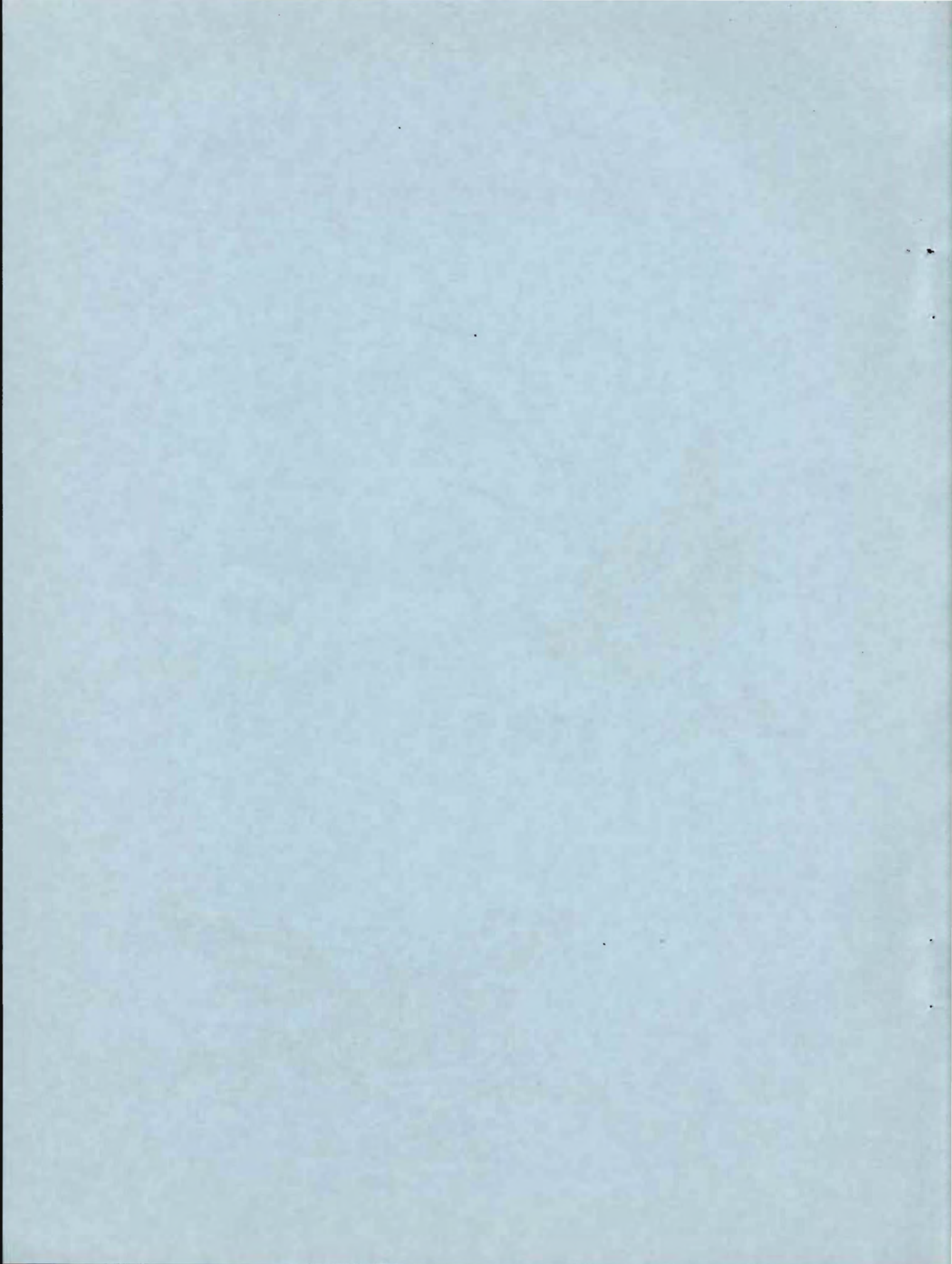


NEW ROCKFORD STUDIES







## INTRODUCTION

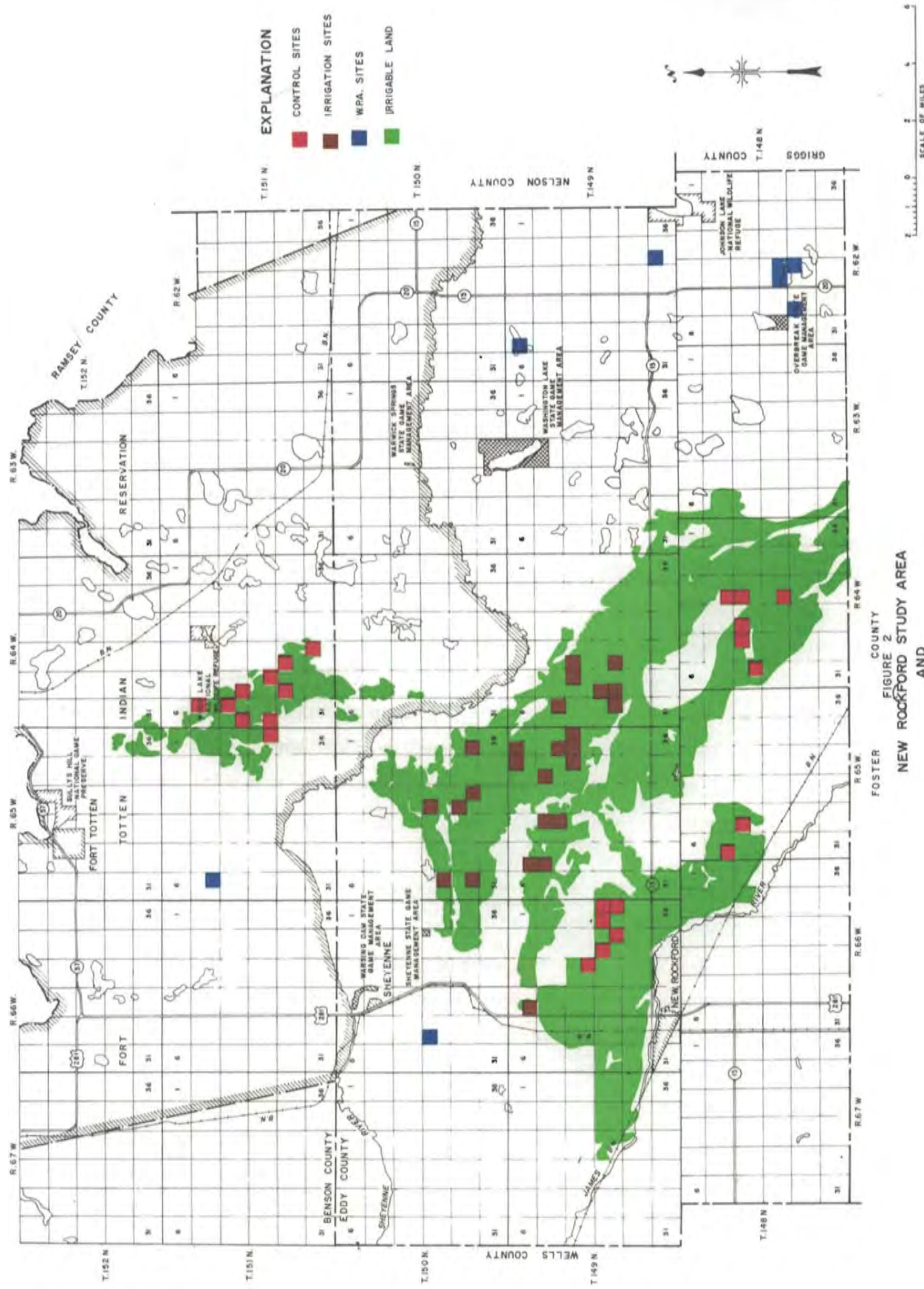
Studies were initiated in 1978 to determine the impacts of sprinkler irrigation development on wildlife as a result of GDU. The objective is to determine the relative abundance and distribution of wildlife and wildlife habitat in an area planned for irrigation development, and to monitor relative abundance and distribution until wildlife populations adjust to the more intensive irrigation agriculture.

### New Rockford Study Area

The New Rockford study area is described in the FSSES 79-7 (USDI 1979). The area consists of 8,472 irrigable hectares (20,935 acres) located northeast of New Rockford in Eddy County (Figure 2). The area is predominantly agricultural, and consists of 69 percent cropland, 22 percent grassland, 6 percent wetland, and 2 percent planted trees. Some private irrigation is being developed in the area. The New Rockford irrigation area consists of mostly fine sandy soil, overlying medium to coarse sands and gravel. The adjacent control areas in Eddy and Benson Counties have sandy types of soil, but an exact subsoil match for a similar sized area was not possible.

### Study Site Selection

Study sites were selected to sample at least 10 percent of the total arable land in the proposed New Rockford irrigation area. The random selection of 25 quarter section study sites allowed approximately 12 percent coverage. An equal number of control sites were randomly selected for comparison of data, but right-of-way (ROW) could not be obtained on all sites. Also, ROW was restricted on some sites after studies were begun. Therefore, the number of control sites varies from 23 to 24 depending on the study. In addition, 8 WPA quarter sections were selected to provide comparative information on areas managed for wildlife (Figure 2).



FOSTER COUNTY  
 FIGURE 2  
 NEW ROCKFORD STUDY AREA  
 AND  
 1979 SITE LOCATIONS



### Parameters Studied

The following 1978 studies were continued in the New Rockford study area in 1979:

- Land Use and Habitat
- Residual Vegetation
- Breeding Birds
- Roadside Bird Survey
- Waterfowl
- Raptors
- Mammalian Predators
- Deer
- Small Mammals

In addition, mourning dove and prairie grouse surveys were initiated in 1979 in the New Rockford Area. Progress reports on each New Rockford study are presented in this section.

### Terminology

In this section, the term irrigation area refers to areas proposed for irrigation. At this time, actual GDU irrigation development has not taken place.

Random irrigation quarter section study sites are referred to as irrigation quarters in this report. Study sites in the control area and on WPA quarter sections are referred to as control quarters and WPA quarters, respectively.

### Scope of New Rockford Studies

These studies are designed to monitor wildlife populations in the New Rockford study area for several years (construction dates are not yet firmly established) before irrigation development and for a minimum of 5 years after the study area is irrigated. Data will document the impacts of sprinkler irrigation on wildlife, and determine what changes occur. Interim data obtained can be used by WPRS planning to design irrigation systems that are more compatible with the wildlife resource.

## METHODS

Techniques used in the in 1979 were, for the most part, standardized techniques used in other studies conducted in the Prairie Pothole Region. Details of the 1979 techniques are contained in a manual (unpublished 1979) for use by field personnel. The following is a brief description of the techniques used in the New Rockford Area.

### Land Use and Habitat

The study sites were covermapped and habitats recorded as described in the 1978 annual report using photographs taken in May 1979. The sites were individually checked in July and November of 1979 to record changes which occurred during the season.

### Residual Vegetation

Residual vegetation (vegetation remaining after winter) was measured on quarter section study sites between April 25 and May 14, 1979. The height-density of residual vegetation of specific habitats was measured using visual obstruction methods described by Robel, et al. (1970).

### Breeding Birds

The methods used in 1979 were the same as those in 1978 using techniques developed by Stewart and Kantrud (1972). Each study site was surveyed once between May 13 and June 2, 1979, and once between June 18 and July 8, 1979.

### Roadside Bird Survey

Roadside bird surveys were conducted June 11-14 in the irrigation area and the control areas (Figure 3). Methods were based on the standard instructions for the Cooperative Breeding Bird Survey of North America (available from the Migratory Bird and Habitat Research Laboratory, Laurel, Maryland).

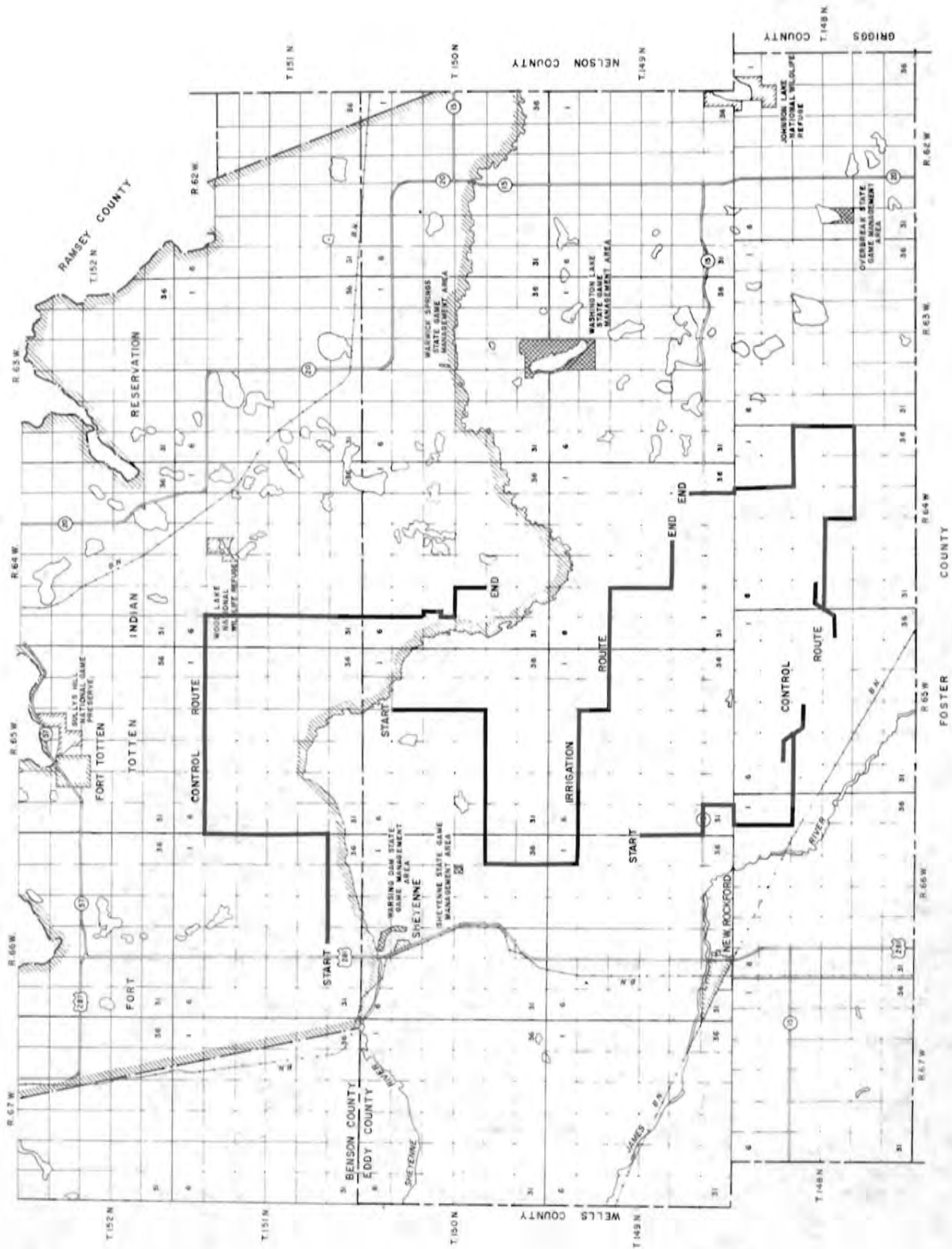


FIGURE 3  
1979 ROUTES  
ROADSIDE BIRD TRANSECTS  
NEW ROCKFORD STUDY AREA

FOSTER COUNTY

## Waterfowl

Three types of waterfowl censuses were conducted in the study area in 1979: ground breeding pair counts, aerial breeding pair counts, and a cable-chain drag nest search. Both the aerial breeding pair counts and the nest search were pilot studies to evaluate their suitability for monitoring changes in waterfowl populations related to irrigation development in the area.

### Breeding Duck Study (Ground)

Two breeding pair counts were conducted in 1979: the first, during May 9-14, censused early nesting species (mallard, pintail, and canvasback) and the second, during May 27-31, censused late nesting species (all other ducks). Techniques followed those of Hammond (1969).

### Breeding Duck Study (Aerial)

Two aerial breeding pair counts were conducted in 1979 to coincide with the ground breeding pair counts. Techniques generally followed those of the U.S. Fish and Wildlife Service (USFWS 1977). Sixteen percent of the 324 km<sup>2</sup> (125 mi<sup>2</sup>) study area was censused during the aerial breeding pair census with 212 km (82 mi) of transects (Table 1). Ground checks were made on May 10 and 12 for the first count and on May 29 for the second count to calculate visibility rates for each species.

### Nest Search

A single nest search was conducted on selected study quarters in the study area between June 6 and June 10 using cable-chain search techniques (Higgins, et al. 1977).

## Mourning Doves

Mourning dove censuses were initiated in the study area in 1979. Two 32-km (20-mi) transect routes were established, one each in the control



Table 1

TRANSECT DATA, AERIAL DUCK PAIR CENSUS

New Rockford Study Area - 1979

<u>Area</u>	<u>Total Area (km<sup>2</sup>)</u>	<u>Transect Length (km)</u>	<u>Total Transect Area (km<sup>2</sup>)</u>	<u>Total Area Sampled (%)</u>
Irrigation	113.2	46.67	18.78	16.6
Control	<u>210.8</u>	<u>85.30</u>	<u>34.32</u>	<u>16.3</u>
TOTALS	324.0	131.97	53.10	16.4

and irrigation areas. Both routes are within the arable land of the study area. The survey procedures followed those described by the U.S. Fish and Wildlife Service on Form 3-159 (1973, available from Office of Migratory Bird Management, Laurel, Maryland).

#### Prairie Grouse

Listening routes were established in the study area; however, heavy snow and blowing wind conditions prevented a systematic search. When possible, searches were made, and any observations of prairie grouse were noted during the spring and throughout the summer.

#### Raptors

Raptor survey methods were modified from those used in 1978, and consisted of nest searches conducted over a 124-km<sup>2</sup> (48-mi<sup>2</sup>) block. Two nest searches were conducted, one during the last week of April and the first week of May, and a second from the third week in June through the first week of July.

Nests located during the performance of other studies were also recorded. Pairs observed in preliminary territorial displays, but which did not nest at that particular site, were recorded but are not included in totals.

#### Mammalian Predators

Field procedures for predator scent station surveys outlined by Linhart and Knowlton (1975) were used in 1978 and modified for use on smaller study areas in 1979 as described by Roughton (1979, in press). Surveys were conducted during the second week of September. A total of 24 survey lines were established. Twelve lines each were located in both the irrigation and control areas.

## Deer

Aerial and spotlight surveys were conducted in Benson and Eddy Counties. The aerial survey was conducted on February 28, 1979, when snow cover was considered adequate throughout the entire study area. Transects were flown at 1.6-km (1-mi) intervals over the entire study area plus 44 km (17 mi) of the Shyenenne River adjacent to the study area.

The spotlight survey was conducted July 17-19, 1979. The control routes comprised a total of 58 km (36 mi). The proposed irrigation route consisted of 61 km (38 mi).

## Small Mammals

The small mammals survey techniques were changed from those used in 1978. The 1979 sampling method used a line transect of snap traps similar to that used by Golley, et al. (1965). The sampling was conducted over a 10-day period in April. Trapping was conducted immediately after snowmelt to provide an index of the abundance and distribution of species prior to reproduction. All specimens were dissected for analyses of sex, age, and reproductive characters.

## RESULTS AND DISCUSSION

### Land Use and Habitat

The data from 1979 are tabulated in Table 2. The control and irrigation sites are similar: cropland comprises about 70 percent of the sites, grasslands occupy 15 to 20 percent, and wetlands 8 to 12 percent. WPA sites were dominated by grassland (51.8 percent) and wetland habitats (43.6 percent).

Only the irrigation sites are directly comparable between 1978 and 1979 because of site changes in the control and WPA sites. In the irrigation area, the largest change was a 36 percent (35-ha or 86-acre) reduction in grassland acreage between fall 1978 and July 1979. This is approximately balanced by the 32 percent (23-ha or 57-acre) increase in wetland



Table 2

LAND USE - NEW ROCKFORD, 1979

	Control		Irrigation				WPA		1979 Total	
	24 Sites Ha	Percent	1978 25 Sites Ha	Percent	1979 25 Sites Ha	Percent	8 Sites Ha	Percent	57 Sites Ha	Percent
Agricultural	1,100.9	70.9	1,114.5	69	1,111.4	69.7	17.30	3.3	2,229.7	60.7
Grassland	307.8	19.8	327.8	20	240.8	15.1	270.90	51.8	819.5	22.3
Brush	1.1	0.1	0.8	T <sup>1/</sup>	0.9	0.1	-0-	-0-	2.0	0.1
Trees	6.6	0.4	43.3	3	33.2	2.1	7.00	1.3	46.8	1.3
Wetland	131.7	8.5	118.6	7.0	175.0	11.0	227.90	43.6	534.5	14.6
Misc.	4.1	0.3	15.4	1.0	31.0	1.9	0.04	T	35.1	1.0
TOTAL	1,552.2		1,620.4		1,592.3		523.2		3,667.6	

1/ T equals trace or less than 0.1 percent.

acreage, probably the result of the heavy winter snows and a late spring.

#### Residual Vegetation

Four thousand seven hundred and sixteen visual obstruction measurements and 1,179 vegetation height measurements were made in 1979 (Table 3). Measurements were taken in 63 fields totaling 1,022 ha (2,525 acres) on 37 study quarters. Seven grassland and two agricultural habitats, which included five different treatments, were sampled (Table 3). Vegetation height-density and height varied with both vegetation type and treatment. The average overall height-density in all fields was 0.38 dm (1.5 in) and ranged from 0.0 dm in harvested small grains, legumes, and heavily grazed mixed grasslands to 1.85 dm (7.3 in) in a field of seeded nesting cover. Generally, grazed areas had the lowest height densities followed by harvested and idle habitats (Figure 4). Heavily grazed habitats had the lowest height density, 0.04 dm (0.2 in) compared to lightly grazed areas, 0.17 dm (0.7 in) and moderately grazed habitats, 0.32 dm (1.3 in). Moderately grazed habitats had a greater height-density than lightly grazed areas because of the inclusion of two fields of grassland-brush habitats, 0.52 dm (2.0 in) in the moderately grazed sample. Harvested habitats (small grains, legumes, and hayed grasslands) had an average height-density of 0.20 dm (0.8 in) compared to 0.68 dm (2.7 in) for all idle habitats. Vegetation height measurements generally showed the same relationship to habitat and treatment as visual obstruction measurements. Height readings were positively correlated with height-density readings ( $r=.776$ ,  $p<.01$ ).

Residual vegetation measurements will be correlated with wildlife population data and covermapping information to more accurately describe changes in wildlife populations and habitat associated with irrigation development.

Table 3

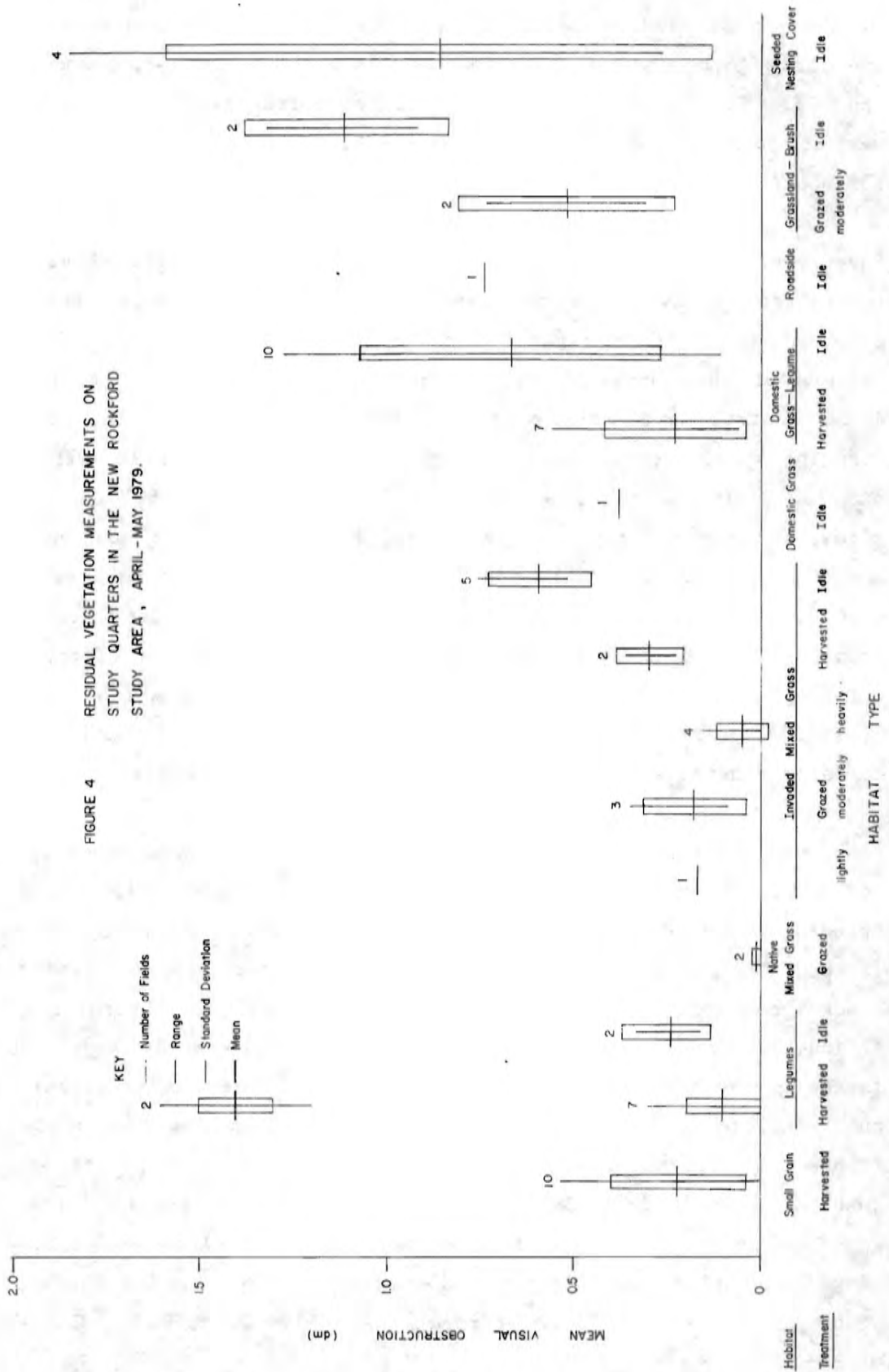
## VISUAL OBSTRUCTION AND HEIGHT MEASUREMENT OF RESIDUAL VEGETATION ON STUDY QUARTERS

New Rockford Study Area - 1979

Habitat - Treatment	Hectares	Fields	Visual Obstruction (dm)				Height (dm)					
			No.	Mean	Std. Dev.	Field Mean Min. Max.	No.	Mean	Std. Dev.	Field Mean Min. Max.		
<b>AGRICULTURAL</b>												
Small Grain - Harvested	132.1	10	436	.22	.18	.00	.53	109	2.00	.55	1.05	2.81
Legumes - Harvested	66.5	7	520	.10	.10	.00	.30	130	2.37	.90	1.36	3.74
- Idle	45.5	2	92	.25	.12	.16	.33	23	3.26	.29	3.05	3.46
Subtotal (Legumes)	112.0	9	612	.13	.12	.00	.33	153	2.57	.87	1.36	3.74
Total	244.1	19	1,048	.18	.16	.00	.53	262	2.28	.75	1.05	3.74
<b>GRASSLAND</b>												
Native Mixed Grass - Heavily grazed	93.0	2	44	.01	.01	.00	.01	11	1.77	.54	1.25	2.29
Invaded Mixed Grass - Lightly grazed	30.6	1	100	.17	--	--	--	25	3.33	--	--	--
- Moderately grazed	85.1	3	300	.18	.14	.09	.35	75	3.17	.49	2.81	3.73
- Heavily grazed	45.1	4	290	.05	.07	.00	.16	70	2.64	.98	1.31	3.35
- Harvested	9.2	2	200	.30	.09	.23	.36	50	1.81	.35	1.56	2.05
- Idle	52.2	5	404	.59	.14	.45	.76	101	4.22	.78	2.84	4.69
Subtotal (Invaded Mixed Grass)	222.2	15	1,284	.30	.25	.00	.76	321	3.21	1.08	1.31	4.69
Domestic Grass - Idle	7.9	1	100	.38	--	--	--	25	2.18	--	--	--
Domestic Grass/Legume - Harvested	140.7	7	460	.23	.19	.06	.56	115	2.52	1.30	1.25	4.24
- Idle	154.3	10	1,000	.67	.40	.11	1.28	250	4.78	1.34	3.15	6.64
Subtotal (Domestic Grass/Legume)	295.0	17	1,460	.49	.39	.06	1.28	365	3.85	1.72	1.25	6.64
Roadside - No treatment	39.4	1	100	.74	--	--	--	25	3.37	--	--	--
Grassland/Brush - Moderately grazed	59.2	2	200	.52	.29	.31	.73	50	4.63	.05	4.59	4.66
- Idle	24.8	2	200	1.11	.27	.92	1.30	50	4.18	.54	3.80	4.56
Subtotal (Grassland/Brush)	84.0	4	400	.81	.41	.31	1.30	100	4.40	.40	3.80	4.66
Seeded Nesting Cover - Idle	35.9	4	280	.86	.73	.27	1.85	70	7.41	1.54	5.45	8.71
Total	777.4	44	3,668	.47	.42	.00	1.85	917	3.86	1.81	1.25	8.71
<b>TOTAL</b>	1,021.5	63	4,716	.38	.38	.00	1.85	1,179	3.39	1.73	1.05	8.71



FIGURE 4 RESIDUAL VEGETATION MEASUREMENTS ON STUDY QUARTERS IN THE NEW ROCKFORD STUDY AREA, APRIL - MAY 1979.



## Breeding Birds

The number of birds observed on a study site ranged from a maximum of 568 birds to a minimum of 41 in comparison to 580 and 52, respectively, in 1978. The maximum number of indicated pairs was 252 and the minimum was 18 compared to 202 and 17 in 1978. A total of 18,456 birds of 137 species was observed on the study sites.

Seventy-seven species (compared to 83 in 1978) exhibited breeding or territorial behavior on the study sites. Seventy-one of these were recorded on either irrigation or control sites (Table 4). The populations of the total irrigation area ( $84.72 \text{ km}^2$  or  $32.71 \text{ mi}^2$ ) and an equal control area were projected for these species. The number of breeding species on a quarter section ranged from 2 to 38, with a mean of 17. In 1978, the range was 3 to 37, with a mean of 16. WPA study sites, which are managed for wildlife, had the greatest mean number of breeding species (28). The control and irrigation sites had means of 14 and 18, respectively. In 1978, the irrigation sites had a mean of 15. Because of site changes, WPA and control sites are not directly comparable from last year to this year. Those species which totaled at least 100 recorded pairs during 1978 or 1979 are shown in Table 5, which compares density and habitat preferences for those species.

Four species (horned lark, red-winged blackbird, grasshopper sparrow, and savannah sparrow) comprised 35 percent of the total number of breeding pairs recorded. This compares to 1978's four major species (horned lark, red-winged blackbird, clay-colored sparrow, and brown-headed cowbird) which comprised 38 percent of the breeding pairs. Agriculture comprises the major land use in the study area. Horned larks are the predominant species associated with agricultural lands and, therefore, are the most abundant species in the study area (Table 5). Grasshopper and savannah sparrows were the most abundant species recorded in grassland habitats, with more than half the indicated pairs for those species recorded there. Yellow-headed and red-winged blackbirds were the most abundant species recorded for wetlands with  $52.6 \text{ pairs/km}^2$  ( $136.2 \text{ pairs/mi}^2$ ) and  $51.0 \text{ pairs/km}^2$  ( $132.1 \text{ pairs/mi}^2$ ), respectively.

Table 4

BREEDING BIRD DENSITY AND POPULATIONS PROJECTED TO 84.72 KM<sup>2</sup>  
IRRIGATION AND CONTROL SITESNew Rockford Study Area - 1979

Species	Irrigation		Control	
	Pairs/km <sup>2</sup>	Projected Population	Pairs/km <sup>2</sup>	Projected Population
Horned lark	20.38	1,727	20.78	1,761
Savannah sparrow	9.64	816	5.53	469
Brown-headed cowbird	8.21	696	4.96	420
Red-winged blackbird	8.09	686	6.50	551
Clay-colored sparrow	6.61	560	2.18	185
Grasshopper sparrow	6.49	549	11.57	981
Bobolink	6.42	544	8.17	692
Blue-winged teal	4.20	356	1.61	136
Mourning dove	4.14	351	2.96	251
Western meadowlark	3.89	330	4.57	387
Common yellowthroat	3.77	319	0.39	33
Chestnut-collared longspur	3.64	309	11.26	954
Vesper sparrow	2.90	246	1.68	142
Yellow-headed blackbird	2.78	235	0.32	27
Barn swallow	2.16	183	0.06	5
House wren	1.85	157	0.39	33
Pintail	1.79	152	1.16	98
Wilson's phalarope	1.61	136	0.84	71
Mallard	1.48	126	0.65	55
Eastern kingbird	1.42	120	0.71	60
Common grackle	1.17	99	1.81	153
Northern shoveler	1.11	94	0.77	65
American robin	1.11	94	0.13	11
Least flycatcher	1.05	89	0.06	5
Western kingbird	0.93	78	0.65	55
Killdeer	0.93	78	1.10	93
Brewer's blackbird	0.80	68	—	—
Brown thrasher	0.80	68	0.32	27
American goldfinch	0.80	68	0.06	5
Common snipe	0.74	63	—	—
Dickcissel	0.62	52	0.26	22
House sparrow	0.62	52	0.45	38



Table 4 cont.

Species	Irrigation		Control	
	Pairs/km <sup>2</sup>	Projected Population	Pairs/km <sup>2</sup>	Projected Population
American coot	0.56	47	--	--
Black-billed cuckoo	0.49	42	0.13	11
Common flicker	0.43	37	--	--
Song sparrow	0.43	37	--	--
Gadwall	0.37	31	0.58	49
Green-winged teal	0.37	31	0.26	22
Starling	0.37	31	0.13	11
Sora	0.31	26	0.32	27
Blue jay	0.31	26	--	--
Cedar waxwing	0.31	26	--	--
Brewer's blackbird	0.31	26	--	--
Redhead	0.25	21	0.19	16
Canvasback	0.25	21	--	--
Upland sandpiper	0.25	21	0.77	65
Northern oriole	0.25	21	0.13	11
Baird's sparrow	0.25	21	1.03	87
Sharp-tailed sparrow	0.25	21	--	--
Chipping sparrow	0.25	21	--	--
Marbled godwit	0.19	16	0.13	11
Common crow	0.19	16	0.13	11
Swainson's hawk	0.12	10	--	--
Willet	0.12	10	--	--
Willow flycatcher	0.12	10	0.26	22
Long-billed marsh wren	0.12	10	0.19	16
Gray catbird	0.12	10	--	--
Yellow warbler	0.06	5	0.06	5
American bittern	0.06	5	0.06	5
American avocet	0.06	5	0.06	5
American wigeon	0.06	5	0.13	11
Red-tailed hawk	0.06	5	--	--
Red-headed woodpecker	0.06	5	--	--
Great crested flycatcher	0.06	5	--	--
Say's phoebe	0.06	5	--	--
Black-capped chickadee	0.06	5	--	--
LeConte's sparrow	0.06	5	0.26	22
Ring-necked duck	--	--	0.06	5
Lesser scaup	--	--	0.06	5
Orchard oriole	--	--	0.19	16
Warbling vireo	--	--	0.06	5
TOTAL	120.87	10,204 (67 species)	97.12	8,228 (53 species)

Table 5

## MAJOR BREEDING SPECIES DENSITY AND BREEDING HABITAT PREFERENCE

	Agricultural (2,229.71 ha)		Grassland (819.45 ha)		Wetland (537.60 ha)		Trees (46.79 ha)		Irr. Cropland (35.77 ha)		Human Hab. (18.52 ha)		Irr. Trees <sup>2/</sup> (14.88 ha)		Brush (1.99 ha)		Misc. (1.40 ha)		
	Prs/km <sup>2</sup>	%	Prs/km <sup>2</sup>	%	Prs/km <sup>2</sup>	%	Prs/km <sup>2</sup>	%	Prs/km <sup>2</sup>	%	Prs/km <sup>2</sup>	%	Prs/km <sup>2</sup>	%	Prs/km <sup>2</sup>	%	Prs/km <sup>2</sup>	%	
Horned lark	26.7	90.6	7.4	9.3	--	--	--	--	2.8	0.2	--	--	--	--	--	--	--	--	
Red-winged blackbird	1.0	5.8	6.0	13.0	51.0	72.5	34.2	4.2	--	--	--	--	--	--	703.5	3.7	214.3	0.8	
Clay-colored sparrow	0.2	1.8	13.1	49.3	0.2	0.5	141.1	30.4	--	--	--	--	215.1	15.2	201.0	0.2	142.9	0.9	
Grasshopper sparrow	6.7	45.3	21.2	52.6	0.9	1.5	4.3	0.6	--	--	--	--	--	--	--	--	--	--	
Savannah sparrow	3.0	19.9	21.6	53.5	15.1	24.5	4.3	0.6	2.8	0.3	--	--	--	--	201.0	1.2	--	--	
Brown-headed cowbird	2.5	20.2	10.4	30.7	12.1	23.5	102.6	17.3	--	--	5.4	0.4	26.9	1.4	753.8	5.4	214.3	1.1	
Chestnut-collared longspur	5.5	48.8	15.5	50.8	--	--	--	--	--	--	--	--	6.7	0.4	--	--	--	--	
Western meadowlark	1.1	15.2	12.6	62.4	2.4	7.9	23.5	6.7	11.2	2.4	10.8	1.2	20.2	1.8	50.3	0.6	214.3	1.8	
Yellow-headed blackbird	--	--	--	--	52.6	100.0	--	--	--	--	--	--	--	--	--	--	--	--	--
Common yellowthroat	0.8	11.7	3.3	18.6	10.4	38.6	70.5	22.8	--	--	5.4	0.7	40.3	4.1	251.3	3.4	--	--	
Mourning dove	0.4	6.3	0.5	3.1	0.2	0.8	209.4	77.2	--	--	10.8	1.6	33.6	3.9	452.3	7.1	--	--	
Bobolink	5.9	50.0	15.3	47.3	0.9	1.9	4.3	0.8	--	--	--	--	--	--	--	--	--	--	
Vesper sparrow	1.2	35.5	1.2	13.2	--	--	64.1	39.5	--	--	5.4	1.3	33.6	6.6	100.5	2.6	71.4	1.3	
Common grackle	--	--	--	--	98.3	90.2	--	--	--	--	10.8	3.9	--	--	150.8	5.9	--	--	
Blue-winged teal	0.1	1.0	1.3	5.7	32.6	90.2	2.1	0.5	--	--	--	--	--	--	251.3	2.6	--	--	

1/ Percent of indicated pairs.

2/ Trees adjacent to irrigated fields.

The breeding pairs of each species recorded in 1978 and 1979 on the irrigation sites were compared. Only four species (gadwall, blue-winged teal, pintail, and Wilson's phalarope), all wetland associated, showed significant increases ( $p < .05$ ). This agrees with the covermapping data from 1978 and 1979, which shows an increase in wetland hectarage. No species showed a significant decrease.

There were more bird species in the irrigation area than the control area. Five of the six species that occurred in substantially greater abundance in the control area were grassland associated species (grasshopper sparrow, bobolink, chestnut-collared longspur, upland sandpiper, and Baird's sparrow). This agrees with the land use and habitat data collected in 1979, which shows grassland habitat more abundant in the control area (15.1 percent of irrigation sites versus 19.8 percent of the control sites).

Stewart and Kantrud (1972) estimated the mean density of selected species statewide. Table 6 shows how the densities in the New Rockford study area compare to statewide estimates. Two species (bobolink and grasshopper sparrow) have substantially higher densities in the New Rockford study area than statewide data indicates. All other species show either similar or lower densities.

#### Roadside Bird Survey

In 1979, 908 individuals of 48 species were observed on the irrigation route, 701 individuals of 45 species on the north control route, and 921 individuals of 44 species on the south control route. Thirty-eight (63 percent) of 60 species occurred in approximately similar numbers and at a similar number of stops along the irrigation and control routes in 1979.

Table 7 compares the abundance of the species observed on the 1979 routes with that observed in 1978. Comparisons between years were not possible for the south control route as it was first used in 1979.



Table 6

## BREEDING BIRD DENSITIES

Species	Stewart and Kantrud (1972)		This Study (1979)	
	Statewide Mean Density (prs/km <sup>2</sup> )		Irr. Sites (prs/km <sup>2</sup> )	Con. Sites (prs/km <sup>2</sup> )
Mallard	2.59	1.48	0.65	
Gadwall	1.19	0.62	0.58	
Pintail	2.09	1.79	1.16	
Green-winged teal	0.59	0.37	0.26	
Blue-winged teal	3.72	4.20	1.61	
Northern shoveler	1.10	1.11	0.77	
American wigeon	0.31	0.06	0.13	
Marsh hawk	0.19	—	—	
Gray partridge	0.20	—	—	
Sora	0.36	0.31	0.32	
American coot	4.18	0.56	—	
Killdeer	1.26	0.93	1.10	
Upland sandpiper	0.75	0.25	0.77	
Willet	0.22	0.12	—	
Marbled godwit	0.20	0.19	0.13	
Wilson's phalarope	0.94	1.61	0.84	
Black tern	1.49	0.37	0.06	
Mourning dove	3.51	4.14	2.96	
Common flicker	0.49	0.43	—	
Eastern kingbird	1.95	1.42	0.71	
Western kingbird	1.22	0.93	0.65	
Willow flycatcher	0.34	0.12	0.26	
Horned lark	14.91	20.38	20.32	
Barn swallow	1.18	2.16	0.06	
Common crow	0.36	0.19	0.13	
House wren	0.65	1.85	0.39	
Gray catbird	0.58	0.12	—	
Brown thrasher	0.50	0.80	0.32	
American robin	0.84	1.11	0.13	
Yellow warbler	1.32	0.06	0.06	
Common yellowthroat	1.60	3.77	0.39	
House sparrow	1.29	0.37	0.45	
Bobolink	2.57	6.42	8.17	
Western meadowlark	10.98	3.89	4.57	
Yellow-headed blackbird	1.12	2.78	0.32	
Red-winged blackbird	11.44	8.09	6.50	
Northern oriole	0.25	0.25	0.13	
Common grackle	1.86	1.17	1.81	
Brown-headed cowbird	5.46	8.21	4.96	
American goldfinch	1.28	0.80	0.07	
Rufous-sided towhee	1.19	—	—	
Lark bunting	7.21	—	—	
Savannah sparrow	6.24	9.64	5.53	
Grasshopper sparrow	3.52	6.49	11.57	
Baird's sparrow	2.02	0.25	1.03	
Vesper sparrow	2.44	2.90	1.68	
Lark sparrow	0.55	—	—	
Clay-colored sparrow	4.35	6.61	2.18	
Song sparrow	0.65	0.43	—	
Chestnut-collared longspur	13.45	3.64	11.26	

Table 7

## SPECIES ABUNDANCE - ROADSIDE BIRD SURVEY (1978-1979)

Species	Irrigation Route			North Control Route			South Control Route		
	1978	1979	% Change	1978	1979	% Change	1978	1979	% Change
	# Observ.	# Stops		# Observ.	# Stops		# Observ.	# Stops	
Double-crested cormorant	--	--	--	3	1	--	--	1	--
Black-crowned night heron	--	--	--	--	--	--	1	1	--
American bittern	--	1	--	--	--	--	1	1	--
Mallard	2	1	+50.0	9	4	-44.4	5	1	4
Gadwall	--	5	--	--	--	--	7	4	--
Pintail	--	7	--	--	--	--	2	1	--
Blue-winged teal	--	5	--	4	2	+175.0	11	5	2
American wigeon	--	--	--	--	--	--	--	--	1
Northern shoveler	--	2	--	--	--	--	3	1	5
Redhead	--	--	--	--	--	--	--	--	7
Dabbling duck species	--	--	--	--	--	--	9	4	1
Duck species	--	8	--	--	--	--	1	1	1
Red-tailed hawk	1	1	+200.0	2	1	--	--	--	2
Swainson's hawk	--	2	--	2	2	-50.0	1	1	1
Marsh hawk	--	--	--	--	4	-75.0	3	1	--
American kestrel	1	1	--	--	--	--	--	--	--
Sharp-tailed grouse	3	3	+133.3	--	--	--	5	2	2
Gray partridge	3	2	-66.7	--	--	--	--	--	--
Sora	--	1	--	--	--	--	4	2	2
American coot	1	1	--	1	1	0.0	1	1	5
Killdeer	10	7	+10.0	12	6	-75.0	3	2	9
Common snipe	--	2	--	1	1	+400.0	5	3	3
Upland sandpiper	2	1	+50.0	1	1	--	--	--	3
Sandpiper species	2	1	--	--	--	--	--	--	6
Willet	2	1	0.0	1	1	--	--	--	6
Marbled godwit	3	3	-33.3	3	3	+100.0	6	4	3
American avocet	--	--	--	--	--	--	--	--	8
Wilson's phalarope	--	3	--	--	--	--	--	--	2
California gull	1	1	0.0	--	--	--	--	--	--
Ring-billed gull	--	--	--	2	2	--	--	--	--
Franklin's gull	--	--	--	1	1	--	--	--	--
Gull species	1	1	--	--	--	--	1	1	--
Forster's tern	2	1	--	--	--	--	--	--	--
Black tern	--	1	--	2	1	--	--	--	1





Table 7 cont.

Species	Irrigation Route			1978			1979			North Control Route			1979			South Control Route		
	# Observ.	# Stops	% Change	# Observ.	# Stops	% Change	# Observ.	# Stops	% Change	# Observ.	# Stops	% Change	# Observ.	# Stops	% Change	# Observ.	# Stops	% Change
Brewer's blackbird	1	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Common grackle	44	15	+125.0	99	18	47	10	19	8	47	59.6	19	8	47	47	16	59.6	
Brown-headed cowbird	71	29	+33.8	95	30	83	27	28	13	54	-66.3	28	13	54	25	25	-66.3	
Icterid species	--	--	--	--	--	--	--	--	--	--	--	--	--	--	13	3	--	
Dickcissel	--	--	--	--	--	--	1	1	--	--	--	--	--	--	--	--	--	
American goldfinch	6	4	-66.7	2	1	2	1	1	1	1	-50.0	1	1	1	--	--	--	
Savannah sparrow	18	4	-61.1	7	4	--	--	8	5	8	--	8	5	6	6	5	--	
Grasshopper sparrow	13	8	-53.8	6	4	25	16	16	13	16	-36.0	16	13	15	15	10	-36.0	
Vesper sparrow	40	23	-62.5	15	14	17	13	12	12	12	-29.4	12	12	11	11	8	-29.4	
Clay-colored sparrow	32	17	-31.3	22	14	14	9	21	13	21	+50.0	21	13	8	8	6	+50.0	
Song sparrow	--	--	--	11	6	2	2	2	2	1	-50.0	1	1	--	--	--	-50.0	
Chestnut-collared longspur	1	1	0.0	1	1	7	5	6	2	6	-14.3	6	2	1	1	1	-14.3	

Six species, the mourning dove, horned lark, western meadowlark, red-winged blackbird, common grackle, and brown-headed cowbird were among the 10 most observed species on all three routes in 1979. Seven species (the aforementioned six and the clay-colored sparrow), were among the 10 most common species on both the irrigation and the north control routes. Of these, the mourning dove, western meadowlark, and red-winged blackbird declined in abundance from 1978 to 1979 along both routes. The other listed species exhibited a variety of changes in abundance between routes.

The roadside bird survey is designed to compare long-term changes (over several years) in numbers of each species on each route and not short-term changes in abundance from one year to the next. The comparisons of 2-years' data that are given here, are offered only as a progress report that is descriptive of the study area.

#### Waterfowl Studies

##### Breeding Duck Survey (Ground)

Sixty quarter sections were censused in 1978, and 56 quarter sections were censused in 1979. Some study sites were changed after 1978 to improve the comparability of data (USBR 1979). Ten control quarters, 25 irrigation quarters, and 5 WPA quarters were sampled in both 1978 and 1979. Direct comparisons of pair populations between 1978 and 1979 can be made for these 40 study sites.

Wetlands.--Based on covermapping conducted in June and July, 14.5 percent of all 1979 study quarters and 13.5 percent of the 40 quarters studied in both years were wetlands (Table 8). The wetland area increased 33 percent from 1978 to 1979 in the 40 quarters surveyed in both years, reflecting the better water conditions present in 1979. In 1979, wetlands comprised 49 percent of the WPA quarters, 11 percent of the irrigation quarters, and only 3 percent of the control quarters studied in both years. Type IV wetlands comprised the largest area in all areas and accounted for 48 percent of the total wetland area.

Table B

## HECTARES OF WETLAND TYPES IN THE NEW ROCKFORD STUDY AREA - 1978 AND 1979

	Control Quarters		Irrigation Quarters		WPA Quarters		Total	
	1978*	1979	1978*	1979*	1978*	1979*	1978*	1979
<b>Quarter Sections Studied:</b>								
Number	10	23	25	25	5	5	40	56
Total ha	647.5	1,489.3	1,618.8	1,618.8	323.8	323.8	2,590.0	3,626.1
<b>Wetland Type (ha):</b>								
Type I	2.0	6.5	2.2	1.1	0.1	0.8	4.3	8.7
Type II	0.0	0.0	0.7	6.6	0.0	0.0	0.7	6.6
Type III	0.5	12.8	18.5	25.4	0.0	2.1	19.0	40.9
Type IV	4.6	6.1	38.3	65.0	73.5	97.6	116.4	236.1
Type V	0.0	0.0	0.0	0.0	57.4	57.1	57.4	57.1
Tillage Ponds	1.4	3.1	6.6	26.1	0.0	0.0	8.0	29.2
Dugouts and Stock Dams	T	0.1	0.3	1.3	0.1	0.3	0.4	1.7
Drainage Course	4.5	4.3	52.5	49.6	0.0	0.4	57.0	120.8
<b>Total Wetlands (ha):</b>	13.0	122.2	119.1	175.1	131.1	158.3	263.4	350.2
<b>Percent of Total Area</b>	2.0	8.2	7.4	10.8	40.5	48.9	10.3	13.5
								14.5

\*Same quarters sampled in both years.



Because wetlands are dynamic, covermapping conducted in June and July is not a true representation of the wetland habitat available to ducks in the spring. Therefore, information on the number of wetlands with water was collected during both pair counts in 1979. During the first count, 174 ponds were tallied on 56 quarter sections (Table 9). Tillage ponds were the most numerous (30 percent) followed by Type III wetlands (22 percent) and Type I wetlands (18 percent). Total ponds decreased 38 percent to 108 ponds by the second pair count, with decreases only occurring in tillage ponds (73. percent), Type I wetlands (45 percent), and Type III wetlands (31 percent). Between the first and second census, the number of ponds decreased 47 percent on control quarters, 43 percent on irrigation quarters, and remained the same on WPA quarters. Similar wetland data are not available for the 1978 census.

Breeding Pair Counts.--Overall, 449 indicated duck pairs were tallied on the 56 quarter sections censused in 1979. The number of pairs on sites censused in both years was up 51 percent from the 249 pairs observed in 1978 (Table 10). Because two breeding pair counts were conducted in 1979, as opposed to one in 1978, it is not known how much of this increase is due to an actual increase in populations and how much is due to the change in census techniques. It is expected that more duck pairs would be counted with the two-count technique, therefore, the duck population increase observed in 1979 is probably somewhat less than 51 percent.

As in 1978, 12 of the 13 duck species commonly nesting in North Dakota were observed on study sites in 1979 (Table 10). Dabbling ducks were more abundant (370 indicated pairs) than diving ducks (79 indicated pairs) (Figure 5). Blue-winged teal were the most abundant species in all areas and comprised 39 percent of all indicated pairs. Other important species were mallard (11 percent), shoveler (11 percent), pintail (10 percent), and gadwall and redhead (7 percent each). Generally, species distributions were similar between areas. All species were observed in each of the three areas, except wigeon, ring-necked ducks, and ruddy ducks which were not observed on irrigation quarters. Wood ducks were not seen in either year.

Table 9

NUMBER OF PONDS WITH WATER DURING GROUND BREEDING PAIR COUNTS

New Rockford Study Area - May 9-14 and May 27-31, 1979

<u>Type</u>	<u>Control</u>		<u>Irrigation</u>		<u>WPA</u>		<u>Total</u>	
	<u>Count No. 1</u>	<u>Count No. 2</u>	<u>Count No. 1</u>	<u>Count No. 2</u>	<u>Count No. 1</u>	<u>Count No. 2</u>	<u>Count No. 1</u>	<u>Count No. 2</u>
I	23	13	7	3	1	1	31	17
II	--	--	--	--	--	--	--	--
III	13	10	18	7	8	8	39	25
IV	1	1	8	8	16	16	25	25
V	--	--	--	--	2	2	2	2
Tillage	36	10	16	4	--	--	52	14
Stock pond	3	3	4	4	1	1	8	8
Drainage course	<u>7</u>	<u>7</u>	<u>10</u>	<u>10</u>	<u>--</u>	<u>--</u>	<u>17</u>	<u>17</u>
TOTAL	83	44	63	36	28	28	174	108
Density (No. Ponds/km <sup>2</sup> )	5.6	3.0	3.9	2.2	5.4	5.4	4.8	3.0

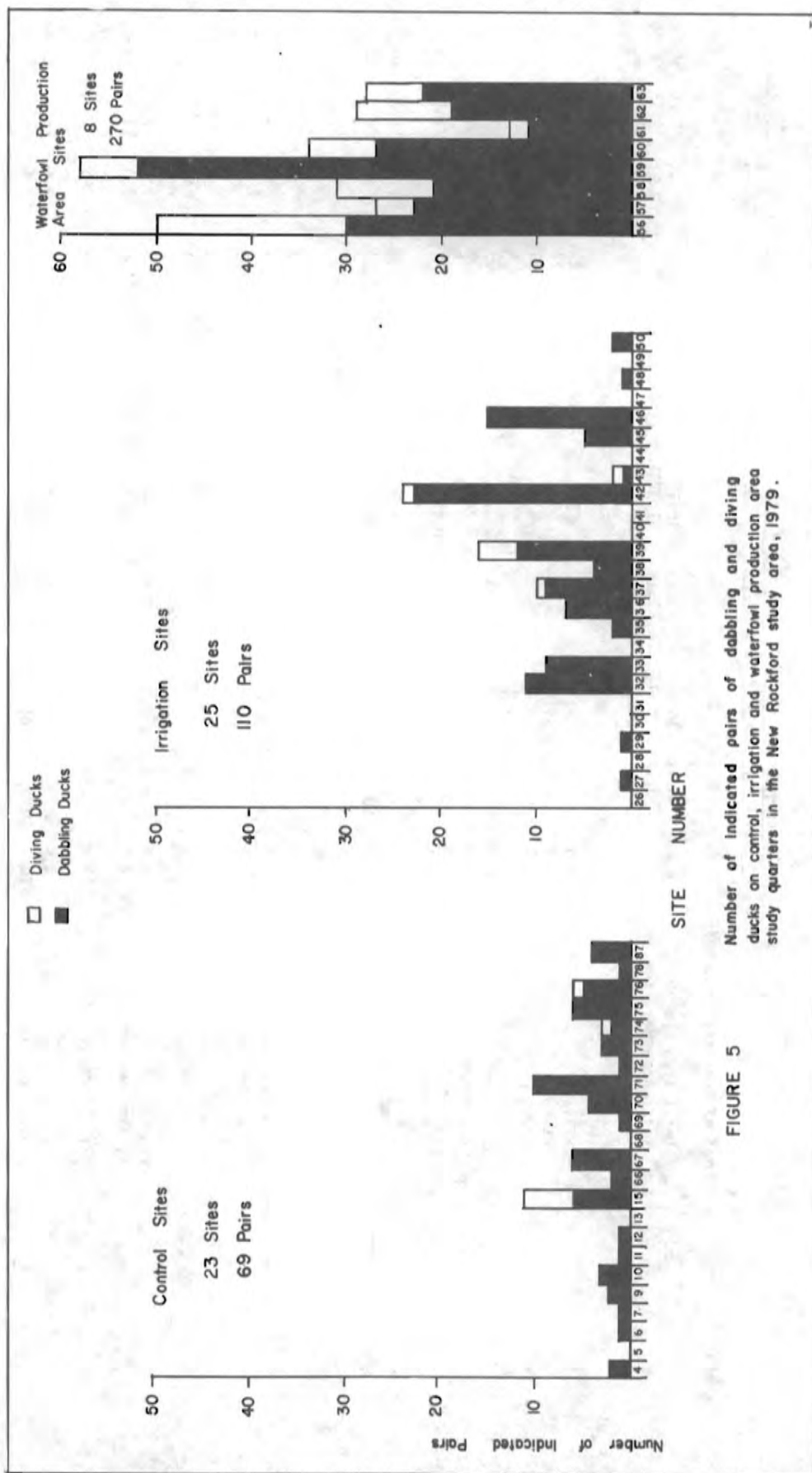


FIGURE 5  
Number of indicated pairs of dabbling and diving ducks on control, irrigation and waterfowl production area study quarters in the New Rockford study area, 1979.



Table 10

## NUMBER AND DENSITY OF INDICATED DUCK PAIRS ON STUDY QUARTERS

## New Rockford Study Area - 1978 and 1979

	Control Quarters		Irr. Quarters		WPA Quarters		Total					
	1978*	1979*	1978*	1979*	1978*	1979*	1978*	1979*				
No. of Quarters Censused:	10	10	23	25	25	5	5	8	40	40	56	
Total Area (km <sup>2</sup> )	6.48	6.48	14.89	16.19	16.19	3.24	3.24	5.18	25.90	25.90	36.26	
Total Area Wet. (km <sup>2</sup> )	0.13	0.17	1.06	1.19	1.72	1.34	1.58	2.28	2.66	2.66	3.47	
Dabbling Ducks:												
Mallard	5	6	11	1	17	17	21	23	23	44	51	
Pintail	6	4	14	0	18	12	10	14	18	32	46	
Gadwall	2	1	4	2	5	25	20	21	29	26	30	
Wigeon	0	1	2	0	0	3	4	4	3	5	6	
Shoveler	2	0	7	1	15	10	16	27	13	31	49	
Blue-winged teal	7	4	19	5	46	95	102	108	107	152	173	
Green-winged teal	0	1	5	0	2	7	8	8	7	11	15	
Subtotal	22	17	62	9	103	169	181	205	200	301	370	
Prs/km <sup>2</sup>	3.4	2.6	4.2	0.6	6.4	52.2	55.9	39.6	7.7	11.6	10.2	
Prs/km <sup>2</sup> wetland	169.2	100.0	58.5	7.6	59.9	126.1	114.6	89.9	75.2	86.7	73.1	
Diving Ducks:												
Redhead	0	0	1	0	2	31	29	30	31	31	33	
Canvasback	0	0	1	0	4	3	9	7	3	13	12	
Ring-necked duck	1	3	3	0	0	2	1	2	3	4	5	
Lesser scaup	0	1	1	0	1	0	2	5	0	4	7	
Ruddy duck	0	1	1	0	0	12	21	21	12	22	22	
Subtotal	1	5	7	0	7	48	62	65	49	74	79	
Prs/km <sup>2</sup>	0.2	0.8	0.5	0.0	0.4	14.8	19.1	12.5	1.9	2.9	2.2	
Prs/km <sup>2</sup> wetland	7.7	29.4	6.6	0.0	4.1	35.8	39.2	28.5	18.4	21.3	15.6	
Total Indicated Pairs	23	22	69	9	110	217	243	270	249	375	449	
Prs/km <sup>2</sup>	3.6	3.4	4.6	0.6	6.8	70.0	75.0	52.1	9.6	14.5	12.4	
Prs/km <sup>2</sup> wetland	176.9	129.4	65.1	7.6	64.0	161.9	153.8	118.4	93.6	108.1	88.7	

\*Same quarters sampled in both years.

## Breeding Duck Survey (Aerial)

Wetlands.--Pond data collected during the first aerial duck pair count indicated pond densities were similar in both the control area ( $6.32/\text{km}^2$  or  $16.36/\text{mi}^2$ ) and the irrigation area ( $6.18/\text{km}^2$  or  $16.02/\text{mi}^2$ ) (Table 11). Pond data for the second count also showed similar densities, ( $2.74/\text{km}^2$  or  $7.10/\text{mi}^2$ ) for control and ( $2.88/\text{km}^2$  or  $7.46/\text{mi}^2$ ) for irrigation quarters. Overall, wetland densities decreased 56 percent from the first aerial count to the second count compared to a 45 percent decrease for ponds on irrigation and control study quarters during the same time period. The difference in these two estimates is due in part to a difference in recording procedures during the first and second aerial surveys. During the first count, all wetlands, regardless of type, were counted. On the second count, only wetland Types III, IV, V, dugouts, stockdams, and drainage courses were counted. This factor could not be separated in the data analysis. Thus, the actual decrease in ponds is probably closer to the 45 percent figure derived from quarter section surveys than the 56 percent figure derived from aerial surveys.

Breeding Pair Counts.--A total of 132 indicated duck pairs was tallied during the aerial censuses (Table 12). Pintail were the most frequently observed species (39), followed by blue-winged teal (27), mallard (26), and shoveler (22). Four species (wigeon, ring-necked duck, lesser scaup, and ruddy duck) recorded on quarter section breeding pair counts were not observed on aerial pair counts. These four species all had low densities with  $0.1 \text{ pair}/\text{km}^2$  ( $0.3/\text{mi}^2$ ) or less on the study quarters. When adjusted for visibility rates for each species, the density of indicated pairs as determined from the aerial census ( $5.52/\text{km}^2$  or  $14.30/\text{mi}^2$ ) was in close agreement with the density calculated for irrigation and control quarter section pair counts ( $5.76/\text{km}^2$  or  $14.92/\text{mi}^2$ ) (Table 13).

Two methods of adjusting the number of ducks observed with the air/ground correction factor were tried. The first used visibility rates recommended by the FWS for strata 45-49. The second technique used only

Table 11

NUMBER, ADJUSTED NUMBER, AND ADJUSTED DENSITY OF PONDS COUNTED  
ON AERIAL DUCK PAIR SURVEYS

New Rockford Study Area - 1979

<u>Survey</u>	<u>Control</u>			<u>Irrigation</u>			<u>Total</u>		
	<u>No.</u>	<u>Adj. No.</u>	<u>Density<sub>2</sub> Ponds/km</u>	<u>No.</u>	<u>Adj. No.</u>	<u>Density<sub>2</sub> Ponds/km</u>	<u>No.</u>	<u>Adj. No.</u>	<u>Density<sub>2</sub> Ponds/km</u>
May 9	172	217	6.32	92	116	6.18	264	333	6.27
May 30	75	94	2.74	43	54	2.88	118	148	2.79
Percent decrease		57%			53%			56%	



Table 12

NUMBER, ADJUSTED NUMBER, AND ADJUSTED DENSITY OF INDICATED DUCK PAIRS  
OBSERVED ON AERIAL PAIR COUNTS

New Rockford Study Area - 1979

Species	Control			Irrigation			Total		
	No.	*Adj. No.	Density <sub>2</sub> Pairs/km <sup>2</sup>	No.	*Adj. No.	Density <sub>2</sub> Pairs/km <sup>2</sup>	No.	*Adj. No.	Density <sub>2</sub> Pairs/km <sup>2</sup>
Dabbling Ducks:									
Mallard	16	28.0	0.82	10	17.5	0.93	26	45.5	0.86
Pintail	25	37.5	1.09	14	21.0	1.12	39	58.5	1.10
Gadwall	6	24.0	0.70	0	0.0	0.00	6	24.0	0.45
Wigeon	0	0.0	0.00	0	0.0	0.00	0	0.0	0.00
Shoveler	17	25.5	0.74	5	7.5	0.40	22	33.0	0.62
Blue-winged teal	14	47.6	1.39	13	44.2	2.35	27	91.8	1.73
Green-winged teal	2	2.0	0.58	0	0.0	0.00	2	2.0	0.04
Subtotal	80	164.6	5.32	42	90.2	4.80	122	254.8	4.80
Diving Ducks:									
Redhead	0	0.0	0.00	3	3.0	0.16	3	3.0	0.06
Canvasback	2	10.0	0.29	5	25.0	1.33	7	35.0	0.66
Ring-necked ducks	0	0.0	0.00	0	0.0	0.00	0	0.0	0.00
Lesser scaup	0	0.0	0.00	0	0.0	0.00	0	0.0	0.00
Ruddy duck	0	0.0	0.00	0	0.0	0.00	0	0.0	0.00
Subtotal	2	10.0	0.29	8	28.0	1.49	10	38.0	0.72
TOTAL	82	174.6	5.61	50	118.2	6.29	132	292.8	5.52

\*Using air/ground correction factors calculated from ground checks of aerial counts in the New Rockford study area (see Table 14).

Table 13

DENSITIES OF INDICATED DUCK PAIRS (PAIRS/KM<sup>2</sup>) DETERMINED BY  
QUARTER SECTION GROUND COUNTS AND AERIAL COUNTS

New Rockford Study Area - 1979

<u>Species</u>	<u>Ground Census</u> <sup>1/</sup>	<u>Aerial Census</u> <sup>2/</sup>
Dabbling Ducks:		
Mallard	.90	.86
Pintail	1.03	1.10
Gadwall	.29	.45
Wigeon	.06	0.00
Shoveler	.71	0.62
Blue-winged teal	2.09	1.73
Green-winged teal	<u>.23</u>	<u>0.04</u>
Subtotal	5.31	4.80
Diving Ducks:		
Redhead	.10	.06
Canvasback	.16	.66
Ring-necked duck	.10	0.00
Lesser scaup	.06	0.00
Ruddy duck	<u>.03</u>	<u>0.00</u>
Subtotal	.45	.72
TOTAL	5.76	5.52
Area censused (km <sup>2</sup> )	31.1	53.1

1/Data for irrigation and control quarters combined.

2/Adjusted with New Rockford study area visibility rates.

Table 14

VISIBILITY RATES USED IN ANALYZING AERIAL DUCK PAIR CENSUS DATA

New Rockford Study Area - 1979

<u>Species</u>	<u>Values Calculated With Ground Checks in the NRSA</u>	<u>Values Recommended by FWS (1977)</u>
Mallard	1.75	1.75 <sup>1/</sup>
Pintail	1.50	1.50 <sup>1/</sup>
Gadwall	4.00	4.00 <sup>1/</sup>
Wigeon	--	--
Shoveler	1.50	5.6642
Blue-winged teal	3.40	3.40 <sup>1/</sup>
Green-winged teal	1.00	8.2471
Redhead	1.00	7.19
Canvasback	5.00	2.4848
Ring-necked duck	--	--
Lesser scaup	--	--
Ruddy duck	--	--

<sup>1/</sup>U.S. Fish and Wildlife Service recommends using observed values for certain species or if values fall within designated limits.



the values calculated from the air/ground correction transects censused in the study area. The visibility rates used in both techniques are presented in Table 14. For all species, except the canvasback, the visibility rate calculated from the New Rockford study area ground routes were lower than the values recommended by the FWS. Indicated pair densities for each species observed on quarter section pair counts were more closely correlated with aerial indicated pair densities corrected with the study area visibility rate ( $r=.94$ ), than when corrected with the FWS visibility rates ( $r=.76$ ). However, both correlations were highly significant ( $p < .01$ ).

Although the study area air/ground correction transects were not a large sample (12 percent), they have the advantage of being site, time, and observer specific as opposed to only area and technique specific correction factors recommended by the FWS. These factors probably account for the close correlation of the quarter section pair population estimates with aerial data corrected with New Rockford visibility rates.

#### Nest Search

A total of 669 ha (1,653 acres) was searched for nests: 472 ha (1,167 acres) in control, 108 ha (267 acres) in irrigation, and 89 ha (219 acres) in WPA quarter section study sites (Table 15). Five major habitat types were searched including pasture (37 percent), idle grassland (27 percent), hayfields (20 percent), stubble fields (11 percent), and fallow fields (6 percent). Habitats were classified according to their use the previous year, i.e., an idle grassland was one which had not had the previous year's growth removed and remained idle throughout the nesting period.

A total of 106 nests of ducks and other birds were found during the search (Table 15). Fifty-one nests were found on control quarters, 27 on irrigation quarters, and 33 on WPA quarters. Nests of 10 species were found: 5 species of ducks (mallard, pintail, gadwall, blue-winged teal, and shoveler) and 5 other species of birds (sharp-tailed grouse, upland sandpiper, Wilson's phalarope, marsh hawk, and mourning dove).

Table 15

## NUMBER OF NESTS AND PERCENT OF SUCCESSFUL NESTS IN THE NEW ROCKFORD STUDY AREA - 1979

	Control Quarters			Irrigation Quarters			VPA Quarters			Total									
	Idle	Hay	Past.	Idle	Hay	Past.	Idle	Hay	Past.	Idle	Hay	Past.							
Ha searched	95.7	104.2	162.6	70.1	39.6	472.2	10.8	15.9	81.5	108.2	75.0	13.7	88.7	181.5	133.9	244.1	70.1	39.6	660.1
Ducks:																			
Fallard	3	3	--	--	6	4	--	4	--	4	1	--	1	4	7	--	--	--	11
Pintail	1	5	1	--	7	1	--	2	1	2	1	--	1	2	6	2	--	--	10
Gadwall	--	2	--	--	2	--	--	0	--	0	2	--	2	2	2	--	--	--	4
Blue-winged teal	1	5	5	--	11	12	--	14	--	14	14	--	14	15	6	16	--	--	37
Shoveler	--	1	--	--	1	1	--	1	--	1	5	--	6	5	3	--	--	--	9
Subtotal	5	16	6	--	27	19	--	23	1	24	28	--	24	28	24	18	--	--	70
Pct. Success, $\frac{1}{80}$	64	33	--	--	60	38	--	55	38	77	74	--	74	45	47	--	--	51	
Other birds:																			
Sharp-tailed grouse	1	6	--	1	8	8	--	8	1	1	1	--	1	2	6	1	1	--	10
Upland sand-piper	--	4	4	--	8	8	--	8	1	1	6	1	7	6	5	5	--	--	16
Wilson's phalarope	--	3	1	--	4	4	--	4	--	1	1	--	1	1	3	1	--	--	5
Parsh hawk	1	--	--	--	1	1	--	1	--	--	--	--	--	1	--	--	--	--	1
Mourning dove	--	1	1	1	3	3	--	3	1	1	4	--	4	2	1	2	1	--	4
Subtotal	2	14	6	2	24	24	--	24	3	3	8	1	9	10	15	9	2	--	36
Pct. Success, $\frac{1}{75}$	--	75	60	--	57	57	--	67	67	85	100	88	88	67	69	75	--	--	66
TOTAL	7	30	12	2	51	22	7	15	22	31	2	33	38	39	27	2	2	--	106
Pct. Success, $\frac{1}{57}$	69	45	--	--	59	42	--	57	42	79	50	77	75	55	56	--	--	--	61

$\frac{1}{}$ Percent success calculations are adjusted to exclude nests destroyed by search operations and nests with unknown fates.

Blue-winged teal were the most frequently found species (37), followed by upland sandpiper (16), mallard (11), and sharp-tailed grouse and pintail (10 nests each).

Nest densities (nests/km<sup>2</sup>) of all species combined were 10.81 (27.97/mi<sup>2</sup>) in control quarters, 20.33 (52.66/mi<sup>2</sup>) in irrigation quarters, and 37.20 (96.36/mi<sup>2</sup>) in WPA quarters. The overall nest density for the 669 ha (1,653 acres) searched was 15.84 nests/km<sup>2</sup> (41.03 nests/mi<sup>2</sup>). Nest densities were greatest in haylands (29.13/km<sup>2</sup> or 74.45/mi<sup>2</sup>) and idle grasslands (20.94/km<sup>2</sup> or 54.23/mi<sup>2</sup>), and lower in pastures (11.06/km<sup>2</sup> or 28.65/mi<sup>2</sup>) and stubble fields (2.85/km<sup>2</sup> or 7.38/mi<sup>2</sup>) (Table 16). No nests were found in fallow fields.

Nest success was 77 percent on WPA quarters, 59 percent on control quarters, and 42 percent on irrigation quarters. Nest success for duck species was 59 percent compared to 66 percent for other species. Birds nesting in idle grasslands had a higher nest success (75 percent) than birds nesting in pasture (56 percent) and haylands (55 percent). Neither of the two nests found in stubble fields were successful.

Visual obstruction measurements were obtained at 97 of the 106 nests found during the search. Height-density readings were greater at duck nests (2.06 dm or 8.11 in) than at nests of other species (1.52 dm or 5.98 in) (Table 17). Mallards had the highest average reading (3.16 dm or 12.44 in), followed by marsh hawk (3.00 dm or 11.81 in), gadwall (2.81 dm or 11.06 in), and pintail (2.18 dm or 8.58 in). The lowest average reading was for Wilson's phalarope (0.70 dm or 2.76 in). Although sample sizes are small, vegetation at successful nests tended to have higher height-density readings than depredated nests. The higher visual obstruction reading at successful nests illustrates the value of tall, dense vegetation as a predator deterrent.

The density of successful nests is the best indicator of the suitability of a habitat for nesting. The overall successful nest density was 8.82 successful nests/km<sup>2</sup> (22.84/mi<sup>2</sup>). Successful nest densities were the highest in idle grasslands (14.88/km or 38.54/mi<sup>2</sup>), and hayland

Table 16

## NEST DENSITIES AND SUCCESS

## New Rockford Study Area - 1979

	<u>Nests Found</u>	<u>Nest Hatched</u>	<u>Pct. Nests Successful</u>	<u>Nests/km<sup>2</sup></u>	<u>Successful Nests/km<sup>2</sup></u>
Idle (181.5 ha)					
Ducks	28(1) <sup>1/</sup>	21	78	15.43	11.57
Other birds	<u>10(1)</u>	<u>6</u>	<u>67</u>	<u>5.51</u>	<u>3.31</u>
Total	38(2)	27	75	20.94	14.88
Hayland (133.9 ha)					
Ducks	24(4)	9	45	17.92	6.72
Other birds	<u>14(2)</u>	<u>9</u>	<u>69</u>	<u>11.20</u>	<u>6.72</u>
Total	39 (6)	18	55	29.13	13.44
Pasture (244.1 ha)					
Ducks	18(1)	8	47	7.37	3.28
Other birds	<u>9(1)</u>	<u>6</u>	<u>75</u>	<u>3.69</u>	<u>2.46</u>
Total	27(2)	14	56	11.06	5.74
Stubble (70.1 ha)					
Ducks	0	0	0	0.00	0.00
Other birds	<u>2</u>	<u>0</u>	<u>0</u>	<u>2.85</u>	<u>0.00</u>
Total	2	0	0	2.85	0.00
Fallow (39.6 ha)					
Ducks	0	0	0	0.00	0.00
Other birds	<u>0</u>	<u>0</u>	<u>0</u>	<u>0.00</u>	<u>0.00</u>
Total	0	0	0	0.00	0.00
Total (669.2 ha)					
Ducks	70(6)	38	51	10.46	5.68
Other birds	<u>36(4)</u>	<u>21</u>	<u>66</u>	<u>5.38</u>	<u>3.14</u>
Total	106(10)	59	61	15.84	8.82

<sup>1/</sup>Ten nests (shown in parenthesis) had unknown fates or were destroyed by search operations. Therefore, they are not included in calculation of percent success, but are included in density calculations.



Table 17

AVERAGE VISUAL OBSTRUCTION MEASUREMENTS (DM) FOR NESTS FOUND

New Rockford Study Area - 1979

<u>Species</u>	<u>Successful Nests</u>	<u>Depredated Nests</u>	<u>All Nests</u>
Ducks:			
Mallard	4.00 (1) <sup>1/</sup>	2.92 (6)	3.16 (7)
Pintail	2.08 (6)	2.00 (2)	2.18 (9)
Gadwall	2.81 (1)	--	2.81 (3)
Blue-winged teal	1.86 (21)	1.58 (10)	1.76 (35)
Shoveler	<u>2.17 (4)</u>	<u>1.80 (4)</u>	<u>1.98 (8)</u>
Subtotal	2.03 (33)	2.02 (22)	2.06 (62)
Other Birds:			
Sharp-tailed grouse	1.97 (7)	2.22 (2)	1.86 (10)
Upland sandpiper	1.62 (11)	0.97 (2)	1.55 (15)
Wilson's phalarope	0.69 (1)	--	0.70 (5)
Marsh hawk	--	3.00 (1)	3.00 (1)
Mourning dove	<u>0.91 (2)</u>	<u>2.50 (1)</u>	<u>1.16 (4)</u>
Subtotal	1.63 (21)	1.98 (6)	1.52 (35)
TOTAL	1.88 (54)	2.01 (28)	1.86 (97)

1/Sample size in ( ).

(13.44/km<sup>2</sup> or 34.81/mi<sup>2</sup>), and considerably lower in pastures (5.74/km<sup>2</sup> or 14.87/mi<sup>2</sup>) (Table 16).

Predators were the greatest cause of nest failure, accounting for 26 percent of all nests found and 80 percent of all nests destroyed (Table 18). Fox appeared to be the principle nest predator. This is supported by the predator scent station survey results, which indicate fox had the highest occurrence index of the predators in the area. At least two sharp-tailed grouse hens were killed by raptors at their nest sites. Predation rates were lowest on idle grasslands (24 percent) and slightly higher on haylands (28 percent) and pastures (30 percent). Irrigation sites, which had only hayland and pasture habitats, had more nests destroyed by predators (45 percent) than control and WPA sites (22 and 21 percent, respectively). Other causes of nest failure were abandonment (3 percent), farming operations (2 percent), flooding (1 percent), and trampling by cattle (1 percent). Three percent of all nests found were destroyed by unknown causes, and 3 percent were destroyed by search operations.

Because this study used only a single search as an index to habitat productivity, calculations of nest density and success are not comparable with studies using multiple searches. The true nest density for any habitat is likely to be considerably higher than that determined from a single search. Likewise, nest success figures are probably inflated. Many of the nests found were probably renests which may have a higher success rate than first nests (Sowls 1955). However, in the future, comparisons can be made between habitats, areas, and even years with the single search technique. The technique probably undersamples early (mallard and pintail) and late (gadwall) nesting species, but a single search during the peak of nesting is probably the most efficient means of obtaining an index to the productivity of upland nesting habitats.

Table 18

FATE OF NESTS LOCATED IN NEW ROCKFORD STUDY AREA - 1979

	<u>Control Quarters</u>	<u>Irrigation Quarters</u>	<u>WPA Quarters</u>	<u>Total</u>
Number of nests:	22	51	33	106
Nest fate (percent):				
Successful	53(59) <sup>1/</sup>	36(42) <sup>1/</sup>	73(77) <sup>1/</sup>	56(61) <sup>1/</sup>
Destroyed				
Predator	22	45	21	26
Cattle	2	0	0	1
Farm Mach.	2	0	0	2
Flooded	2	0	0	1
Unknown	<u>6</u>	<u>0</u>	<u>0</u>	<u>3</u>
Subtotal	34	45	21	33
Abandoned	4	5	0	3
Destroyed by Search Operations	6	0	0	3
Unknown Fate	<u>2</u>	<u>14</u>	<u>6</u>	<u>6</u>
TOTAL	99%	100%	100%	101%

<sup>1/</sup>Percent success in ( ) is calculated excluding nests destroyed by search operations and nests with unknown fate.

### Mourning Doves

Both routes were censused on May 26. A total of 98 doves was heard in the control area compared to 107 doves in the irrigation area (Table 19). The mean number of doves heard per stop was not significantly different between areas ( $t=1.46$ ,  $p \geq .05$ ).

No conclusions can be drawn from the first year's data. Although the call-count census technique may not accurately estimate breeding dove densities (Baskett, et al. 1978), it is the best technique presently available for monitoring dove populations. Long-term call-count census data should reveal trends in dove populations associated with changes in dove habitat in the New Rockford study area.

### Prairie Grouse

Eleven sharp-tailed grouse dancing grounds were found and another nine possible grounds were suspected. Birds were not displaying on areas listed as possible dancing grounds at the time of observation, and time and weather restrictions prevented follow-up observations to confirm the suspected grounds. Observations of grouse during the spring and summer (Figure 6) suggest other dancing grounds may exist.

Heavy snow and high winds caused cancellation of most survey days. On several occasions when grouse were observed in a group, they were not actively displaying. Despite poor weather, many sharp-tailed grouse were observed and several dancing grounds located. However, complete survey coverage of the study area was not possible due to weather restrictions.

Four of the 11 dancing grounds and 6 of the 9 possible dancing grounds are on arable land in the New Rockford Area (Figure 6). These grounds would be adversely affected by the intensive agriculture associated with sprinkler irrigation.



Table 19

RESULTS OF MOURNING DOVE CALL-COUNT SURVEY

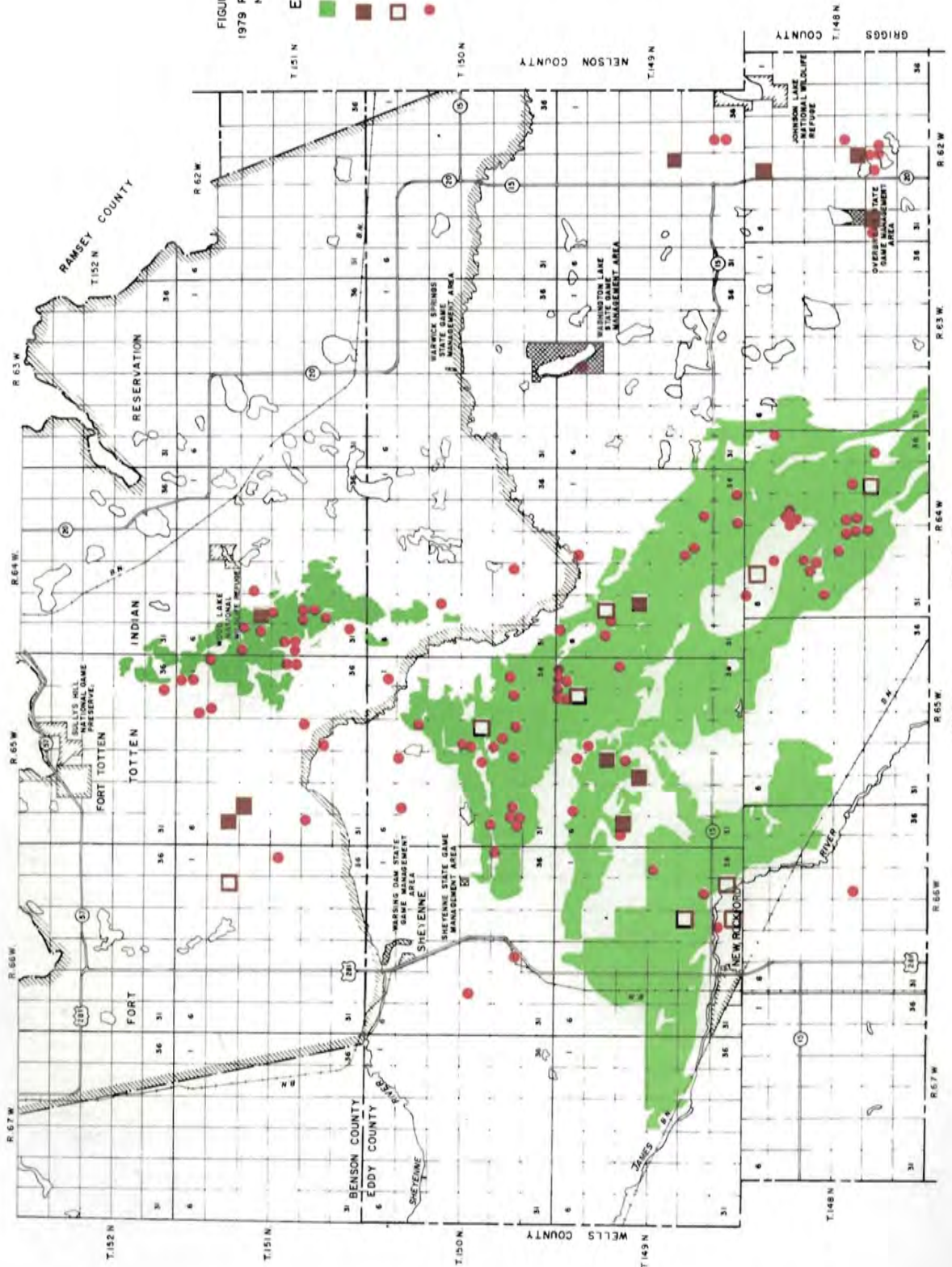
New Rockford Study Area - 1979

	<u>Control Areas</u>	<u>Irrigation Areas</u>	<u>Total</u>
Doves Heard:			
Number	98	107	205
Mean	4.90	5.35	5.13
Stan. Dev.	2.29	2.11	2.19
Range	1-9	2-10	1-10
Calls Heard:			
Number	466	484	950
Mean	23.30	24.20	23.75
Stan. Dev.	12.60	14.49	2.12
Range	3-47	2-53	2-53
Mean No. Calls/Dove	4.76	4.52	4.63
Doves Observed:			
At Stops	19	42	61
Between Stops	<u>25</u>	<u>42</u>	<u>67</u>
Total	44	84	128

FIGURE 6  
1979 PRAIRIE GROUSE STUDY  
NEW ROCKFORD AREA

EXPLANATION

- ARABLE LAND
- SHARP-TAIL DANCING GROUND
- POSSIBLE DANCING GROUND
- SHARP-TAIL GROUSE SIGHTINGS



FOSTER COUNTY  
NEW ROCKFORD IRRIGATION AREA



Based on the preliminary information obtained this year, sharp-tailed grouse should be considered common to abundant in the New Rockford Area. Stewart's data indicates there were over 100 booming male prairie chickens in one of the townships (T. 149 N., R. 66 W.) of the study area in 1942. This area was searched, and no prairie chickens were found. If the actual impacts to the grouse population due to GDU are to be measured, further studies must be conducted to obtain more complete density and distribution information.

### Raptors

Fifty-seven raptor nests of eight species were found in the study area in 1979: 25 in the irrigation area, 18 in the control areas, and 14 outside the search areas (Table 20). Swainson's hawks (10), red-tailed hawks (7), and long-eared owls (4) were the most common species in the irrigation area, while Swainson's hawks (8), red-tailed hawks (3), and great horned owls (3) were most abundant on the control areas (Figure 7). Nests of three species (ferruginous hawk, long-eared owl, and burrowing owl) were found for the first time in 1979. The burrowing owl with dependent young was found outside the search areas, but within the arable land of the study area.

Nest densities were  $0.20 \text{ nests/km}^2$  ( $0.51 \text{ nests/mi}^2$ ) in the irrigation area and  $0.15 \text{ nests/km}^2$  ( $0.39 \text{ nests/mi}^2$ ) in the control area in 1979. Nest densities are not directly comparable with 1978 data because of the change of search areas and search technique.

Nest success (the percentage of nests of known fate fledging at least one young) was 73 percent in the irrigation area and 92 percent in the control area (Table 21). Reasons for differences in nest success between areas are not clear at this time.

### Mammalian Predators

Table 22 summarizes the results of the 1979 survey. Data collected in 1978 was limited by rain, and is not comparable to this year's data.

Table 20

NUMBER OF RAPTOR NESTS FOUND IN THE NEW ROCKFORD STUDY AREA - 1979

<u>Species</u>	<u>Irrigation Area (124 km<sup>2</sup>)</u>	<u>Control Area (124 km<sup>2</sup>)</u>	<u>Outside Search Area</u>	<u>Total</u>
Swainson's hawk	10	8	4	22
Red-tailed hawk	7	3	4	14
Ferruginous hawk	1	1	1	3
Kestrel	1	1	0	2
Marsh hawk	0	1	0	1
Great horned owl	2	3	4	9
Long-eared owl	4	1	0	5
Burrowing owl	<u>0</u>	<u>0</u>	<u>1</u>	<u>1</u>
TOTAL	25	18	14	57
Density (nests/km <sup>2</sup> )	.20	.15		



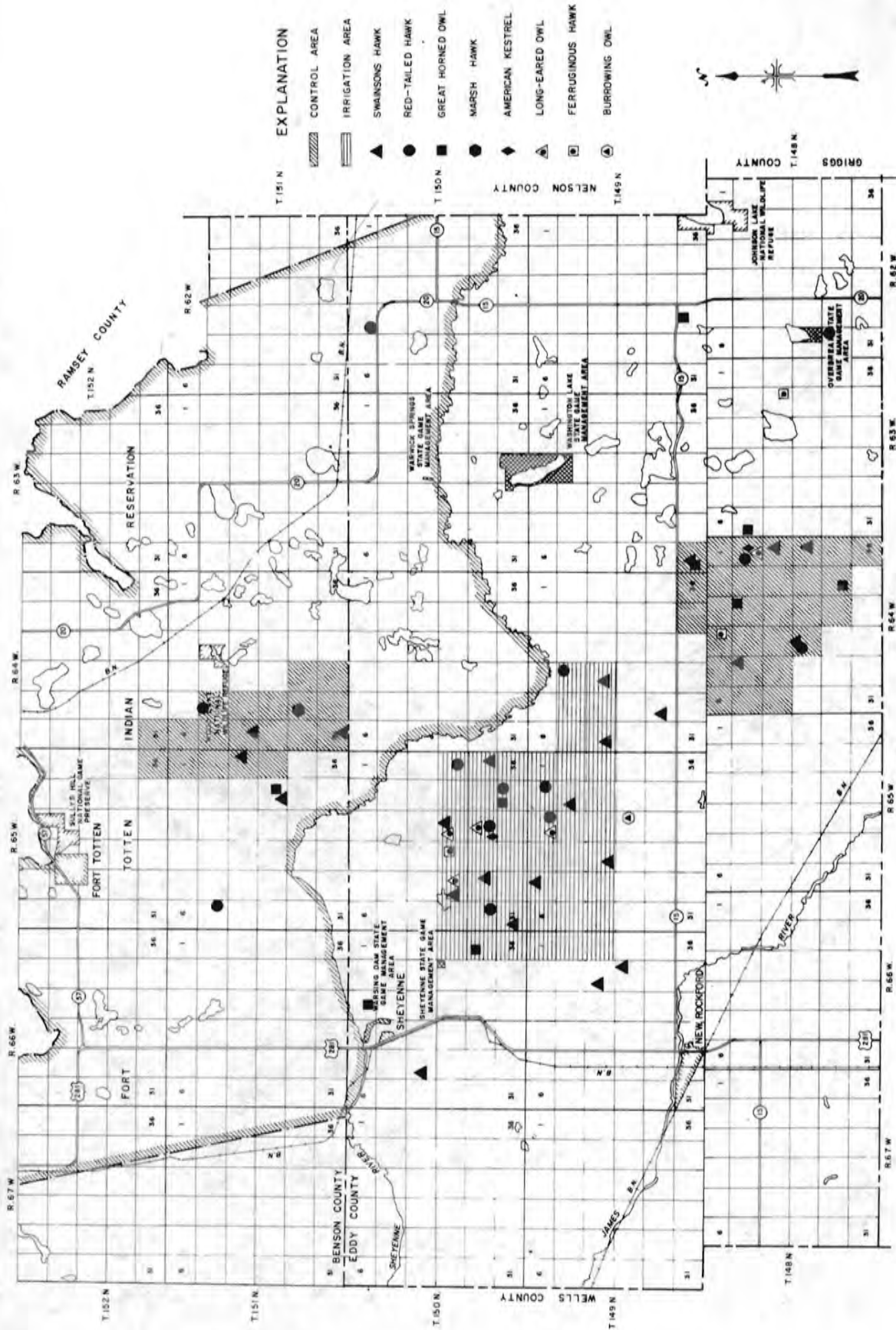


FIGURE 7  
 NEW ROCKFORD STUDY AREA  
 AND  
 1979 RAPTOR NEST LOCATION

Table 21

FATE OF RAPTOR NESTS IN NEW ROCKFORD STUDY AREA - 1979

<u>Nest Fate</u>	<u>Irrigation Area</u>	<u>Control Area</u>	<u>Outside Area</u>	<u>Total</u>
Successful	16 (73) <sup>1/</sup>	12 (92)	10 (91)	38 (83)
Unsuccessful	6	1	1	8
Unknown	<u>3</u>	<u>5</u>	<u>3</u>	<u>11</u>
TOTAL	25	18	14	57

1/Percent success calculated from nests of known fate only.

Table 22

NEW ROCKFORD PREDATOR SCENT STATION SURVEY ABUNDANCE INDEX  
SEPTEMBER 11-15, 1979

	<u>Control Area</u>		<u>Irrigation Area</u>	
Number of Operable Station-Nights (of possible 120)	97		91	
<u>Species</u>	<u>No. of Visits</u>	<u>Index*</u>	<u>No. of Visits</u>	<u>Index*</u>
Fox	16	164.9	10	109.9
Skunk	4	41.2	3	33.0
Raccoon	1	10.3	2	22.0
Mink	1	10.3	1	11.0
Badger	0	0.0	1	11.0
Weasel	1	10.3	0	0.0
Domestic Cat	5	51.5	8	87.9
Domestic dog	7	72.2	5	54.9
Unidentified predator	<u>2</u>	<u>20.6</u>	<u>7</u>	<u>76.9</u>
Total Predator Visits	37	381.3	37	406.6

\*Index =  $\frac{\text{Total Number of Visits}}{\text{Total Number of Operable Station-Nights}} \times 1,000$

Fox, domestic cat, domestic dog, and skunk tracks were recorded most frequently. Fox were also abundant on the spotlight deer survey (see Deer Study, Table 24). The occurrence of fox was not significantly different between the irrigation and control areas for either survey ( $\chi^2=1.19$ ,  $p < 0.05$  for scent post and  $\chi^2=0.17$ ,  $p < 0.05$  for spotlight). Several years' data will be needed before predator population trends can be determined.

## Deer

### Aerial Survey

The results of the 1979 aerial survey are given in Table 23. A total of 119 deer were observed during the census. Over 90 percent of the deer (108 animals) were observed along the Sheyenne River bottoms adjacent to the study area. Only 9 percent of the deer were observed in the study area. Four were seen in the north control area, seven in the irrigation area, and all were within 10 km (6 mi) of the Sheyenne River. The mean numbers of deer per  $\text{km}^2$  in the control and irrigation areas were 0.03 ( $0.08/\text{mi}^2$ ) and 0.05 ( $0.13/\text{mi}^2$ ), respectively. The low number of deer observed within the study area seems to reflect the lack of cover due to agricultural practices in the area. The extensive woody cover along the Sheyenne River also attracts deer from the surrounding area during the winter months.

### Spotlight Survey

The results of the spotlight survey are given in Table 24. Two deer were observed along the control route and four deer along the irrigation route. The mean numbers of deer per km of transect for the control and irrigation route were 0.04 ( $0.06/\text{mi}$ ) and 0.07 ( $0.11/\text{mi}$ ), respectively. All deer observed during the survey were seen feeding in fields adjacent to woody cover, such as treebelts and woodlots.

The most abundant species observed during the survey was the jackrabbit. A total of 19 was seen along the control route compared to 20 along the



Table 23

AERIAL SURVEY RESULTS - FEBRUARY 1979

<u>Species</u>	<u>Control Area</u>	<u>Irrigation Area</u>	<u>Sheyenne River</u>	<u>Total</u>
White-tailed deer	4	7	108	119
Red fox	1	2	--	3
Jackrabbit	6	13	--	19

Table 24

SPOTLIGHT SURVEY RESULTS - JULY 1979

<u>Species</u>	<u>Control Area</u>	<u>Irrigation Area</u>	<u>Mean Number/Km of Transect</u>	
			<u>Control</u>	<u>Irrigation</u>
White-tailed deer	2	4	0.03	0.07
Jackrabbit	19	20	0.33	0.33
Red fox	9	7	0.16	0.11
Skunk	1	1	0.02	0.02
Unidentified	2	6	0.03	0.10

irrigation route. The mean number of jackrabbits per transect km was 0.33 (0.53/mi) for both the control and irrigation routes.

A total of 16 red fox was observed during the survey. The mean numbers of foxes per transect km were 0.16 (0.26/mi) and 0.11 (0.18/mi) for the control and irrigation routes, respectively.

#### Small Mammals

Six hundred seventy-nine small mammals of 8 species were collected in 16,044 trap nights (Table 25). A total of 10 habitat types was sampled in 1979. Two habitat types (weeds and dense nesting cover) were sampled only on WPA sites and one habitat type was sampled only on irrigation sites.

Dissection analysis revealed that the early trapping schedule sampled the population at or near its low point; all specimens were adults. Although mating had occurred prior to trapping (many females were pregnant), there was no evidence of parturition or lactation.

The overall catch rate (catch per 1,000 trap nights) recorded for the study area was 42.3. The highest catch rate occurred on irrigation sites (48.2), followed by WPA sites (40.0) and control sites (35.8). The most frequently caught species in the study area were the meadow vole (20.9 catches/1,000 trap nights) and deer mouse (16.3 catches/1,000 trap nights).

Idle grassland in the irrigation area showed the highest catch rate of any habitat sampled (122.1). Wetlands in the irrigation area and alfalfa hayland in the control areas showed the next highest rates with 117.6 and 67.0, respectively. The lowest catch rate was recorded in grazed grasslands in control areas (11.4). Only one species (deer mouse) was captured in every habitat sampled.

Three species captured in 1978 and not captured in 1979 were meadow jumping mouse, house mouse, and short-tailed shrew. One species was

Table 25

## SMALL MAMMALS - NEW ROCKFORD STUDY AREA, 1979

Habitat (Total Trap-Nights)	Masked Shrew	Arctic Shrew	13-lined Ground Squirrel	Olive-backed Pocket Mouse	Deer Mouse	Grasshopper Mouse	UNID Voles	Meadow Vole	Prairie Vole	UNID Sm. Mamm.	Total
<b>CONTROL</b>											
Tilled cropland (1,713)	--	--	--	--	42(24.5) <sup>1/</sup>	--	--	27(15.8)	1(0.6)	--	70(40.9)
Untilled cropland (837)	--	--	--	--	23(27.5)	--	--	1(1.2)	1(1.2)	--	25(29.9)
Alfalfa hayland (836)	--	--	1(1.2)	1(1.2)	34(40.7)	2(2.4)	--	16(19.1)	2(2.4)	--	56(67.0)
Idle grass (1,372)	5(3.6)	--	--	--	19(13.8)	2(1.5)	2(1.5)	27(19.7)	3(2.2)	--	58(42.3)
Grazed grass (1,402)	1(0.7)	--	--	--	6(4.3)	1(0.7)	--	6(4.3)	2(1.4)	--	16(11.4)
Hayed grass (280)	--	--	--	--	6(21.4)	--	--	1(3.6)	--	--	7(25.0)
Grass/brush (285)	--	--	1(3.5)	--	1(3.5)	--	--	6(21.1)	1(3.5)	--	9(31.6)
Total (6,725)	6(0.9)	--	2(0.3)	1(0.2)	131(19.5)	5(0.7)	2(0.3)	84(12.5)	10(1.5)	--	241(35.8)
<b>IRRIGATION</b>											
Tilled cropland (1,183)	--	--	--	--	23(19.4)	--	--	--	--	--	23(19.4)
Untilled cropland (1,730)	--	--	1(0.6)	--	41(23.7)	1(0.6)	1(0.6)	4(2.3)	2(1.2)	--	50(28.9)
Alfalfa hayland (286)	--	--	--	--	11(38.5)	--	--	1(3.5)	--	--	12(42.0)
Idle grass (827)	3(3.6)	--	--	--	40(48.4)	4(4.8)	--	48(58.0)	6(7.3)	--	101(122.1)
Grazed grass (1,124)	--	--	--	--	5(4.4)	1(0.8)	--	11(9.8)	8(7.1)	--	25(22.2)
Hayed grass (1,421)	--	--	1(0.7)	--	6(4.2)	--	--	24(16.9)	3(2.1)	1(0.7)	35(24.6)
Wetland (1,088)	2(1.8)	4(3.7)	--	--	1(0.9)	--	2(1.8)	116(106.6)	3(2.8)	--	128(117.6)
Grass/brush (285)	--	--	--	--	--	--	--	9(31.6)	--	--	9(31.6)
Total (7,944)	5(0.6)	4(0.5)	2(0.3)	--	127(16.0)	6(0.8)	3(0.4)	213(26.8)	22(2.8)	1(0.1)	383(48.2)
<b>WPA</b>											
Weeds (278)	1(3.6)	--	--	--	2(7.2)	3(10.8)	--	5(18.0)	--	--	11(39.6)
Idle grass(267)	--	--	--	--	--	--	--	6(22.5)	1(3.7)	--	7(26.2)
Grass/brush (271)	2(7.4)	--	--	--	--	--	--	8(29.5)	1(3.7)	--	11(40.6)
DNC (559)	--	--	1(1.8)	--	2(3.6)	1(1.8)	--	20(35.8)	1(1.8)	1(1.8)	26(44.7)
Total (1,375)	3(2.2)	--	1(0.7)	--	4(2.9)	4(2.9)	--	39(28.4)	3(2.2)	1(0.7)	55(40.0)
GRAND TOTAL (16,044)	14(0.9)	4(0.3)	5(0.3)	1(0.1)	262(16.3)	15(0.9)	5(0.3)	336(20.9)	35(2.2)	2(0.1)	679(42.3)

<sup>1/</sup>Numbers in parentheses indicate catches per 1,000 trap-nights.

recorded for the first time in 1979 (arctic shrew). Deer mice and meadow voles were the most numerous species captured in both 1978 and 1979.

Differences in catch rates and species composition between 1978 and 1979 may be the result of different trapping techniques. In some instances, different control and WPA sites were sampled in 1979.



