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CIRCLE WEST

WILDLIFE MONITORING STUDY

SECOND ANNUAL REPORT

Technical Report

No. 6

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Circle West Wildlife Monitoring Study

Second Annual Report

For the Period March 8, 1979 - February 29, 1980

Circle West Technical Report No. 6

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October, 1980

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INTRODUCTION

This report covers the second year of the Circle West wildlife monitoring study coordinated by the Montana Department of Natural Resources and Conservation (DNRC) as described in the Circle West Wildlife Baseline Study (WBS) final report (DNRC, 1978) and the first wildlife monitoring report (DNRC, 1979a). The report period extends from March 8, 1979, through February 29, 1980.

STUDY AREAS

As during the first monitoring period, field effort was limited primarily to the 174.3 km^2 (99 $mile^2$) Mine Study Area described in the WBS, with the most intensive study occurring in the 29.8 km^2 (11.5 $mile^2$) Proposed Mining Area. However, Northern Resources informed DNRC on August 6, 1979, that coal strip mining is being considered in certain additional areas. These new mining areas (with the exception of a small area east of the Dreyer Ranch) lie almost entirely within the Mine Study Area; consequently, they have been studied since December of 1976 but at a lower level of intensity than the Proposed Mining Area. In order to begin a more thorough study of these new areas as quickly as possible, DNRC obtained permission to conduct small mammal trapping in these areas concurrent with the regular September small mammal monitoring, and to intensity monthly on-the-ground surveys of these areas. On January 8, 1980, DNRC received 7.5' maps showing the boundaries of the new mining areas (see Figure 1). On January 23, 1980, DNRC received a map showing the boundaries of the new Permit Area (Figure 1), which would need additional baseline study. The letters X, Y, and Z are used to refer to sectors of the Permit Area, as shown in Figure 1. The Mine Study Area was then expanded by approximately 14 sections to include a 1.6km (1 mile) buffer surrounding the Permit Area, as shown in the figure. That portion of the Mine Study Area which lies outside the Permit Area was considered a "control" area for some aspects of the study.

APPROACH

This monitoring study focuses on a few key parameters which (1) are indicators of overall environmental conditions and/or of year-to-year trends; (2) are believed to be especially sensitive to mine-related impacts; (3) are cost-effective in terms of amount of field work required, and (4) are capable of being measured quantitatively with an acceptable degree of accuracy and with a minimum of "noise" or unexplained fluctuation. This approach allows both yearly updating of the data gathered during the baseline study and measurement of long-term trends and variability while keeping study costs to a minimum. The quantitative parameters selected for the long-term monitoring study are listed below. Justification for selection of these parameters is presented elsewhere in this or previous reports.

Weather

Annual Precipitation
April-July Precipitation
November-March Precipitation
Average January Temperature
Average July Temperature

Big Game

Mule Deer Production
Mule Deer Winter Density
Mule Deer Winter Distribution
Pronghorn Production
Pronghorn Winter Density
Pronghorn Winter Distribution
Pronghorm Summer Density
Pronghorn Summer Distribution

Small Mammals And Lagomorphs

Small Mammal Biomass
Small Mammal Spring-Fall Biomass Change
Cottontail and White-tailed Jackrabbit Density Index

Waterfowl

Production of Young
Specied Composition
Numbers of individuals and species recorded on June runs of roadside survey routes

Raptors

Number and productivicy of nests

Upland Game Birds

Number of and attendance at Leks
Ring-necked Pheasant June Sample Abundance

Bird Communities

June Species Number (excluding water birds)
June Species Richness
June Lognormal Standard Deviation
June Lognormal Curve Parameters

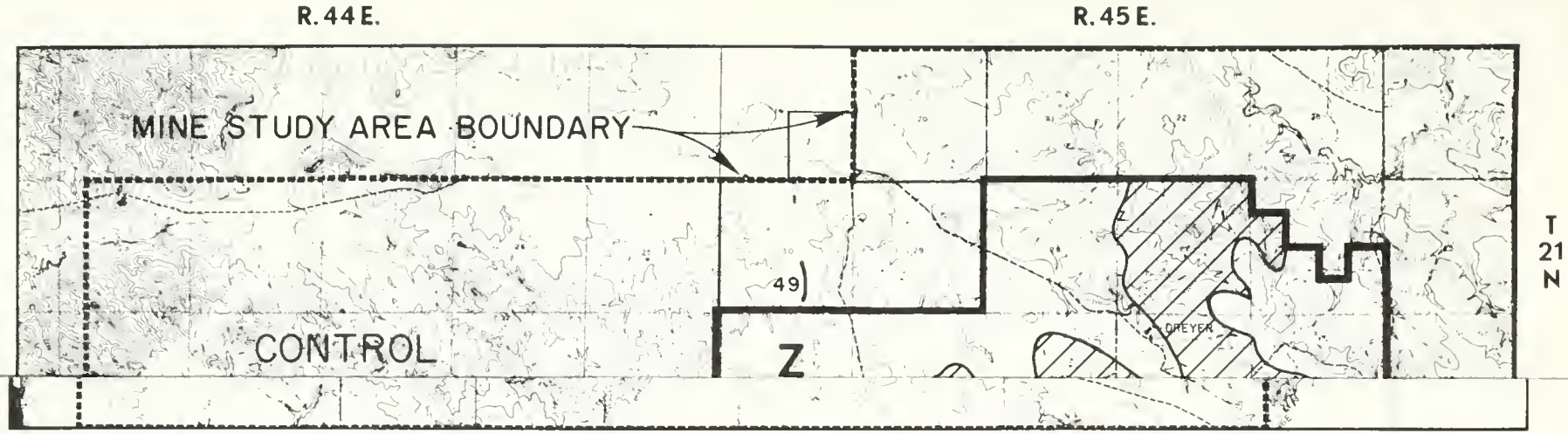

FIGURE I. Location of new study area boundaries, areas considered for mining, and new small mammal traplines, Circle West area.

LEGEND

Area Being Considered For Mining

49 New Small Mammal Traplines

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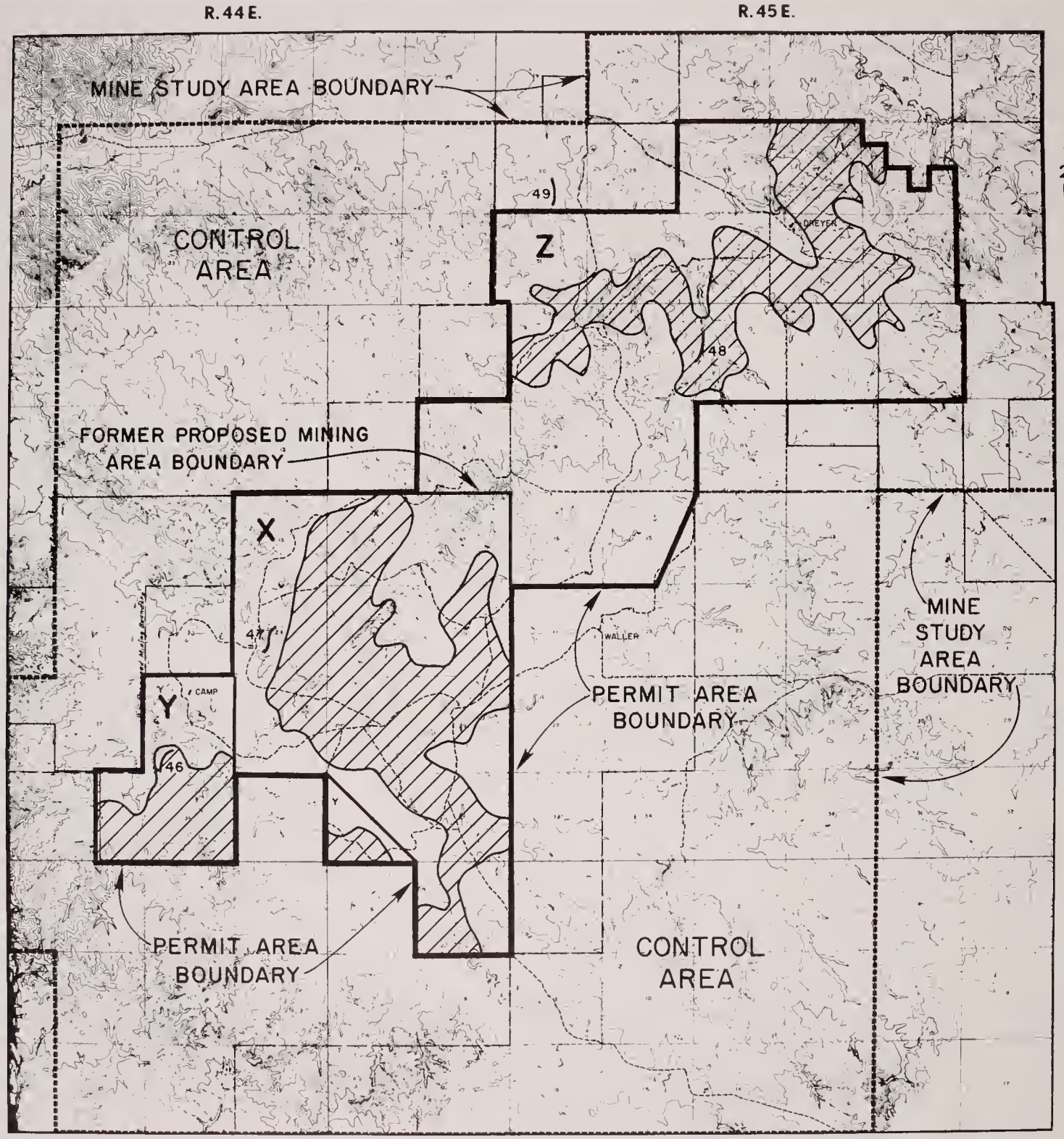

FIGURE I. Location of new study area boundaries, areas considered for mining, and new small mammal traplines, Circle West area.

LEGEND

Area Being Considered For Mining

49 New Small Mammal Traplines

METHODS

Field techniques and analytical methods followed those described in the Wildlife Baseline Study (WBS) Final Report. Six biologists worked in the study area at various times during the March 8, 1979 to February 24, 1980 study period. A total of 73 person-days field time was spent in the Mine Study Area by project biologists. Of these 73 person-days, 44 were spent in the Permit Area. The Reconnaissance Study Area received an additional 10 person-days field effort. A brief summary of methods employed for individual study segments follows.

GENERAL GROUND AND AERIAL SURVEYS

With the exception of August, 1979, monthly aerial surveys were made over the Mine Study Area through February, 1980. All observations (both ground and aerial) of large mammals, upland game birds, and raptors were recorded on the same data sheets and maps used during the baseline study, and identified in the level column by area, using the revised code shown in Appendix B of the WBS. (Note:mining areas Y and Z were not recorded in the level column during the report period.) Locations of all recorded observations within the Mine Study Area were plotted on maps at a scale of 1:24,000. All data (including data sheets and field maps) are on file with DNRC.

WATERFOWL SURVEY AND CENSUS

All waterfowl observations were recorded on the waterfowl data sheets used in the baseline study. In addition, censuses were taken of bodies of water in the Mine Study Area (see Figure 2) three or more times during the study period, using methods described in the First Monitoring Report (DNRC 1979). A computer program was developed to analyze the waterfowl data, and work was begun on preparing written documentation and a user's guide.

MONITORING OF RAPTOR NESTS AND GROUSE LEKS

Raptor nests located in the Mine Study Area were visited in May and June to determine productivity. Leks located in the Mine Study Area were visited in April and October to determine the number of birds in attendance.

ROADSIDE WILDLIFE SURVEY

Each of the five roadside wildlife survey routes were run in May, June, and July, 1979, using methods outlined in the WBS and following the 1977 dates as closely as possible. The theoretical total number of species was determined for cumulative sample abundance distributions as breeding-season (May-July) data were pooled for each route and for the five routes combined. The average sample abundances of each indicator species, as well as various community parameters, were plotted in order to graphically portray the nature and magnitude of year to year fluctuations.

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WINTER BIRD CENSUS

The five bird census grids established in the baseline study were censused in January and February of 1980, using standard methods (Kolb, 1965).

SMALL MAMMAL TRAPPING

The eight small mammal traplines sampled in 1978 (numbers 15, 17, 18, 20, 33, 34, 35, and 44) were snap-trapped for three consecutive nights in May and again for three consecutive nights in October. A new pair of traplines in scoria habitats of Mining Area Y and another new pair in coulee trunk habitats of Mining Area Z (Figure 1) were snap-trapped for three consecutive nights in October. Methods followed those outlined in the WBS.

LAGOMORPH SURVEY

The two lagomorph survey routes were run consecutively on each of three mornings (October 3-5) beginning with the mining area route at 4:00.

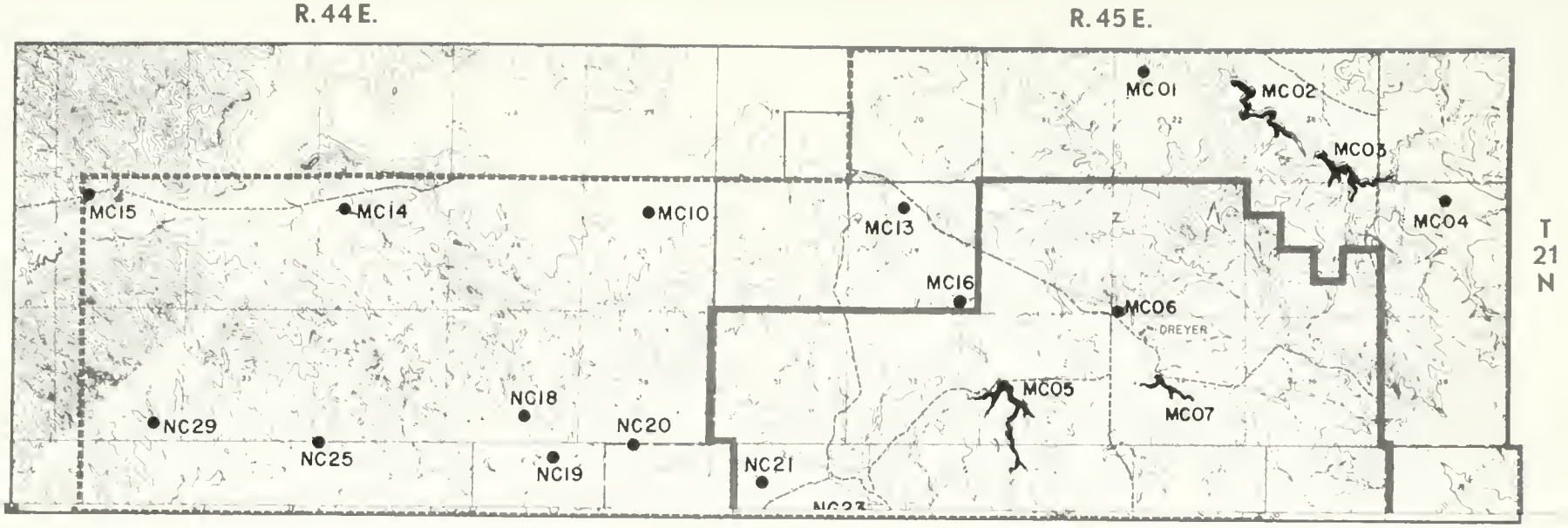

FIGURE 2. Stockpond and reservoir codes, Circle West area.

LEGEND

● <1.0 ha

◥ >1.0 ha

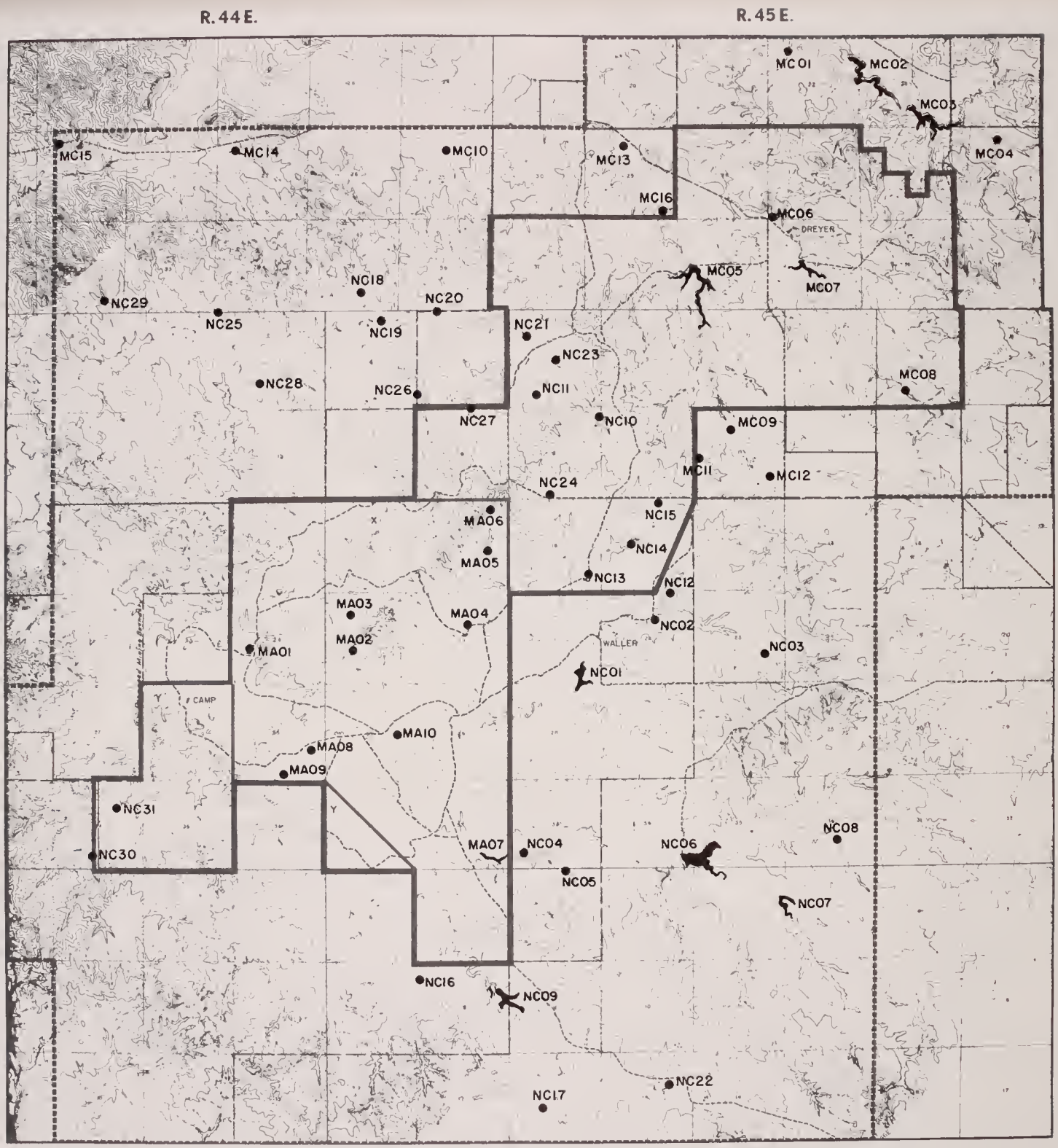

FIGURE 2. Stockpond and reservoir codes, Circle West area.

LEGEND

● <1.0 ha

◥ >1.0 ha

WEATHER

Annual precipitation, growing season (April-July) precipitation, and winter (November-March) precipitation were compiled from weather stations to document moisture availability for vegetation and waterfowl and the amount of winter snow cover. Average January and July temperatures were monitored as well, as they are related to the amounts of thermal stress experienced by wildlife during the months which typically have the lowest and highest average temperatures. Using these data, a "severe" winter can be identified as one with a lower than normal January temperature and higher than normal November-March precipitation (for example, the winter of 1978-79).

Figures 3 and 4 summarize year-to-year changes in the weather at the Circle and Fort Peck recording stations. Despite a relatively cool, moist spring, 1979 was a relatively dry year; growing season precipitation was at or below normal and precipitation for the remainder of the year was well below normal. Average July 1979 temperatures were slightly higher than normal. Winter precipitation was normal or slightly below normal during the study period, and average January temperatures were near normal, resulting in a mild winter with very little snow cover.

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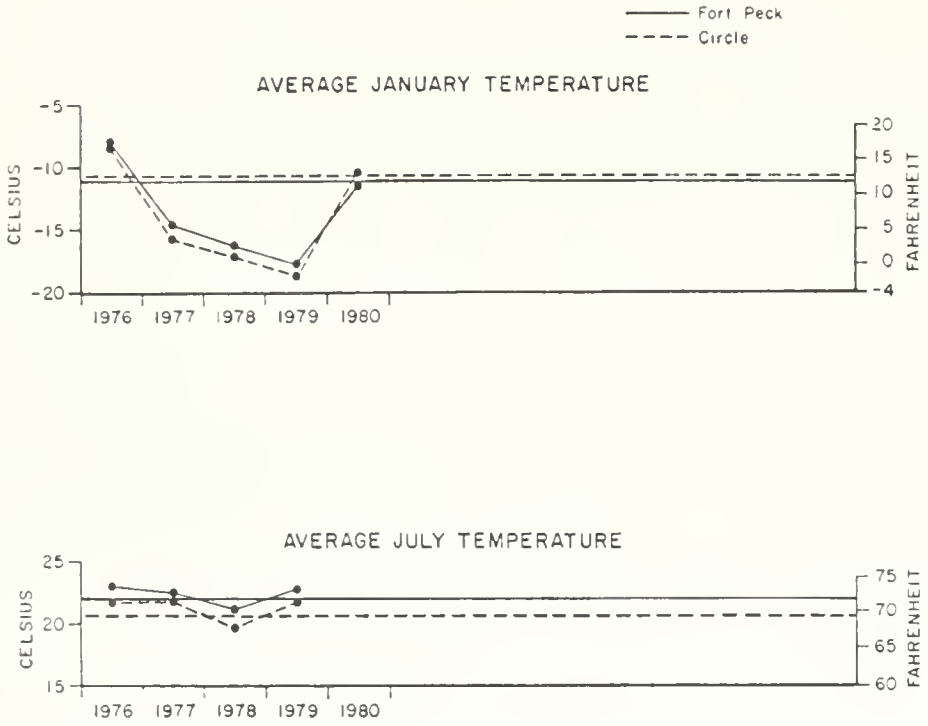


Figure 3. Year-to-year changes in temperature parameters at Circle and Fort Peck recording stations.

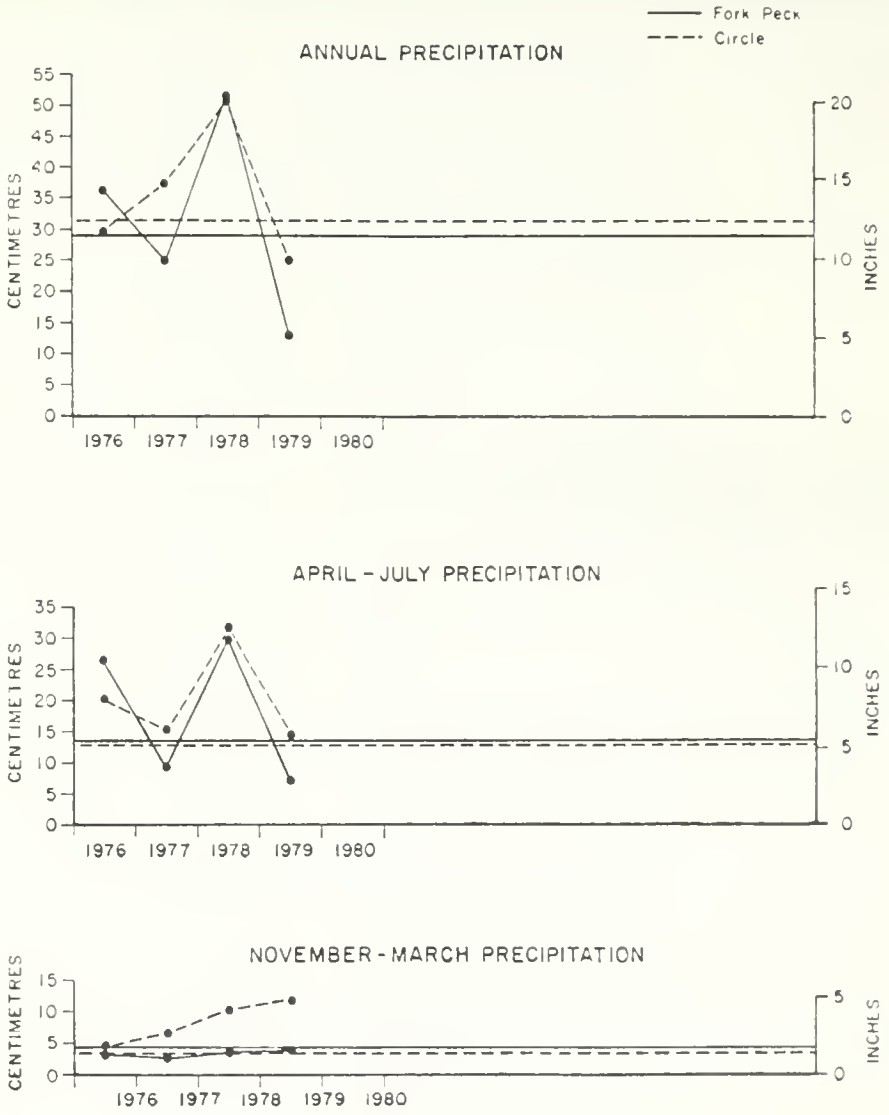


Figure 4. Year-to-year changes in precipitation parameters at Circle and Fort Peck recording stations.

VEGETATION AND HABITATS

A quantitative description of 1978-1979 changes in vegetation has been presented in the 1979 vegetation monitoring study annual report (DNRC, 1979b). Due to the relatively moist summer, fall, and winter of 1978, 1979 soil moisture was good, and vegetative productivity was quite high (although not as high as the exceptional productivity observed in 1978). Residual grass stems from 1978 produced a striking increase in litter accumulation, which may explain the high 1978-1979 overwinter survival rates shown by small mammal populations in spite of the severe winter (see page 65). Heavy snow accumulations in coulees over the winter of 1978-79 caused considerable damage to Shepherdia argentea plants in the Mine Study Area, and many branches or even entire shrubs were killed on some of the bird census plots.

Habitat mapping of the entire Mine Study Area was completed during the study period at a scale of 1:24,000. Mapping of habitat categories followed the classification system reported in the WBS. Copies of the map are available at cost from DNRC.

RESULTS AND DISCUSSION

WILDLIFE SPECIES PARAMETERS

Tabular Summary

A total of 203 species of vertebrates was observed through the monitoring period (five species of amphibians, seven of reptiles, 164 of birds, and 27 of mammals). Data on birds and mammals are summarized in tables 1 and 2. The types of data included and the abbreviations used are as described on pages 41 and 56 of the WBS, with the exceptions noted. Any additions or changes to the data base resulting from the second year's monitoring study are printed in italics. No additions were made to the data on amphibians and reptiles in the first monitoring report.

Table 3 summarizes the cumulative numbers of species encountered in the study areas during the baseline study and through the first and second monitoring periods. It can be seen from this table that only four new vertebrate species were added to the species list as a result of the second year's monitoring effort; of these, three were migratory birds, and one a summer resident bird.

Narrative Accounts for Selected Species

Data in addition to that in tables 1 and 2 were obtained for certain species, and are summarized in the following species accounts. In general, information presented here is limited to nesting raptors, upland game birds, and ungulates, and is primarily an assessment of changes occurring in the Mine Study Area since the baseline study.

Red-tailed Hawk. The nest located on the proposed mining area in 1977 was inactive in 1979. The nest found in 1977 in the southwestern corner of the Mine Study Area produced four young in 1979, and a new nest located near Stockpond MC10 contained at least one young bird.

Swainson's Hawk. Swainson's hawks were much more commonly seen in 1979 than during previous years. Three active nests were located in 1979, one in the originally proposed mining area (with at least two young), one in the northern portion of the Mine Study Area (four young), and one along the Circle route (three young). Another pair is believed to have nested near the Waller Ranch, although the nest could not be located.

Ferruginous Hawk. A pair was heard repeatedly calling overhead near the location of the 1977 active nest, but the nest was empty again in 1979. A new nest was located in the northern portion of the Mine Study Area; it contained three young on June 15, 1979. Another new nest, located on a scoria butte within the northern addition to the Mine Study Area, contained at least four young.

Table 1. Summary of inventory data for bird species observed in the Circle West study area, June 1976 - February 1980. See WBS for explanation of abbreviations.

Species	Preferred Habitat	Distribution [1]	Guild	Classification	Status	Evidence	Monthly Occurence											
							Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Common Loon (Gavia immer)	PR	-, 2, -	4680	N	M	V	-	-	-	-	T	-	-	-	-	-	-	-
Horned Grebe (Podiceps auritus)	PR	1, 2, -	2680	N	M	V	-	-	-	-	T	-	-	-	-	-	-	-
Eared Grebe (Podiceps nigricollis)	SW, PR	1, 2, 3	2682	N	S(NE)	P	-	-	-	-	T	T	T	T	-	-	S	-
Western Grebe (Aechmophorus occidentalis)	SW	-, 2, 3	4680	BN	M	V	-	-	-	-	-	T	-	-	-	T	-	-
Pied-billed Grebe (Podilymbus podiceps)	PR	1, 2, 3	2682	N	S(PJ)	V	-	-	-	-	T	T	T	-	T	T	-	-
White Pelican (Pelecanus erythrorhynchos)	SW	-, 2, 3	4680	BN	V	V	-	-	-	S	T	T	S	-	-	-	-	-
Double-crested Cormorant (Phalacrocorax auritus)	SW, PR	1, 2, 3	4687	BN	S(NY)	V	-	-	-	S	S	D	D	T	-	T	-	-
Great Blue Heron (Ardea herodias)	FW,SW,SH, PR,SM	1, 2, 3	4677	N	S(NY)	V	-	-	-	S	B [2]	S	B	B	B	T	-	-
American Bittern (Botaurus lentiginosus)	SM,PR	1, -, -	2670	N	M	V	-	-	-	-	T	-	-	-	-	-	-	-
Canada Goose (Branta canadensis)	PR,FW,SW, SH,CU	1, 2, 3	3674	M	S(PJ)	V	-	-	B	B	B	S	S	B	B	X	S	-
Mallard (Anas platyrhynchos)	PR,FW,SG	1, 2, 3	3674	M	S(PJ)	V	-	-	B	B	B	B	S	S	S	X	S	-
Gadwall (Anas strepera)	PR,SG	1, 2, 3	3674	M	S(PJ)	V	-	-	-	S	T	S	S	S	S	S	S	-
Pintail (Anas acuta)	PR,FW	1, 2, 3	3674	M	S(PJ)	V	-	-	B	S	D	S	S	-	-	-	-	-
Green-winged Teal (Anas crecca)	PR	1, 2, 3	3674	M	S(PJ)	V	-	-	S	S	S	B	S	-	S	S	S	-
Blue-winged Teal (Anas discors)	PF,FW,SA	1, 2, 3	3674	M	S(PJ)	V	-	-	-	B	B	B	S	T	S	S	-	-
American Wigeon (Anas americana)	PR,FW,SH	1, 2, 3	3674	M	S(PJ)	V	-	-	S	B	B	D	T	T	S	S	S	-

Table 1 (continued)

Species	Preferred Habitat	Distribution	Guild	Classification	Status	Evidence	Monthly Occurence											
							Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Northern Shoveler (Anas clypeata)	PR,FW,SM, SH	1, 2, 3	3674	M	S(PJ)	V	-	-	S	S	S	S	S	S	-	-	-	-
Redhead (Aythya americana)	PR	-, 2, 3	3682	M	S(PJ)	V	-	-	S	S	T	T	T	-	-	S	-	-
Ring-necked Duck (Aythya collaris)	PR	1, 2, -	3680	M	S	V	-	-	S	T	T	T	-	-	-	S	S	-
Canvasback (Aythya valisineria)	PR	1, 2, 3	3682	BM	S(PJ)	V	-	-	-	S	T	D	T	-	-	S	S	-
Lesser Scaup (Aythya affinis)	PR,SH	1, 2, 3	3684	M	S(RH)	V	-	-	S	S	S	T	T	-	-	-	-	-
Common Goldeneye (Bucephala clangula)	PR	-, 2, 3	3680	M	S	V	-	-	S	S	-	T	-	-	-	-	-	-
Bufflehead (Bucephala albeola)	PR,SW	, 2, 3	3680	M	S	V	-	-	-	S	T	-	-	-	-	S	S	-
Ruddy Duck (Oxyura jamaicensis)	PR	-, 2, 3	3682	M	S(CD)	V	-	-	-	-	-	S	D	-	-	-	-	-
Hooded Merganser (Lophodytes cucullatus)	*PR*	*-, 2, -*	*4680*	*M*	S	*V*	-	-	-	*T*	*T*	*T*	-	-	-	-	-	-
Common Merganser (Mergus merganser)	PR,SW	-, 2, 3	4680	M	S	V	-	-	S	S	-	-	-	-	-	T	-	-
Red-breasted Merganser (Mergus serrator)	PR	-, 2, -	4680	M	S	V	-	-	-	S	-	-	-	-	-	-	-	-
Turkey Vulture (Cathartes aura)	BA,SC	1, 2, 3	5233	N	S(AN)	V	-	-	-	-	T	S	S	S	-	-	-	-
Sharp-shinned Hawk (Accipiter striatus)	CF,CU,TL	-, 2, 3	4267	BN	S(RH)	V	-	-	-	S	-	-	-	-	*T*	B	-	-
Red-tailed Hawk (Buteo jamaicensis)	Various	1, 2, 3	4267	N	S(PJ)	P	-	-	-	B	B	B	B	B	S	B	-	-
Swainson's Hawk (Buteo swainsoni)	GR,CU,SC, TL,FR,SG	1, 2, 3	4267	BN	S *(NY)*	V	T	-	-	B	B	S	B	B	S	B	-	-
Rough-legged Hawk (Buteo lagopus)	GR,CU,BA TL,SG,LB	1, 2, 3	4260	N	W	V	S	B	B	*T*	-	-	-	-	-	S	S	T
Ferruginous Hawk (Buteo regalis)	GR,BA,SC, FR,TL,HJ	1, 2, 3	4263	BNU	S(PJ)	P	-	-	-	*T*	T	B	S	S	-	-	S	B

Table 1 (continued)

Species	Preferred Habitat	Distribution	Guild	Classification	Status	Evidence	Monthly Occurence Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Golden Eagle (Aquila chrysaetos)	Various	1, 2, 3	4263	N	R(PJ)	P	B	B	B	B	S	B	D	S	B	B	S	B
Bald Eagle (Haliaeetus leucocephalus)	CF,SH,CG	1, 2, 3	4660	E	W	V	T	X	X	-	-	-	S	-	-	-	S	S
Marsh Hawk (Circus cyaneus)	WM,SR,GR, SS,LC,SG	1, 2, 3	4264	BN	S(PJ)	V	-	-	S	B	B	B	B	B	B	B	S	-
Osprey (Pandion haliaetus)	SW,CG	-, -, 3	4687	BNU	S(NY)	V	-	-	-	S	S	S	-	-	-	-	-	-
Prairie Falcon (Falco mexicanus)	GR,BA,SC, CU,CG,SG	1, 2, 3	4263	BNT	R(PJ)	P	-	S	S	S	S	B	B	B	S	B	-	-
Peregrine Falcon (Falco peregrinus)	CU,SG	1, 2, 3	4260	NE	M	V	-	S	-	-	S	-	-	-	-	T	-	S
Merlin (Falco columbarius)	CF,CU	-, 2, 3	4260	BNU	M	V	-	B	-	-	T	-	-	B	-	-	-	-
American Kestrel (Falco sparverius)	GR,CU,SC, BA,CG,TL	1, 2, 3	2268	BN	S(PJ)	V	-	-	S	B	B	B	B	B	B	T	-	-
Sharp-tailed Grouse (Pedioecetes phasianellus)	see WBS	1, 2, 3	3234	BG	R(PJ)	S(P)	B	B	B	B	B	B	B	B	B	B	S	B
Sage Grouse (Centrocerus urophasianus)	SS,SG,BS, BG,SA,GR	1, 2, 3	1234	BG	R(PJ)	S(P)	T	-	-	S	B	B	B	B	B	T	-	-
Ring-necked Pheasant (Phasianus colchicus)	see WBS	1, 2, 3	1234	G	R(PJ)	S(P)	B	B	B	B	B	B	B	B	B	B	S	B
Gray Partridge (Perdix perdix)	CU,GR,LC, SG,SS,BX	1, 2, 3	1234	G	R(RH)	S(P)	S	B	-	B	B	B	B	B	B	B	S	B
Sandhill Crane (Grus canadensis)	CU,GR	1, 2, 3	3230	M	M	V	-	-	-	T	-	-	-	-	S	S	-	-
Sora (Porzana carolina)	CM,SM	1, 2, 3	3672	M	S(TO)	V	-	-	-	-	T	B	-	-	-	-	-	-
American Coot (Fulica americana)	PR,SW,FW	1, 2, 3	3682	M	S(PJ)	V	-	-	-	S	T	T	T	-	-	T	-	-
Killdeer (Charadrius vociferus)	SH,GR,SA, CU,SM	1, 2, 3	2234	M	S(PJ)	V	-	-	B	B	B		B	B	T	B	-	-

Table 1 (continued)

Species	Preferred Habitat	Distribution	uild	Classification	Status	Evidence	Monthly Occurence Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Black-bellied Plover (Pluvialis squatarola)	GR	1, -, -	230	M	M	V	-	-	-	-	T	-	-	-	-	-	-	-
Common Snipe (Capella gallinago)	FW,WM,SM	1, 2, 3	234	M	S(RH)	B	-	-	-	S	-	T	-	-	-	T	-	-
Long-billed Curlew (Numenius americanus)	GR	1, 2, 3	2234	MU	S(RH)	V	-	-	-	-	T	T	B	-	-	-	-	-
Upland Sandpiper (Bartramia longicauda)	GR,SA	1, 2, 3	2234	BM	S(TO)	V	-	-	-	S	B	B	B	-	-	-	-	-
Spotted Sandpiper (Actitis macularia)	FW,PR,SH	1, 2, 3	2294	M	S(RH)	V	-	-	-	-	T	T	D	S	-	-	-	-
Solitary Sandpiper (Tringa solitaria)	SH,PR	1, 2, -	2290	M	M	V	-	-	-	-	T	T	T	-	-	-	-	-
Willet (Catoptrophorus semipalmatus)	CU,WM	1, 2, 3	2294	M	S(TO)	V	-	-	-	B	T	T	T	-	-	-	-	-
Greater Yellowlegs (Tringa melanoleuca)	SH,PR	-, 2, -	2290	M	M	V	-	-	-	-	-	-	T	-	-	-	-	-
Lesser Yellowlegs (Tringa flavipes)	SH,PR	-, 2, 3	2290	M	M	V	-	-	-	S	T	T	T	-	-	-	-	-
Baird's Sandpiper (Calidris bairdii)	FW,SH	1, -, -	2290	M	M	V	-	-	-	-	T	-	-	-	-	-	-	-
Least Sandpiper (Calidris minutilla)	FW,SH	1, -, -	2290	M	M	V	-	-	-	-	T	-	-	-	-	-	-	-
Long-billed Dowitcher (Limnodromus scalopaceus)	FW,SN	1, 2, -	2290	M	M	V	-	-	-	-	T	-	T	-	-	-	-	-
Western Sandpiper (Calidris mauri)	FW,SN	1, -, -	2290	M	M	V	-	-	-	-	T	-	-	-	-	-	-	-
Sanderling (Calidris alba)	PR	1, -, -	2290	M	M	V	-	-	-	-	-	-	S	-	-	-	-	-
American Avocet (Recurvirostra americana)	PR,GR	1, 2, 3	2294	M	S(RH)	V	-	-	-	-	S	T	-	T	-	-	-	-
Wilson's Phalarope (Steganopus tricolor)	FW,PR	1, 2, 3	2674	N	S(RH)	V	-	-	-	-	B	D	D	-	-	-	-	-

Table 1 (continued)

Species	Preferred Habitat	Distribution	Guild	Classification	Status	Evidence	Monthly Occurence											
							Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
California Gull (Larus californicus)	PR,FW,CU, SH	1, 2, 3	3230	N	V	V	-	-	-	S	-	S	S	S	-	T	-	-
Ring-billed Gull (Larus delawarensis)	PR,CU,GR, SH	1, 2, 3	3230	N	V	V	-	-	-	S	-	D	D	S	-	-	-	-
Common Tern (Sterna hirundo)	PR	1, 2, -	2680	N	V	V	-	-	-	-	-	T	T	-	-	-	-	-
Black Tern (Chlidonias niger)	GR,PR	1, 2, 3	2682	N	S(RH)	V	-	-	-	-	T	T	T	-	-	-	-	-
Rock Dove (Columba livia)	CU,GR,OF	-, -, 3	1233	N	R(PJ)	V	T	S	B	B	B	B	B	B	B	B	S	T
Mourning Dove (Zenaida macroura)	TC,CU,GR, LC,CG	1, 2, 3	1236	N	S(PJ)	V	-	-	-	B	B	B	B	B	S	T	-	-
Black-billed Cuckoo (Coccyzus erythropthalmus)	SF,RS	-, -, 3	2336	N	S(RH)	A	-	-	-	-	-	B	T	-	-	-	-	-
Great Horned Owl (Bubo virginianus)	FG,TC,CG BA	1, 2, 3	4267	N	R(PJ)	V	-	B	B	B	B	T	B	B	B	B	T	T
Snowy Owl (Nyctea scandiaca)	CU,GR	-, -, 3	4260	N	W	V	-	B	B	-	-	-	-	-	-	-	-	T
Burrowing Owl (Speotyto cunicularia)	GR,SG	1, 2, 3	2269	BNU	S(PJ)	S(1)	-	-	-	S	B	B	B	B	S	-	-	-
Long-eared Owl (Asio otus)	CG	-, -, 3	4267	N	S(RH)	V	-	-	-	-	-	S	-	-	-	-	-	-
Short-eared Owl (Asio flammeus)	WM,SG,GR CU,SR	1, 2, 3	4264	BN	R(PJ)	S(1)	S	T	-	B	T	T	S	B	S	T	-	-
Common Nighthawk (Chordeiles minor)	CG,GR,SS	1, 2, 3	2504	N	S(NE)	V	-	-	-	-	S	B	B	B	S	-	-	-
Belted Kingfisher (Megaceryle alcyon)	SM,FW	-, -, 3	4683	N	S(RH)	V	-	-	-	-	B	-	-	-	-	-	-	-
Common Flicker (Colaptes auritus)	CF,CG,FG, SG,GR	1, 2, 3	2238	N	S(RH)	V	-	-	-	B	B	B	B	B	B	-	-	-
Red-headed Woodpecker (Melanerpes erythrocephalus)	CF,CG,GR	1, 2, 3	2118	BN	S(RH)	V	-	-	-	-	D	S	B	B	-	-	-	-

Table 1 (continued)

Species	Preferred Habitat	Distribution	Guild	Classification	Status	Evidence	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Hairy Woodpecker (Dendrocopos villosus)	FG	-, 2, 3	2118	BN	R(SS)	V	-	S	-	-	-	T	-	-	-	-	-	-
Eastern Kingbird (Tyrannus tyrannus)	TC,LC,SG, GR,SR	1, 2, 3	2556	N	S(PJ)	V	-	-	-	-	B	B	B	B	-	-	-	-
Western Kingbird (Tyrannus verticalis)	TC,CG,FG, LC,GR	1, 2, 3	2557	N	S(PJ)	V	-	-	-	-	B	B	B	B	-	-	-	-
Say's Phoebe (Sayornis saya)	BA,GR	1, 2, 3	2553	N	S(NY)	V	-	-	-	B	B	B	B	S	-	-	-	-
Least Flycatcher (Empidonax minimus)	FG,CF,TC	-, 2, 3	2556	N	S(TO)	V	-	-	-	-	B	B	T	-	-	-	-	-
Empidonax, Flycatcher (Empidonax spp.)	SG,TC	1, 2, -	2550	N	M	V	-	-	-	-	T	-	-	-	-	-	-	-
Western Wood Pewee (Contopus sordidulus)	BX	-, 2, 3	2557	N	S(RH)	A	-	-	-	-	T	B	-	-	-	-	-	-
Horned Lark (Eremophila alpestris)	GR,CU,SG	1, 2, 3	3234	N	R(NY)	S(2)	B	B	B	B	B	B	B	B	B	B	S	B
Tree Swallow (Iridoprocne bicolor)	FW,CF	-, -, 3	2508	N	S(RH)	V	-	-	-	-	-	T	-	-	-	-	-	-
Bank Swallow (Riparia riparia)	GR,SA,SM	-, 2, 3	2503	N	S(AN)	V	-	-	-	-	-	B	S	S	-	-	-	-
Rough-winged Swallow (Stelgidopteryx ruficollis)	GR,SA,SM	-, 2, 3	2503	N	S(RH)	V	-	-	-	-	B	B	B	B	-	-	-	-
Barn Swallow (Hirundo rustica)	AF,OF,GR	1, 2, 3	2503	N	S(NY)	V	-	-	-	-	B	B	B	B	-	-	-	-
Cliff Swallow (Petrochelidon pyrrhonota)	GR,SA,AF	1, 2, 3	2503	N	S(NY)	V	-	-	-	-	B	B	B	B	-	-	-	-
Black-billed Magpie (Pica pica)	CF,TC,LC, CG,FG,GR	1, 2, 3	3236	N	R(PJ)	V	B	B	B	B	B	B	B	B	B	B	S	B
Common Crow (Corvus brachyrhynchos)	CF,GR,CU	1, 2, 3	3237	N	S(RH)	V	-	-	S	B	B	B	B	B	B	T	-	-
Black-capped Chickadee (Parus atricapillus)	CF,TC,RS, FG	-, 2, 3	2348	N	R(TO)	V	T	B	B	-	T	T	B	-	B	B	S	B
Red-breasted Nuthatch (Sitta canadensis)	FG	-, -, 3	2120	N	M	V	-	-	-	-	-	-	-	-	S	-	-	-
House Wren (Troglodytes aedon)	CF,FG	-, 2, 3	2338	N	S(TO)	V	-	-	-	-	B	B	B	-	-	-	-	-

Table 1 (continued)

Species	Preferred Habitat	Distribution	Guild	Classification	Status	Evidence	Jan	Feb	Mar	Apr	May	Jun	Jl	Aug	Sep	Oct	Nov	Dec
Rock Wren (Salpinctes obsoletus)	BA,SC	1, 2, 3	2233	N	S(TO)	V	-	-	-	B	B	B	B	B	B	-	-	-
Gray Catbird (Dumetella carolinensis)	CF,RS	-, -, 3	2336	N	S(RH)	V	-	-	-	-	S	T	B	-	-	-	-	-
Brown Thrasher (Toxostoma rufum)	LC,TC,GR	1, 2, 3	2335	N	S(PJ)	V	-	-	-	-	B	B	B	B	-	-	-	-
Sage Thrasher (Oreoscoptes montanus)	BS,BA	-, -, 3	2335	N	S(TO)	A	-	-	-	-	T	T	B	-	-	-	-	-
American Robin (Turdus migratorius)	FG,LC,GR	1, 2, 3	3237	N	R(RH)	V	B	-	-	B	B	B	B	B	B	B	-	-
Swainson's Thrush (Catharus ustulatus)	BX	1, 2, 3	2330	N	M	A	-	-	-	-	S	-	-	-	-	-	-	-
Mountain Bluebird (Sailia currocoides)	GR,BA	1, 2, 3	2338	N	S(TO)	V	-	-	-	-	T	B	B	B	X	-	-	-
Townsend's Solitaire (Myadestes townsendi)	FG	-, -, 3	3330	N	W	A	-	-	-	-	-	-	-	-	-	-	-	B
Golden-crowned Kinglet (Regulus satrapa)	TC	-, 2, 3	3330	N	M	V	-	-	-	-	-	-	-	-	-	T	-	-
Water Pipit (Motacilla spinoletta)	SH	-, 2, 3	2290	N	M	V	-	-	-	S	-	-	-	-	-	-	-	-
Sprague's Pipit (Anthus spragueii)	SG,SG	1, 2, 3	2234	N	S(TO)	V	-	-	-	B	B	B	B	S	-	-	-	-
Bohemian Waxwing (Bombycilla garrulus)	CF,RS,CU	-, -, 3	1440	N	W	V	B	B	B	-	-	-	-	-	-	-	S	B
Cedar Waxwing (Bombycilla cedrorum)	CF,RS,FG	-, -, 3	3447	N	S(RH)	V	-	-	-	-	-	-	T	-	B	-	-	-
Northern Shrike (Lanius excubitor)	TC,GR,SG	-, 2, 3	4260	N	W	S(1)	B	B	-	-	-	-	-		-	B	S	B
Loggerhead Shrike (Lanius ludovicianus)	TC,LC,GR, SG	1, 2, 3	4266	BN	S(PJ)	S(1)	-	-	-	B	B	B	B	B	-	-	-	-
Starling (Sturnus vulgaris)	OF,AF,FG, CG	1, 2, 3	3233	N	R(NY)	V	T	-	B	B	B	B	B	B	B	B	S	B
Red-eyed Vireo (Vireo olivaceus)	CF	-, -, 3	2447	N	S(RM)	A	-	-	-	-	-	-	T	-	-	-	-	-
Warbling Vireo (Vireo gilvus)	CG,FG,CF	-, 2, 3	2447	BN	S(TO)	V	-	-	-	-	S	B	B	-	-	-	-	-

Table 1 (continued)

Species	Preferred Habitat	Distribution	Guild	Classification	Status	Evidence	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Tennessee Warbler (Vermivora peregrina)	BX,FG	-,-,3	2440	N	M	S(1)	-	-	-	-	T	-	-	-	-	-	-	-
Orange-crowned Warbler (Vermivora celata)	BX	-,-,3	2440	N	M	V	-	-	-	B	-	-	-	-	-	-	-	-
Yellow Warbler (Dendroica petechia)	LC,TC,SR, FG,CF,CG	1,2,3	2336	BN	S(TO)	V	-	-	-	-	B	B	B	-	-	-	-	-
Magnolia Warbler (Dendroica magnilia)	FG	-,-,3	2330	N	M	V	-	-	-	-	T	-	-	-	-	-	-	-
Yellow-rumped Warbler (Dendroica coronata)	TC,LC,SR, SS	-,2,3,	3230	N	M	V	-	-	-	B	T	-	-	-	B	T	-	-
Blackpoll warbler (Dendroica coronata)	PW,CG,RC	-,2,3	2	N	M	P	-	-	-	-	T	-	-	-	-	-	-	-
Northern Waterthrush (Seiurus noveboracensis)	PW,CG	-,2,-	23	N	M	V	-	-	-	-	T	-	-	-	-	-	-	-
Common Yellowthroat (Geothlypis trichas)	SR,SS,LC	1,2,3	2334	N	S(AF)	V	-	-	-	-	B	B	B	S	-	-	-	-
Yellow-breasted Chat (Icteria virens)	TC	1,2,3	2336	BN	S(TO)	V	-	-	-	-	T	S	S	B	-	-	-	-
American Redstart (Setophaga ruticilla)	CG,BX	-,2,3	24	N	S(RH)	V	-	-	-	-	T	-	-	-	-	-	-	-
Wilson's Warbler (Wilsonia pusilla)	RS,TC	-,2,3	3230	N	M	V	-	-	-	-	-	-	-	-	B	T	-	-
House Sparrow (Passer domesticus)	OF,AF,FG	1,2,3	3233	N	R(PJ)	V	B	B	B	B	B	B	B	B	B	B	S	B
Boblink (Dolichonyx oryzivorus)	CU	1,2,3	3234	N	S(AF)	V	-	-	-	-	B	T	T	-	-	-	S	-
Western Meadowlark (Sturnella neglecta)	GR,SS,SG, CU,LC,SR	1,2,3	2234	N	S(NY)	V	-	-	T	B	B	B	B	B	B	B	-	-
Yellow-headed Blackbird (Xanthocephalus xanthocephalus)	SM,GR	1,2,3	2231	N	S(TO)	V	-	-	-	S	B	B	B	S	-	T	-	-
Red-winged Blackbird (Agelaius phoeniceus)	CM,SM,GR	1,2,3	2231	N	R(NY)	V	-	B	T	B	B	B	B	S	B	B	T	-
Orchard Oriole (Icterus spurius)	BX,CF	-,2,3	2447	N	S(TO)	V	-	-	-	-	B	T	-	-	-	-	-	-

Table 1 (continued)

Species	Preferred Habitat	Distribution	Guild	Classification	Status	Evidence	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Northern Oriole (Icterus galbula)	CF,CG,BX, SS	1, 2, 3	2447	N	S(TO)	V	-	-	-	-	B	B	B	-	-	-	-	-
Brewer's Blackbird (Euphaga cyanocephalus)	GR,CU,BA	1, 2, 3	2234	N	S(PJ)	S(1)	-	-	-	B	B	B	B	B	T	B	T	-
Common Grackle (Quiscalus quiscula)	GR,CG	1, 2, 3	2236	N	S(RH)	V	-	-	-	B	B	B	S	-	-	-	-	-
Brown-headed Cowbird (Molothrus ater)	GR,LC,TC	1, 2, 3	223	N	S(NE)	V	-	-	-	-	B	B	B	-	-	-	S	-
Rose-breasted Grosbeak (Pheucticus ludovicianus)	LC,TC	1, -, -	3330	N	M	V	-	-	-	-	-	-	-	-	-	T	-	-
Black-headed Grosbeak (Pheucticus melanocephalus)	TC	-, 2, -	3330	N	V	V	-	-	-	-	T	-	-	-	-	-	-	-
Lazuli Bunting (Passerina amoena)	RS,CU	-, -, 3	3236	N	S(TO)	V	-	-	-	-	B	B	B	-	-	-	-	-
Gray-crowned Rosy Finch (Leucosticte tephrocotis)	LC	1, -, -	1230	N	M	V	-	-	-	-	-	-	S	-	-	-	-	-
Common Redpoll (Acanthis flammea)	CU,GR,TC	1, 2, 3	1230	N	W	V	B	B	B	-	-	-	-	-	-	B	S	B
American Goldfinch (Spinus tristis)	FG,TC,RS, CG,LC,GR	1, 2, 3	1236	N	S(RH)	V	-	-	-	-	B	B	B	B	B	-	-	-
Rufous-sided Towhee (Pipilo erythrophthalmus)	TC,LC	1, 2, 3	3235	N	S(PJ)	V	-	-	-	-	B	B	B	B	B	-	-	-
Lark Bunting (Calamospiza melanocorys)	SS,SG,GR	1, 2, 3	3234	N	S(PJ)	V	-	-	S	-	B	B	B	B	-	-	S	-
Savannah Sparrow (Passerculus sandwichensis)	GR,SS,WM	1, 2, 3	3234	N	S(TO)	V	-	-	-	-	B	B	B	-	B	-	-	-
Grasshopper Sparrow (Ammodramus savannarum)	SG,GR	1, 2, 3	3234	BN	S(TO)	V	-	-	-	-	B	B	B	-	-	-	-	-
Baird's Sparrow (Ammodramus bairdii)	GR,SA	1, 2, 3	3234	N	S(TO)	V	-	-	-	-	T	T	T	-	-	-	-	-
Vesper Sparrow (Pooecetes gramineus)	SS,SG,GR BS,BG	1, 2, 3	3234	BN	S(TO)	S(1)	-	-	-	B	B	B	B	B	B	-	-	-
Lark Sparrow (Chondestes grammacus)	GR,BA,SG	1, 2, 3	3234	N	S(PJ)	V	-	-	-	-	B	B	B	B	-	-	-	-
Dark-eyed Junco (Junco hyemalis)	TC,SG,BA	1, 2, 3	3230	N	M	V	-	-	-	-	-	-	-	-	B	T	-	-

Table 1 (continued)

Species	Preferred Habitat	Distribution	Guild	Classification	Status	Evidence	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Tree Sparrow (Spizella arborea)	TC,RS,SR, WI	1, 2, 3	1230	N	W	V	-	-	B	-	-	-	-	-	-	B	*T*	-
Chipping Sparrow (Spizella passerina)	SS,SG,TC, RS	1, 2, 3	3236	N	S(RH)	V	-	-	-	-	B	T	B	B	B	-	-	-
Clay-colored Sparrow (Spizella pallida)	SR,RS	1, 2, 3	3234	N	S(TO)	V	-	-	-	-	B	B	B	-	-	-	-	-
Brewer's Sparrow (Spizella breweri)	SS,SG,BS, BG	1, 2, 3	2235	N	S(NY)	V	-	-	-	B	B	B	B	S	-	-	-	-
Field Sparrow (Spizella pusilla)	GR,SG	-, -, 3	3234	N	S(TO)	V	-	-	-	-	B	B	B	B	-	-	-	-
Harris' Sparrow (Zonotrichia querula)	FG	-, -, 3	3230	N	M	V	-	-	-	-	T	-	-	-	-	-	-	-
White-crowned Sparrow (Zonotrichia leucophrys)	TC,RS,CF, FG	-, -, 3	1230	N	M	V	-	-	-	B	B	-	-	-	B	-	-	-
Song Sparrow (Melospiza melodia)	CF,CG,RS FG	-, -, 3	3334	N	S(RH)	V	-	-	-	S	T	T	-	B	-	-	-	-
McCown's Longspur (Calcarius mccownii)	GR	-, -, 3	3234	N	S(TO)	V	-	-	-	-	B	B	B	B	-	-	-	-
Lapland Longspur (Calcarius lapponicus)	CU,GR	-, 2, 3	1230	N	W	V	B	B	*T*	-	-	-	-	-	-	-	S	S
Chestnut-collared Longspur (Calcarius ornatus)	GR,CU	1, 2, 3	3234	N	S(NE)	S(1)	-	-	-	B	B	B	B	B	B	*T*	-	-
Snow Bunting (Plectrophenax nivalis)	CU,GR	1, 2, 3	1230	N	W	V	B	B	*T*	-	-	-	-	-	-	B	S	S

1/ 1 = Permit Area; 2 = Mine Study Area (excluding Permit Area); 3 = Reconnaissance Study Area (excluding Mine Study Area).

2/ B = Recorded on one or more of four standard roadside routes during baseline study. Other abbreviations as in the WBS.

Table 2. Summary of inventory data for mammal species observed in the Circle West study area, June 1976 - February 1980. (See WBS for explanation of abbreviations.)

Species	Preferred Habitat	Distribution	Major Food Sources	Classification	Evidence	Monthly Occurence and Sample Abundance											
						Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Merriam's Shrew (Sorex merriami)	HJ	1, -, -	Invertebrates	N	S(1)	-	-	-	-	-	-	-	-	-	S	-	-
Desert Cottontail (Sylvilagus auduboni)	LC,TC,SS, SG,AF	1, 2, 3	Grasses, seeds, leaves, fruit	N	S(3)	B[1/]	B	-	B	B	B	B	B	B	B	S	B
White-tailed Jackrabbit (Lepus townsendi)	GR,SS,SG	1, 2, 3	Grasses, forbs, buds, twigs	N	P	X	B	-	B	B	B	B	S	S	B	S	S
Least Chipmunk (Eutamias minimus)	TC,LC,BA	1, 2, 3	Plants, seeds, fruits, insects	N	S(1)	-	-	-	-	T	S	S	S	S	S	-	-
13-lined Ground Squirrel (Spermophilus tridecemlineatus)	GR	1, 2, 3	Grass, seeds, insects	N	V	-	-	-	X	B	S	S	S	S	S	-	-
Black-tailed Prairie Dog (Cynomys ludovicianus)	GR	-, 2, 3	Grasses, insects	N	S(2)	-	-	S	S	S	S	B	S	B	S	S	-
Northern Pocket Gopher (Thomomys talpoides)	GR,WM	1, 2, 3	Roots, grasses	N	S(1)	-	-	-	-	-	-	-	-	-	-	-	-
Wyoming Pocket Mouse (Perognathus fasciatus)	GR,SS	1, 2, 3	Seeds, grass	N	V	-	-	-	-	-	-	-	-	-	-	-	-
Beaver (Castor canadesis)	FW	1, 2, 3	Bark and twigs, green plants	F	R	-	-	-	-	T	T	-	-	-	-	-	-
Western Harvest Mouse (Reithrodontomys megalotis)	SC,GR,LC	1, 2, 3	Seeds, grass	N	S(2)	-	-	-	-	-	-	-	-	-	-	-	-
Deer Mouse (Peromyscus maniculatus)	Various	1, 2, 3	Seeds, grass insects, fruit	N	S(12)	-	-	-	S	-	S	S	S	S	S	-	-
Prairie Vole (Microtus ochrogaster)	SR	1, 2, -	Grasses, seeds, insects	N	S(6)	-	T	-	-	-	-	-	-	-	-	-	-
Meadow Vole (Microtus pennsylvanicus)	SM	1, 2, -	Grasses, seeds, insects	N	S(1)	-	-	-	-	-	-	-	-	-	-	-	-
Long-tailed Vole (Microtus longicaudus)	TC	1, 2, -	Grasses, seeds, insects	N	S(1)	-	-	-	-	-	-	-	-	-	-	-	-
Muskrat (Ordatra zibethicus)	FW,SA	1, 2, 3	Aquatic plants and animals	F	V	-	-	S	S	S	B	S	S	S	S	S	-
Porcupine (Erethizon dorsatum)	CG,CF,TC, LC	1, 2, 3	Bark, buds, twigs, forbs	N	S(1)	T	S	S	-	T	S	B	S	S	S	S	S
Coyote (Canis latrans)	Various	1, 2, 3	Mice, rabbits, carrion, insects	P	S(1)	T	T	S	B	B	S	B	S	B	S	S	S

Table 2 (continued)

Species	Preferred Habitat	Distribution	Major Food Sources	Classification	Evidence	Monthly Occurence and Sample Abundance											
						Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Red Fox (Vulpes fulva)	Various	1, 2, 3	Mice, rabbits, insects, fruit	N	V	T	B	S	*T*	-	S	S	B	B	B	S	B
Racoon (Procyon lotor)	CF,BX,CU	-, 2, 3	Various	N	V	T	-	-	S	B	S	S	S	S	T	-	-
Long-tailed Weasel (Mustela frenata)	RD	*1*, 2, 3	Small rodents, birds	P	P	*T*	*T*	X	-	-	-	T	-	-	*T*	-	-
Mink (Mustela vison)	FW	-, 2, 3	Fish, small mammals, birds	F	R	-	-	-	-	-	-	-	-	-	*T*	-	-
Badger (Taxidea taxus)	GR	1, 2, 3	Rodents, rabbits	N	V	-	-	-	S	-	-	S	*T*	S	-	-	-
Striped Skunk (Mephitis mephitis)	Various	1, 2, 3	Insects, fruit eggs, carion	P	V	-	-	S	S	X	B	S	B	S	S	-	T
Bobcat (Lynx rufus)	BA	1, 2, -	Rabbits, rodents, birds	F	V	-	-	-	-	-	-	-	S	-	-	-	-
Mule Deer (Odocoileus hemionus)	See Text*	1, 2, 3 See text	See text	G	V	B	B	B	S	B	B	B	B	B	B	S	B
White-tailed Deer (Odocoileus virginianus)	See Text*	1, 2, 3 See text	See text	G	V	S	B	B	B	B	B	B	B	B	B	S	B
Pronghorn Antelope (Antilocapra americana)	See Text*	1, 2, 3 See text	See text	G	V	B	B	B	B	B	B	B	B	B	B	S	B

1/ 1 = Permit Area; 2 = Mine Study Area (excluding Permit Area); 3 = Reconnaissance Study Area (excluding Mine Study Area)

2/ B = Seen on one or more of four standard roadside counts during baseline study. (1977). Additional data gathered during the report period are shown in italics.

Table 3. Summary of cumulative numbers of species observed in the Circle West study areas through February 29, 1980.

	Baseline Study (through February 28, 1978)			Through First Monitoring Period (March 7, 1979)			Through Second Monitoring Period (Feb. 29, 1980)		
	PMA	MSA	REC[1]	PMA	MSA	REC	PA	MSA	REC
AMPHIBIANS									
Total number of Species	2	4	4	4	5	5	4	5	5
REPTILES									
Total number of Species	6	7	7	6	7	7	6	7	7
BIRDS									
Total number of Species(T)	79	109	139	101	132	160	109	141	164
Summer Residents(S)	56	68	85	66	75	92	69	80	93
Permanent Residents(R)	12	16	17	13	16	17	14	16	17
Non-breeding Summer Vis.(V)	2	2	3	3	5	5	3	5	5
Migrants(M)	6	16	24	15	29	36	18	33	39
Winter Residents(W)	4	7	10	4	7	10	5	7	10
Total Breeding Species (S&R)	68	84	102	79	91	109	83	96	110
MAMMALS									
Total number of Species	19	26	26	20	27	27	24	27	27
TOTAL VERTEBRATE SPECIES	106	146	176	131	171	199	143	180	203

[1] PMA=Proposed Mining Area; PA=Permit Area; MSA=Mine Study Area; (now 113 sections, including PA); REC=Reconnaissance Study Area (including MSA)

Golden Eagle. The nest located in 1977 in the proposed mining area fledged only one young in 1979.

Marsh Hawk. The nest located on the silver sagebrush breeding census plot fledged an undetermined number of young (probably at least four) in 1979. Although territorial pairs were observed elsewhere in the Mine Study Area, no additional nests were discovered.

Prairie Falcon . The 1977 nest site fledged four young in 1979.

Peregrine Falcon. An adult male was seen at Stockpond MC05 on October 7, 1979; its light axillaries were clearly seen. A possible but unverified sighting was made on March 21, 1979, in section 4 of the Permit Area.

American Kestrel. A nest with at least three young was found in a sandstone cliff in the northwestern corner of the proposed mining area.

Sharp-tailed Grouse. At least 25 birds were displaying at lek No. 6 when visited in April, 1979. Two new leks, No. 13 (S14, T20N, R45E), and 14 (S2, T20N, R45E) were located during the study period. Thirteen birds were seen at lek 13 in April, 1979, and 25 birds were seen at lek 14 in October, 1979. No activity was observed at lek No. 7 (WBS), which may have been abandoned.

Sage Grouse. Only one sage grouse was observed in the Mine Study Area in 1979; it was encountered in sagebrush-grassland of section 35, area Y. No indications of breeding were noted, although lek No. 4 (WBS) was not visited.

Ring-necked Pheasant. Figure 5 shows year-to-year changes in June sample abundances of ring-necked pheasants as sampled by five roadside wildlife survey routes. Sample abundances decreased sharply between 1977 and 1978, probably because of the severe winter. The data indicate some recovery between 1978 and 1979. The Missouri River and Prairie Elk routes consistently have the highest sample abundances, while the Flowing Well and Dreyer Ranch routes have the lowest. The pattern shown by a graph of average May-July sample abundances is virtually identical.

Great Horned Owl . Great horned owls showed an apparent population increase in the Mine Study Area in 1979, possibly due to the small mammal population increase. Three active nests were located in the northern portion of the Mine Study Area (all had at least two young), but the nest found in the old proposed mining area in 1978 was not used in 1979.

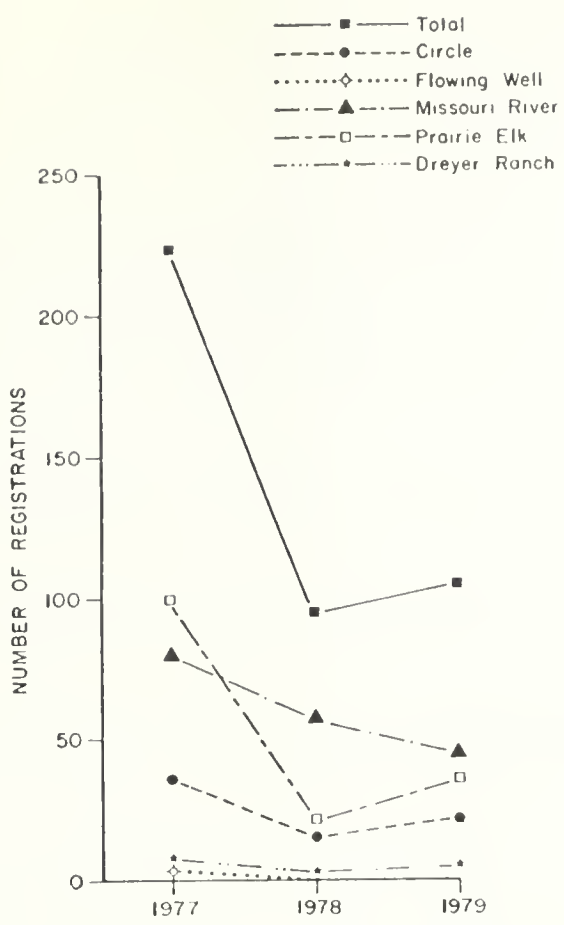


Figure 5. Year-to-year changes in sample abundance of ring-necked pheasant along five roadside survey routes, Circle West area.

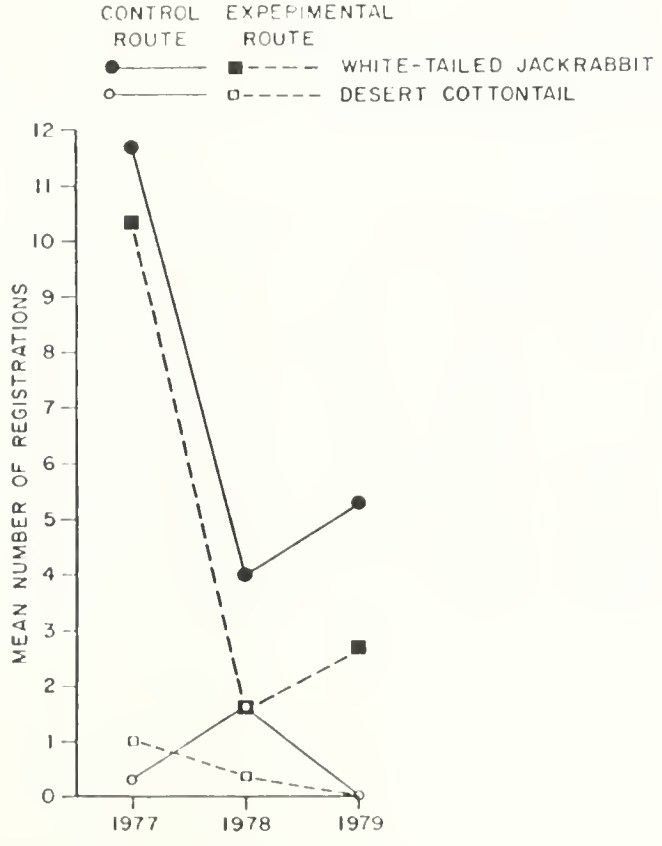


Figure 6. Year-to-year changes in lagomorph density indices, Circle West area.

Short-eared Owl. A spectacular increase in short-eared owl density was apparent in 1979. While only two owls were recorded in 1977-1978 May-July runs of the five roadside routes (30 runs total), 25 registrations were made in 1979 (15 runs). Although no nests were discovered by project biologists, local ranchers reported that nests were fairly common.

Eastern Kingbird. Eighteen nests were located in the Mine Study Area; the average number of eggs or young per nest was 3.0 (n=13, range=1-4).

Loggerhead Shrike. Six nests were located in the Mine Study Area; the average number of eggs or young per nest was 6.3 (n=4, range=4-7).

Desert Cottontail. Results of the 1979 lagomorph survey are presented in Table 4. While no cottontails were observed during this survey, 1979 data do not differ significantly from the 1978 data ($p>.05$)(figure 6).

White-tailed Jackrabbit. The number of jackrabbits observed during the 1979 lagomorph survey (table 4) does not differ significantly from the number observed in 1978 (t-test, $p>.20$)(figure 6).

Mule Deer. A summary of mule deer observations during the study period is presented in table 5. Production ratios obtained during the period 1977-1979 are shown in figure 7. These were based on September-October data since summer foliage cover limits observability of fawns prior to September and since hunting mortality influences November population age structure. The 1979 production ratio was 118 fawns/100 does, the highest obtained since the study began in 1977.

Aerial census data are presented in table 6. It should be emphasized that the low numbers of deer observed during the summer reflect decreased observability and do not necessarily indicate a corresponding decrease in abundance. Since observability is highest in winter, both density and distribution estimates are based on the winter aerial census. Figure 8 shows winter density indices obtained since 1976. Since the census data in table 6 represent the minimum number known present (i.e., there were at least 208 mule deer present during the December flight, but there may actually have been more that were not seen), the density indices shown in figure 8 may be somewhat lower than true densities. The data indicate an increase in mule deer winter density in the Mine Study Area since the last monitoring period, although the Permit Area showed a decrease. The control area appears to support considerably higher winter densities of mule deer each year than does the Permit Area.

Table 4. Results of 1979 lagomorph survey, Circle West study area.

Date	Desert Cottontail		White-tailed Jackrabbit	
	Control Route	Experimental Route	Control Route	Experimental Route
October 3, 1979	0	0	7	1
October 4, 1979	0	0	4	2
October 5, 1979	0	0	5	5
Mean	0.0	0.0	5.3	2.7

Table 5. Classification summary for mule deer observed in the Circle West area, March 1979 - February 1980.

riod	All Groups											
	Number of Groups	Group Size Average	Group Size Range	Total No. Observed	Total No. Classified	Total Adults	Adult Males	Adult Females	Young	Young/ 100 Adults	Young/ 100 Females	Males/ Females
ring 1979	51	5	1-30	272	9	6	0	6	0	-	-	-
mmer 1979	56	2	1-5	102	93	76	10	66	17	-	-	-
ll 1979	108	3	1-9	356	350	167	16	151	183	109.5	121.2	0.11
nter 1979-80	99	6	1-35	546	41	25	2	23	16	-	-	-

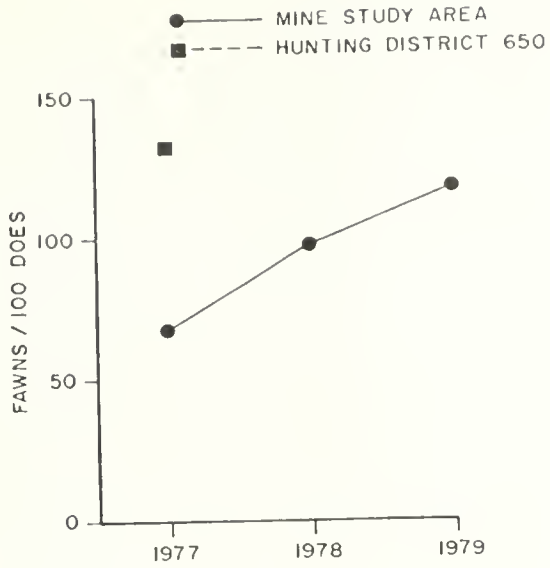


Figure 7. Year-to-year changes in mule deer production ratios, Circle West study areas (based on September-October ground and aerial survey data).

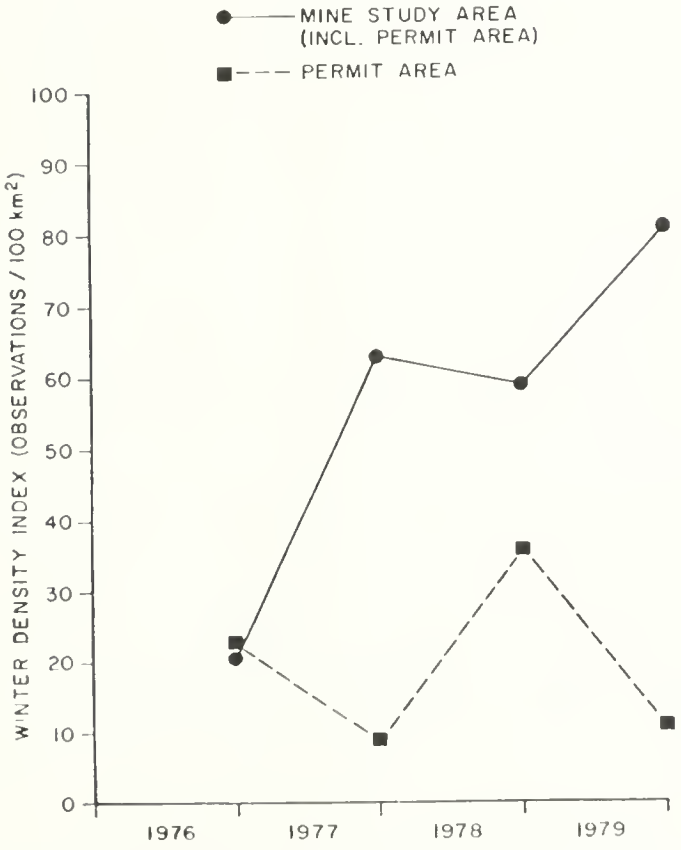


Figure 8. Year-to-year changes in the mule deer winter density index for the Circle West study areas (based on the month of the largest census obtained for the mine study area during the winter season).

Table 6. Deer and antelope aerial census data, Circle West area, March 1979 - February 1980.

Date	Observer	Mine Study Area 1/ 2/			Proposed Mining Area 3/			Permit Area 4/		
		Pronghorn	Mule Deer	White-tailed Deer	Pronghorn	Mule Deer	White-tailed Deer	Pronghorn	Mule Deer	White-tailed Deer
04-20-79	Stoneberg	40	122	-	-	5	-	-	43	-
05-15-79	Stoneberg	52	49	2	-	-	-	14	3	-
06-12-79	Stoneberg	55	17	-	3	-	-	4	2	-
08-02-79	Stoneberg	110	19	3	15	2	-	36	8	-
09-20-79	Stoneberg	57	83	-	-	-	-	2	22	-
10-04-79	Stoneberg	60	75	-	-	-	-	7	18	-
11-14-79	Stoneberg	79	69	-	-	-	-	6	22	-
12-14-79	Stoneberg	64	208	-	-	-	-	-	9	-
01-14-80 5/	Stoneberg	60	97	-	-	6	-	-	14	-
02-15-80 5/	Stoneberg	66	82	-	-	8	-	-	8	-

1/ Includes permit area and proposed mining area.

2/ Expanded February 1, 1980 to include c. 114 sections.

3/ 11.5 sections.

4/ c. 32 sections

5/ Poor census conditions due to lack of snow cover.

Monthly mule deer winter density indices obtained during aerial census were averaged for each section in the Mine Study Area for the winter of 1979-1980 and for all four winters since 1976. These data were used to create density index isopleths which show general patterns of winter distribution (figures 9 and 10). Both figures show that deer tend to concentrate in areas of coulee and badlands topography in the northwest, southwest, and southeast portions of the Mine Study Area, as well as near the Waller Ranch. (Since for mapping purposes deer were assumed to be concentrated in the center of each section, distribution as indicated by the isopleths is only accurate to within approximately one kilometer.)

White-tailed Deer. Only 28 observations of white-tailed deer were recorded during the report period (table 7). Groups of up to five white-tailed deer were seen in the north-central portion of the Mine Study Area (sections 25, 29, 30, 31, and 32) in May, June, July, August, and October. A single observation was made near the sagebrush census plot in July.

Pronghorn. A summary of pronghorn observations during the study period is presented in table 8. Production ratios during the period 1977-1979 (based on all July through October observations of fully classified groups) are shown in figure 11. A production ratio of 197 fawns/100 does was obtained in 1979; this is the highest obtained since the study began in 1977. Results of the July, 1979, pronghorn aerial census of Hunting District 650 are presented in table 9. Aerial census data are presented in table 6. Winter density indices (as described under Mule Deer above) and summer-fall density indices (based on the largest aerial census obtained during a single flight in the period July-October) are shown in figure 12 for the period 1977-1979. These data indicate a decrease in summer-fall pronghorn density in the Mine Study Area since 1978, although the Permit Area showed an increase. Winter density increased markedly since the last monitoring period due to mild winter conditions and lack of snow cover.

Monthly pronghorn summer and winter density indices obtained during aerial censuses were averaged for each section in the Mine Study Area for the report period and also for all years since 1976 combined. These data were used to create density index isopleths which show general patterns of distribution (figures 13 through 16). As indicated by these maps, pronghorn are most commonly found in the southwestern, south central, and northwestern portions of the Mine Study Area in summer. During the mild winter encountered during the study period, pronghorn were very abundant on the rolling grassland and sagebrush areas immediately southwest of the Mine Study Area. Some groups ranged into the southwestern corner of the Mine Study Area and into the sagebrush flats along lower Romine Coulee. A few groups were seen during the ground surveys 2-4 km (3 to 6 miles) northwest of the Dreyer ranch house.

Table 7. Classification summary for white-tailed deer observed in the Circle West area. March 1979 - February 1980.

Period	All Groups				
	Number of Groups	Group Size Average	Group Size Range	Total No. Observed	Total Number Classified
Spring 1979	1	2	2	2	2
Summer 1979	7	1	1-3	9	9
Fall 1979	5	3	3-5	17	17
Winter 79-80	0	-	-	0	0

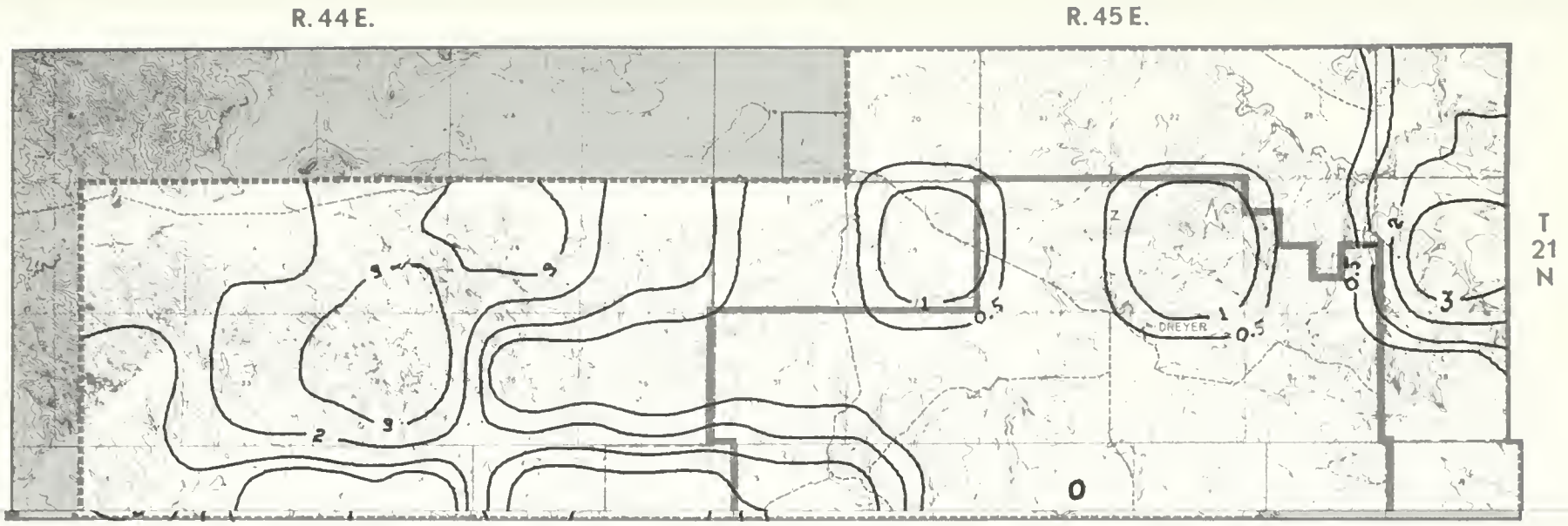
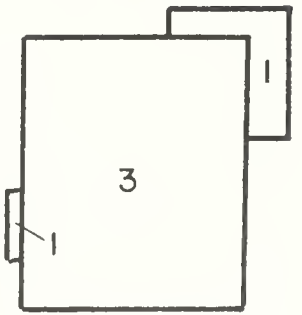


FIGURE 9. Mule deer winter density index isopleths, 1979-80.



No. of Flights

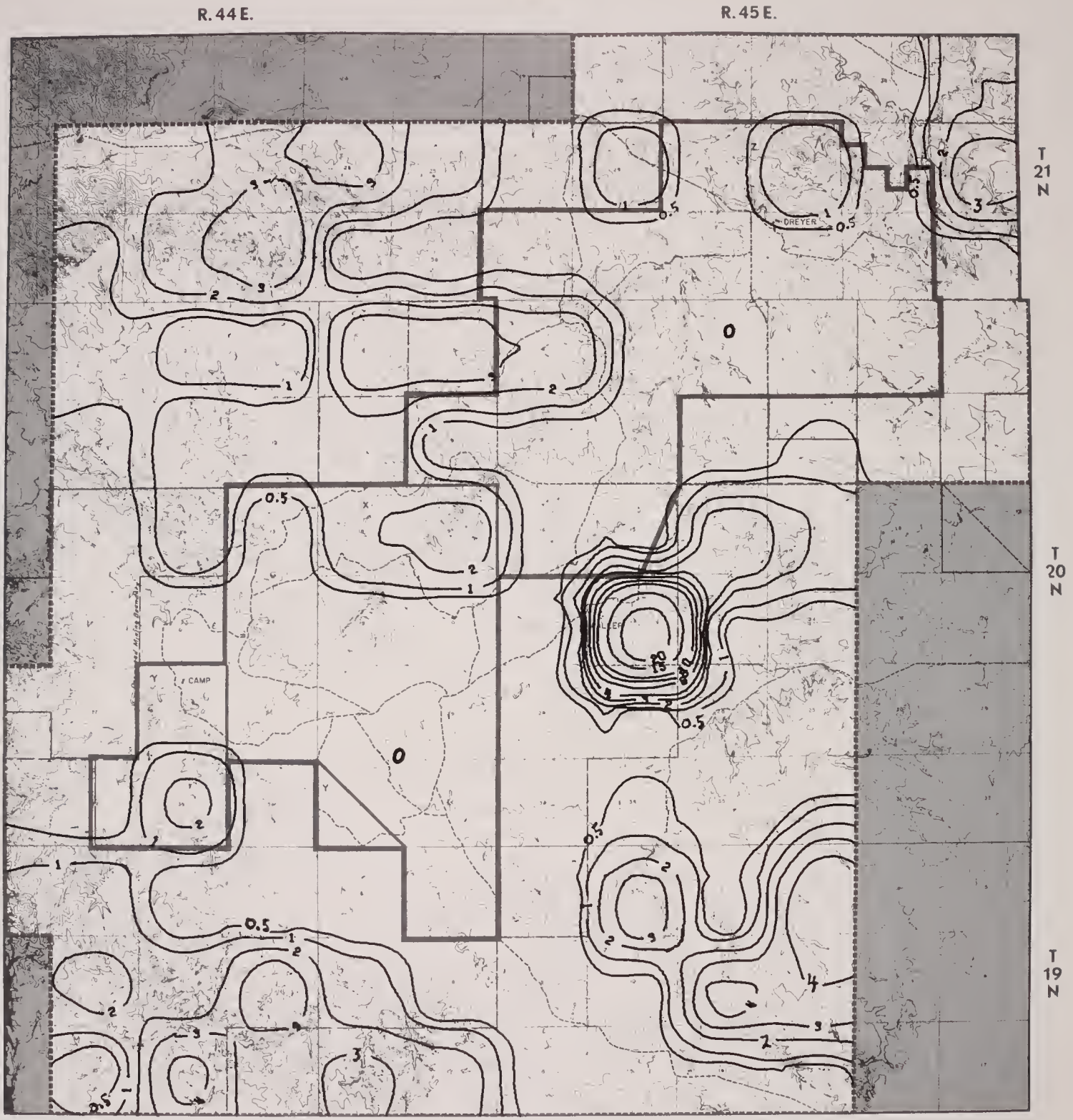
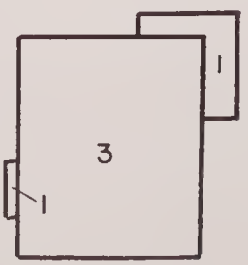


FIGURE 9. Mule deer winter density index isopleths, 1979-80.



No. of Flights

Table 8. Classification summary for pronghorn observed in the Circle West areas, March 1979 - February 1980.

Period	All Groups											
	Number of Groups	Group Size Average	Group Size Range	Total No. Observed	Total No. Classified	Total Adult	Adult Males	Adult Females	Young	Young/ 100 Adults	Young/ 100 Females	Males/ Females
Spring 1979	35	5	1-17	163	9	9	4	5	0	0	0	-
Summer 1979	85	4	1-20	344	247	175	75	100	72	41.1	72.0	0.75
Fall 1979	47	7	1-29	336	214	139	59	80	75	54.0	93.8	0.73
Winter 1979-80	19	32	2-87	609	28	-	-	-	-	-	-	-

Table 8. Classification summary for pronghorn observed in the Circle West areas, March 1979 - February 1980.

Period	All Groups						Adult Males	Adult Females	Young	Young/ 100 Adults	Young/ 100 Females	Males/ Females
	Number of Groups	Group Size Average	Group Size Range	Total No. Observed	Total No. Classified	Total Adult						
Spring 1979	35	5	1-17	163	9	9	4	5	0	0	0	-
Summer 1979	85	4	1-20	344	247	175	75	100	72	41.1	72.0	0.75
Fall 1979	47	7	1-29	336	214	139	59	80	75	54.0	93.8	0.73
Winter 1979-80	19	32	2-87	609	28	-	-	-	-	-	-	-

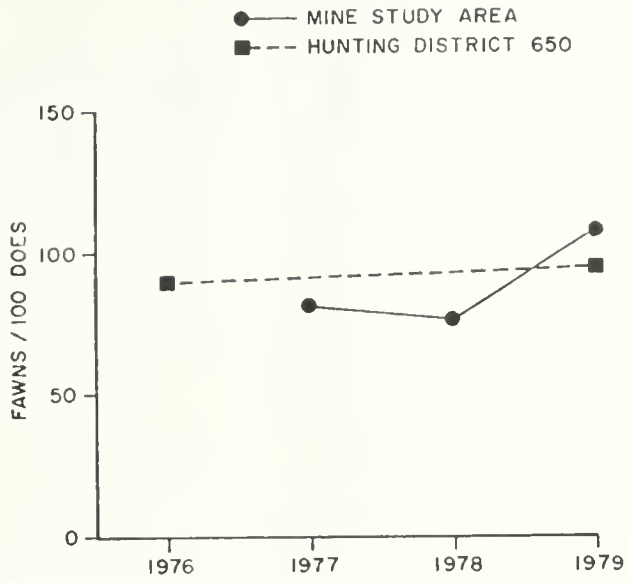


Figure 11. Year-to-year changes in pronghorn production ratios, Circle west study areas (based on July-October ground and aerial survey data).

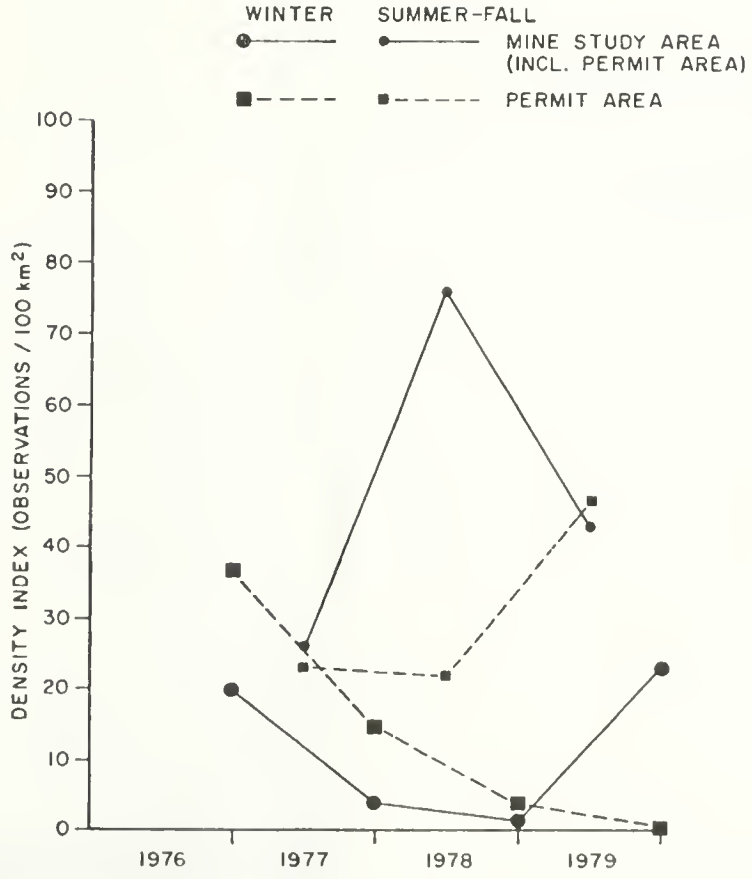


Figure 12. Year-to-year changes in pronghorn summer and winter density indices for the Circle West study areas (based on the largest aerial censuses obtained for the mine study area during July-October and December-February, respectively).

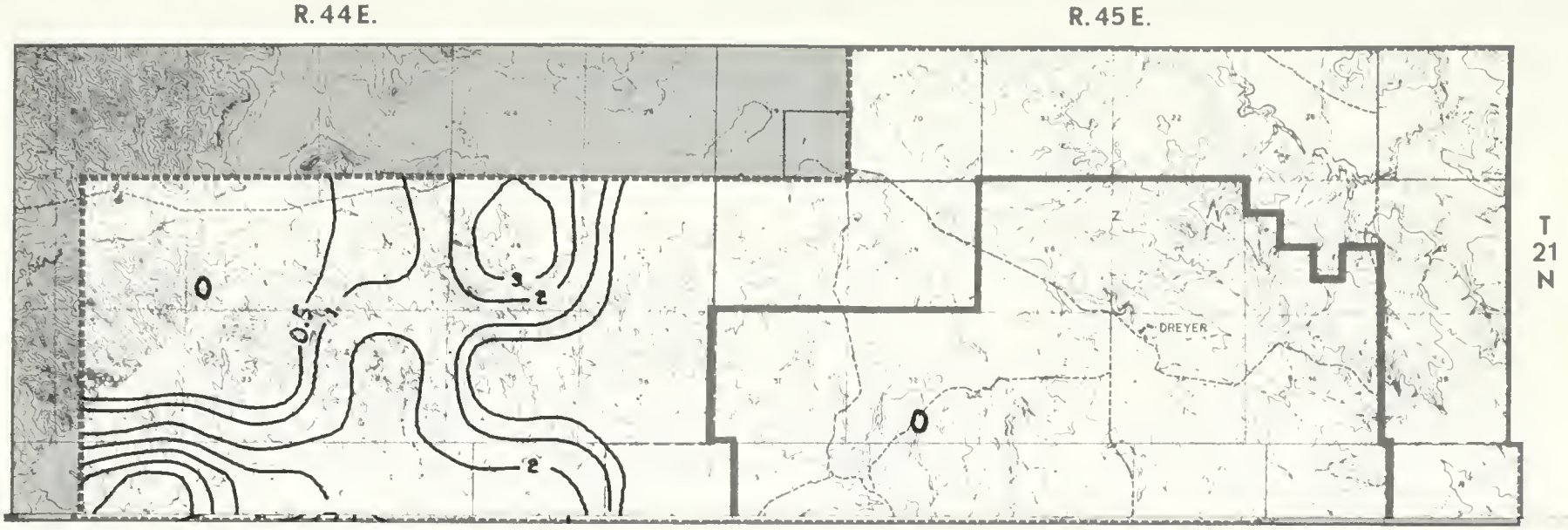
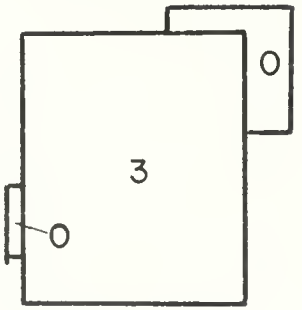


FIGURE 13. Pronghorn summer density index isopleths, 1979.



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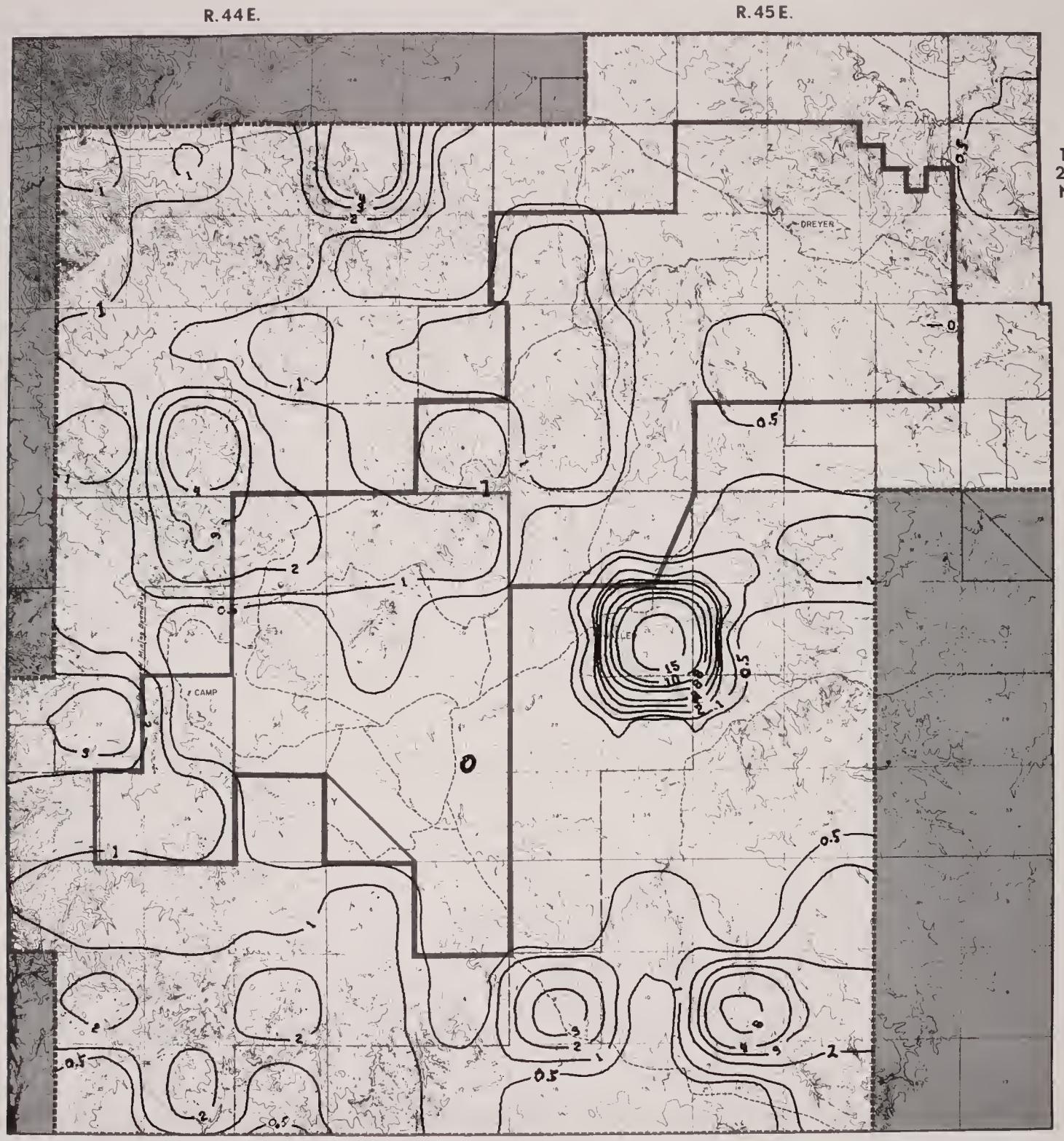


FIGURE 10. Mule deer winter density index isopleths, four-year average, 1976-80.

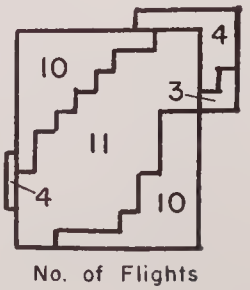


Table 9. Summary of July 1980 pronghorn aerial census, Hunting District 650

Census Unit 1/	Time (min.)	Bucks		Does	Fawns	Total	Bucks/ 100 Does	Fawns/ 100 Does
		Adult	Yearling					
1	120	1	0	3	5	9	33	167
2	115	7	2	4	2	15	225	50
3	110	3	1	21	19	44	19	90
4&5	200	3	0	21	22	46	14	105
6	140	3	4	25	24	56	28	96
7	75	8	7	46	55	116	33	120
8	70	5	1	31	27	64	19	87
9	110	5	0	27	35	67	18	130
10	80	0	0	7	7	14	0	100
11	135	5	0	40	29	74	13	73
12	120	48	12	81	73	214	74	90
13	85	15	1	50	39	105	32	78
Total	1,360	103	28	356	337	824	37	95

1/ Units 9, 11, and 12 include portions of the mine study area.

R.44E. R.45E.

T 21 N

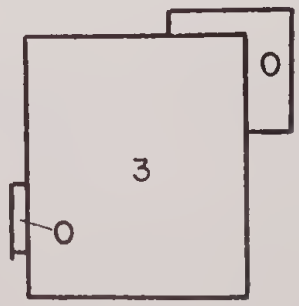
T 20 N

T 19 N

DREYER

WALLER

FIGURE 13. Pronghorn summer density index isopleths, 1979.



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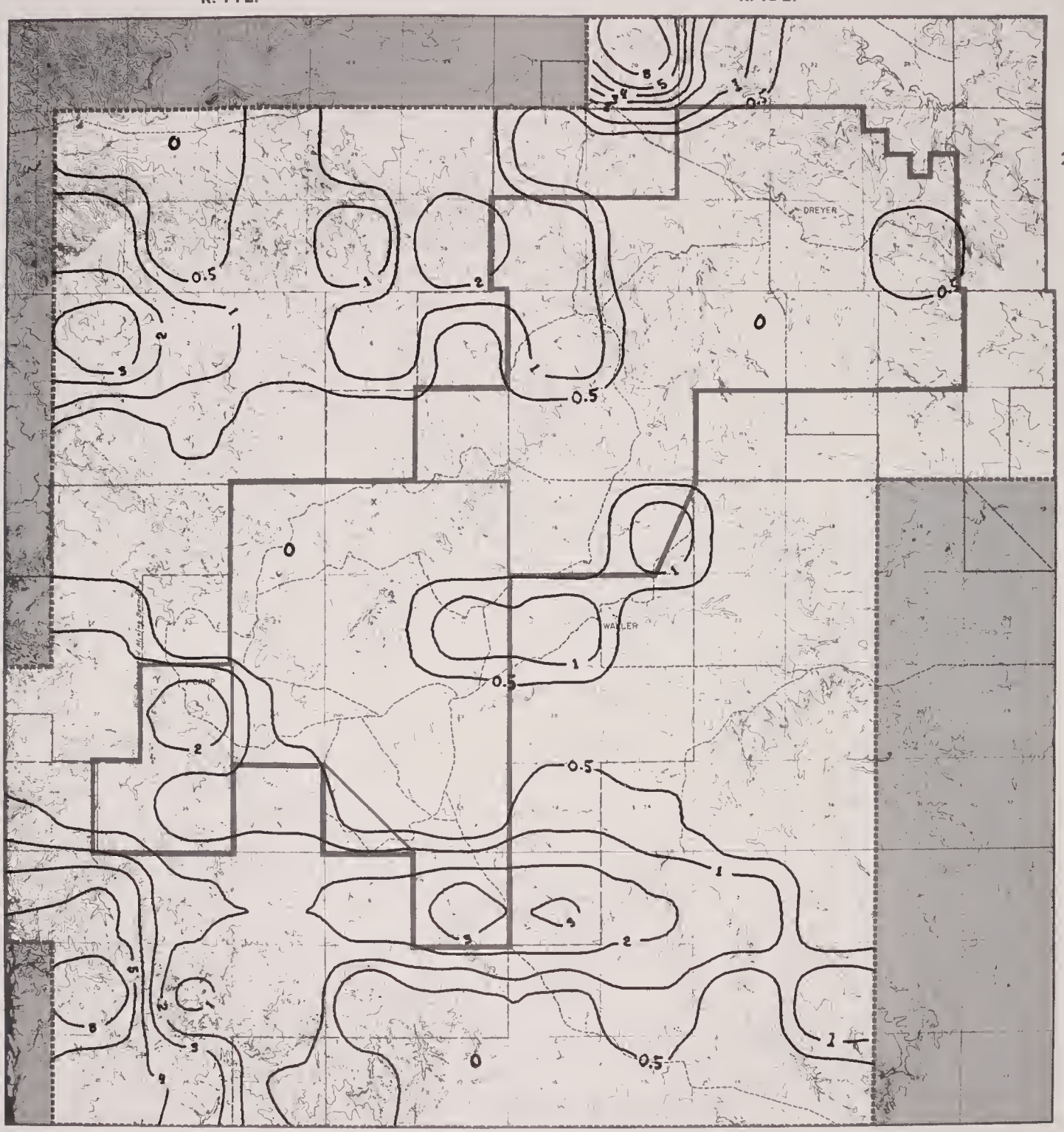
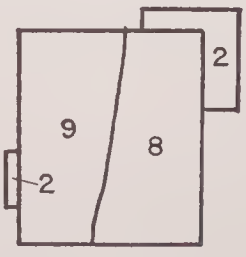


FIGURE 14. Pronghorn summer density index isopleths, three-year average, 1977-79.



R. 44 E.

R. 45 E.

T 21 N

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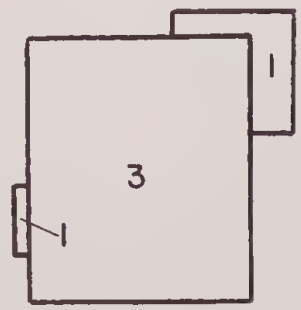
DREYER

WALLER

CAMP

FIGURE 15. Pronghorn winter density index isopleths, 1979-80.



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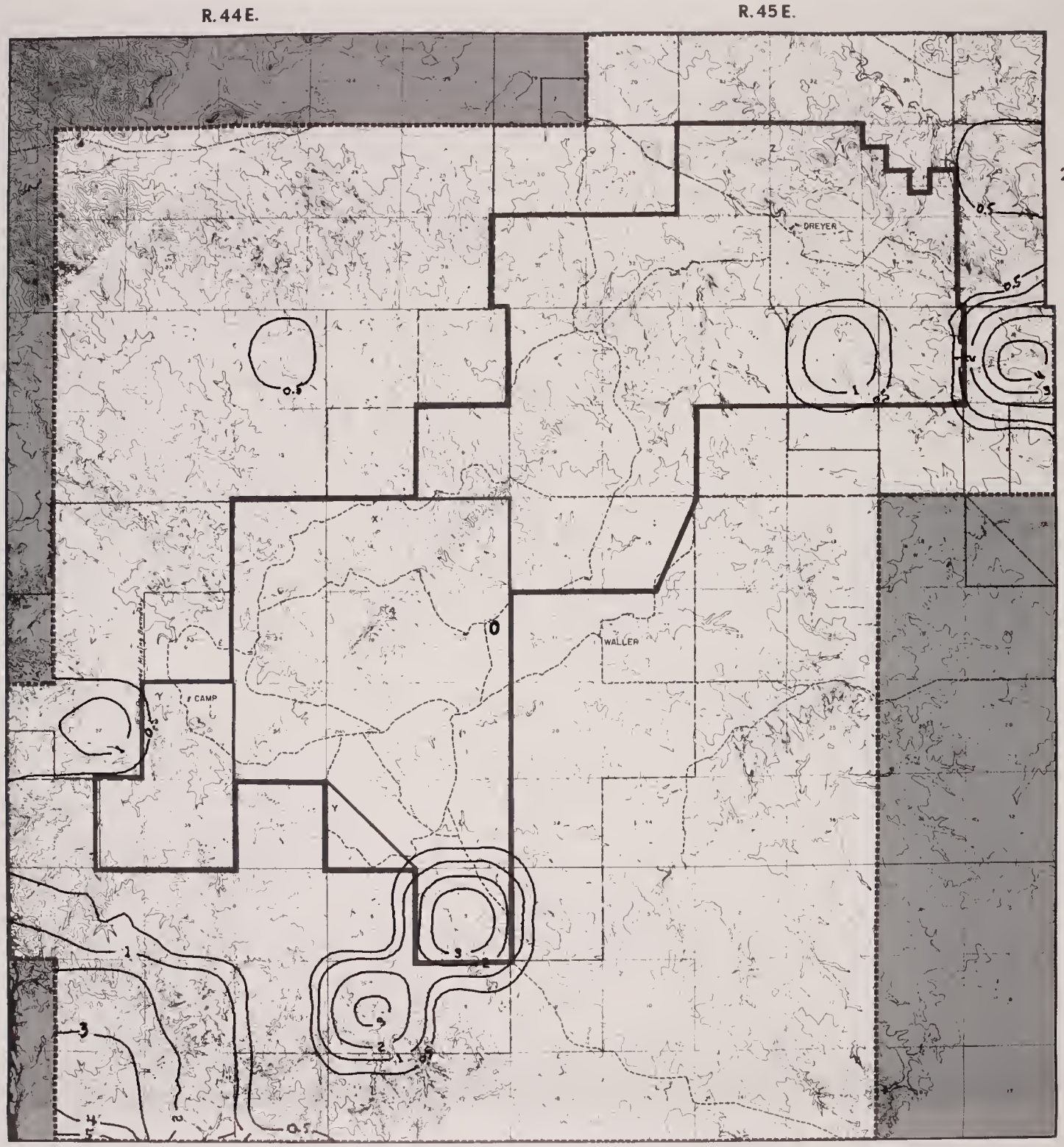

FIGURE 16. Pronghorn winter density index isopleths, four-year average, 1976-80.

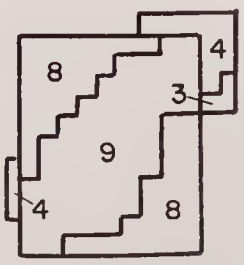

Table 9. Summary of July 1980 pronghorn aerial census, Hunting District 650

Census Unit 1/	Time (min.)	Bucks		Does	Fawns	Total	Bucks/ 100 Does	Fawns/ 100 Does
		Adult	Yearling					
1	120	1	0	3	5	9	33	167
2	115	7	2	4	2	15	225	50
3	110	3	1	21	19	44	19	90
4&5	200	3	0	21	22	46	14	105
6	140	3	4	25	24	56	28	96
7	75	8	7	46	55	116	33	120
8	70	5	1	31	27	64	19	87
9	110	5	0	27	35	67	18	130
10	80	0	0	7	7	14	0	100
11	135	5	0	40	29	74	13	73
12	120	48	12	81	73	214	74	90
13	85	15	1	50	39	105	32	78
Total	1,360	103	28	356	337	824	37	95

1/ Units 9, 11, and 12 include portions of the mine study area.

BIRD COMMUNITY PARAMETERS

Waterfowl Communities

The relatively cool, moist spring and early summer of 1979 provided favorable conditions for waterfowl; both waterfowl use and production showed an increase over 1978.

Breeding season species composition of all recorded waterfowl and large water bird observations in the Mine Study Area is presented in table 10. Monthly changes in waterfowl species composition, as well as year-to-year changes, are portrayed graphically in figure 17. The mallard was again the predominant breeding waterfowl species; it constituted a larger proportion of the total waterfowl community in 1979 than in 1978, and increased in relative abundance over the breeding season.

Waterfowl breeding season census data for stockponds in the study areas are summarized in table 11. These data are converted to production and density estimates in table 12; production is shown graphically in figure 18. Production (young/km^2) showed a slight increase from 1978 to 1979 for all study areas. Breeding season waterfowl density in the originally proposed mining area appears to be roughly twice that of the Mine Study Area, while density in the Permit Area is slightly higher than that of the Mine Study Area.

The relationship among the number of broods, number of young, and breeding pair censuses obtained by four different methods was examined by means of Pearson product-moment correlation coefficients. The study used 1978 and 1979 census data for all stockponds in the Mine Study Area for which pairs and/or broods were recorded (a total of 67 censuses).

All six census parameters were positively and significantly ($p<.01$) correlated, indicating a close relationship between production and stockpond use by pairs. Of the four breeding pair census techniques, that described by Hammond (1969) and modified for this study (see WBS) was the most strongly correlated with both the number of broods ($r\sim.84$) and the number of young ($r\sim.79$). The results indicate that this method is best for censusing breeding pairs. This analysis also shows that June and July census data for young birds would be a single suitable parameter for long-term monitoring of waterfowl production in the Mine Study Area.

Waterfowl data obtained on the roadside surveys showed a trend very similar to that mentioned above. As shown in figure 19, both the number of species and number of observations of Anatidae and other water birds (as recorded on June runs of the five routes) showed an increase over the period 1977-1979. The sharpest increase occurred between 1977 (a very dry year) and 1978 (a relatively moist year). A similar pattern is indicated using pooled May-July data for the five routes.

Data on broods observed during 1979 are presented in table 13.

Table 10. Species composition of all recorded waterfowl and large water bird observations in the 114 section mine study area during the breeding season (May-July), 1977-1979.

	May-July[1,2] 1977	May-July[1] 1978	May-July 1979
Ducks and Geese			
Canada Goose	24(4)[3]	2(tr)	45(3)
Mallard	327(56)	403(25)	644(41)
Gadwall	10(2)	121(8)	102(6)
Pintail	15(3)	77(5)	123(8)
Green-winged Teal	28(5)	61(4)	31(2)
Blue-winged Teal	60(10)	348(22)	240(15)
American Wigeon	91(16)	377(24)	234(15)
Northern Shoveler	22(4)	133(8)	87(5)
Redhead	-	3(tr)	14(1)
Ring-necked Duck	-	4(tr)	-
Canvasback	1(tr)	3(tr)	14(1)
Lesser Scamp	1(tr)	46(3)	40(3)
Bufflehead	-	3(tr)	-
Ruddy Duck	1(tr)	6(tr)	10(1)
Hooded Merganser	-	-	4(tr)
Red-breasted Merganser	-	-	-
Total Classified	580	1587(100)	1588(100)
Total Unclassified	18	226	1117
Grand Total	598	1813	2705
Other Large Water Birds			
Common Loon	-	1	-
Horned Grebe	-	3	-
Eared Grebe	-	35	70
Western Grebe	-	1	-
Pied-billed Grebe	-	8	13
White Pelican	5	1	1
Double-crested Cormorant	43	24	22
Great Blue Heron	1	4	3
American Bittern	-	1	-
American Coot	-	47	33
Wilson's Phalarope	112	356	340
California Gull	-	1	7
Ring-billed Gull	-	12	8
Common Tern	-	-	4
Black Tern	-	11	-

[1]Figures may differ from those presented in earlier reports due to differences in analysis techniques.

[2]99 sections only.

[3]Numbers observed (percent of all waterfowl identified to species).

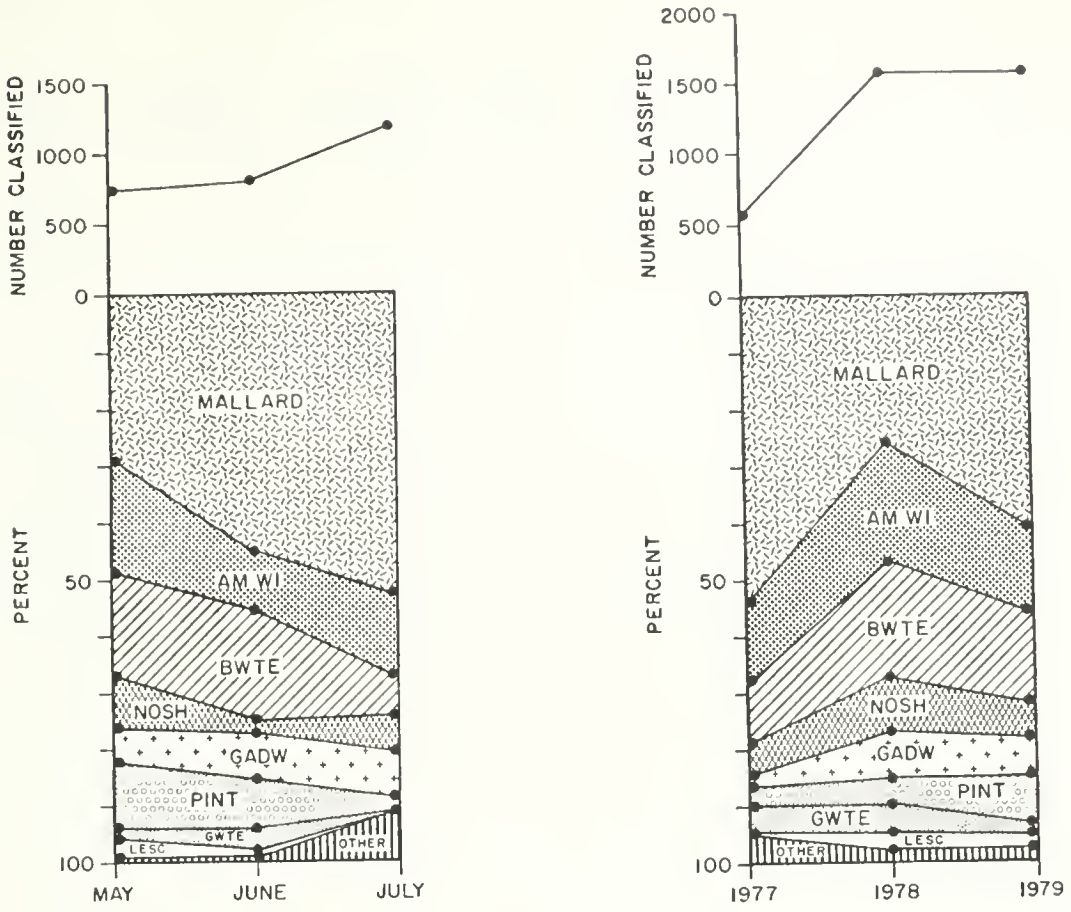

Figure 17. Percent species composition of all recorded 1979 waterfowl observations, Circle West study area (1977-1979 changes also shown).

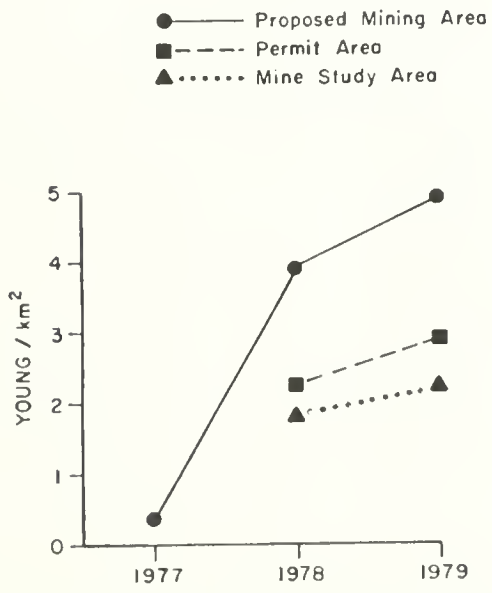

Figure 18. Year-to-year changes in waterfowl production, Circle West study areas.

Table 11. Summary of waterfowl breeding season census data for stockponds in the Circle West Mine Study Area, 1979.

Species	Proposed Mining Area[1]	Permit Area[2]	Mine Study Area[3]
ANATIDAE			
Mallard	10(10,57)[4]	14(14,81)	31(31,166)
Gadwall	8(0,0)	13(0,0)	23(2,18)
Pintail	2(2,10)	3(3,12)	6(6,35)
Green-winged Teal	2(0,0)	3(0,0)	12(0,0)
Blue-winged Teal	10(1,3)	20(1,3)	53(2,7)
American Wigeon	7(1,6)	15(3,20)	27(7,39)
Northern Shoveler	2(1,2)	3(2,6)	9(3,14)
Redhead	-	-	5(0,0)
Canvasback	-	1(0,0)	4(0,0)
Lesser Scaup	-	1(0,0)	5(0,0)
Ruddy Duck	-	-	5(0,0)
Hooded Merganser	-	-	1(0,0)
Unidentified Teal	0(3,39)	0(7,63)	0(11,89)
Unidentified Duck	0(0,31)	0(2,42)	1(25,191)
TOTAL ANATIDAE	41(18,148)	73(32,227)	182(87,559)

[1]Includes stockponds Nos. MA01-10, MAFW, and MASW

[2]Includes all ponds in proposed mining area plus: MC05-08, NC10, 11, 13-15, 21, 23, 24, 27, 31.

[3]Includes all ponds in 99-section area.

[4]Minimum number of indicated pairs (number of broods, minimum number of young known present).

Table 12. Summary of 1978-1979 waterfowl production data, Circle West Study Area.

	1978			1979		
	PMA	PA[6]	MSA	PMA	PA	MSA
No. Stockponds Visited	10	18	28	10	21	45
No. Stockponds Censused	9	18	28	10	21	43
Area Censused[1]	30(11.5)	78(31.5)	171(66)	30(11.5)	78(31.5)	257(99)
Water Area Censused[2]	3.0(7.5)	8.5(21.2)	19.3(47.4)	3.0(7.5)	8.9(22.0)	25.7(62.7)
Min. No. Pairs[3]	41	64	120	41	73	182
No./Total Area Censused[4]	1.4(3.6)	0.8(2.0)	0.7(1.8)	1.4(3.6)	0.9(2.3)	0.7(1.8)
No./Water Area Censused[5]	13.7(5.5)	7.5(3.0)	6.2(2.5)	13.7(5.5)	8.2(3.3)	7.1(2.9)
Broods	19	31	55	18	32	87
No./Total Area Censused[4]	0.6(1.7)	0.4(1.0)	0.3(0.8)	0.6(1.6)	0.4(1.0)	0.3(1.4)
No.Water Area Censused[5]	6.3(2.5)	3.6(1.5)	2.8(1.2)	6.0(2.4)	3.6(1.5)	3.4(1.4)
Young	117	180	310	148	227	559
No./Total Area Censused[4]	3.9(10.2)	2.3(5.7)	1.8(4.7)	4.9(12.9)	2.9(7.2)	2.2(5.6)
No./Water Area Censused[5]	39.0(15.6)	21.2(8.5)	16.16(6.5)	49.3(19.7)	25.5(10.3)	21.8(8.9)

[1] km^2 (mi^2)
[2] ha (acres)
[3] including brood data
[4] km^{-2} (mi^{-2})
[5] ha^{-1} ($acres^{-1}$)
[6] PMA=Proposed Mining Area (11.5 sections); PA=Permit Area: MSA=Mine Study Area (99 sections)
NOTE: 1978 data differs somewhat from those in the first monitoring report due to the application of more rigorous census criteria.

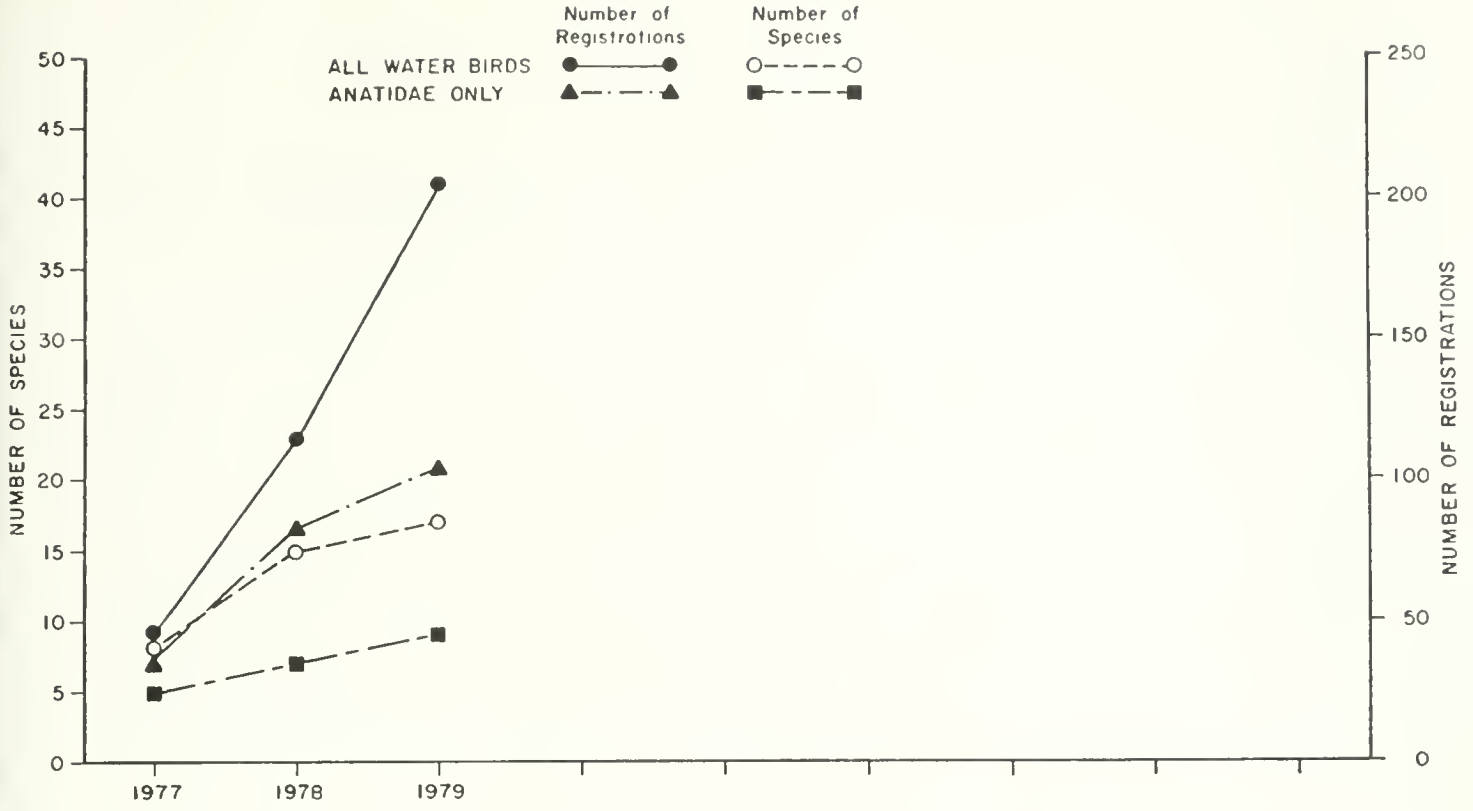

Figure 19. Year-to-year changes in numbers of species and numbers of registrations of water birds recorded on June runs of five roadside wildlife survey routes, Circle West study area.

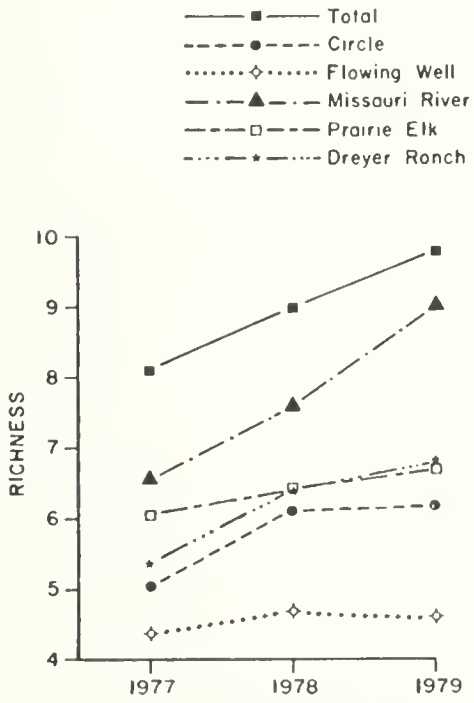

Figure 20. Year-to-year changes in June breeding bird species richness for five roadside wildlife survey routes, Circle West study area.

Table 13. Average sizes of waterfowl broods recorded in the mine study area during 1979.

Mallard	5.2	(2-10,n=31)[1]
Gadwall	9.0	(8-10,n=2)
Pintail	6.0	(2-10,n=6)
Blue-winged Teal	3.0	(2-4,n=2)
American Wigeon	5.5	(4-8,n=7)
Northern Shoveler	4.6	(2-8,n=3)

[1] range and sample size in parentheses.

Winter Bird Census

Table 14 summarizes the results of the winter bird census for the five bird census plots. Information on use of the plots by mammals is included here as well. A more complete account of the 1980 winter bird census is given in appendix A, and plot descriptions can be found in appendix F of the WBS.

Roadside Wildlife Survey

Data obtained during the fifteen 1979 roadside survey runs are presented in appendix B. The cumulative numbers of species for all May-July runs (1977-1979) are presented in table 15. Since the roadside wildlife survey appears to be a particularly appropriate and sensitive monitoring technique, some features of the analysis will be described in detail below.

Table 16 summarizes 1978-1979 changes in May-July sample abundances of selected species, based on data obtained during runs of the five roadside survey routes. The eastern kingbird, yellow warbler, common yellowthroat, and lark bunting showed significant decreases, while Sprague's pipit showed a significant increase. Figure 5, which shows year-to-year changes in sample abundances of ring-necked pheasants, is an example of the graphs which were prepared to monitor individual species.

A computer program was developed which calculates a number of diversity parameters for the community samples obtained by the roadside counts. Factor analysis was used to determine which of these community parameters were most sensitive to ecological differences among the five routes, and which were redundant (that is, which are measuring essentially the same community attribute). The first factor, which accounted for most of the variation among routes and replicates (65%), was closely related to measures which are sensitive to the variety of species in the sample, such as species number (S), species richness (D), and the height of the mode of the lognormal species-abundance curve (S_0). The parameters with the highest loading on this factor were species richness and species number, which may be considered the best measures of species variety for this data set. The second factor accounted for an additional 24% of the variation, and was closely related to measures sensitive to the equitability of distribution of individuals among species. Showing high loadings on this factor were the logarithmic dispersion factor (a), the lognormal standard deviation (sigma), and evenness (e) (see WBS for definitions of parameters). The Shannon-Weaver diversity index H', as well as the theoretical total number of species S_t, are "hybrid" parameters with moderately high loadings on both factors. Figures 20 and 21 show year-to-year changes in D and sigma, the two parameters loading most heavily on Factors I and II, respectively. Changes in species number (excluding visitors, migrants, and water birds) are shown in figure 22. Note that the relative positions of the routes remain fairly constant from year to year. This analysis also showed that June data alone provide nearly as much discriminating power among routes as do pooled May-July data or even pooled 1977-1979 data.

Table 14. Summary of winter bird and mammal census data, Circle West study area, January 29-February 2, 1980.

	1. Silver Sagebrush Flat	2. Silver Buffaloberry-Red Osier Dogwood Coulee	3. Silver Buffaloberry-Silver Sagebrush Coulee	4. Needle-and-Thread--Blue Grama Grassland	5. Western Wheatgrass-Blue Grama Pasture	TOTALS
BIRDS						
Golden Eagle	-	+	+	-	+	+
Sharp-tailed Grouse	-	+	tr	-	-	+
Great Horned Owl	-[1]	+	-	-	-	+
Short-eared Owl	+	-	-	-	-	+
Black-billed Magpie	-	+	-	-	-	+
Snow Bunting	-	1	-	-	+	+
MAMMALS						
Desert Cottontail	tr[2]	-	tr	-	-	tr
White-tailed Jackrabbit	tr	tr	tr	-	-	tr
Deer Mouse	tr	tr	tr	-	-	tr
Porcupine	-	tr	+	-	-	+
Coyote	-	tr	tr	tr	tr	tr
Red Fox	tr	tr	tr	tr	tr	tr
Long-tailed Weasel	tr	tr	-	-	tr	tr
Mule Deer	-	2	-	-	-	+
MINUTES SPENT IN PLOT	250	430	311	189	239	1419

[1]Average number of registrations per visit (+=less than 0.5)

[2]tr=tracks

Table 15. Summary of cumulative numbers of species observed during May through July roadside counts, Circle West Study.

	Baseline Study (1977 runs), Five Routes	Through First Monitoring Period (1977-1978 runs), Five Routes	Through Second Monitoring Period (1977-1978 runs), Five Routes
AMPHIBIANS			
Total number of Species	2(50.0)[1]	2(40.0)	2(40.0)
REPTILES			
Total number of Species	1(14.3)	1(14.3)	1(14.3)
BIRDS[2]			
Total number of Species(T)	88(63.3)	110(68.8)	114(69.5)
Summer Residents(S)	72(84.7)	84(91.3)	85(91.4)
Permanent Residents(P)	15(88.2)	16(94.1)	16(94.1)
Non-breeding Summer Vis.(V)	1(33.3)	1(20.0)	3(60.0)
Migrants(M)	0(0.0)	9(25.0)	10(25.6)
Winter Residents(W)	0(0.0)	0(0.0)	0(0.0)
Total Breeding (S&R)	87(85.3)	100(91.7)	101(91.8)
MAMMALS			
Total number of Species	14(53.9)	15(55.6)	15(55.6)
TOTAL VERTEBRATE SPECIES	105(59.7)	128(64.3)	132(65.0)

[1]Number of species (percentage of cumulative totals for reconnaissance study area, Table 3).

[2]Some totals may differ from those reported in the first monitoring report because new information led to a change in status of certain species.

Table 16. Summary of 1977-79 changes in May-June sample abundances of selected species sampled by five roadside survey routes, Circle West area.

Species	1977-78 change	1978-79 change
Sharp-tailed Grouse	NS[1/]	NS
Ring-necked Pheasant	D**	NS
Killdeer	NS	NS
Mourning Dove	D**	NS
Eastern Kingbird	NS	D**
Horned Lark	NS	NS
Black-billed Magpie	D**	NS
Sprague's Pipit	NS	I*
Loggerhead Shrike	NS	NS
Yellow Warbler	NS	D*
Common Yellowthroat	NS	D*
House Sparrow	NS	NS
Western Meadowlark	NS	NS
Red-winged Blackbird	NS	NS
Rufous-sided Towhee	NS	NS
Lark Bunting	NS	D**
Savannah Sparrow	NS	NS
Grasshopper Sparrow	NS	NS
Baird's Sparrow	I*	NS
Vesper Sparrow	NS	NS
Brewer's Sparrow	NS	NS
Chestnut-collared Longspur	I*	NS

1/ NS=no significant change; D=significant decrease; I=significant increase.

* $.01 < p < .05$ (paired t-test).

** $p \leq .01$.

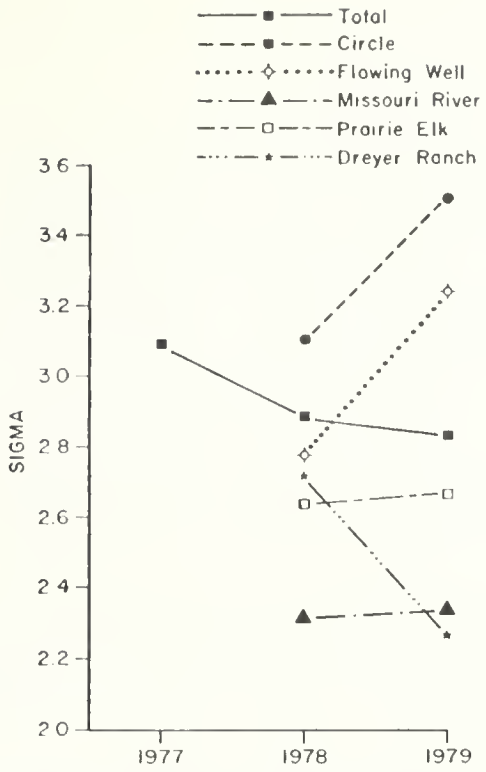

Figure 21. Year-to-year changes in June breeding bird community sigma for five roadside wildlife survey routes, Circle West study area.

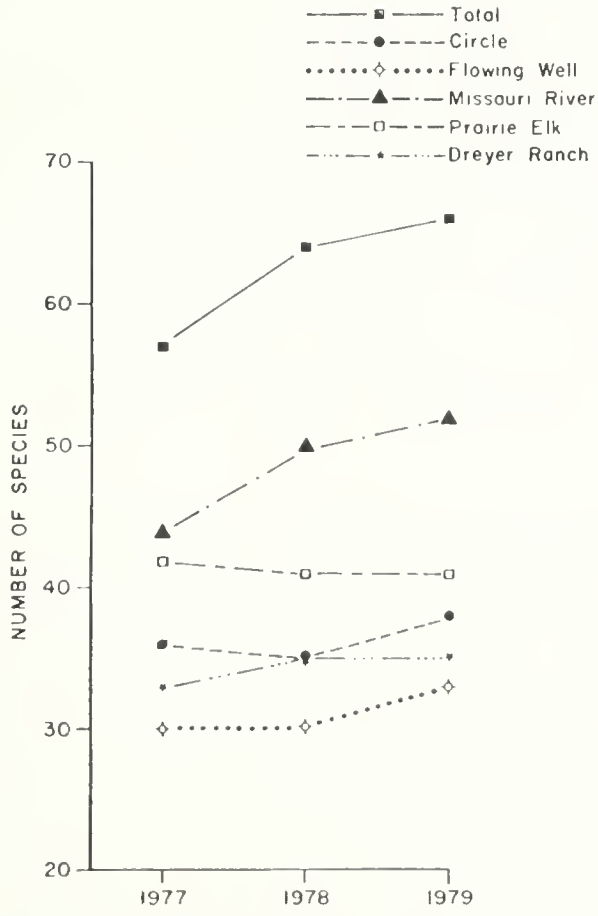

Figure 22. Year-to-year changes in June breeding bird species number (exclusive of summer visitors and water birds) for five roadside wildlife survey routes, Circle West study area.

The lognormal species curves obtained using pooled data for the five routes are shown in figure 23. In 1978, 94 breeding species were registered on May-July runs of the routes, while the species-abundance relation predicts 101.7 species in the theoretical universe bounded by the curve. Sampling, therefore, appears to be about 92% complete. When all May-July data for the period 1977-1979 are pooled, the number of breeding species actually encountered rises to 101, while the theoretical number of species if 104.4. Sampling in this case appears to be 97% complete. As shown in the figure, the curve advances to the right as sample size increases, yet retains its shape. The roadside survey is, therefore, 92% or more effective in sampling the bird community present in the area defined by the sample radius. For individual routes, sampling completeness based on cumulative 1977-1979 data is somewhat more variable, ranging from 75% to 97%.

The shape of the species curve provides an accurate and precise "fingerprint" of the bird community--and hence of environmental conditions--sampled by the roadside survey. Curves for different routes are shaped differently and distinctively (figure 24), while curves for individual routes are remarkably constant in shape from year to year (figure 25).

The shape of the various species curves is closely related to the species variety and equitability parameters as revealed by the factor analysis discussed above. In general, a more diverse community will show: (1) a taller species curve, reflecting a larger valve of S_0 and greater species variety; (2) a narrower species curve, reflecting greater equitability; and (3) a species curve encompassing a larger area. Examination of figure 24 allows quick visual comparison of various ecological features of the five routes. It is evident from this figure that the floodplain habitats sampled by the Missouri River route have a high species variety and high equitability, as the species curve is relatively tall and steep. The badlands community sampled by the Flowing Well route has much lower values for these parameters, and hence a low, shallow species curve. The Circle route also has low species variety and equitability, but its species curve encompasses a relatively large area. The lognormal curves, therefore, provide an ideal monitoring tool: they are sensitive to community attributes, allow easy visual comparison of samples, and provide a precise measurement of the community which, if undisturbed, varies little from year to year.

These data lend support to the use of breeding bird community structure as a sensitive environmental indicator. We would expect bird community structure to be indirectly but measurably affected by any major change in (1) habitat quality or extent; (2) habitat vertical structure and patchiness; (3) prey availability (seeds, insects, rodents, other birds, etc.); (4) densities of competitors and predators, and (5) intensity of disturbances such as noise, dust, traffic, and increased hunting pressure. The synergistic effects of several such changes occurring together should have an especially marked influence. Therefore, while the three years' pre-project data reported here show community structure in the study area to be remarkably constant from year to year, a statistically significant change in the relative positions of experimental and control communities would provide strong evidence for a biologically significant change. In the words of Sharma et al. (1975), "...if an impact is measurable, then a change detected by our crude schemes must be very large and consequently significant." Concurrent monitoring of single species abundances as well as several community attributes (diversity, evenness, trophic composition, etc.) would provide

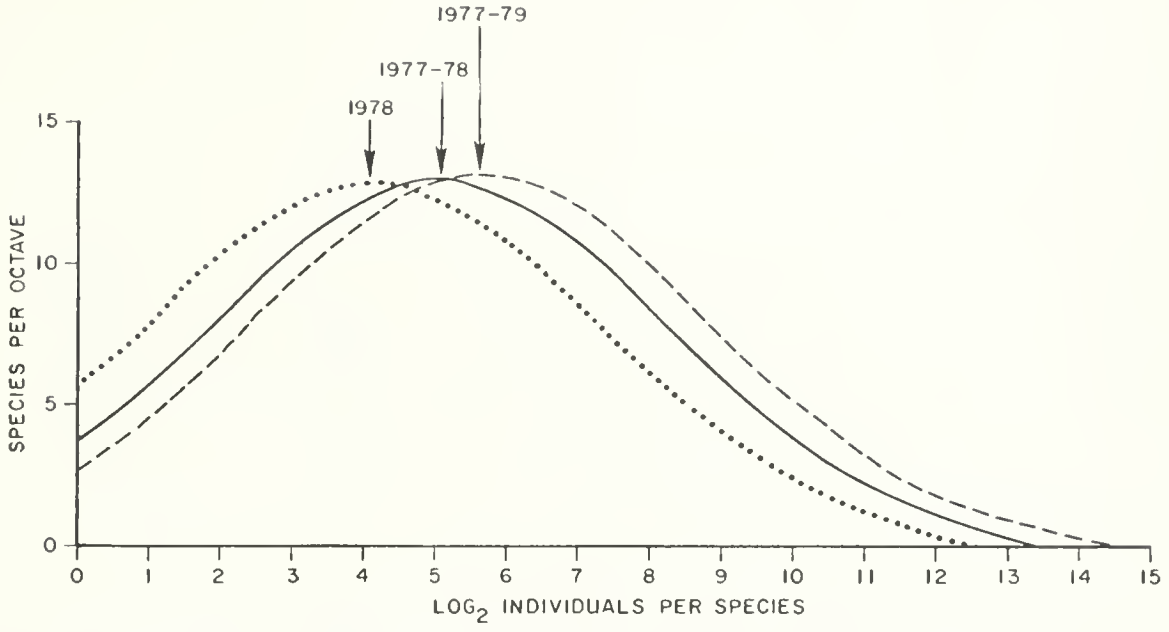

Figure 23. Year-to-year changes in cumulative May-July species curves for breeding birds encountered on five roadside wildlife survey routes, Circle West study area, 1977-1979.

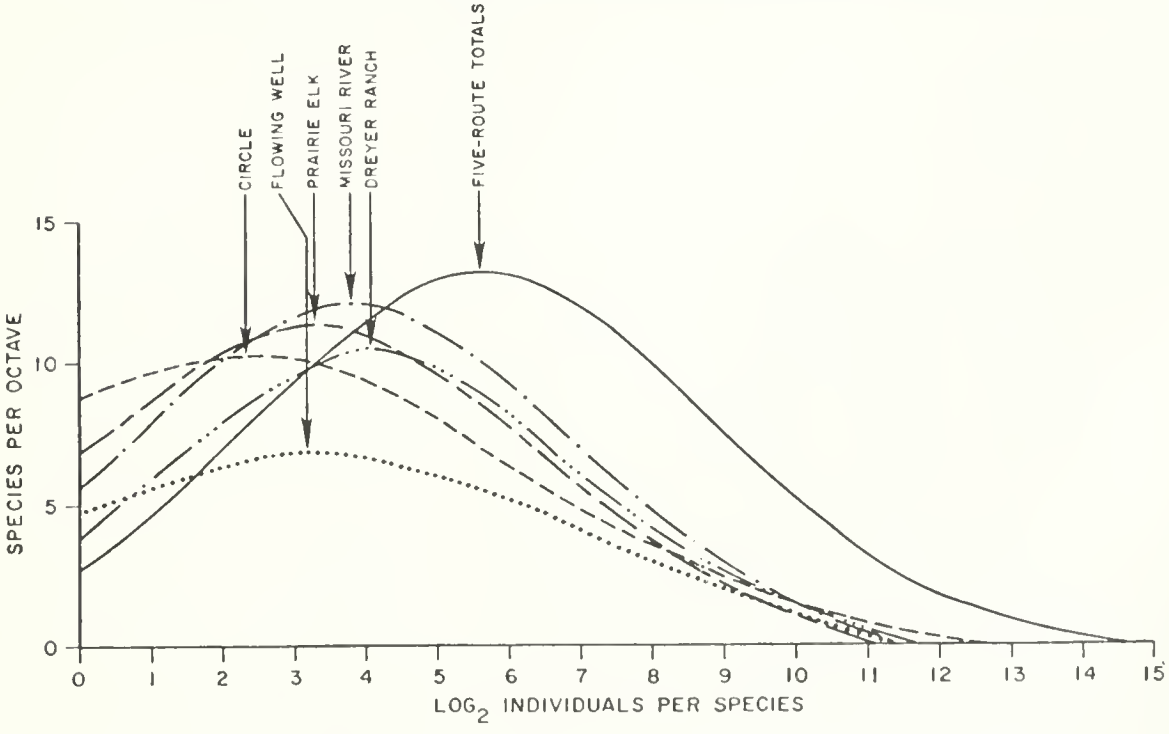

Figure 24. Cumulative May-July 1977-1979 breeding bird species curves for five roadside wildlife survey routes, Circle West study area.

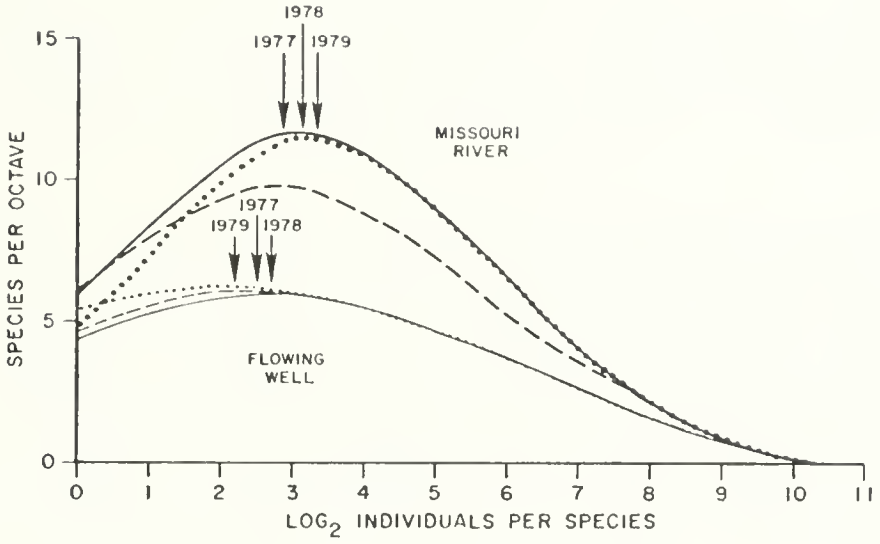

Figure 25. Year-to-year changes in shapes of breeding bird species curves for the Missouri River and FLowing Well roadside wildlife survey routes, based on pooled May-July data for each year. (Arrows indicate position of mode.)

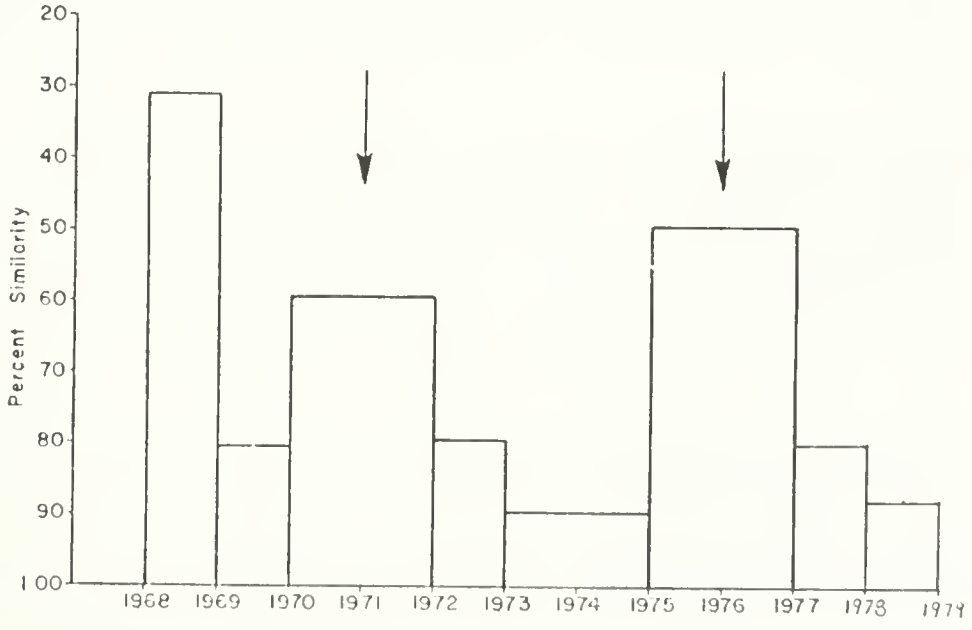

Figure 26. Similarity in percent for 1968-1979 June runs of the Circle roadside wildlife survey route. (Arrows indicate change in observers.)

valuable clues in tracing the cause-and-effect chain of the impact.

A drawback of the roadside survey technique used in this study is its strong dependence on observer bias in estimating sample abundances; data gathered by two different observers for the same route at the same time may be considerably different, even if both observers are equally skilled. In order to gain some insight into the importance of observer bias, the percent similarity of results from the Circle route between subsequent runs was determined, using the coefficient of similarity as defined by Bray and Curtis (1957). Prominence values (Beals 1960) were used in place of sample abundances.

Between-year similarities for 1968-1979 runs of the Circle Route ranged from 0.32 to 0.89 (figure 26). This wide variation may reflect ecological differences in breeding bird populations from year to year, but is most likely due to changes in observers and observer bias. Figure 17 shows an increase in similarity between 1968-1970, between 1972-1975, and between 1977-1979, as the observers became more familiar with the birds and the route. Observers were changed between 1970 and 1972 and again between 1975 and 1977, and these changes are accompanied by a sharp drop in similarity (note: no runs were made in 1971, 1974, or 1976). This demonstrates the extreme importance of maintaining observer continuity for long-term monitoring.

SMALL MAMMAL COMMUNITY PARAMETERS

Small mammal capture data for 1979 are summarized in table 17. The two habitats first sampled in 1979, Coulee Trunk and Scoria, were sampled only in October. (Note: the biomass increase data presented in table 18 of the first monitoring report are in error; each number should be multiplied by a factor of two).

Figure 27 shows year-to-year changes in small mammal biomass for four habitats (biomass estimates obtained for control and experimental sites were averaged for combined spring and fall data). It should be emphasized that 1977 data are not strictly comparable, since a spring-fall trapping regime was not used that year. However, it is clear from this figure that tall coulee shrub habitats yielded the most captures by far during all three years. An overall increase in small mammal captures between 1978 and 1979 is apparent.

Figure 28 shows year-to-year changes in the spring-fall small mammal biomass increase (which is related to production) for the same four habitats. The tall coulee shrub habitats are by far the most productive; the spring-fall biomass increase was remarkably large in 1979. Surprisingly, small mammal biomass in silver sagebrush habitats decreased sharply over the summer of 1979, possibly indicating over-winter use of the dense grass and shrub cover offered by this habitat followed by late spring dispersal or predation.

Table 17. Summary of small mammal trapping data, Circle West study area, May-October, 1979

Habitat Category	Blue Gram-Needle-and-thread Grassland		Western Bulrush		Silver Sagebrush		Tall Coulee Shrubbery		Coulee Trunk[2]		Scoria[2]		Totals[5]
Treatment[1]	E	C	C	E	C	E	C	E	C	E	C	E	
Location Number	34	17	15	20	33	18	44	35	49	48	47	46	all
Number of Trap Nights (TN)	300	300	300	300	300	300	300	300	150	150	150	150	2400
Trapping Schedule[3]	5/10	5/10	5/10	5/10	5/10	5/10	5/10	5/10	10	10	10	10	-
CAPTURES/100 TN													
Meadow Vole	-	-	-	-	.33	-	1.00	.67	-	-	-	-	.25
Prairie Vole	-	-	1.00	1.33	2.33	.33	-	-	.67	-	-	-	.62
Deer Mouse	-	1.00	1.33	.67	2.67	-	20.00	3.33	11.33	24.00	2.67	6.67	3.62
Western Harvest Mouse	-	-	.33	-	-	2.67	-	-	-	-	-	-	.38
Total Captures/100 TN	0.00	1.00	2.67	2.00	5.33	3.00	21.00	4.00	12.00	24.00	2.67	6.67	4.88
Number of Species	0	1	3	2	3	2	2	2	2	1	1	1	4
Biomass (g/100 TN)	0.00	18.00	66.33	62.33	101.33	35.67	364.00	63.00	194.67	482.00	44.00	122.67	88.82
Biomass Increase (g/100 TN)[4]	0.00	9.33	107.33	124.67	-113.33	6.00	544.00	108.7	-	-	-	-	98.34

[1] C=Control; E=experimental

[2] These sites were sampled only in October

[3] Month of first trapping/month of last trapping

[4] Change in biomass between May and October sampling=(October biomass-May biomass)÷1.50

[5] The Coulee Trunk and Scoria sites were excluded from these totals

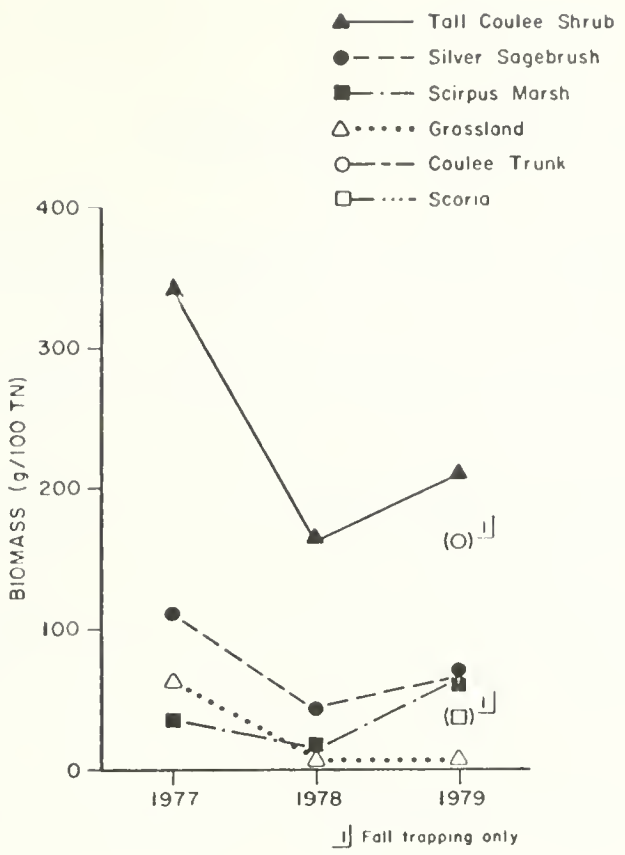

Figure 27. Year-to-year changes in small mammal biomass for six habitats sampled in the Circle West study area (control and experimental data are averaged for combined spring-fall data for each habitat).

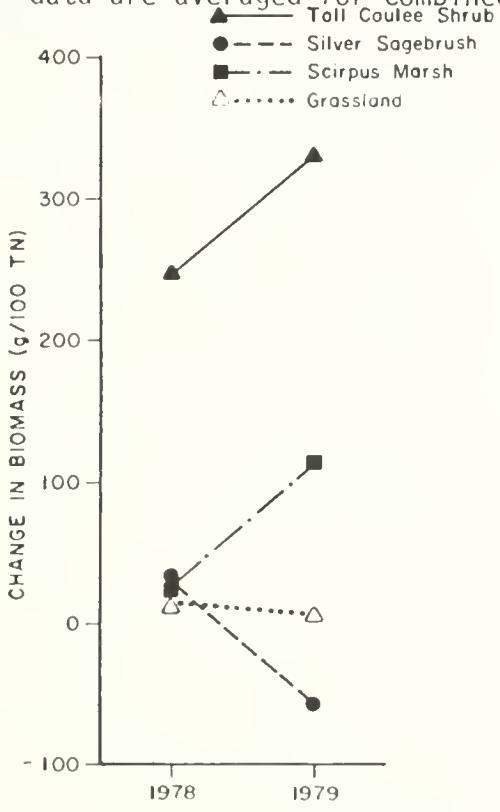

Figure 28. Year-to-year changes in spring-fall small mammal biomass change for six habitats sampled in the Circle West study area (control and experimental data are averaged for each habitat).

RECOMMENDATIONS FOR FUTURE MONITORING

A long-term monitoring program which allows annual measurement of the parameters listed on pages 1 & 2 would require, at the minimum, the following amount of field work:

AERIAL SURVEYS. Each year the Mine Study Area should be flown during the following months: January, February, July, September, October, and December (six flights total).

GROUND SURVEYS. Four trips to the study area each year would provide the minimum amount of data necessary for long-term monitoring. These trips should be made during the following periods:

May 4 - 25. General ground surveys, spring small mammal trapping, waterfowl census, raptor nest survey, and sharp-tailed grouse lek counts (9 person-days required, assuming 300 snap-traps are available).

June 2 - 20. General ground surveys, waterfowl census, raptor nest survey, roadside wildlife surveys (6 routes) (12 person-days required).

July 15 - 30. General ground surveys, waterfowl census (5 person-days).

September 15 - October 15. General ground surveys, lagomorph surveys, fall small mammal trapping, sharp-tailed grouse lek counts (8 person-days required).

TOTAL MANPOWER REQUIREMENTS FOR FIELD WORK

Aerial Surveys	6 person-days
Ground Surveys	34 person-days
Subtotal	40 person-days
Contingency for rainy days	4 person-days
Total	44 person-days

ACKNOWLEDGEMENTS

During the 1979-1980 monitoring period, data were gathered by: Joe Elliott, Stacy Kiser, Tom Olson, and Dana Schmidt of Olson-Elliott and Associates (small mammal trapping, waterfowl census, and general ground survey); Ron Stoneberg, MDFWP (aerial big game census), and Larry Thompson, DNRC (project coordination, roadside wildlife surveys, winter bird and mammal census, waterfowl census, and general ground surveys). George Cawlfield, Ed Madej, Chris Raver, and Larry Thompson of DNRC performed the data analysis. Rose Ann Montgomery typed the manuscript, and June Virag produced the graphics. The waterfowl computer program was developed by Chris Raver, and the computer-generated big game density maps were prepared by Randy Holm of the Montana Department of Community Affairs. Gail Kuntz and Hal Matthews of DNRC reviewed the manuscript. This report was prepared by Larry Thompson of DNRC and was funded by Northern Resources. Special thanks are extended to the Mike McKeever, Lee Witte, and Ted Waller families for their help in the field.

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SILVER BUFFALOBERRY-RED OSIER DOGWOOD COULEE. -- Location: Montana; McCone Co.; overlaps boundary of Sec. 3 and 10, T20N, R45E; 47° 31´N, 105° 58´W; AMS, Glendive (NL 13-2). Continuity: New (BBC 1977 and 1978). Size: 25 ha = 61.8 acres. Description of Plot: See AB 32:108 (1978). Coverage: Jan. 29 - Feb. 2; two trips/day except Jan. 29, Feb. 2. Total: 8 trips between 0750 and 1714 averaging 54 minutes each. Count: Snow Bunting, 1; Golden Eagle, +; Sharp-tailed Grouse. +; Great Horned Owl, +; Black-billed Magpie, +. Average Total: 1.4 birds. Remarks: Total, 5 species. The lone Snow Bunting was seen repeatedly on the wind-swept hillside above the head of the coulee. The Great Horned Owl was flushed twice from its daytime roost in silver buffaloberry near the head of one of the coulee arms. A group of at least 13 Sharp-tailed Grouse were frequently seen feeding on a grassy ridge about 100 m from the plot; the abundance of tracks on the plot indicates possible nighttime use by these birds. A dead Golden Eagle, probably killed 1-2 weeks earlier, was found on the coulee bottom. Mammal tracks identified include: Coyote, Red Fox, Long-tailed Weasel, White-tailed Jackrabbit, Porcupine, Deer Mouse. Groups of 7 and 6 Mule Deer were seen on the plot Jan. 29 and 30, respectively.

SILVER BUFFALOBERRY-SILVER SAGEBRUSH COULEE. -- Location: Montana: McCone Co.; overlaps border of Sec. 19 and 20, T20N, R45E; 47° 28´ N, 106° 1´W, AMS, Jordan (NL 13-1). Continuity: New (BBC 1977 and 1978). Size: 25 ha = 61.8 acres. Description of Plot: See AB 32:108-9 (1978). Coverage: Jan. 29 - Feb. 1; two trips/day. Total, 8 trips between 0924 and 1546 averaging 39 minutes each. Count: Golden Eagle, +. Remarks: the Golden Eagle was observed on Jan. 31 flying low over the plot and apparently hunting. Tracks identified include: Sharp-tailed Grouse, Coyote, Red Fox, White-tailed Jackrabbit, Desert Cottontail, Deer Mouse. A Porcupine was feeding on the bark of a silver buffaloberry shrub within the plot on Jan. 29-30.

SILVER SAGEBRUSH FLAT. -- Location: Montana; McCone Co.; SE quarter of Sec. 31, T20N, R45E; 47° 25´ N, 106° 1´W, AMS, Jordan (NL 13-1). Continuity: New (BBC 1977 and 1978). Size: 24 ha = 59.3 acres. Description of Plot: See AB 32:107-8 (1978). Coverage: Jan. 29 - Feb. 1; 8 trips (2/day) between 0818 and 1455 averaging 31 minutes each. Count: Short-eared Owl, +. Remarks: Mammal tracks were very abundant on the plot, and included those of: Coyote, Red Fox, Long-tailed Weasel, Desert Cottontail, White-tailed Jackrabbit, Deer Mouse. The absence of Sharp-tailed Grouse tracks was surprising, as the plot supported wintering grouse during the two previous winters.

NEEDLE-AND-THREAD -- BLUE GRAMA GRASSLAND. -- Location: Montana; McCone Co.; borders center of E boundary of Sec. 25, T20N, R44E; 47° 27´ N, 106° 2´ W; AMS, Jordan (NL 13-1). Continuity: New (BBC 1977 and 1978). Size: 25 ha = 61.8 acres. Description of Plot: See AB 32:109 (1978). Coverage: Jan. 29 - Feb. 1; 8 trips (2/day) between 0900 and 1507, averaging 24 minutes each. Count: No birds seen. Remarks: Coyote and Red Fox tracks were observed on the plot.

WESTERN WHEATGRASS - BLUE GRAMA PASTURE. -- Location: Montana; McCone Co.; Sec. 23 T20N, R44E; 47° 28´ N, 106° 3´W; AMS Jordan (NL 13-1). Continuity: New (BBC 1977 and 1978). Size: 25 ha = 61.8 acres. Description of Plot: See AB 32:109 (1978). Coverage: Jan. 29 - Feb. 1; 8 trips (2/day) between 0952 and 1630 averaging 30 minutes each. Count: Golden Eagle, +; Snow Bunting, +. Remarks: The Golden Eagle flew over the plot on Jan. 30 and perched on a scoria butte about 500 m from the plot. The lone Snow Bunting was seen on two occasions feeding on western wheatgrass seedheads protruding above the snow. Tracks of Coyote, Red Fox, and Long-tailed Weasel were observed on the plot.

APPENDIX B. Summary of Data for 1979 Roadside Wildlife Survey.

NOTE: Results are given for each of the five routes (indicated by the first letter of the route name), for the four control routes combined (i.e., excluding the Dreyer Ranch route), and for all give routes combined (including the Dreyer Ranch route). Numbers indicate sample abundance and frequency for each species (e.g., 12/7 indicates that twelve birds were recorded at seven stops).

MAY 1979

Species	AOU	(65)	(69) ROUTE C	(72) ROUTE F	(75) ROUTE G	(78) ROUTE M	(81) ROUTE D	(84) TOT. EXCL. 4	(88) TOT. INCL. 5
PIED-BILLED GREBE	006					1/1		1/1	1/1
DBL-CR. CORMORANT	120								
GREAT BLUE HERON	194		1/1				1/1	1/1	2/2
BLK-CR. NIGHT HERON	202								
AM. BITTERN	190								
MALLARD	132		12/7	2/2	2/1	9/4	22/7	25/14	41/21
GADWALL	135						1/2		1/2
PINTAIL	143		1/1		1/1		1/2	2/2	11/4
GREEN-WINGED TEAL	139				4/1		3/1	4/1	7/2
BLUE-WINGED TEAL	140		12/6		4/2	11/3	10/4	35/11	48/15
AM. WIGEON	137		2/2	1/1	1/1	X	9/4	4/4	13/9
N. SHOVELER	142		4/4		2/1	3/1	2/1	9/6	11/7
WOOD DUCK	144								
REDHEAD	146								
CANVASBACK	147								
LESSER SCAUP	149								
RUDDY DUCK	167								
RED-TAILED HAWK	337								
SWAINSON'S HAWK	342				1/1			1/1	1/1
FERRUGINOUS HAWK	348								
MARSH HAWK	331		6/5	3/2	5/4	1/1	1/1	15/12	16/13
AM. KESTREL	360		X		3/2	10/6		12/8	13/8
SHARP-TAIL. GROUSE	308				21/8	14/3	4/3	35/11	39/14
BOBWHITE	289								
RING-NECK PHEASANT	3091		15/12	3/3	45/26	113/41	7/6	174/82	188/88
GRAY PARTRIDGE	2881								
SORA	214				1/1	3/3	1/1	4/4	5/5
AM. COOT	221				1/1	2/1		3/2	3/2
KILLDEER	273		4/8	4/4	14/12	2/9	15/2	39/33	54/45
COMMON SNIPE	230								
LONG-BILLED CURLEW	264								
UPLAND SANDPIPER	261				7/7	7/7	1/1	14/14	15/15
SPOTTED SANDPIPER	263								
WILLET	258								
MARBLED GODWIT	249								
AM. AVOCET	225								
WILSON'S PHALAROPE	224		9/3		3/2	1/1	2/1	11/6	12/11
RING-BILLED GULL	054								
FRANKLIN'S GULL	059								
BLACK TERN	077								
ROCK DOVE	3131		8/3					8/3	8/3
MOURNING DOVE	316		13/3	58/32	86/54	29/32	23/18	227/103	250/121
YELLOW-BIL. CUCKOO	387								
BLACK-BILL CUCKOO	388								
GREAT HORNED OWL	375				1/1			1/1	1/1
BURROWING OWL	CS								
SHORT-EARED OWL	367		2/2		1/1			3/3	3/3
COMMON NIGHTHAWK	420								
CHIMNEY SWIFT	423								
BELTED KINGFISHER	390								
Common RED-SHAFT FLICKER	412				4/4	9/8		13/12	13/12
RED-SHAFT FLICKER	413								
RED-HD. WOODPECKER	406								
HAIRY WOODPECKER	393								
DOWNY WOODPECKER	394								
E. KINGBIRD	444		X	1/1	5/5	8/1	8/2	14/11	22/18
W. KINGBIRD	447		6/2	1/1	7/1	3/2		11/6	11/6
G.E. CREST FLYCATCHER	452								
E. PHOEBE	456								
SAY'S PHOEBE	457		7/1	13/3		3/3		23/23	23/23
WILLOW FLYCATCHER	4664								
LEAST FLYCATCHER	467		1/1					1/1	1/1
E. WOOD PEWEE	461								
W. WOOD PEWEE	462								
HORNED LARK	474		265/49	69/21	113/57	24/14	16/4	487/145	678/162
TREE SWALLOW	614								
BANK SWALLOW	616		1/1				1/1	1/1	2/2
ROUGH-WG. SWALLOW	617								
BARN SWALLOW	613		9/5	9/7	6/4	6/5	7/2	36/21	37/23
CLIFF SWALLOW	612		50/1	466/17	3/1	23/2		540/21	549/21
PURPLE MARTIN	611								
BLUE JAY	477								
BLK-BILLED MAGPIE	475			1/1		12/9		13/10	13/10
COMMON CROW	488					8/6		8/6	8/6
BLK-CAP. CHICKADEE	735								
WHITE-BR. NUTHATCH	727								
HOUSE WREN	721			1/1	6/3	17/10		24/14	24/14
LONG-BIL MARSH WREN	725								
SHORT-B. MARSH WREN	724								
ROCK WREN	715			51/27	2/2	3/3	4/5	56/32	64/31
GRAY CATBIRD	704								
BROWN THRASHER	705		1/1		14/10	13/12	15/8	28/23	43/31
SAGE THRASHER	702								
AM. ROBIN	761		3/3		1/1	4/3	1/1	8/7	9/8
VEERY	756								
E. BLUEBIRD	766								
MOUNTAIN BLUEBIRD	768								
SPRAGUE'S PIPIT	700			15/9	3/2	1/1	23/20	19/12	41/34
CEDAR WAXWING	619								
LOGGERHEAD SHRIKE	622			4/3	2/2	2/1	X	3/6	8/6
STARLING	493		8/3			9/4	3/1	17/7	20/8
RED-EYED VIREO	624								
WARBLING VIREO	627				1/1			1/1	1/1
YELLOW WARBLER	652				5/3	4/3		9/6	9/6
COM. YELLOWTHROAT	681			1/1	1/1	6/5	2/1	8/7	10/8
YELLOW-BR. CHAT	683				3/1	2/2		5/3	5/3
AM. REDSTART	687				2/1			2/1	2/1
HOUSE SPARROW	6882		23/1	2/1	3/1	9/2	5/1	39/11	42/12
BOBOLINK	494								
W. MEADOWLARK	5011		112/52	241/92	254/94	227/98	266/98	887/197	1158/245
YEL-HD. BLACKBIRD	497					9/2		9/2	8/2
RED-WG. BLACKBIRD	498		42/15	24/5	54/21	104/32	45/16	225/68	279/84
ORCHARD ORIOLE	506					1/1		1/1	1/1
BALTIMORE ORIOLE	507								
BULLOCK'S ORIOLE	508								
BREWER'S BLACKBIRD	510			15/8	6/3	58/20	18/8	74/31	99/39
COMMON GRACKLE	511			X		12/4		12/4	12/4
BROWN-HD. COWBIRD	495		19/10	19/14	37/18	19/12	16/9	94/54	110/63
ROSE-BR. GROSBEAK	595								
BLACK-HD. GROSBEAK	596								
BLUE GROSBEAK	597								
INDIGO BUNTING	598								
LAZULI BUNTING	599					2/1		2/1	2/1
DICKCISSEL	604								
AM. GOLDFINCH	529				10/3	2/1		12/4	12/4
RUFOUS-SIDE TOWHEE	587			3/3	5/3	22/15	1/1	30/21	31/22
LARK BUNTING	605		44/13	86/13	18/12		4/1	322/48	334/45
SAVANNAH SPARROW	542		4/4				2/2	4/4	6/6
GRASSHOPPER SPARROW	546		4/3	20/12	12/9	3/2	24/16	39/30	63/46
BAIRD'S SPARROW	545		26/19	7/5	3/3		32/26	34/27	66/47
VESPER SPARROW	540		8/5	51/33	34/18	35/21	34/22	127/80	161/102
LARK SPARROW	552		2/2	18/16	5/3	20/11		45/26	45/26
CHIPPING SPARROW	560								
CLAY-COL. SPARROW	561				5/4	18/13		23/17	23/17
BREWER'S SPARROW	562			68/31	3/3		19/4	71/34	51/38
FIELD SPARROW	563				5/5	34/24		39/29	39/29
SWAMP SPARROW	584								
SONG SPARROW	581								
MCCOWN'S LONGSPUR	539		3/1					3/1	3/1
CH-COL. LONGSPUR	538		123/36	22/8			55/21	147/44	204/65
Canada Goose					X	X	2/1		2/1
Golden Eagle							1/1		1/1
Whit. P. Pelican							1/1		1/1
Sp. Towhee			5/3					5/3	5/3
Unk. Duck			1/2	2/1	1/1	4/2	8/2	16	16
Swainson's Thrush					1/1	1/1		2/2	2/2

Form 3-6 (1975)

JUNE 1979

Species	AOU	(69) ROUTE C	(72) ROUTE F	(75) ROUTE P	(78) ROUTE M	(81) ROUTE D	(84) TOT. EXCL. D. 4	(88) TOT. INCL. D. 5
PIED-BILLED GREBE	006				1/1		1/1	1/1
DBL-CR. CORMORANT	120		2/2				2/2	2/2
GREAT BLUE HERON	194				1/1	1/1	1/1	2/2
BLK-CR. NIGHT HERON	202							
AM. BITTERN	190							
MALLARD	132	28/3		2/1	10/2	13/6	40/6	53/12
GADWALL	135	1/1			2/1	0/2	3/2	4/4
PINTAIL	143	3/1		9/1		1/1	12/2	13/3
GREEN-WINGED TEAL	139				2/1	1/1	2/1	3/2
BLUE-WINGED TEAL	140	2/2				8/5	2/2	10/7
AM. WIGEON	137				1/1	9/4	1/1	10/5
N. SHOVELER	142					1/1		1/1
WOOD DUCK	144							
REDHEAD	146							
CANVASBACK	147							
LESSER SCAUP	149	2/1					2/1	2/1
RUDDY DUCK	167	2/1					2/1	2/1
RED-TAILED HAWK	337	1/1					1/1	1/1
SWAINSON'S HAWK	342							
FERRUGINOUS HAWK	348							
MARSH HAWK	331	2/2	2/1	2/2	3/3	2/2	9/8	11/10
AM. KESTREL	360	1/1			5/5		6/6	6/6
SHARP-TAIL. GROUSE	308			1/1	4/1	3/1	5/2	8/3
BOBWHITE	289							
RING-NECK PHEASANT	3091	22/16		37/24	45/29	4/4	108/69	104/73
GRAY PARTRIDGE	2881							
SORA	214				1/1		1/1	1/1
AM. COOT	221	2/1			1/1		3/2	3/2
KILLDEER	273	5/4	1/0	31/19	14/12	10/6	59/41	76/47
COMMON SNIPE	230							
LONG-BILLED CURLEW	261							
UPLAND SANDPIPER	261				1/1		1/1	1/1
SPOTTED SANDPIPER	263			1/1		1/1	1/1	2/2
WILLET	258				1/1		1/1	1/1
MARBLED GODWIT	249							
AM. AVOCET	225							
WILSON'S PHALAROPE	224				2/1	6/5	2/1	8/6
RING-BILLED GULL	054			1/1	1/1		2/2	2/2
FRANKLIN'S GULL	059							
BLACK TERN	077							
ROCK DOVE	3131	12/3					12/3	12/3
MOURNING DOVE	316	44/24	69/36	71/36	44/25	8/5	236/123	234/128
YELLOW-BIL. CUCKOO	387							
BLACK-BILL CUCKOO	388	2/1			1/1		3/2	3/2
GREAT HORNED OWL	375		1/1				1/1	1/1
BURROWING OWL	378							
SHORT EARED OWL	367	8/7		6/4	2/2		16/13	16/13
COMMON NIGHTHAWK	420		2/2	7/5	9/4	4/1	18/11	27/16
CHIMNEY SWIFT	423							
BELTED KINGFISHER	390				2/1		2/1	2/1
YELLOW-SHAFT FLICKER	412		1/1		7/7		8/8	8/8
RED-SHAFT FLICKER	413							
RED-HD. WOODPECKER	406				3/2		3/2	3/2
HAIRY WOODPECKER	393							
DOWNY WOODPECKER	394							
E. KINGBIRD	444	9/4	3/2	7/7	14/10	12/10	21/23	33/33
W. KINGBIRD	447	8/7			3/3	1/1	11/10	12/11
GT. CREST FLYCATCHER	452							
E. PHOEBE	456							
SAY'S PHOEBE	457	2/2	7/7		2/2	1/1	11/11	13/12
WILLOW FLYCATCHER	4064							
LEAST FLYCATCHER	467			1/1			1/1	1/1
E. WOOD PEWEE	461							
W. WOOD PEWEE	462	1/1			1/1		2/2	2/2
HORNED LARK	474	58/30	61/20	59/31	54/11	103/54	413/146	586/246
TREE SWALLOW	614							
BANK SWALLOW	616					4/2	4/2	4/2
ROUGH-WG. SWALLOW	617	1/1		2/2	4/2	5/3	11/8	13/8

Species	AOU	(69) ROUTE C	(72) ROUTE F	(75) ROUTE P	(78) ROUTE M	(81) ROUTE D	(84) TOT. EXCL. D. 4	(88) TOT. INCL. D. 5
BARN SWALLOW	613	8/1	6/3	7/5	10/6	1/1	31/21	32/22
CLIFF SWALLOW	612	83/2	135/69	1/1	40/1	1/1	419/21	420/22
PURPLE MARTIN	611							
BLUE JAY	477							
BLK-BILLED MAGPIE	475		1/1	3/2	20/13	2/2	23/16	25/15
COMMON CROW	488				5/5		5/5	5/5
BLK-CAP. CHICKADEE	735							
WHITE-BR. NUTHATCH	727							
HOUSE WREN	721		3/1	3/3	15/11		20/15	20/15
LONG-BIL MARSH WREN	725							
SHORT-B. MARSH WREN	724							
ROCK WREN	715		41/26		1/1		42/27	42/27
GRAY CATBIRD	704							
BROWN THRASHER	705	1/1	5/3	1/1	4/4		11/10	11/11
SAGE THRASHER	702		3/3				3/3	3/3
AM. ROBIN	761	4/4		2/1	2/2	2/2	8/7	10/9
VEERY	756							
E. BLUEBIRD	766							
MOUNTAIN BLUEBIRD	768							
SPRAGUE'S PIPIT	700	2/2	5/4	3/3		17/13	10/9	23/22
CEDAR WAXWING	610							
LOGGERHEAD SHRIKE	622	3/3	4/3	4/3	5/5	2/2	14/14	18/16
STARLING	493	8/4	2/1	2/1	30/7	9/2	42/13	51/15
RED-EYED VIREO	624							
WARBLING VIREO	627		1/1	1/1	3/2		5/4	5/4
YELLOW WARBLER	652			7/6	17/9		21/15	21/15
COM. YELLOWTHROAT	681	1/1		4/4	11/8	1/1	16/13	17/14
YELLOW-BR. CHAT	683			2/1	3/3		5/4	5/4
AM. REDSTART	687							
HOUSE SPARROW	6882	46/6			11/3	6/1	57/9	63/10
BOBOLINK	494	3/2		1/1	3/3	3/5	12/10	12/11
W. MEADOWLARK	5011	179/20	249/50	146/44	143/44	185/46	852/183	942/229
YEL-HD. BLACKBIRD	497	8/3				6/1	8/3	14/4
RED-WG. BLACKBIRD	498	67/25	24/14	32/17	81/11	27/11	208/78	235/89
ORCHARD ORIOLE	506			1/1			1/1	1/1
~~BALTIMORE~~ ORIOLE	507			1/1	1/1		2/2	2/2
BULLOCK'S ORIOLE	508							
BREWER'S BLACKBIRD	510	2/1	24/11	11/6	45/24	16/10	132/42	148/52
COMMON GRACKLE	511	2/1			1/1		3/2	3/2
BROWN-HD. COWBIRD	495	12/7	19/12	25/14	21/11	4/10	77/44	93/54
ROSE-BR. GROSBEAK	595							
BLACK-HD. GROSBEAK	596							
BLUE GROSBEAK	597							
INDIGO BUNTING	598							
LAZULI BUNTING	599				3/3		3/3	3/3
DICKCISSEL	604							
AM. GOLDFINCH	529	1/1		6/2	5/4		12/7	12/7
RUFOUS-SIDE TOWHEE	587			5/4	11/11		16/15	16/15
LARK BUNTING	605	12/1	50/12	6/5	14/3	2/2	84/22	86/24
SAVANNAH SPARROW	542	5/5				2/2	4/5	11/7
GRASSHOPPER SPARROW	546	30/21	25/17	18/15	4/4	4/9	80/57	125/76
BAIRD'S SPARROW	545	22/13		7/6		2/1/4	29/25	50/29
VESPER SPARROW	540	8/5	61/29	15/11	31/20	8/6	113/65	133/71
LARK SPARROW	552		11/6	1/1	12/1		24/14	24/14
CHIPPING SPARROW	560		1/1				1/1	1/1
CLAY-COL. SPARROW	561		1/1	1/1	10/9		12/11	13/11
BREWER'S SPARROW	562		65/22	5/4	1/1	4/3	71/30	75/33
FIELD SPARROW	563			6/5	23/18		29/23	29/23
SWAMP SPARROW	584							
SONG SPARROW	581							
MCCOWN'S LONGSPUR	539							
CH-COL. LONGSPUR	538	112/79	20/6			62/21	172/45	234/106
- CALIFORNIA GULL			2/1			x	2/1	2/1
- GOLDEN EAGLE						1/1		1/1
- TURKEY VULTURE					1/1		1/1	1/1

Form 3-6 (1975)

JULY 1979

Species	AOU	(65) ROUTE C	(69) ROUTE F	(72) ROUTE P	(75) ROUTE M	(78) ROUTE D	(81)	(84) TOT. EXCL D 4	(88) TOT. INCL D 5
PIED-BILLED GREBE . .	006								
DBL-CR. CORMORANT	120								
GREAT BLUE HERON .	194					4/3			4/3
BLK-CR. NIGHT HERON	202								
AM. BITTERN.	190								
MALLARD.	132	23/2				4/4		23/2	37/6
GADWALL	135					1/1			1/1
PINTAIL.	143								
GREEN-WINGED TEAL	139								
BLUE-WINGED TEAL .	140								
AM. WIGEON	137					2/2			2/2
N. SHOVELER.	142								
WOOD DUCK.	144								
REDHEAD.	146								
CANVASBACK	147								
LESSER SCAUP	149								
RUDDY DUCK	167								
RED-TAILED HAWK .	337								
SWAINSON'S HAWK .	342	1/1	2/2	1/1	2/2	4/3		9/9	10/9
FERRUGINOUS HAWK.	348	1/1				1/1		1/1	2/2
MARSH HAWK	331	4/4		4/4	2/2	6/6		10/10	10/10
AM. KESTREL	360		3/2		11/10			14/12	14/12
SHARP-TAIL. GROUSE	308			3/3				3/3	3/3
BOBWHITE	289								
RING-NECK PHEASANT	3091	11/11		12/1	24/8	2/2		44/26	46/28
GRAY PARTRIDGE. . .	2881			1/1				1/1	1/1
SORA	214				1/1			1/1	1/1
AM. COOT	221								
KILLDEER	273	14/13	9/6	39/23	19/7	4/4		72/49	116/63
COMMON SNIPE . . .	230								
LONG-BILLED CURLEW	264								
UPLAND SANDPIPER .	261	1/1		6/5	2/2			9/8	9/8
SPOTTED SANDPIPER.	263					2/1			2/1
WILLET	258				2/1			2/1	2/1
MARBLED GODWIT . .	249								
AM. AVOCET	225								
WILSON'S PHALAROPE	224				11/1	3/3		11/1	14/4
RING-BILLED GULL . .	054			1/1	2/2	1/1		3/3	4/4
FRANKLIN'S GULL . .	059								
BLACK TERN	077								
ROCK DOVE.	3131								
MOURNING DOVE . . .	316	9/6	45/31	10/10	78/59	15/10		234/116	254/126
YELLOW-BIL. CUCKOO	387								
BLACK-BILL CUCKOO	388				3/2			3/2	3/2
GREAT HORNED OWL	375								
BURROWING OWL . . .	378								
SHORT-EARED OWL .	367	1/1		4/4	1/1			6/6	6/6
COMMON NIGHTHAWK	420		15/11	6/5	6/4	4/3		27/20	31/23
CHIMNEY SWIFT . . .	423								
BELTED KINGFISHER .	390								
Common FLICKER .	412			3/3	10/9			13/11	13/11
FLICKER .	413								
RED-HD. WOODPECKER	406				1/1			1/1	1/1
HAIRY WOODPECKER	393								
DOWNY WOODPECKER	394								
E. KINGBIRD	444	4/4	1/1	11/8	18/12	14/11		34/25	48/36
W. KINGBIRD.	447	9/5		1/1		1/1		10/6	11/7
GT. CREST FLYCATCHER	452								
E. PHOEBE	456								
SAY'S PHOEBE	457	3/3	5/5	1/1				9/9	9/9
WILLOW FLYCATCHER	4664								
DUSKY FLYCATCHER .	467	1/1						1/1	1/1
E. WOOD PEWEE . . .	461								
W. WOOD PEWEE . .	462	1/1						1/1	1/1
HORNED LARK	474	163/46	24/13	53/32	4/3	109/29		249/84	334/113
TREE SWALLOW . . .	614								
BANK SWALLOW . . .	616								
ROUGH-WG. SWALLOW	617			6/2	7/2	4/6		9/4	18/10

Species	AOU	(65) ROUTE C	(69) ROUTE F	(72) ROUTE P	(75) ROUTE M	(78) ROUTE D	(81)	(84) TOT. EXCL D 4	(88) TOT. INCL D 5
BARN SWALLOW . . .	613	9/6	4/3	15/11	1/1	4/4		27/21	36/30
CLIFF SWALLOW . . .	612	113/4	44/21		46/2	5/4		657/30	662/34
PURPLE MARTIN . . .	611								
BLUE JAY.	477								
BLK-BILLED MAGPIE .	475		4/4	2/2	21/4	12/6		34/24	44/30
COMMON CROW . . .	488				10/5			10/5	10/5
BLK-CAP. CHICKADEE	735								
WHITE-BR. NUTHATCH	727								
HOUSE WREN	721			5/3	18/7			23/10	27/20
LONG-BIL MARSH WREN	725								
SHORT-B. MARSH WREN	724								
ROCK WREN.	715		37/21		1/1	6/4		35/22	41/26
GRAY CATBIRD. . . .	704			1/1	1/1			2/2	2/2
BROWN THRASHER . .	705			8/6	1/1	3/2		4/7	12/9
SAGE THRASHER . . .	702		1/1					1/1	1/1
AM. ROBIN	761			4/4	7/5			11/9	11/9
VEERY.	756								
E. BLUEBIRD	766								
MOUNTAIN BLUEBIRD	768					4/1			4/1
SPRAGUE'S PIPIT . . .	700	1/1	5/4	6/5		21/9		12/10	33/27
CEDAR WAXWING . .	619								
LOGGERHEAD SHRIKE.	622	1/1	16/9	25/9	3/3	9/7		45/22	54/29
STARLING.	493	9/3	18/1		9/1	12/2		36/5	48/7
RED-EYED VIREO . . .	624								
WARBLING VIREO. . .	627		1/1					1/1	1/1
YELLOW WARBLER . .	652			3/3	3/3			6/6	6/6
COM. YELLOWTHROAT	681	2/2		3/3	8/5	3/2		13/7	16/9
YELLOW-BR. CHAT. .	683			3/2	11/6			14/8	14/8
AM. REDSTART. . . .	687								
HOUSE SPARROW . . .	6882	22/8	2/1	3/2	57/4	3/1		84/15	89/16
BOBOLINK.	494	2/1						2/1	2/1
W. MEADOWLARK . .	5011	10/46	16/46	16/46	24/42	48/47		556/280	724/327
YEL-HD. BLACKBIRD.	497					3/1			3/1
RED-WG. BLACKBIRD.	498	34/21	5/5	18/14	71/12	13/7		128/52	141/59
ORCHARD ORIOLE . .	506					1/1			1/1
BALTIMORE ORIOLE .	507								
BULLOCK'S ORIOLE . .	508	1/1				1/1		1/1	2/2
BREWER'S BLACKBIRD.	510	1/1	21/8	8/3	24/7	59/7		54/19	113/34
COMMON GRACKLE .	511				3/1			3/1	3/1
BROWN-HD. COWBIRD	495	2/2	5/3	7/5	7/4	7/3		21/14	38/17
ROSE-BR. GROSBEAK .	595								
BLACK-HD. GROSBEAK	596								
BLUE GROSBEAK . . .	597								
INDIGO BUNTING . .	598								
LAZULI BUNTING . .	599				5/4			5/4	5/4
DICKCISSEL.	604								
AM. GOLDFINCH. . .	529			12/4	19/2			31/16	31/16
RUFOUS-SIDE TOWHEE	587			5/5	24/14	6/5		29/19	35/24
LARK BUNTING. . . .	605	2/2	20/9	5/5		6/4		27/16	33/20
SAVANNAH SPARROW	542	2/2				1/1		2/2	3/3
GRASSHOPPER SPARROW	546	15/14	6/5	8/5	1/1	34/18		30/25	66/43
BAIRD'S SPARROW. . .	545	27/23	5/5	2/2		28/18		34/30	62/48
VESPER SPARROW . . .	540	4/3	24/9	38/22	22/14	17/14		86/58	105/72
LARK SPARROW	552		21/16	3/3	13/9	3/3		34/28	37/31
CHIPPING SPARROW. .	560								
CLAY-COL. SPARROW	561	3/3		1/1	11/8			15/12	15/12
BREWER'S SPARROW. .	562		36/9	9/10		4/1		57/29	61/30
FIELD SPARROW. . . .	563			13/10	32/24			45/34	45/34
SWAMP SPARROW. . .	584								
SONG SPARROW. . . .	581								
MCCOWN'S LONGSPUR	539	16/10						16/10	16/10
CH-COL. LONGSPUR .	538	103/55	6/4			4/21		109/59	159/80
Golden Eagle . . .	—			2/1		1/1		2/1	3/2
. . . . .	—								
. . . . .	—								
. . . . .	—								
. . . . .	—								

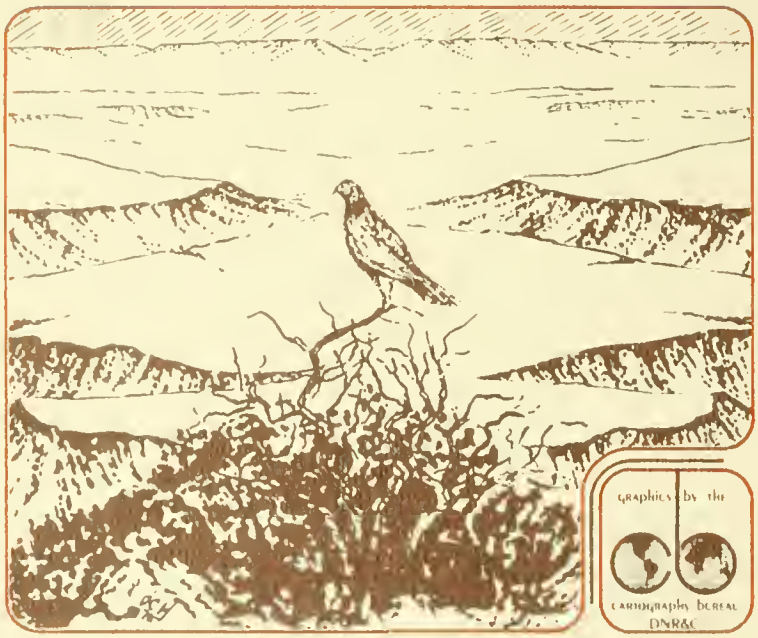
Form 3-6 (1975)

MONTANA

DEPARTMENT OF NATURAL RESOURCES

& CONSERVATION

Helena, Montana



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