indicate that a total of 77 species was identified during the first six months of 1979. The algal populations consisted of 44 diatom species, 18 green algae, five euglenoids, four blue-green algae, three golden-brown algae, one cryptomonad, one undescribed dinoflagellate, and one yellow-green alga. The greatest species diversity occurs in diatoms at all sampling sites and reflects past observations. However, the overwhelming dominance in diatom species at site GQ is absent. The lowest species diverisity is found at SPGQ and SP and might be caused by the swifter currents at these two sampling sites. By any species diversity

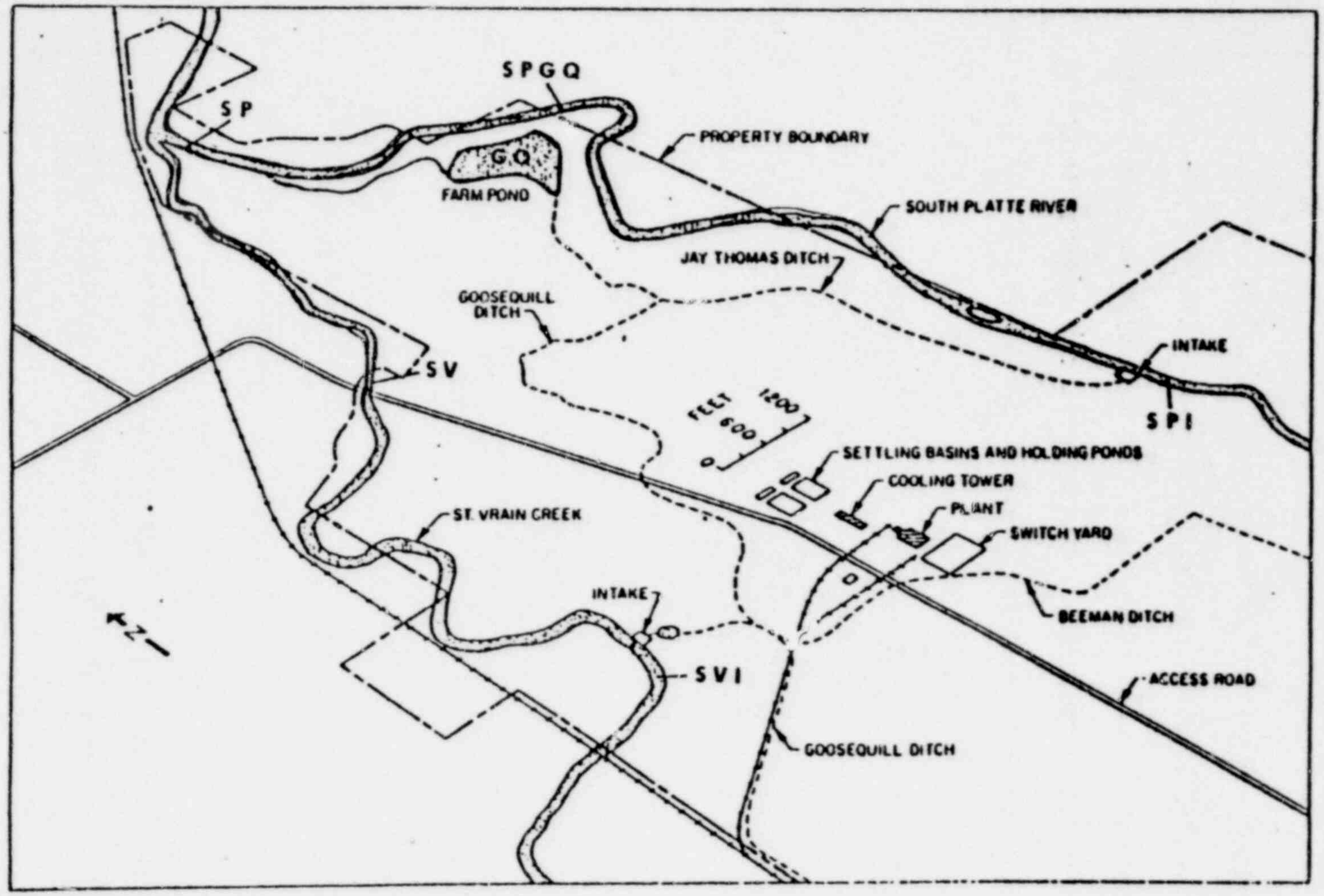

Figure 1. Algae sampling sites, Fort St. Vrain Nuclear Generating Station

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index, all sites represent a low species diversity, a characteristic of polluted or dystrophic aquatic habitats. The number of species at any given time is dependent upon temperature, ice, water level, and scouring by swift currents. Table V indicates the relative number of species from the four most prominent divisions and shows that diatom species dominate the algal populations. As the temperatures increased during March and April, a corresponding increase in species also took place but declined in May and June. Euglenoids were present in January through April at various sites but were absent in subsequent months. Blue-green algal species were occassionally present but for the most part are absent during the colder months. Green algae also were low in species numbers except in Goosequill Pond. The decline in species during May and June is attributed to the high, swift water created by spring runoffs. These scour the substrates of algae and do not allow populations to become established. This trend is also noted in the quantitative aspects of this monitoring period.

2. Algal Populations and Succession

All river sites had large proportions of Nitzschia palea throughout this monitoring period with Navicula cryptocephala also being prominent. Euglena viridis made it's appearance in the winter flora as it has in past years, generally growing in large numbers from January to April (Table II). Diatoms, in general, are most prominent in the rivers (Table III) whereas green algae represent the dominants in Goosequill Pond, a characteristic noted previously. Euglenoids appear during mid- to late winter depending on the river. Blue-green algae are generally absent during the winter months.

St. Vrain River

The St. Vrain River had, as its most common dominant, Navicula cryptocephala with Nitzschia palea being dominant at SVI in March and at SV during March and April. While Euglena viridis never became dominant, it constituted a significant portion of the algal population during March and April at both St. Vrain River sites. This is somewhat later than the appearance of E. viridis in the South Platte River.

The highest number of algae also occurred during March and April indicating favorable temperatures and more stable water conditions. Prior to and after these two months, water was either frozen (SVI in January) or spring runoff created extremely swift and high water conditions.

Goosequill Pond

Throughout this sampling period, Scenedesmus quadricauda dominated the algal population in Goosequill Pond and as the water temperatures increased, so did the proportion of dominance by this alga. Population numbers also increased with the warmer water, even when the pond was being drained during April and May, eventually increasing to 224,786 individuals/ml.

South Platte River

The 1979 monitoring period began with Euglena viridis being the dominant during the first three months, except at SVI during January and SP during March. During April and May Nitzschia palea was the dominant at all sites with N. palea being the only consituent of the algal populations during May.

The number of periphyton was low during this monitoring period due to the continual swift currents present each month, finally eliminating all living representatives during June. Only empty cell walls were collected and identified through their ornamentation. The water conditions during May and June eliminated algal growth at all sampling sites in the South Platte River.

3. Comparison of Algal Populations between Rivers.

In general, the same species occur in both rivers but the dominants and the time of appearance of certain species varies. For instance Navicual cryptocephala is generally more dominant in the St. Vrain River whereas Nitzschia palea dominates periphyton in the South Platte River. In addition, Euglena viridis was never dominant in the St. Vrain River but dominated for three months in the South Platte River. Furthermore Euglena viridis grows later (March-April) in the South Platte (January-March). Other algae that occur sporadically during certain months in both rivers are of little significance.

4. Effects of Fort St. Vrain Nuclear Generating Station on Algal Populations.

No discernible effects from the generating station on algal populations were detected during this monitoring period.

5. Comparison with Corresponding 1978 Monitoring Period.

The algal populations in both rivers were considerably higher in 1978, reaching population numbers of 2 million or more by June in the South Platte River, but considerably lower in the St. Vrain River.

The decrease in the St. Vrain River was attributed to fast water in 1978. The South Platte River, on the other hand, did not experience any spring runoff in 1978 which allowed populations to build up to high levels.

This year the spring runoff was greater in both rivers, either eliminating algae or greatly reducing their numbers.

The dominant algae were the same as last year with similar trends of succession and appearance.

While Scenedesmus quadricauda was the dominant in Goosequill Pond at all sampling times in 1979, this was not the case in 1978. Nitzschia palea and Cryptomomas ovata were the dominants in February and April respectively in 1978. Goosequill Pond was completely frozen in January 1978, but was partially open at all times in 1979.

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Legend for Tables

SVI = St. Vrain Intake

SV = St. Vrain below Intake

GQ = Goosequill Pond

SPI = South Platte River below Intake

SPGQ = South Platte River below Intake but above effluent

SP = South Platte River below effluent near the confluence

A = Periphyton

B = Phytoplankton

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Table I. Algal List and Sites for January - June 1979

Genus or Species	Sampling Sites					
	SVI	SV	GQ	SPI	SPGQ	SP
Division Bacillariophyta						
Achnanthes lanceolata		AB		AB	AB	AB
Amphora ovalis		A		AB		
Asterionella formosa	AB	AB	A	AB	AB	B
Biddulphia laevis		AB				
Caloneis amphisbaena	AB	A	AB	AB	A	AB
Cocconeis placentula	AB	A			A	
Cyclotella meneghiniana			A			
Cymatopleura solea		A		A	A	
Cymbella turgida	A	B		A		
Diatoma elongatum				A	A	
Diatoma vulgare	AB	AB		AB		B
Fragilaria capucina				B		
Fragilaria construens	B	A		B	B	
Fragilaria crotonensis		A		AB	B	B
Gomphonema constrictum	A					B
Gomphonema lanceolatum					A	
Gomphonema olivaceum		A		AB	AB	
Gomphonema parvulum	AB	AB	A	AB	AB	AB
Gyrosigma acuminatum	A	AB	A	AB	A	A
Gyrosigma scalproides		B		A		
Hannea arcus	B	A				
Melosira granulata	AB	AB		B	B	
Melosira varians				A	B	
Navicula cryptocephala	AB	AB	AB	AB	AB	AB
Navicula cuspidata	AB		AB	A		AB
Navicula minima	B	B	A	B	B	A
Navicula pygmaea		B				
Navicula radiosa	AB	AB				
Navicula viridula	AB	AB		A	A	AB
Nitzschia acicularis	AB	AB		AB	AB	AB
Nitzschia gracilis	AB	AB	A			
Nitzschia holsatica			B			
Nitzschia hungarica	AB	AB	AB	AB	AB	AB
Nitzchia palea	AB	AB	AB	AB	AB	AB
Nitzschia sigmoidea		B		A		
Nitzschia vermicularis	A	AB		A		
Pinnularia latevittata						B
Rhoicosphenia curvata	A	A		B		AB
Stephanodiscus hantzschii	AB	AB	AB	AB	AB	AB
Surirella capronii	A	A	B			
Surirella ovata	AB	AB		A	AB	AB
Synedra rumpens	B	B				
Synedra ulna	AB	AB	A	AB	AB	AB

A - Periphyton
B - Phytoplankton

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Table I. Algal List and Sites for January - June 1979 (continued)

Genus or Species	Sampling Sites					
	SVI	SV	GQ	SPI	SPGQ	SP
Division Chlorophyta						
Ankistrodesmus falcatus		B	B	A		
Chlamydomonas sp.			AB			B
Chlorogonium elongatum			B			
Cladophora glomerata		A			A	
Closteriopsis longissima			B			
Closterium lunula		A	A			
Coelastruin microporuin			A			
Cosmarium sp.		B				
Dictyosphaerium pulchellum						B
Micractinium pusillum	B		AB			
Oedogonium sp.			A	AB		A
Oocystis lacustris						B
Pediastrum duplex			AB			B
Pteromonas acuminatus			B			
Rhizoclonium hieroglyphicum			A			
Scenedesmus acuminatus		B	A			
Scenedesmus quadricauda	A	AB	AB	B		AB
Stigerclonium tenue			A			
Division Chrysophyta						
Anthophysa vegetans			B			
Dinobryon sp.		B		B	AB	B
Gonyostomum semen	B					
Division Cryptophyta						
Cryptomonas ovata		B	AB	B		
Division Cyanophyta						
Aphanizomenon flos-aquae	B					
Oscillatoria sp.	B					
Oscillatoria limosa	B			A		
Oscillatoria princeps	A		AB	A	AB	
Division Euglenophyta						
Astasia sp.					B	
Euglena acus	A	A	AB	AB	A	A
Euglena viridis	AB	AB	AB	AB	A	AB
Peranema sp.	B					
Phacus brevicauda			A			

Table I. Algal List and Sites for January - June 1979 (continued)

Genus or Species	Sampling Sites					
	SVI	SV	GQ	SPI	SPGQ	SP
Division Pyrrophyta						
Unidentified dinoflagellate			AB	B		
Division Xanthophyta						
Vaucheria sp.		A				

2013 050

Table II. Comparison of Algal Populations and their Dominants as Influenced by Certain Physical Conditions at their Respective Sites. Results in Total Population, Dominant Species and Percent of each Species in the Population in parenthesis. River Populations Represent Periphyton whereas GQ Represents Phytoplankton Counts.

Site	Months		
	January	February	March
SVI	Frozen completely. No samples.	4,622 Navicula cryptocephala (64) Navicula viridula (14)	813,430 Nitzschia palea (49) Navicula cryptocephala (28) Euglena viridis (17) Euglena acus (5)
SV	115,554 Navicula cryptocephala (56) Surirella ovata (20) Nitzschia palea (10) Navicula viridula (6)	18,718 Navicula cryptocephala (67) Nitzschia palea (22)	104,452 Nitzschia palea (47) Navicula cryptocephala (34) Euglena viridis (12)
GQ	7,423 Scenedesmus quadricauda (62) Stephanodiscus hantzschii (30)	10,084 Scenedesmus quadricauda (67) Euglena viridis (20)	26,050 Scenedesmus quadricauda (87) Chlamydomonas sp. (8)
SPI	16,176 Euglena viridis (43) Nitzschia palea (29) Gomphonema parvulum (14) Navicula cryptocephala (14)	113,233 Euglena viridis (24) Navicual cryptocephala (13) Nitzschia palea (11)	136,342 Euglena viridis (53) Euglena acus (19) Nitzschia palea (12) Navicula cryptocephala (8)

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Table II. (continued)

Site	Months January	 February	 March
SPGQ	6,932 Nitzschia palea (33) Achnanthes lanceolata (11) Euglena viridis (11) Surirella ovata (11) Synedra ulna (11)	286,549 Euglena viridis (60) Navicula cryptocephala (27) Nitzschia palea (6)	198,736 Euglena viridis (47) Nitzschia palea (24) Navicula cryptocephala (20)
SP	16,176 Euglena viridis (71) Nitzschia palea (21)	67,015 Euglena viridis (38) Gomphonema parvulum (17) Navicula cryptocephala (14) Nitzschia palea (7)	76,259 Navicula cryptocephala (42) Euglena viridis (27) Nitzschia palea (15) Nitzschia acicularis (6)
General Water Conditions	GQ - 4.5° C: Completely frozen SV - Completely frozen SP - 2° C: Clear, swift water. Some ice along banks.	GQ - 6.5°C: Open water in center only. SV - 7°C: High, turbid, swift. Considerable ice along banks. SP - 10°C: High, turbid, swift.	GQ - 9°C: High water, slightly green, entering and exiting. SV - 10.5°C: Low, clear. Algal populations evident. SP - 9-11°C: High, swift, Turbid.

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Table II. (continued)

Site	Months		
	April	May	June
SVI	494,528 Navicula cryptocephala (46) Euglena viridis (21) Nitzschia palea (16)	23,108 Navicula cryptocephala (80) Navicula radiosa (10) Scenedesmus quadricauda (10)	4,044 Navicula cryptocephala (57) Nitzschia palea (29) Melosira granulata (14)
SV	1,261,740 Nitzschia palea (37) Navicula cryptocephala (33) Euglena viridis (10)	9,243 Navicula cryptocephala (75) Melosira granulata (25)	2,889 Navicula cryptocephala (20) Melosira granulata (20) Nitzschia acicularis (20) Nitzschia palea (20) Synedra ulna (20)
GQ	19,957 Scenedesmus quadricauda (98)	46,848 Scenedesmus quadricauda (96) Navicula cuspidata (3)	224,786 Scenedesmus quadricauda (99+)
SPI	11,957 Nitzschia palea (46) Navicula cryptocephala (33)	23,109 Nitzschia palea (100)	No living cells.
SPGQ	88,234 Nitzschia palea (50) Navicula cryptocephala (25)	190 Nitzschia palea (100)	No living cells.

2013 053

Table II. (continued)

Site	Months		
	April	May	June
SP	238,230 Nitzschia palea (56) Navicula cryptocephala (26) Nitzschia acicularis (7)	4,622 Nitzschia palea (100)	No living cells.
General Water Conditions	GQ - 18°C: Green water, no water entering or exiting. SV - 15°C: High, swift, turbid. SP - 18.5°C: High, swift, turbid.	GQ - 22.5°C: Green, no water entering but some exiting. SV - 16°C: Extremely swift, high, turbid. No algal populations visible. SP - 20°C: Extremely swift, high, turbid. No algal populations visible.	GQ - 30°C: Deep green high water, exiting over concrete dam. SV - 17.5°C: Extremely high, muddy, swift. SP - 20°C: Extremely high, muddy, swift.

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Table III. Percent of Populations Comprised of Diatoms, Green Algae, Euglenoids and Blue-Green Algae.

Month	Sites					
	SVI	SV	GQ	SPI	SPGQ	SP
January	0-0-0-0	100-0-0-0	33-65-2-0	57-0-43-0	89-0-11-0	29-0-71-0
February	100-0-0-0	100-0-0-0	6-73-21-0	100-0-0-0	49-0-51-0	59-0-38-3
March	78-0-22-0	87-0-13-0	3-97-0-0	28-2-70-0	52-0-48-0	70-0-30-0
April	76-0-24-0	90-0-10-0	2-98-0-0	98-0-2-0	100-0-0-0	96-0-4-0
May	90-10-0-0	100-0-0-0	4-96-0-0	100-0-0-0	100-0-0-0	100-0-0-0
June	100-0-0-0	80-20-0-0	0-100-0-0	0-0-0-0	0-0-0-0	0-0-0-0

2013 055

Table IV. Species Diversity according to Taxonomic Divisions from January through June 1979.

Division	Sites						Total Species Identified per Division
	SVI	SV	GQ	SPI	SPGQ	SP	
Bacillariophyta	27	34	15	31	23	22	44
Chlorophyta	2	6	14	3	1	6	18
Chrysophyta	1	1	1	1	1	1	3
Cryptophyta	--	1	1	1	--	--	1
Cyanophyta	4	--	1	2	1	--	4
Euglenophyta	3	2	3	2	3	2	5
Pyrrophyta	--	--	1	1	--	--	1
Xanthophyta	--	1	--	--	--	--	1
Total Number of Species per site	37	45	36	41	29	31	77

2013 056

Table V. Diatom - Green - Euglenoid - Blue-green Algal Species Ratios at Sampling Sites Showing Monthly Fluctuations in the Species Diversity of these Four Dominant Divisions.

Months	Sites: SVI	SV	GQ	SPI	SPGQ	SP	Total Number of Species
January	0-0-0-0	14-1-1-0	5-5-2-0	14-2-2-1	9-1-2-0	9-1-1-0	24-6-3-1
February	1[illegible]-0-1-0	10-6-6-0	4-3-1-0	9-0-1-0	15-0-2-0	12-1-1-1	29-3-2-1
March	14-0-2-1	17-5-2-0	11-4-3-0	16-2-2-1	13-0-2-1	8-2-2-0	25-8-3-2
April	21-1-3-0	19-0-1-1	9-3-1-0	16-2-2-0	15-0-0-1	14-1-1-0	31-4-4-2
May	16-1-0-2	12-0-1-0	5-5-0-1	8-1-0-0	11-0-0-0	11-3-0-0	22-6-2-3
June	14-0-0-0	11-2-0-0	9-5-0-0	14-0-0-0	7-0-1-0	10-3-0-0	28-7-1-0
Total Number of Species per Site	27-2-3-4	34-6-2-0	15-14-3-1	30-3-2-2	23-1-3-1	22-6-2-0	44-18-5-4

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AVIAN SECTION

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AVIAN MONITORING

by

Ronald A. Ryder

2013 059

INTRODUCTION

Monitoring avifauna on areas adjoining the St. Vrain Nuclear Generating Station was continuedin an effort to evaluate avian populations as possible indicators of the effects of operation of the Generating Station. This report discusses data collected from January through June 1979 and compares these data with similar periods from 1972 through 1978.

METHODS

Descriptions of study areas and methods and modifications thereof were presented in earlier progress reports.

FINDINGS

Eight-year population trends for the month of June are presented in Figure 2. Total count data are presented in Table 1. Data for distribution of dominant species over the eight years of monitoring are presented in Table 2. Most bird populations have continued to decline. Several species, particularly blackbirds, showed even more pronounced reductions than in 1978. Except for the 15 May 1979 count, Goosequill Pond was virtually deserted by all species. On that date the pond was practically dry, exposing many dead and dying fish. Seventy-five individuals (17 species) were noted, compared to an average of four June counts of only 5 individuals (3 species). Except for the one count when Goosequill Pond was drained, the pond was unusually full of water all year. There appear to be more environmental perturbations than in 1978, mainly flooding on all areas and heavy livestock grazing on the St. Vrain River area. The only notable increase in 1979 was in mourning doves on the St. Vrain River area, an all-time high average of 31 compared to last year's 23, then a 7-year high. Red-winged blackbirds and common flickers were down on both the St. Vrain River and South Platte River areas.

It is not known whether these declines were due to any direct effect of operation of the Generating Station. High water and a cold, wet spring are

2013 060

believed to be largely responsible for the decline in avian use and delay in start of the 1979 nesting season.

2013 061

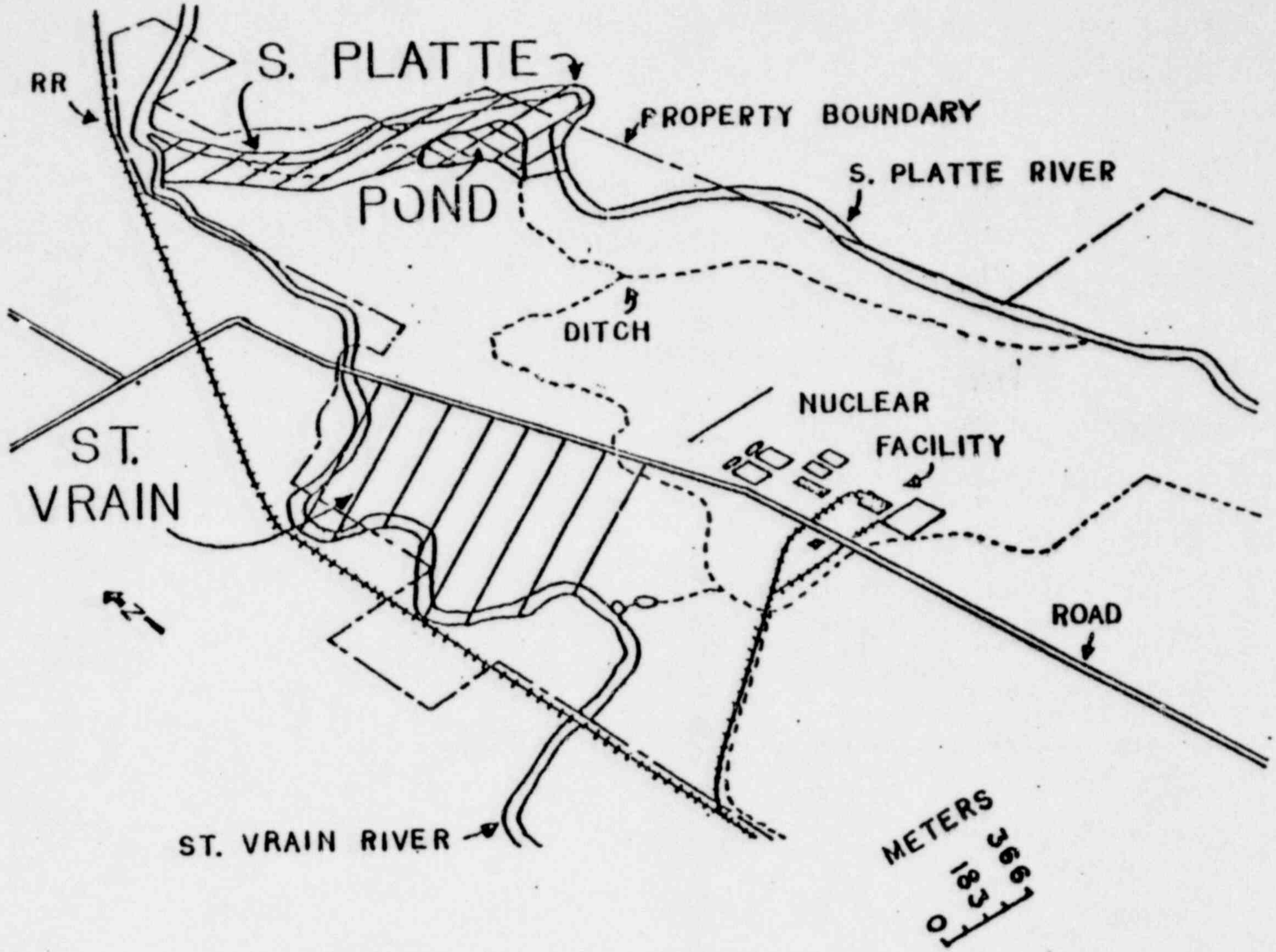

Figure 1. Location of three bird census areas (St. Vrain River, South Platte River and Goosequill Pond).

2013 062

Table 1. Eight-year tabulation of species numbers and population levels from monitoring at the Fort St. Vrain Nuclear Generating Station (Number of species seen per count followed by total individuals).

Time Period	1972	1973	1974	1975	1976	1977	1978	1979
January	No count	19(762)	19(319)	20(335)	10(340)	No count	No count	No count
February	No count	29(847)	19(2884)	24(15,474)	No count	23(422)	24(478)	30(1121)
March	No count		32(709)	25(14,063)	29(709)	33(627)	30(715)	31(546)
early April	28(823)	26(326)	32(487)	34(688)	38(720)	No count	43(622)	34(498)
late April	50(871)	34(561)	37(441)	44(719)	46(903)	40(717)		
1st wk May	47(574)	47(410) 1/	33(381)	45(534)	45(591)	48(729)	No count 2/	37(488)
2nd wk May	47(583)		39(382)	62(833)	52(533)	47(777)	50(640)	54(510)
3rd wk May	48(593)	45(466) 1/	45(543)	43(563)	55(728)	54(855)	43(522)	38(397)
4th wk May	48(691)		38(450)	46(523)	50(635)	49(656)	45(565)	44(451)
1st wk June	35(500)	39(373)	40(641)	42(491)	38(569)	49(614)	43(518)	40(426)
2nd wk June	41(588)	33(414)	42(583)	40(419)	42(513)	46(660)	42(450)	40(416)
3rd wk June	38(551)	38(426)	33(469)	34(340)	39(585)	44(635)	40(457)	43(536)
4th wk June	37(509)	32(324)	34(426)	37(373)	No count	40(589)	41(510)	37(378)

1/ May 1973 counts probably not comparable to those in 1972 and 1974. Due to floods it was not possible to complete counts on all three areas weekly in May of 1973.

2/ Early May count in 1978 delayed by unusually late snowstorm.

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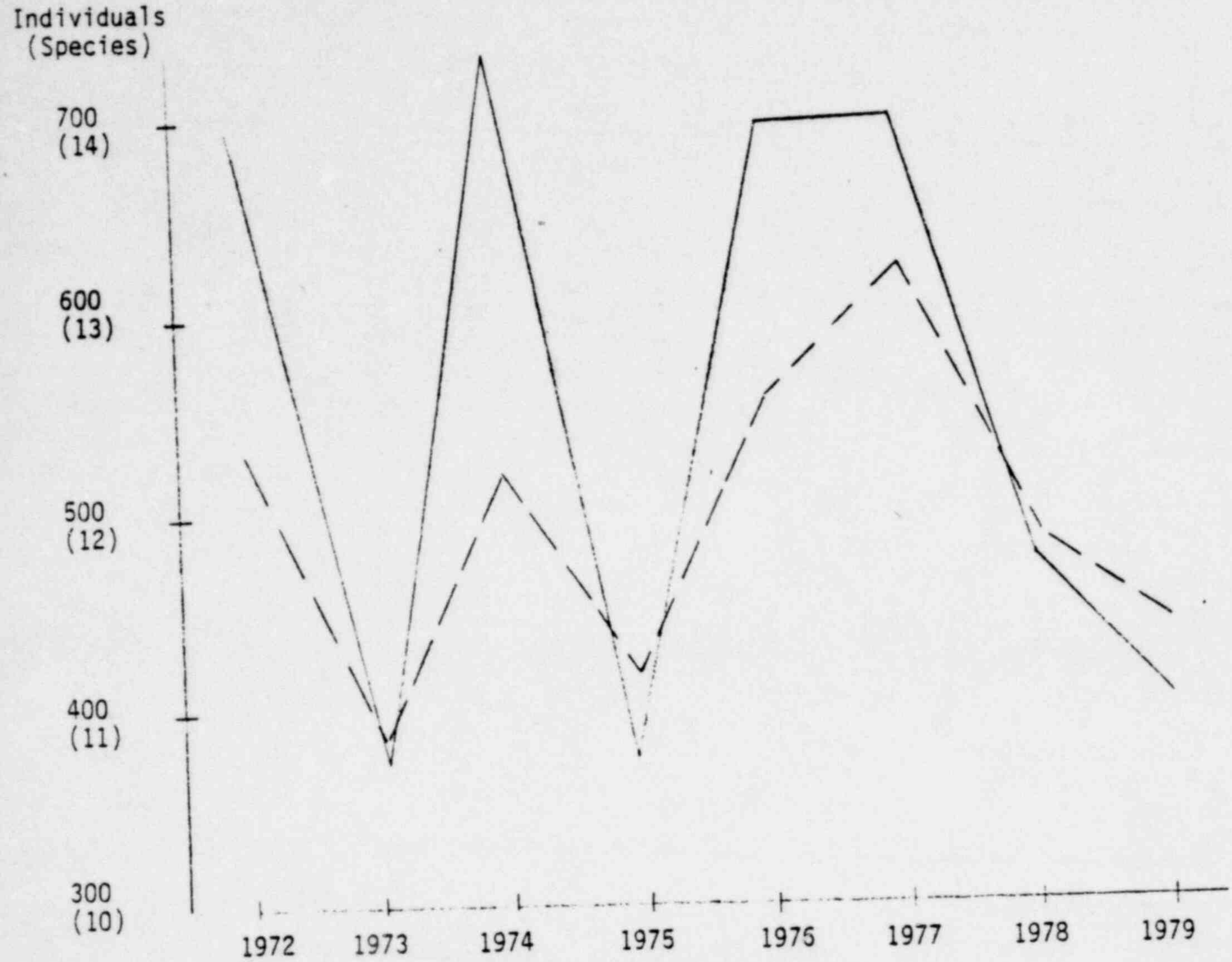
Table 2. Comparison of numbers of dominant species on three study areas of the Fort St. Vrain Nuclear Generating Station during the springs of 1972-1979.

Study Areas and Species	Average Number of Birds per Census*							
	1972	1973	1974	1975	1976	1977	1978	1979
St. Vrain River								
Starling	67	58	57	53	65	63	58	53
House Wren	21	20	26	27	20	36	19	19
Red-winged Blackbird	57	34	39	46	50	53	22	17
Mourning Dove	22	14	19	16	16	18	23	31
Common Flicker	13	8	10	9	14	19	14	8
South Platte River								
Starling	48	35	53	43	76	68	67	41
House Wren	54	38	41	38	41	53	54	33
Red-winged Blackbird	10	4	6	4	2	11	10	4
Mourning Dove	17	9	8	10	11	14	21	11
Common Flicker	15	6	7	7	17	15	10	3
Goosequill Pond								
Red-winged Blackbird	10	8	10	10	13	8	2	2
Yellow-headed Blackbird	9	4	10	34	41	38	24	2
Mallard	9	3	5	10	7	3	3	1
Number of censuses per spring	10	8	10	9	10	10	8	9

*Last 8 censuses (May and June) averaged for house wrens and yellow-headed blackbirds because of their late arrival.

2013 064



	1972	1973	1974	1975	1976	1977	1978	1979
Individuals	530	384	530	406	556	624	484	439
Individuals / Species	13.9	10.7	14.3	10.7	13.9	13.9	11.7	11.0

——— mean number of individuals per June count

— — — mean number of individuals per June count / mean number of species per June count

Figure 2. Eight-year population trends of the three study areas combined, for the month of June only.

2013 065

TERRESTRIAL SECTION

2013 066

VEGETATION MONITORING

by

Charles D. Bonham

Dot Helm

Larry L. Larson

2013 067

INTRODUCTION

Both natural plant communities and an irrigated pasture composed of introduced grass species are being monitored at the Fort Saint Vrain Nuclear Generating Station. Data on natural plant communities have been collected since 1972 while information on plant biomass in the irrigated pasture has been collected since 1977. This latter study is concerned only with influences of water temperature on total plant biomass produced above ground. In contrast, the study of natural communities includes observations on individual species ground cover values and standing crop of dominant plant species. Only cover values are obtained during June of each year from these communities.

METHODS

Field sampling was conducted during June 18-21 to obtain cover values of plant species occurring in exclosures and adjacent outside areas. A frame of 20 x 50 cm dimensions was used to estimate the projected foliage ground cover by species. A total of 25 frames was placed at random within each exclosure and 25 frames were placed outside the exclosure in a randomized start fashion (Figure 1).

All cover data was analyzed by a t-test to detect significant differences of species cover in the exclosures protected from livestock grazing compared to outside and grazed areas. A probability of 0.10 was considered to be significant and suggested some biological interpretation be made, if possible. The vegetation of the St. Vrain River loop area has not been grazed for several years since it is inaccessible to livestock. There are, however, two distinct communities and these were sampled individually.

RESULTS

Means for plant cover and their standard errors are presented in Tables 1 through 7. The data on the plant species occurring in the confluence exclosure indicates that no changes have occurred in relative dominance (Table 1) for the early sampling period. No annual species showed any greater degree of occurrence this year with respect to previous years. The only species that differed in cover inside the exclosure vs outside was Lactuca scariola. The small cover value outside, however, was not biologically important.

The presence of Agropyron elongatum within the irrigated pasture exclosure has been previously noted while it still has not been detected in sampling outside the exclosure. This pasture is grazed heavily by livestock and Festuca elatior is noted to have a high cover value outside the exclosure. No doubt that grazing contributes to species differences at this location. (Table 2)

Tables 1, 3, 6, and 7 are cover data for vegetaion representing floodplain communities. These types are periodically subjected to flooding and debris deposition. Therefore, these communities are in various stages of plant succession and seldom have an opportunity to exhibit any stability in plant species composition. Annual species often dominate from early spring to early summer, while warm season perennial forbs and grasses dominate the vegetation structure later on during the growing season. Therefore, no particular interpretation is placed on these particular areas with respect to changes occurring in plant species characteristics until data is obtained during the August period.

2013 369

The data from the exclosure south of Ben Houston's headquarters indicates that Agropyron elongatum continues to dominate inside the fenced area, while Distichlis stricta dominates the adjacent outside area. This area is sub-irrigated and grazed heavily by livestock. The latter perturbation probably continues to influence the vegetation composition more than any other factor.

2013 070

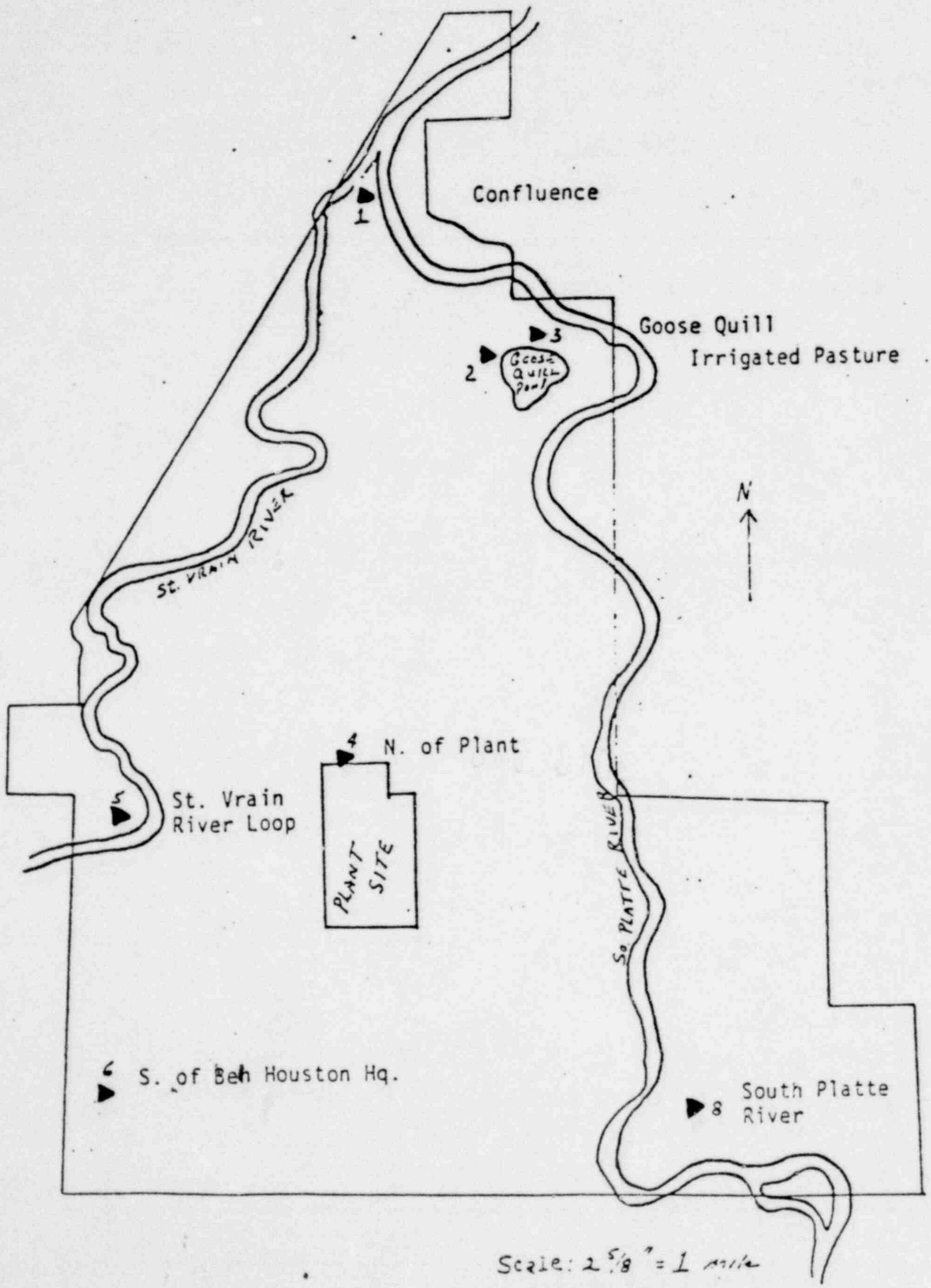


Figure 1. Location of vegetation study exclosures.

2013 071

Table 1. Cover values (percent) for plant species in the confluence exclosure compared to outside, June 1979.

Category	In (n = 25)		Out (n = 25)		
	$\bar{x}$	$s_{\bar{x}}$	$\bar{x}$	$s_{\bar{x}}$	P
Agropyron smithii	.1	.10	.6	.60	.42
Agropyron trachycaulum	27.4	6.45	19.4	6.78	.40
Ambrosia coronopofolia (m)	0.0	0.00	.2	.14	.16
Bromus japonicus	10.6	4.81	3.0	2.08	.15
Bromus tectorum	9.0	4.46	20.0	6.46	.17
Descurainia spp.	0.0	0.00	1.6	1.50	.29
Asparagus officinale	.6	.60	0.0	0.00	.32
Cardaria draba	15.1	4.35	7.1	2.94	.13
Cirsium spp.	4.3	2.16	4.0	2.86	.93
Hordeum pussilum	0.0	0.00	.1	.10	.32
Lactuca scariola	0.0	0.00	.6	.22	.01
Lepidium latifolium	0.0	0.00	2.1	1.59	.19
Lepidium perfoliatum	0.0	0.00	2.5	2.50	.32
Poa pratensisi (m)	0.0	0.00	1.6	1.50	.29
Ribes aureum	2.5	2.50	0.0	0.00	.32
Rosa nutkana	4.7	2.88	.6	.60	.17
Sporobolus cryptandrus (m)	0.0	0.00	.6	.60	.32
Spartina pectinata	0.0	0.00	1.5	1.50	.32
Symphoricarpos occidentalis	28.4	8.09	16.2	6.34	.24
Taraxacum officinale	1.2	.83	5.1	2.51	.15
Rumex triangularvalvis	0.0	0.00	3.1	2.07	.14
Phyla cuneifolia	0.0	0.00	.1	.10	.32
Euphorbia eusula	1.5	1.50	0.0	0.00	.32
Aster ericoides	0.0	0.00	.1	.10	.32
Lepidium virginicum	0.0	0.00	.9	.61	.15
Conya canadensis	0.0	0.00	.7	.60	.25
Euphorbia spp.	0.0	0.00	.1	.10	.32
Agrostis spp.	1.6	1.50	0.0	0.00	.29

(m) = monitoring species

2013 072

Table 2. Cover values (percent) for plant species in the irrigated pasture exclosure compared to outside, June 1979.

Category	In (n = 25) $\bar{x}$	In (n = 25) $s_{\bar{x}}$	Out (n = 25) $\bar{x}$	Out (n = 25) $s_{\bar{x}}$	P
Agropyron elongatum	1.5	1.50	0.0	0.00	.32
Bromus inermis (m)	46.6	6.69	0.0	0.00	.00
Chenopodium album	.1	.10	0.0	0.00	.32
Dactylis glomerata	3.9	3.90	0.0	0.00	.32
Festuca elatior (m)	16.1	5.29	75.2	4.12	.00
Lactuca scariola	2.4	1.58	0.0	0.00	.14
Polygonum coccineum	26.7	5.41	0.0	0.00	.00
Rumex triangularvalvis	.6	.60	0.0	0.00	.32
Thlaspi arvense	2.5	.97	0.0	0.00	.01
Capsella bursa-pastoris	0.0	0.00	.4	.19	.04
Trifolium spp.	0.0	0.00	5.5	3.67	.14
Ambrosia trifida	1.5	1.50	0.0	0.00	.32

(m) = monitoring species

2013 073

Table 3. Cover values (percent) for plant species in the Goosequill exclosure compared to outside, June 1979.

Category	In (n = 25)		Out (n = 25)		
	$\bar{x}$	$s_{\bar{x}}$	$\bar{x}$	$s_{\bar{x}}$	P
Agropyron desertorum	0.0	0.00	.1	.10	.32
Agropyron smithii (m)	2.0	.82	.7	.60	.21
Agropyron trachycaulum	1.6	1.50	2.5	2.50	.76
Ambrosia coronopofolia (m)	.1	.10	.2	.14	.56
Bromus inermis	5.2	2.51	5.4	2.90	.96
Bromus tectorum	56.0	6.48	37.3	7.23	.06
Descurainia spp.	4.4	2.16	.1	.10	.05
Asparagus officinale	0.0	0.00	.1	.10	.32
Cardaria draba	.6	.60	0.0	0.00	.32
Chenopodium album	0.0	0.00	.1	.10	.32
Lepidium perfoliatum	.1	.10	0.0	0.00	.32
Panicum virgatum	.1	.10	0.0	0.00	.32
Portulaca oleracea	0.0	0.00	.7	.60	.25
Poa pratensis (m)	.6	.60	0.0	0.00	.32
Rosa nutkana	1.2	.83	0.0	0.00	.16
Salsola kali	.2	.14	4.3	1.76	.02
Sporobolus cryptandrus (m)	0.0	0.00	6.2	2.23	.01
Xanthium italicum	0.0	0.00	1.2	.83	.16
Thlaspi arvense	2.5	2.50	0.0	0.00	.32
Phyla cuneifolia	0.0	0.00	3.3	1.74	.06
Euphorbia eusula	2.1	1.59	0.0	0.00	.19
Aster ericoides	.6	.60	.6	.60	1.00
Sisymbrium altissimum	.2	.14	.6	.60	.52
Lepidium virginicum	1.7	1.50	0.0	0.00	.26
Asclepias spp.	0.0	0.00	.6	.60	.32
Tradescantia occidentalis	0.0	0.00	.2	.14	.16
Ipomoea leptophylla	0.0	0.00	.7	.60	.25
Conyea canadensis	0.0	0.00	.1	.10	.32
Cleome serrulata	0.0	0.00	.1	.10	.32
Euphorbia spp.	0.0	0.00	.2	.14	.16

(m) = monitoring species

2013 074

Table 4. Cover values (percent) for plant species in the north of plant exclosure compared to outside, June 1979.

Category	In (n = 25) $\bar{x}$	In (n = 25) $s_{\bar{x}}$	Out (n = 25) $\bar{x}$	Out (n = 25) $s_{\bar{x}}$	P
Agropyron desertorum	9.1	2.79	9.7	3.24	.89
Bromus tectorum	31.0	5.55	31.2	5.32	.98
Descurainia spp.	1.0	.25	.9	.61	.88
Lactuca scariola	.1	.10	0.0	0.00	.32
Medicago sativa	0.0	0.00	1.5	1.50	.32
Muhlenbergia asperifolia	.6	.60	0.0	0.00	.32
Oenethera albus	.4	.19	.8	.61	.53
Sporobolus cryptandrus (m)	3.8	1.71	9.1	2.50	.09
Lomatium spp.	.1	.10	0.0	0.00	.32
Plantago spinulosa	.7	.60	.8	.61	.91
Aster ericoides	4.2	2.56	0.0	0.00	.11
Sisymbrium altissimum	0.0	0.00	.8	.61	.19
Erigeron spp.	0.0	0.00	.1	.10	.32

(m) = monitoring species

Table 5. Cover values (percent) for plant species in the exclosure south of Ben Houston's compared to outside, June 1979.

Agropyron elongatum	65.4	5.37	17.4	5.08	.00
Carex praegracilis	.1	.10	5.2	2.91	.09
Chenopudium album	.1	.10	.[illegible]	.22	.04
Distichlis stricta (m)	16.3	4.66	35.[illegible]	5.84	.01
Lappula redowski	0.0	0.00	1.5	1.50	.32
Kochia scoparia	.1	.10	5.4	2.90	.07
Taraxacum officinale	0.0	0.00	.1	.10	.32
Hordeum jubatum	0.0	0.00	5.5	3.67	.14
Glyceria straita	0.0	0.00	6.9	2.56	.01

(m) = monitoring species

Table 6. Cover values (percent) for plant species in the South Platte River exclosure compared to outside, June 1979.

Category	In (n = 25)		Out (n = 25)		
	$\bar{x}$	$s_{\bar{x}}$	$\bar{x}$	$s_{\bar{x}}$	P
Agropyron smithii	1.9	.99	2.6	1.11	.64
Agropyron trachycaulum	3.8	2.58	2.5	1.58	.67
Ambrosia coronopofolia (m)	.3	.17	1.3	.83	.24
Bromus tectorum	19.2	5.52	33.5	5.79	.08
Asparagus officinale	0.0	0.00	.1	.10	.32
Cardaria draba	12.3	4.88	10.6	2.88	.77
Smilacina stellata	1.7	1.50	.6	.60	.50
Lactuca scariola	.1	.10	0.0	0.00	.32
Melilotus officinale	0.0	0.00	.1	.10	.32
Poa pratensis (m)	.6	.60	0.0	0.00	.32
Rhus radicans (m)	37.2	7.15	18.9	5.86	.05
Ribes aureum	.6	.60	0.0	0.00	.32
Spartina pectinata	.1	.10	.6	.60	.42
Symphoricarpos occidentalis (m)	38.6	7.48	25.5	7.10	.21
Taraxacum officinale	.1	.10	1.6	1.50	.32
Tragopogon dubius	.1	.10	.6	.60	.42
Rumex triangularvalvis	.6	.60	0.0	0.00	.32
Trifolium spp.	.6	.60	.1	.10	.42
Euphorbia esula	.6	.60	.6	.60	1.00
Aster ericoides	0.0	0.00	3.4	2.54	.19

(m) = monitoring species

2013 076

Table 7. Cover values (percent) for plant species in the Saint Vrain River loop with stratified sampling, August 1979.

Category	In (n = 25)		Out (n = 25)		
	$\bar{x}$	$s_{\bar{x}}$	$\bar{x}$	$s_{\bar{x}}$	P
Agropyron smithii	0.0	0.00	4.4	1.76	.02
Ambrosia coronopofolia (m)	0.0	0.00	.7	.23	.00
Bromus japonicus	.6	.60	.7	.60	.91
Bromus tectorum	.6	.60	20.1	5.88	.00
Descurainia spp.	0.0	0.00	.7	.60	.25
Cardaria draba	0.0	0.00	15.6	4.72	.00
Juncus balticus	0.0	0.00	4.1	3.42	.24
Carex praegracilis	0.0	0.00	13.0	5.67	.03
Chenopodium album	0.0	0.00	1.5	1.50	.32
Cirsium spp.	52.0	5.56	5.8	2.93	.00
Conium maculatum	7.4	4.71	0.0	0.00	.12
Distichlis stricta (m)	0.0	0.00	.8	.61	.19
Equisetum kansasum	0.0	0.00	1.5	.83	.08
Lactuca scariola	0.0	0.00	.1	.10	.32
Lepidium latifolium	39.7	4.91	.2	.14	.00
Poa pratensis	0.0	0.00	2.0	.99	.05
Glyccyrrhiza spp.	.6	.60	.6	.60	1.00
Sporobolus cryptandrus (m)	0.0	0.00	.7	.60	.25
Spartina pectinata	.6	.60	.6	.60	1.00
Symphoricarpos occidentalis	5.4	4.12	0.0	0.00	.20
Taraxacum officinale	0.0	0.00	.1	.10	.32
Rumex triangularvalvis	0.0	0.00	.6	.60	.32
Asclepias spectosa	1.2	.83	0.0	0.00	.16
Phyla cuneifolia	0.0	0.00	.6	.60	.32
Opuntia polyacantha	0.0	0.00	.1	.10	.32
Convolvulvus spp.	.1	.10	1.2	.83	.19
Aster ericoides	0.0	0.00	.7	.60	.25
Sophora sericea	1.5	1.50	0.0	0.00	.32

(m) = monitoring species

2013 077

ECOPHYSIOLOGICAL CHARACTERISTICS

by

M. J. Trlica

R. S. Carmichael

Dot Helm

2013 078

INTRODUCTION

Terrestrial vegetation surrounding the St. Vrain Nuclear Generating Station may be directly or indirectly affected by the plant's operation. Operation of the Generating Station will probably result in releases of small amounts of radionuclides. Heat, water vapor and salts will also be lost to the atmosphere as a result of cooling tower operation. In addition, water effluents will be released from the station which could affect vegetation along the water courses, or this water could be used for irrigation.

It is, therefore, desirable to have an inventory of the ecophysiology of the vegetation which might be affected by increased heat, water vapor, and salt deposition as a result of cooling tower operations. Since all animal life is dependent either directly or indirectly upon vegetation as a source of food, decreased productivity or palatability of vegetation may be detrimental to animal populations. In addition, operation of the cooling towers may result in increased humidities and temperature changes in the immediate surrounding environment. Since the St. Vrain Nuclear Generating Station is in the Denver Air Pollution Corridor, increased humidity could interact with vegetation, resulting in increased leaf injury caused by the pollutants. Numerous studies have indicated that a significantly-detrimental interaction exists between air pollutants and humidity which can cause severe damage to photosynthetically-active tissues.

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OBJECTIVES

The objectives of this study were:

1. **To determine leaf damage by pollutants, disease, and insects for certain species surrounding the nuclear generating station.**
2. **To determine concentrations of important elements in foliage** of several species as related to distance and direction from the nuclear generating station.

METHODS

Leaves of cheatgrass (*Bromus tectorum*), kochia (*Kochia scoparia*), and cottonwood (*Populus sargentii*) were collected from a maximum of 32 locations on four radii at distances of 1/8, 1/4, 1/2 and one mile from the power plant during rapid spring growth from 1972 through 1978 (Figure 1). Sampling of kochia and cottonwood at these same locations was again repeated when vegetation was mature in August, 1972 through 1978. Estimates were made for each leaf sampled for total leaf area, leaf area injured by chewing insects, and leaf area spotted caused by air pollutants, disease, nutrition and sucking insects.

Chemical analyses were conducted on foliage samples of cottonwood, kochia, and pinto beans (*Phaseolus vulgaris*). Analyses indicated concentrations of nitrogen (N), phosphorus (P), potassium (K), calcium (Ca), magnesium (Mg), zinc (Zn), iron (Fe), manganese (Mn), copper (Cu), sulfate (SO_4-S), mercury (Hg), lead (Pb), cadmium (Cd), and boron (B) in foliage tissues. However, all of the above determinations were not made each

2013 080

POOR ORIGINAL

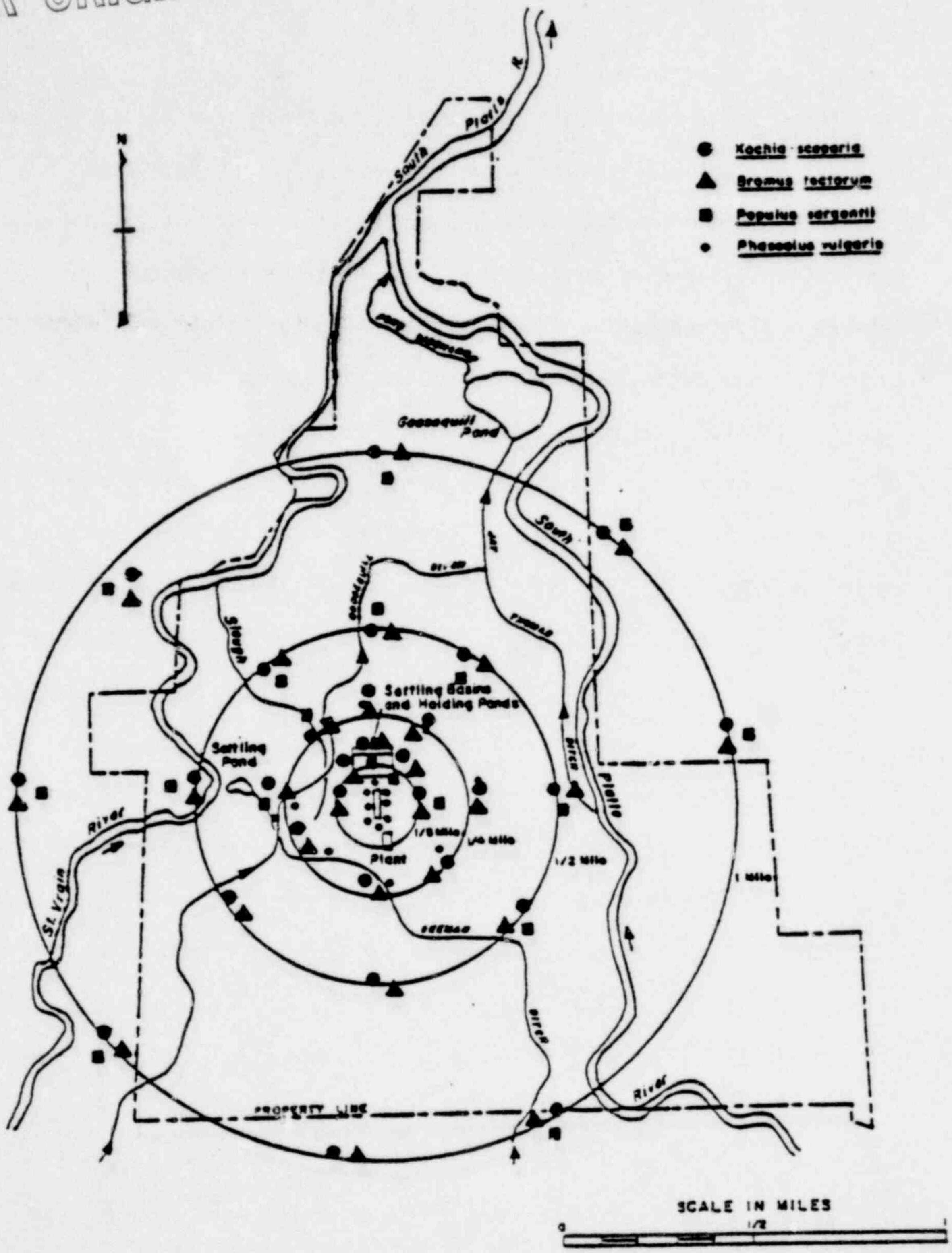

Figure 1. Fort St. Vrain study area showing locations of collection sites.

2013 081

year for each of the species. These analyses indicated whether concentrations of various nutritive and toxic elements were influenced by either distance or direction from the nuclear generating station. These chemical analyses were done by the Front Range Environmental Lab. Methods and procedures for these analyses were given by Jim Rogers in an earlier report on soils of the St. Vrain study site.

A literature search indicated that pinto bean plants were sensitive to air pollutants. As pinto beans are an important crop produced in the area around the St. Vrain Nuclear Generating Station, they were utilized in 1973, 1974, 1976, 1977 and 1978 as a controlled experiment to determine effects of air pollution and drift at varying distances and directions from the cooling towers.

Pinto beans were planted in polyethylene-lined #10 cans in a greenhouse. All plants received similar treatment in the greenhouse until mid-July, when plants and containers were transported to the St. Vrain study site. Sixty-four containers with bean plants (four containers/location) were placed at two distances and eight directions from the cooling towers (Figure 1). Distances from the towers were 50 feet and 1/4 mile. The bean plants all received similar amounts of supplemental fertilizer and water. They were allowed to grow for approximately six weeks during each year at the study area. At that time, leaves from each plant in each container were sampled to determine leaf injury. The remaining foliage was harvested, dried, and analyzed for several elemental concentrations.

2013 082

Wet bulb and dry bulb temperatures at each location for pinto beans were measured in 1976, 1977 and 1978 each time bean plants were watered. Data were collected using a portable psychrometer. Utilizing these data, relative humidity and dew point temperature were calculated to aid in determining the sphere of influence around the cooling towers.

Analyses of data for vegetation samples collected from the 1972-through-1978 growing seasons continued through the winter. Statistical analyses of data for leaf injury of vegetation has been completed and was discussed in the January, 1978 Progress Report. Therefore, only results of chemical analyses of foliage samples will be discussed here. Analyses of variance were utilized for all data analyses. When significant ($p < 0.05$) F-values were found, Tukey's test was utilized to separate significant ($p < 0.05$) mean differences.

RESULTS AND DISCUSSION

Kochia scoparia

Analyses of data for elemental concentrations in foliage samples of kochia collected in August, 1978, indicated that mercury (Hg), lead (Pb), and boron (B) all varied significantly with distance from the St. Vrain cooling towers. Mercury and lead concentrations near (1/8 mile) the towers averaged 0.19 and 1.44 μg/g, respectively, whereas at greater distances they averaged 0.09 and 0.79 μg/g. This may represent only natural variation, however Hg concentrations in kochia were significantly higher in 1976, 1977, and 1978 than they were in 1973 and 1975; but lead concentrations were highest in 1973. Therefore, mercury and cadmium (high in 1978) concentrations

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in future sample collections will be closely monitored. Boron was significantly higher at greater distances from the towers and showed no relation to drift.

Concentrations of sulfate (SO_4-S), mercury (Hg), cadmium (Cd) and boron (B) in samples of kochia have significantly increased during at least one of the last two years. Therefore, it would appear that mercury and cadmium are the toxic elements of greatest concern at the present time.

Populus sargentii

Nitrogen (N), phosphorus (P), potassium (K), calcium (Ca), magnesium (Mg), manganese (Mn), and copper (Cu) in foliage samples of cottonwood have all varied significantly with time from 1974 through 1978. Some of these elements have varied significantly with either distance or direction from the generating station, but no trend is apparent in the data. It would, therefore, appear that these differences represent natural variations or differences in agriculture practices and are not related to the station operations.

Concentrations of Ca and Mg were higher in cottonwood foliage in 1978 than in the previous two years. Nitrogen, P, K, and Mn were all lower in 1978 than in the previous two years. This again may only represent natural variation or site differences and have little to do with the St. Vrain Nuclear Generating Station.

Phaseolus vulgaris

No differences were found for most elemental concentrations in 1978 foliage samples of pinto beans as related to direction from the cooling towers. However, significant differences in N and Fe were found as related to distance from the towers. Iron (Fe) was the only constituent that was higher in plants that were grown 50 feet from the towers as compared with plants grown at 1/4 mile from the towers (Table 1). It is possible that drift from the towers caused an increase in Fe concentrations. Several other elements were also slightly more concentrated in foliage of pinto beans grown near the towers. However, the heavy metals (Hg and Cd) were not concentrated in foliage of plants grown near the towers (Table 1).

All of the elements showed significant yearly variations in concentrations in pinto bean foliage between 1973 and 1978. Most of these differences probably are the result of differences in growing conditions, but are confounded with cooling tower drift effects among years. Mercury and cadmium were the only heavy metals that have shown a significant increase in one of the last two years. Lead concentrations had shown a decreasing trend from 1973 through 1977, but were again higher in 1978.

Comparisons Among Species Through Years

Elemental concentrations in foliage of kochia, cottonwood and pinto beans (controlled experiment) were compared for samples collected before power generation (1973-1976) and after power generation was initiated

Table 1. Concentration of various elements in aboveground biomass of pinto bean plants (*Phaseolus vulgaris*) collected in August, 1977, at two distances and eight directions from the cooling towers of the St. Vrain Nuclear Generating Station.

Distance from cooling towers	Direction from cooling towers	N (%)	P (%)	K (%)	Ca (%)	Mg (%)	Zn (μg/g)	Fe (μg/g)	Mn (μg/g)	Cu (μg/g)	SO_4-S (%)	Hg (μg/g)	Pb (μg/g)	Cd (μg/g)	B (μg/g)
50 feet		2.66b[1]	0.30a	2.38a	3.88a	1.09a	125.9a	635.8a	74.0a	9.6a	2.83a	0.08a	1.33a	0.38a	64.3a
1/4 mile		3.45a	0.30a	2.29a	4.48a	0.67a	114.4a	541.8b	56.0a	11.5a	0.34a	0.13a	0.82a	1.07a	66.0a
	N	2.57a[1]	0.32a	2.69a	4.20a	1.18a	135.6a	667.6bc	77.0a	9.1a	2.69a	0.15a	1.15a	0.57a	45.9a
	NE	3.53a	0.29a	2.29a	5.57a	0.77a	86.2a	466.5de	55.5a	12.4a	0.33a	0.06a	0.45a	1.48a	59.7a
	E	3.01a	0.31a	2.62a	3.62a	0.92a	132.9a	548.3d	60.0a	9.5a	1.70a	0.08a	1.05a	0.34a	59.2a
	SE	3.60a	0.28a	2.54a	4.71a	0.66a	112.9a	420.7e	54.0a	10.4a	0.35a	0.08a	1.74a	0.95a	49.8a
	S	3.13a	0.28a	2.26a	3.71a	0.75a	126.5a	732.6ab	72.0a	11.4a	1.24a	0.15a	1.06a	0.81a	71.8a
	SW	2.54a	0.29a	2.30a	3.48a	1.11a	142.0a	812.6a	93.0a	11.7a	2.80a	0.01a	2.00a	0.24a	82.6a
	W	3.39a	0.34a	2.38a	5.05a	0.78a	141.4a	645.4bc	63.0a	13.7a	0.35a	0.18a	0.37a	1.21a	92.3a
	NW	2.65a	----[2]	1.41a	4.12a	0.97a	65.0a	313.4f	42.0a	6.6a	3.47a	0.09a	0.83a	0.48a	59.3a

[1]Numbers in a column followed by a similar letter are not significantly different at the 0.05 level of probability.

[2]An outlier of 0.07% has been eliminated here.

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(1977-1978) to determine if station operations might have any significant effect. Similar trends in elemental concentration through time were noted for the three species (Table 2). Nitrogen (N), potassium (K), manganese (Mn), copper (Cu), lead (Pb), and boron (B) all tended to be greater before station operation than after the station began operations. The reverse trend, however, was noted for phosphorus (P), magnesium (Mg), sulfate (SO_4-S) and mercury (Hg). It is possible that these last four elements are higher in blowdown water in the cooling towers and are being deposited on nearby vegetation. Analysis of blowdown water planned for 1979 should give us an indication if this hypothesis is correct.

Since trends in elemental concentrations among the three species over the years were quite similar, this may indicate only gross differences in yearly climatic conditions affecting plant growth or differences in agricultural treatments in the surrounding area. Both naturally occurring species (kochia and cottonwood) as well as pinto beans in potted containers responded in a similar manner. For these reasons, it is suspected that the differences were largely caused by influences other than the generating station's operation, such as the agricultural use of herbicides and insecticides or the influence of air pollutants drifting to the area from Denver. Additional data to be collected in 1979 should aid in confirming the causes for the differences in elemental concentrations in vegetation surrounding the nuclear generating station.

Table 2. Concentrations of various elements in foliage tissue of kochia (*Kochia scoparia*), cottonwood (*Populus sargentii*), and pinto bean (*Phaseolus vulgaris*) before (1973-1976) and after (1977-1978) beginning of operation of the St. Vrain Nuclear Generating Station.

	N (%)	P (%)	K (%)	Ca (%)	Mg (%)	Zn (μg/g)	Fe (μg/g)	Mn (μg/g)	Cu (μg/g)	SO_4-S (%)	Hg (μg/g)	Pb (μg/g)	Cd (μg/g)	B (μg/g)
Kochia scoparia														
Before	3.56a[1]									0.38b	0.053b	0.894a	0.325a	73.0b
After	3.17a									0.50a	0.104a	0.470a	0.436a	85.7a
Populus sargentii														
Before	2.31a[1]	0.21b	1.50a	1.92a	0.41b	89.9a	85.8a	40.9a	9.45a	0.49b				112.0a
After	1.87b	0.34a	1.21b	2.09a	0.52a	94.6a	77.0a	18.5b	6.81b	0.74a				100.0b
Phaseolus vulgaris														
Before	3.38a[1]	0.38b	2.94a	2.02a	0.53a	50.0b	525.0a	56.0a	11.32a	0.38b	0.061b	1.292a	0.405a	64.6a
After	2.99b	0.60a	2.45b	2.63a	0.58a	83.0a	426.0a	23.8b	9.10b	0.98a	0.110a	0.582b	0.383a	35.1b

[1]Numbers in a column followed by a similar letter are not significantly different at the 0.05 level of probability.

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CONCLUSIONS

It appears that operation of the St. Vrain Nuclear Generating Station has had little influence on elemental concentrations of naturally occurring plant species in the vicinity of the station. Natural variations and agriculture practices are probably responsible for the significant differences in concentrations observed. However, cooling tower drift may be responsible for increased concentrations of phosphorus, magnesium, and sulfate in foliage samples of pinto beans grown near the cooling towers in the controlled experiment and in two naturally occurring species. It is likely that the drift is limited to a fairly small radius around the towers, but the sphere of influence is not yet known.

Mercury concentrations in both kochia and pinto beans have increased from 1973 to 1978. The reason for these increases is not known, but warrants attention.

MAMMALS, AMPHIBIANS AND REPTILES

by

Bruce A. Wunder

Douglas C. Ure

2013 090

INTRODUCTION AND METHODS

The methods and procedures involved in monitoring amphibians, reptiles and mammalian populations during this phase of the project are those described in previous progress reports (see Progress Reports May 1 - December 31, 1973 and January 1 - June 30, 1974). Small mammal sampling sites were the same as in past years and are indicated in Figure 1.

This report is concerned primarily with data gathered during the first six months of 1979. Tissue heavy metal analyses were not conducted during the first six months of 1979. Presumably, these analyses will be conducted again when the Saint Vrain Nuclear Generating Station has begun full operation. At that point, comparisons can then be made of heavy metal concentrations on amphibian and small mammal tissues acquired prior to and following full operation of the Nuclear Generating Station.

RESULTS AND DISCUSSION

Mammals: species present

The species of mammals noted on Public Service property since 1972 are listed in the yearly progress report for 1976. All species noted were present during the first six months of 1979 as indicated by direct observation, trapping or sign with the exception of species listed in Table 1. All of those species have been noted only as rare occurrences on our specific study plots, except for the thirteen-lined ground squirrel (*Spermophilus tridecemlineatus*)

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and the pocket gopher (*Geomys bursarius*). Thirteen-lined ground squirrels have previously been noted on Grid 1 and Transects 2 and 8. They may be present on more open areas of the Public Service Company property not in the vicinity of our census grids and transects. However, they have not been noted during diurnal surveys. Pocket gopher (*Geomys* or *Thomomys* sp.) burrows were observed on Grid 3 during the late fall 1978 census. It is likely that they were overlooked rather than absent during the first six months of 1979. Black-tailed jackrabbits (*Lepus californicus*) have been seen only in open fields on the southwest portion of the property, far removed from our established census areas. More frequent visitation of these areas would probably yield observations of ground squirrels and more hares.

The smaller, noctural, rare species have never been caught in large numbers and may still be present. Norway rats (*Rattus norvegicus*) are associated with human habitations and are not likely to frequent our census sites. Often, carnivores such as badgers (*Taxidea taxus*) and weasels (*Mustela frenata*) are seldom abundant and therefore, seldom seen. White-tailed deer (*Odocoileus virginianus*) are secretive and we have only incidental records of them. We have no reason to believe that any of these species have disappeared or become locally extinct due to operation of the Nuclear Generating Station.

Cottontail rabbit (*Sylvilagus* sp.) numbers were high during spring 1979, with most activity centered on wooded and grassy floodplains of the Saint Vrain and South Platte Rivers. The eastern cottontail (*Sylvilagus floridanus*) was positively identified from

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a skull and rabbits were noted that fit descriptions of the desert cottontail (*Sylvilagus auduboni*). Both species could be present on Public Service Company property, but positive identification of the latter will be possible only if specimens are taken. White-tailed jackrabbits (*Lepus townsendii*) were observed in June in newly planted fields northeast and southeast of the Nuclear Generating Station. Fox squirrels (*Sciurus niger*) were frequently seen on the wooded floodplain of the South Platte River. Fresh beaver (*Castor canadensis*) cuttings were seen along the outflow from Goosequill Pond, along the Saint Vrain River from Grid 3 up to the confluence of the Saint Vrain and South Platte Rivers, and west of Transect 2 in February and March. During this period, one beaver was seen in Goosequill Pond. Goosequill Pond was partially drained in late spring in an attempt to control muskrat (*Ondatra zibethicus*) populations. During this time, outflow from Goosequill Pond into the beaver dams ceased and water levels behind the dam dropped. No fresh beaver cuttings were seen during May. Low water levels may have forced beaver to leave the pond area. The ultimate affect of the draining on muskrat populations remains to be seen. Muskrats were abundant on other parts of Public Service Company property. Muskrats were seen along the South Platte River from Transect 3 up to the confluence of the Saint Vrain and South Platte Rivers, in the swamp bordering Transect 2, and along the Saint Vrain River west of Transect 2. Prairie dog (*Cynomys ludovicianus*) numbers are increasing again following the June 1978 poisoning campaign. Twenty-two prairie dogs were active in the colony west of the dairy farm in mid-May. Several burrows have been established on a rise southeast of the main colony and contained at least seven animals in late June 1979. In addition, a small second colony was discovered in the southwest quadrant of the Public Service Company property, west of Transect 2.

Ráccoon (*Procyon lotor*) tracks were frequently seen along the banks of the Saint Vrain and South Platte Rivers and between Transect 2 and west of the river. Late in the spring, tracks of both adults and juveniles were seen. Raccoon feces containing primarily green matter and crayfish remains were found along Transect 7 and west of Transect 2. A striped skunk (*Mephitus mephitus*) was seen in the fields near Transect 5 and seven dead skunk kits were found outside a den near Transect 7. Also, a road-killed skunk was found south of the nuclear generating station. Skunk tracks were seen north of Goosequill Pond and on Transect 2. Coyote (*Canis latrans*) scats were found on the west side of Public Service Company property. Foxes (*Vulpes vulpes*) were identified only by tracks which were present in the southwest quadrant of the property. The tracks of domestic dogs (*Canis familiaris*) were seen along the west and north sides of Public Service Company land. Domestic cats (*Felix domesticus*) were present near human habitations and one cat was observed along the shore of Goosequill Pond. Mule deer (*Odocoileus hemionus*) were not seen during winter months, but appeared along the South Platte River and near Transect 2 in spring. Fifteen deer were observed near Goosequill Pond and five others near Grid 2 on the east side of the river. *Odocoileus* sp. tracks were found on the South Platte and Saint Vrain floodplains.

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Mammals: population parameters

In 1979, the late spring census was conducted from 27 May through 1 June. The census consisted of 2300 trap-nights. One hundred-thirty-four unusual individuals were captured, two of which had been marked in the previous late fall census; a harvest mouse (*Reithrodontomys megalotis*) on Grid 3 and the same species on Transect 5. The most abundant species captured were deer mice (*Peromyscus maniculatus*), house mice (*Mus musculus*), western harvest mice (*Reithrodontomys megalotis*), and prairie voles (*Microtus ochrogaster*). Total numbers of individuals captured of the four most abundant species captured during the late spring, early autumn, and late autumn censuses from June 1972 through June 1979 are presented in Figure 2.

The number of deer mice captured in the late spring 1979 census is substantially lower than that of late spring 1978, comparing more closely with the low value of late spring 1977. Although we cannot be certain of the cause of the low numbers of deer mice this spring, it could relate to winter harshness. Precipitation levels were very low during winter 1977 and population levels the following spring were also at a low. Similarly, the duration of subfreezing temperatures was long in winter 1979 and was followed by a late spring. Again, deer mouse population levels are down. This decline in population levels may be a result of high energy demands on the the animals and low energy availability due to a late commencement of plant growth.

Reproductive activity (pregnant and/or lactating) among adult and subadult female deer mice captured on trapping areas unaffected by agricultural practices (Grid 3, Transects 2, 3 and 5) during the late spring census was lower than in the previous three years, although not greatly so (Figure 3). This slight reduction in reproductive activity, like the reduced population levels, may be a result of the relatively late initiation of spring plant growth and potentially low winter population levels due to high mortality during the cold winter. The reduction in the number of deer mice captured in spring 1979 in spite of relatively constant breeding levels in the populations indicates that mortality could have been quite high during winter 1978-1979.

The prairie vole population has remained at a relatively stable low level as that observed in 1975-1978 (Figure 2). Western harvest mouse populations have declined noticeably since spring 1978. Contrary to predictions, the number of harvest mice captured during the 1978 late autumn census did not reach a new high, but declined through the summer and while more mice were captured then prior to 1976, population levels were lower than in fall 1976 and substantially lower than in fall 1977. Building up from these low fall levels, spring 1979 harvest mouse captures were slightly lower than late fall 1978. Two harvest mice marked the previous fall were recaptured during the recent spring census. Perhaps weather extremes and energy availability and demand relationships did not affect the small harvest mice as drastically as the larger deer mice. House mouse captures, which had increased in late fall 1977 and spring 1978, decreased dramatically by fall 1978. They have increased only slightly since then and were within the late spring 1972-late spring 1977 capture range once again during the late spring 1979

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trapping session. As in 1978, most of the house mice captured were on Grid 1. Alfalfa cover was high (up to 0.9 m) and lush during the census period providing abundant food and cover. House mouse captures were also high on Transect 7. This site was greatly disturbed prior to the trapping session. The west side of Goosequill Ditch had been burned and cover was sparse and generally less than 0.2 m high. The east side had been built up and graded and provided even less cover. Seven house mice were collected here during late spring 1979 sampling, but prairie voles, western harvest mice, and meadow voles (*Microtus pennsylvanicus*) which were present throughout 1978 were notably absent following the drastic habitat alternation on Transect 7.

Population levels of deer mice, harvest mice, house mice and prairie voles on our census plots are sufficiently high to serve as indicators of possible environmental change produced by the operation of the Saint Vrain Nuclear Generating Station. In the past years, the populations of these four species have risen and fallen in complimentary fashion. If the populations of all four species drop in concert after the Generating Station reaches full operation, then there may be a cause-effect relationship which should be investigated.

No meadow jumping mice (*Zapus hudsonius*) and only one meadow vole were captured during the 1979 late spring census. Meadow jumping mice were captured on Transect 7 prior to 1978 and meadow voles were captured in the same area prior to spring 1979. They are either both suffering a periodic population low or their numbers are being adversely affected by agricultural practices, specifically chemical spraying and burning being done on irrigation ditches.

Amphibians and Reptiles: species present

Table 2 lists the species of amphibians and reptiles which have been observed since 1972 on the Public Service Company's property surrounding the Saint Vrain Nuclear Generating Station. Two trips in Spring 1979 were made to the Station property to inventory amphibian and reptile presence. Woodhouse's toads (*Bufo woodhousei*), chorus frogs (*Pseudacris triseriata*) and plains spadefoot toads (*Scaphiopus bombifrons*) were actively calling in large numbers and breeding during our censuses. In addition, a few great plains toads (*Bufo cognatus*) and leopard frogs (*Rana pipiens*) were calling and breeding. Bullfrog's (*Rana catesbiana*) were also observed but were not breeding. The absence of calling great plains toads and spadefoot toads in 1977 and 1978 should not be interpreted to mean that they were not present. Calling by these amphibians is temperature dependent, and they could have easily been missed. Breeding populations were high in most marshy areas, but totally absent from Goosequill Pond. In previous years, calling frogs and toads were abundant there, but the draining of the pond for muskrat control left most shore plants far removed from surface water and prevented amphibians from breeding there this spring. This could have the greatest effect on breeders in permanent water, but probably lesser effect on spadefoot toads which were breeding in a temporary pool west of Transect 7 as evidenced by the presence of numerous tadpoles of that species near the end of June.

In addition to amphibians, three species of reptile were observed during the late spring 1979 small mammal census: two bull snakes (*Pituophis melanoleucus*), two racers (*Coluber constrictor*), and two garter snakes (*Thamnophis* sp.)

OVERALL CONCLUSIONS

With the exceptions noted above, the same species of mammals, amphibians and reptiles noted during the inventory phase of this project are still present. Therefore, no drastic effects of the Saint Vrain Nuclear Generating Station have been observed to date. To this point, climatological and most importantly agricultural factors have probably played significant parts in influencing population sizes of species, perhaps exaggerating the natural fluctuations in the sizes of the small mammal populations that are almost certainly occurring. Deer mice (*Peromyscus maniculatus*), house mice (*Mus musculus*), harvest mice (*Reithrodontomys megalotis*), and prairie voles (*Microtus ochrogaster*) have provided adequate baseline population data. Prairie voles will provide adequate heavy metals baseline data on the effects of airborne heavy metal contaminants and Woodhouse's toad (*Bufo woodhousei*) should serve a similar function for possible aquatic concentration effects.

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Table 1. Mammal species previously noted on the Saint Vrain Nuclear Generating Station that were not censused or observed in the first six months of 1979.

Common Name	Scientific Name
1. Shrew	*Sorex* sp.
2. Black-tailed jackrabbit	*Lepus californicus*
3. Thirteen-lined ground squirrel	*Spermophilus tridecemlineatus*
4. Spotted ground squirrel	*Spermophilus spilosoma*
5. Rock squirrel	*Spermophilus variegatus*
6. Pocket gopher	*Geomys bursarius*
7. Northern grasshopper mouse	*Onychomys leucogaster*
8. Norway rat	*Rattus norvegicus*
9. Meadow jumping mouse	*Zapus hudsonicus*
10. Long-tailed weasel	*Mustela frenata*
11. White-tailed deer	*Odocioleus virginianus*
12. Badger	*Taxidea taxus*

Table 2. Amphibians and reptiles present in the vicinity of the Saint Vrain Nuclear Generating Station.

Common Name	Scientific Name	Presence[1]
1. Spadefoot toad	*Scaphiopus bombifrons*	1. V-C
2. Great Plains toad	*Bufo cognatus*	2. C
3. Woodhouse's toad	*Bufo woodhousei*	3. C
4. Western chorus frog	*Pseudacris triseriata*	4. C
5. Bullfrog	*Rana catesbiana*	5. C
6. Leopard frog	*Rana pipiens*	6. V-C
7. Tiger salamander	*Ambystoma tigrinum*	7. V
8. Snapping turtle	*Chelydra serpentina*	8. D
9. Painted turtle	*Chrysemys picta*	9. V-D
10. Spiny soft-shelled turtle	*Trionyx spiniferus*	10. V
11. Racer	*Coluber constrictor*	11. V-C
12. Common garter snake	*Thamnophis sirtalis*	12. C
13. Plains garter snake	*Thamnophis radix*	13. C
14. Bull snake	*Pituophis melanoleucas*	14. C-D
15. Western rattlesnake	*Crotalus viridis*	15. V

[1]C = captured
D = found dead
V = visual observation

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Figure 1. Small mammal sampling areas, grids and North American Census of Small Mammal Lines of Transects (NACSM) on the Saint Vrain Nuclear Generating Station property.

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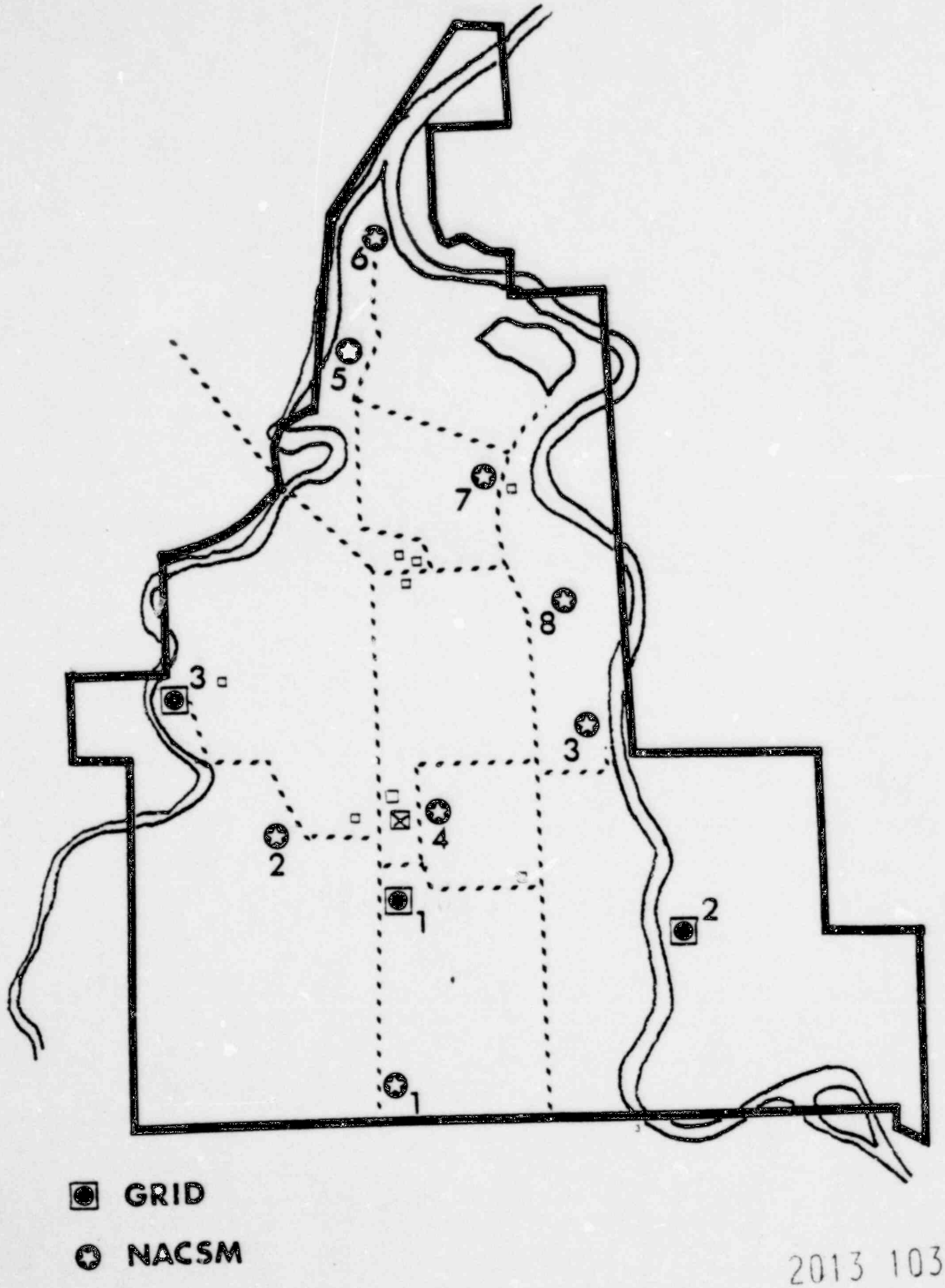

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Figure 2. Total number of small mammal individuals captured at the Saint Vrain Nuclear Generating Station: late spring 1972-late spring 1979.

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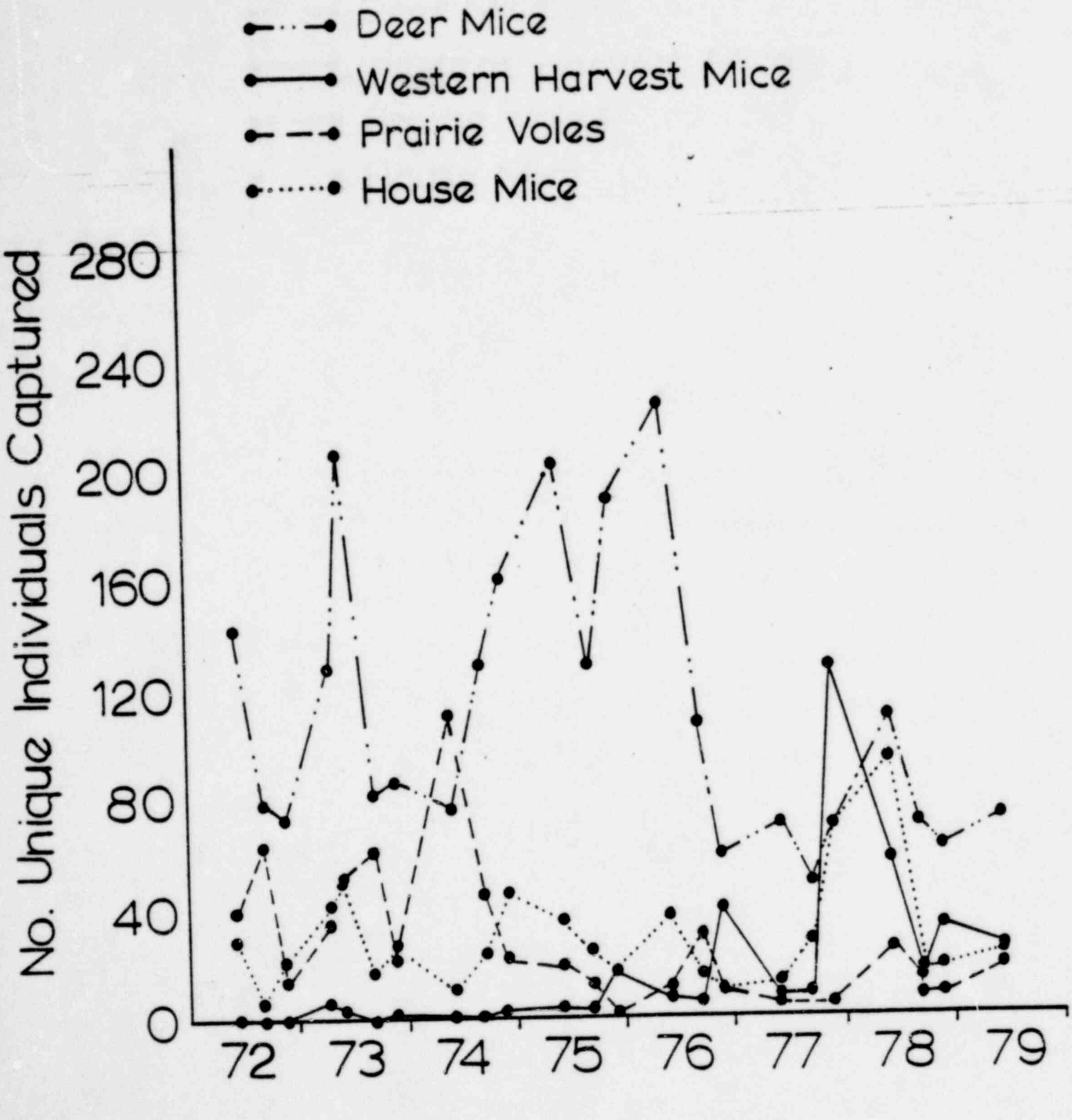
Deer Mice
Western Harvest Mice
Prairie Voles
House Mice
No. Unique Individuals Captured
0
40
80
120
160
200
240
280
72
73
74
75
76
77
78
79

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Figure 3. Percentages of adult and subadult female deer mouse individuals captured on trapping areas unaffected by agricultural practices (Grid 3, Transects 2, 3 and 5) during the late spring census (1972-1978) that were reproductively active (pregnant or lactating).

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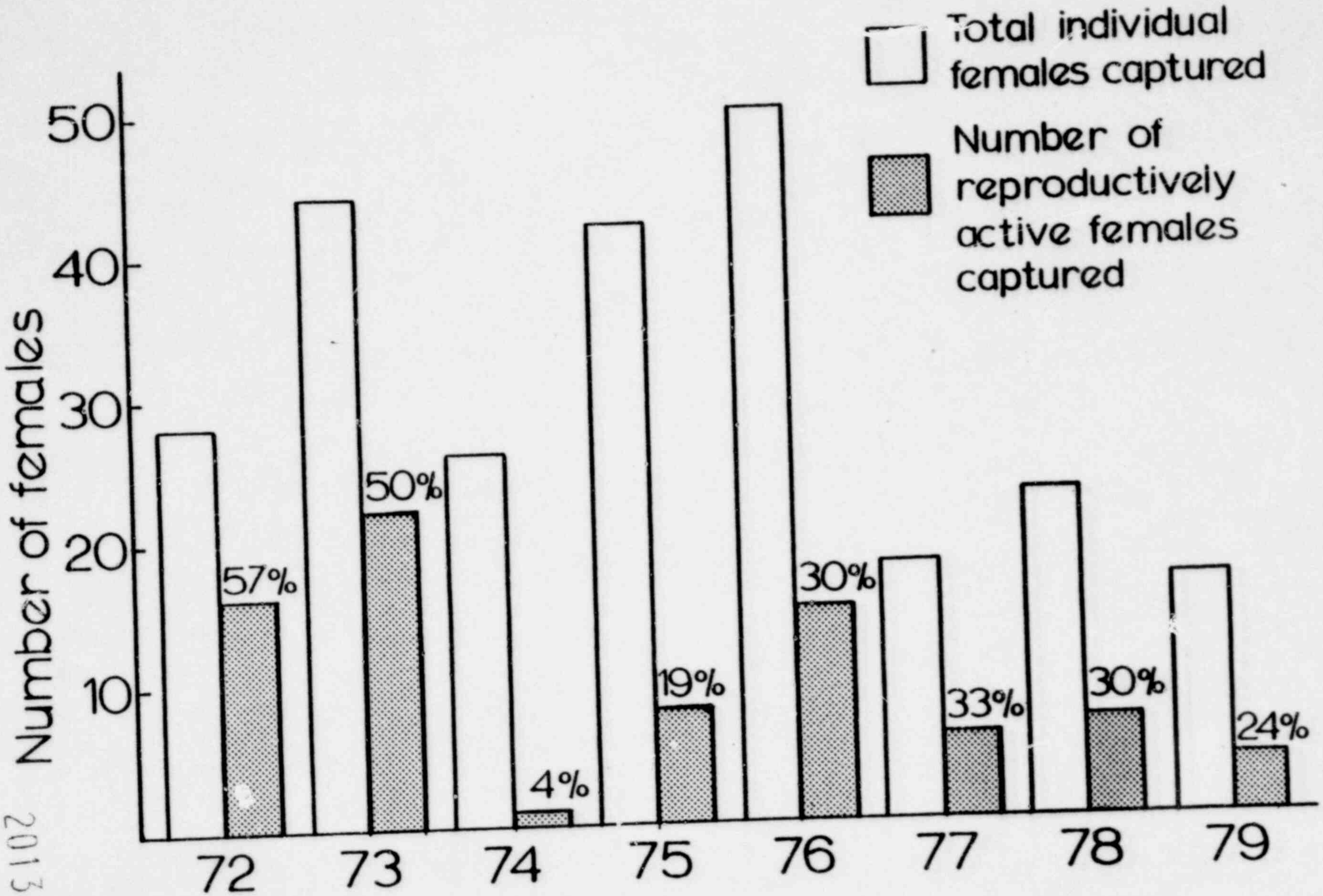
Total individual females captured
Number of reproductively active females captured
Number of females
50
40
30
20
10
57%
50%
4%
19%
30%
33%
30%
24%
72
73
74
75
76
77
78
79

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TERRESTRIAL INVERTEBRATES

by

J. Wayne Brewer

J. Bodenham

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Introduction

Terrestrial invertebrates have been collected from three sites near the Fort St. Vrain Nuclear Generating Station since April 1972. The samples were used to establish (1) an inventory of the area and (2) baseline population estimates of groups selected for the monitoring phase of the study. Previous reports indicate that minor increases in radiation probably do not adversely affect terrestrial invertebrates (Skaife 1968, Cadwell and Whicker 1972, Noordink 1970 and Bushland 1971), but that temperature changes could cause important alterations in species and populations (Wurtz 1969). Therefore, terrestrial invertebrate species and study areas were selected (Figure 1) that would be most greatly affected by the possible increases in environmental temperature.

Procedures

All general procedures used have been previously reported (Brewer 1973). A minor procedural change was instituted in January, 1979, when it was decided that the black light trap collections should be discontinued during the winter months of December, January, February and March. This procedure will be continued in future years. This report summarizes data collected from January 1 until June 30, 1979, and provides a comparison with data collected during the same periods of previous years.

Results and Discussion

Inventory: The species inventory was reported by Brewer (1973) and additional species were appended to the list later (Brewer 1978). Analysis

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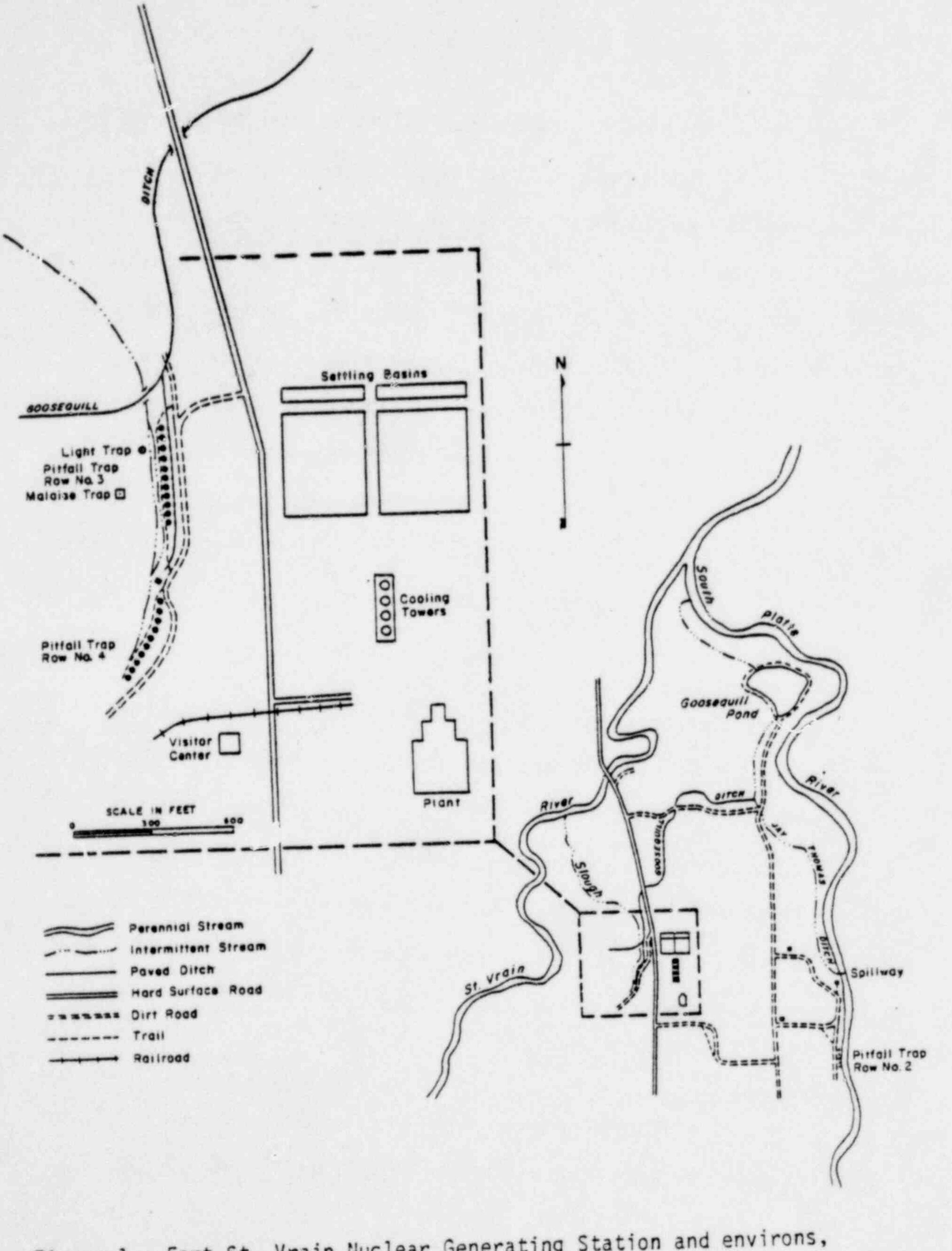

Figure 1. Fort St. Vrain Nuclear Generating Station and environs, showing invertebrate collection sites.

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of collections subsequent to 1978 have not revealed species new to the area.

Formicidae: The number of Formicidae collected during the period covered by this report, along with the range of numbers collected from 1976-1979, is presented in Table 1. Species identifications will be presented later.

No members of this group were collected during January or February. Thereafter numbers generally increased gradually at all three sample sites. This pattern is typical of invertebrates since they are generally less active during periods of low temperature.

Most of the individuals, over 90 percent through May count, were collected from the area around pitfall row 2, where the formicids have been abundant in previous years. Normally the June numbers for row 2 would be as high or higher than those for May, but heavy rains and flooding of the South Platte River coincided with the June collecting period and washed out the trap line. This has happened occasionally in past springs. Thus, the total for all rows in June is substantially lower than would be expected. The number of individuals collected in rows 3 and 4 during this semi-annual period was somewhat low as compared to previous years, although total population levels fall within the range of earlier collections.

Collembola: The Collembola collected in the pitfall traps are sent to a taxonomic specialist for identification and counts. The data for this period are not yet available and will be presented in a later report.

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Table 1. Number of Formicidae collected from pitfall traps at the Fort St. Vrain Nuclear Generating Station, Platteville, Co. January 1 - June 30, 1979[1].

Pitfall Trap Row	Jan. 13	Feb. 10	Mar. 10	Apr. 14	May 12	June 9
Row 2	0(0-0)	0(0-0)	0(0-34)	1820(1047-1857)	4456(1882-4188)	(658-2857)[2/]
Row 3	0(0-0)	0(0-4)	2(7-28)	69(44-248)	82(181-527)	297(130-224)
Row 4	0(0-1)	0(0-1)	4(2-96)	61(73-125)	122(106-150)	92(60-390)
Total	0(0-1)	0(0-4)	6(44-124)	1960(1215-1974)	4660(2169-4865)	389(848-3491)

	1979	1978	1977	1976
Annual Totals for this period (Jan. 1-June 30)	7005	7357	8487	5684

1/Figures in parenthesis are ranges of numbers collected 1976-1978.
2/No data for Row 2 due to flooding and loss of traps.

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Silpha ramosa: This carrion beetle is normally collected in relative high numbers in pitfall traps in the St. Vrain area. The high populations and food habits (Brewer and Bacon 1975) of this species make it an important part of the monitoring program. Brewer and Bacon (1975) suggested that changes in population levels of S. ramosa were correlated with the number of rodents available for food and that population levels of the beetle might be more related to rodent numbers than to other factors. Population levels of adult and immature beetles for this period, along with the range of numbers collected during comparable periods of previous years, is presented in Table 2. One adult beetle was collected in April, a month before any previous collection; thus it appears that emergence is somewhat early this year. Numbers of adult beetles are somewhat low for May and June, but fall within the range of earlier collections. The total collection for Jan. 1 - June 30 of 55 individuals is slightly lower than in any previous year for the period.

Immature beetles were not collected until June, and in rather low numbers. However, the numbers fall within ranges of earlier years, and are possibly due to the influence of the cool, rainy weather during the June collection period.

Araneida: Spiders generally are collected throughout the year and thus comprise an important part of the monitoring program, particularly during the winter when most terrestrial invertebrates are inactive. Seasonal fluctuations in spider populations for this period are shown in Table 3, along with the ranges for comparable periods of previous

Table 2. Number of adult and immature Silpha ramosa collected in pitfall traps near the Fort St. Vrain Nuclear Generating Station, Platteville, Colorado, January 1 - June 30, 1979[1/].

Adults

	Jan. 13	Feb. 10	Mar. 10	Apr. 14		May 12	June 9
Row 2	0(0-0)	0(0-0)	0(0-0)	0(0-0)		0(0-0)	-(0-0)[2/]
Row 3	0(0-0)	0(0-0)	0(0-0)	1(0-0)		2(13-61)	21(9-121)
Row 4	0(0-0)	0(0-0)	0(0-0)	0(0-0)		3(3-47)	28(4-78)
Total	0(0-0)	0(0-0)	0(0-0)	1(0-0)		5(16-108)	49(13-161)
Annual Totals for this period (Jan. 1-June 30)	1979	1978	1977	1976	1975	1974	1973
	55	60	254	221	150	61	62

Immature

	Jan. 13	Feb. 10	Mar. 10	Apr. 14		May 12	June 9
Row 2	0(0-0)	0(0-0)	0(0-0)	0(0-0)		0(0-0)	-(0-0)[2/]
Row 3	0(0-0)	0(0-0)	0(0-0)	0(0-0)		0(0-4)	10(4-282)
Row 4	0(0-0)	0(0-0)	0(0-0)	0(0-0)		0(0-1)	12(2-78)
Total	0(0-0)	0(0-0)	0(0-0)	0(0-0)		0(0-5)	22(12-360)
Annual Totals for this period (Jan. 1-June 30)	1979	1978	1977	1976	1975	1974	1973
	22	18	365	241	60	12	201

1/Figures in parenthesis are ranges of numbers collected 1973-1977.
2/No data for Row 2 due to flooding and loss of traps.

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Table 3. Number of Araneida collected in pitfall traps near the Ft. St. Vrain Nuclear Generating Station, Platteville, Colorado, January 1 - June 30, 1979[1/].

	Jan. 13	Feb. 10	Mar. 10	Apr. 14	May 12	June 9
Row 2	1(1-19)[2/]	1(7-122)	17(7-59)[2/]	33(16-82)	33(70-173)	-(15-201)[3/]
Row 3	7(4-33)	0(5-74)	30(17-193)	58(43-132)	36(154-299)	208(33-372)
Row 4	0(3-32)	9(2-54)	77(72-391)	24(21-145)	42(61-320)	169(48-244)
Total	8(10-84)	1(11-193)	77(72-391)	115(127-307)	111(396-609)	377(119-731)

Annual Totals for this period (Jan. 1 - June 30)	1979	1978	1977	1976	1975	1974[4/]	1973[4/]
	689	919	1608	1721	1015	1333	1473

1/Figures in parenthesis are ranges of numbers collected 1973-1977.

2/Traps disturbed by cows.

3/No data for Row 2 due to flooding and loss of traps.

4/Collection procedures differed somewhat during 1973 and 1974 and the data may not be directly comparable.

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years. The data indicate that population levels of spiders are considerably lower than for previous years. Although collections for most months fall with the range expected for that period they are consistently at the low end of the range.

The collection for June showed good increases for rows 3 and 4, but the loss of the row 2 collection kept the total for the month low. Thus, low spider populations in early months and loss of row 2 data in June combined to give the lowest total for the 6 month period since the study was begun.

Tricoptera: The Tricoptera are aquatic during the immature stages and could be adversely affected by changes in water or temperature, created by operation of the Fort St. Vrain Nuclear Generating Station. The short-lived, nocturnal adults are collected in large numbers during the summer by the black light trap. Data on the collections of Tricoptera for this period are shown in Table 4. A few adult forms have been collected in early May of past years but most do not emerge until later in the summer. Thus it is not unusual that this group was not abundantly represented in the collections for this period.

Heteroceridae: The mud loving beetles live in the shores of ponds and streams. Like Tricoptera they would be affected by changes in water or environmental temperature. Also, like Tricoptera the nocturnal adults are collected in large numbers in the black light trap. Data on the collections of Heteroceridae are presented in Table 5. One heterocerid occurred in the May collection this year. These beetles have been collected this

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Table 4. Number of Tricoptera collected from a black light trap near the Ft. St. Vrain Nuclear Generating Station, Platteville, Colorado, January 1 - June 30, 1979[1/].

Jan.[2/]	Feb.[2/]	Mar.[2/]	Apr. 7	May 5	June 2
-(0-0)	-(0-0)	-(0-0)	0(0-0)	0(0-2)	1(0-61)

	1979	1978	1977	1976	1975	1974	1973
Annual Totals for this period (Jan. 1-June 30)	1	1	63	6	0	0	1

1/Figures in parenthesis are ranges of numbers collected 1973-1977.

2/Black light trap not set out during these months as outlined in procedural revisions submitted to Dr. Fred Glover.

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Table 5. Number of Heteroceridae collected from a black light trap near the Ft. St. Vrain Nuclear Generating Station, Platteville, Colorado, January 1 - June 30, 1979[1/].

Jan.[2/]	Feb.[2/]	Mar.[2/]	Apr. 7	May 5	June 2
-(0-0)	-(0-0)	-(0-0)	0(0-0)	1(0-28)	69(0-626)

	1979	1978	1977	1976	1975	1974	1973
Annual Totals for this period (Jan. 1-June 30)	70	0	654	0	0	0	0

1/Figures in parenthesis are ranges of numbers collected 1973-1977.

2/Black light trap not set out during these months.

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early in previous years but infrequently. They usually are not common until mid-summer. This collection tends to support the indication of a general early emergence of terrestrial invertebrates in the area suggested by the data on Silpha ramosa. The June collection is low but within the range of numbers collected in previous years.

Data obtained on terrestrial invertebrates during this sampling period indicate no discernible effects from the Nuclear Generating Station.

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