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Paul B. Kannowski, *Editor*
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TABLE OF CONTENTS

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THE COVER AND ITS ARTIST

The cover drawing of a great horned owl and her chick was created specially for this volume of *The Prairie Naturalist* by Dr. Glinda Crawford of Grand Forks. An assistant professor in the Department of Home Economics and Nutrition at the University of North Dakota, Glinda has made pen and ink sketches for use in fund-raising projects for the North Dakota Wildlife Federation, the North Dakota chapter of The Wildlife Society, and most recently, for the University of North Dakota Fisheries and Wildlife Biology Club as a benefit for the purchase of the Cross Ranch. Her drawing of a ferruginous hawk graced the cover of the issues of Volume 7.

Prairie Nat. 15(4), 1983, pp. 145-154

Aspects of the Nesting Ecology of Least Terns and Piping Plovers in Central Nebraska

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Breeding habitat of the least tern is made up primarily of coastal beaches and inland river sandbars. Populations of the interior (*Sterna antillarum athalassos*) and east coast (*S. a. antillarum*) subspecies are now declining (Marshall et al. 1975, Duffy 1977, Jernigan et al. 1978) and the western subspecies (*S. a. browni*) is endangered (Wilbur 1974). Although coastal populations have received considerable attention (Wolk 1974, Atwood et al. 1977, Blodgett 1978), little research has been conducted on the interior race (Hardy 1957, Downing 1975).

The piping plover inhabits river sandbars and sand beaches and, like the least tern, breeding populations are declining (Arbib 1975, 1978, Niemi et al. 1977). Of the two races, little is known about the interior population (*Charadrius melodus circumcinatus*) (Pickwell 1925, Renaud 1974, Niemi and Davis 1979).

In Nebraska, the Platte River has historically supported breeding populations of least tern and piping plover (Bent 1929), and both species are found where sandbars are present (Downing 1975). Changes in adjacent land use including increased use of center pivot irrigation systems, and in the water regime of the Platte River, have resulted in reduced availability and quality of sandbar breeding habitat. This is primarily the result of reduced water levels and the subsequent encroachment of woody vegetation within the river channels (Currier 1982). Williams' (1978) study of Platte River channel shrinkage described changes that have occurred in peak discharges, annual flow, channel width, and bed elevations between 1865-1978. Current annual flows are about 69% reduced from pristine times (Krapu et al. 1982).

The objectives of this study were to: 1) determine the distribution and abundance of least tern and piping plover using the Platte River in central Nebraska, 2) quantify selected parameters associated with their nesting habitat, 3) evaluate the impact of changing land use on tern and plover nesting habitat, and 4) suggest management alternatives for least tern and piping plover breeding habitat.

STUDY AREA AND METHODS

The primary study area encompassed reaches of the Platte River between Grand Island, Hall County, and Lexington, Dawson County, a distance of about 150 km (Fig. 1).

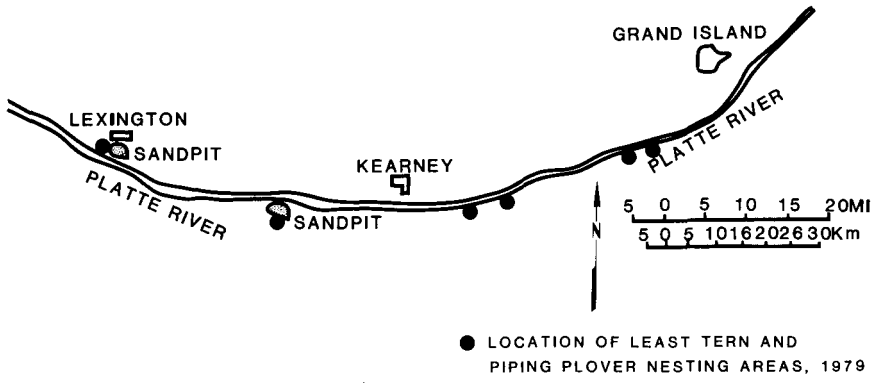

Fig. 1 The Platte River from Lexington to Grand Island, Nebraska, showing colony locations.

Although several channels are present, only the main channel provided habitat suitable for breeding least tern and piping plover. The channels are characterized by numerous islands and sandbars that divert the water flow into many smaller channels. Vegetation associated with the sandbars and adjacent areas is characterized in Currier (1982).

Based on a preliminary 1978 study, and after reviewing aerial photographs (scale = 1:5,000), reaches of river with apparently suitable sandbar habitat were identified for later field study. During 1979, sandbars within about 84 km of river channels were surveyed for tern and plover nests. Nest searches were initiated on 19 May and continued through 26 June.

Each nest was marked with colored surveying tape attached to a metal stake. The location of each nest was marked on reduced 7.5′ U.S. Geological Survey topographic maps.

The following observations or measurements were made at each nest site: length of sandbar (if ≥200 m, then estimated), sandbar width, height of nest above water line, distance of nest to nearest river channel, river channel width, maximum channel depth, distance from nest to nearest vegetation and vegetation type(s), depth to water-saturated soil below nest, length, width, and depth of nest, distance to nearest conspecific nest, percent woody and herbaceous vegetation on sandbar, and percent bare ground, distance from nest to nearest river bank, and type of on-shore vegetation.

Nest elevations were plotted with a transit, and inter-nest distances were individually measured. Square meter quadrats (Phillips 1959) were centered over each nest to quantify percent cover and vegetative composition. Changes in daily river flows were monitored at U.S. Geological Survey gauging stations at Overton and Grand Island, Nebraska.

Each nest was visited 5-7 times during the study period. During each visit, nest contents (eggs or nest materials) were noted. Supplemental nesting phenology and population data were collected on nearby sandpits adjacent to the river.

RESULTS AND DISCUSSION

Phenology, Distribution and Population

Least tern and piping plover were first observed in the study area on 11 May. Arrival dates range from 24 April to 25 May at Lexington, Nebraska, for least tern (Wycoff 1960) and 7 April to 4 May for piping plover (Bent 1929, Tout 1947). Courtship activities began shortly after arrival and nest initiation occurred during 15 May - 21 June for both species.

Four nesting groups were located on the river and two at adjacent sandpits (Fig. 1). The number of nesting pairs at each site is listed in Table 1. One site supported 16 piping plover and 14 least tern nests.

Table 1. Nesting sites and minimum breeding populations along the Platte River during June 1979.

	Number of breeding pairs	
Sites	Least tern	Piping plover
1	0	8
2	0	8
3	14	16
4	3	8
Total	17	40

Least terns typically nest in groups of fewer than 50 pairs and a colony of 30 pairs is probably large for *S. a. athalassos*. Little information exists on piping plover group size, but 16 pairs may represent a substantial number (Wilcox 1959). The use of sandpits and dredge spoil sites by terns is well known (Downing 1975, Jernigan et al. 1978), and both sandpit sites in this study have histories of past use (C. R. Frith, pers. comm.)

Reproduction

The first nest initiation by piping plover and least tern was observed 15 and 21 May, respectively. Young plovers first hatched on 8 June, and terns on 14 June. The incubation period for piping plovers was estimated at 24 days. Wilcox (1959) reported that the mean incubation period among piping plovers on Long Island, New York, was 28 days. Incubation period in the least tern was 19 days which is similar to that reported by Hagar (1937) for Massachusetts, and 17 or 18 days reported by Moser (1940) at Omaha, Nebraska. Mean clutch size among 25 piping plover and 11 tern nests was 4.0 and 2.9. Two young least terns were

successfully hatched from one nest on 14 June, and 13 piping plovers hatched from five nests ($\bar{x}$ = 2.6) during 8-19 June.

All nests, both hatched and active, were submerged by rising water on 21 June. Hardy (1957) suggested that the beginning of nesting by least terns on river systems was directly related to the cessation of spring floods. Prairie streams are frequently subjected to flash floods during the summer months. In 1979, normal late spring fluctuations in river stage were greatly altered because of a heavy, late snowmelt in the Rocky Mountains coupled with very heavy rainfall in western and central Nebraska during 10-20 June.

We monitored river stages throughout the nesting period. Low flow was from 6-9 June, peak discharge was 28-30 June (Fig. 2). Only two nests were lost to rising water prior to 16 June, but by 21 June only one area was not flooded.

The river remained high through mid-July. During this period, we attempted to locate additional plover nests on the Platte River. Portions of the Loup River system, 50 km north of the study area in Howard County, Nebraska were also searched and 10 least tern nests were found. The complete inundation of sandbar habitats combined with the stage at which the first nests were lost, obviously discouraged renesting on both river systems.

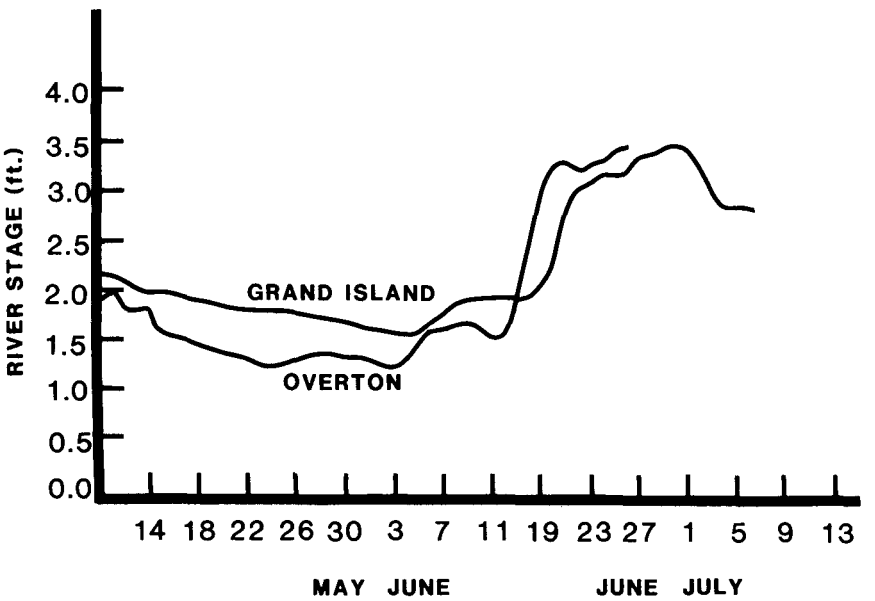

Fig. 2 Flow stages of the Platte River at Overton and Grand Island, Nebraska, May-July 1979.

Nest Colony Characteristics

Terns placed 17 nests at two locations, and 40 plover nests were located at four locations. The high percentage of bare ground (Table 2) in the vicinity of nest sites is comparable with that found in other regions (Jernigan et al. 1978, Niemi and Davis 1979). Ducey (1981) reported that 5-10% of the area of sandbars used by nesting least terns and piping plovers on the lower Platte River had been invaded by cottonwood saplings.

Normal vegetational succession created some problems interpreting the impact of vegetative growth on nest site selection. When early arrivals began selecting nest sites the sandbars were virtually bare. By mid-June, nesting cover had changed from the date of nest initiation. Thus, later nesting birds were required to choose and evaluate habitat that was much different from that found earlier.

Table 2. Mean values for physical characteristics of sandbars used for nesting and some nest characteristics. Number of samples in parentheses.

	Least tern	Piping plover
Sandbar characteristics		
Distance to nearest riverbank (m)	104 (5)	161.9 (28)
Sandbar length (m)	259 (5)	285.9 (28)
Width at nest (m)	58.9 (17)	55.4 (39)
% woody vegetation	9.6 (5)	7.3 (28)
% herbaceous vegetation	18.4 (5)	18.1 (28)
% bare ground	72.05 (5)	74.6 (28)
Nest characteristics		
Height above river stage (cm)	33.0 (9)	19.6 (14)
Depth to moisture (cm)	2.6 (17)	1.0 (39)
Distance to nearest river channel (m)	18.9 (17)	16.4 (39)
Depth of nearest river channel (cm)	30.8 (17)	26.0 (39)
Width of nearest river channel (m)	19.5 (17)	14.1 (39)
Diameter (cm)	1.2 (23)	1.1 (41)
Depth (cm)	0.3 (23)	0.2 (41)

Nest Characteristics

Nest height above river stage (Table 2) differed markedly between terns and plovers. The nonparametric Wilcoxon two-sample test for unpaired, ranked data (Sokal and Rohlf 1969) indicated that this difference in nest height was significant ($P = 0.1$). The greater mean depth to moisture also suggested that terns preferred higher and drier habitat. On one sandbar in the Middle Loup River, the mean height of 10 nests was 68.0 cm. Ducey (1981) reported that piping plovers occupied nest sites on the lower Platte River that were closer in elevation to the water level of the river.

Vegetation Characteristics

Three characteristics were chosen to evaluate vegetation surrounding the nest site, i.e., frequency of occurrence by class, percent plant cover by class (Table 3), and density of woody vegetation by species (Table 4). Values for these parameters suggest that piping plovers tolerate sites with more vegetation surrounding them than do terns. I tested whether the distribution of total woody stems within quadrats was the same for both species. Repeating the Wilcoxon two-sample test procedure resulted in rejection of equality ($P = 0.001$). The woody stem densities averaged greater for least terns primarily because one quadrat had extremely high stem densities (Table 4). This pair may have been forced to nest in marginal habitat because of competition for more favorable sites. Excluding changes in vegetative cover that occurred after nest initiation, both plovers and terns appeared to select nest sites that were barren of vegetation.

Table 3. Vegetative characteristics of habitat surrounding least tern and piping plover nests expressed as percent cover by class ($\bar{x}$ total percent/total quadrats) and frequency of occurrence by class (number quadrats containing a character/total number of quadrats).

	Least tern (n = 17)		Piping plover (n = 37)	
Characteristic	% cover	Frequency	% cover	Frequency
Bare ground	89.1	-	79.4	-
Grass	3.4	0.47	4.4	0.62
Sedge/rush	0.6	0.41	1.2	0.32
Forb	4.1	0.47	9.4	0.73
Shrub	2.3	0.29	5.4	0.55

Substrate Characteristics

Although substrate characteristics were not quantified, piping plovers appeared to select sand of larger grain size for nesting than that chosen by terns. For example, at nesting area 3 the sandbar with the highest combined nest density consisted of two parts: a raised area in the center of the sandbar made up of fine sand, and a surrounding plain of coarser particles. Only least terns nested on the raised area, while piping plovers nested within 1 m of the plain. Most research has shown that least terns nest on substrates of large particle size (Massey 1971, Fisk 1978, Jernigan et al. 1978), but Platte River least terns may be an exception.

MANAGEMENT IMPLICATIONS

The least tern population along the Central Platte River appears to be in danger of further decline. Unless steps are taken to alleviate the continued reduction of open sandbar habitat, this population may be eliminated. Changing

Table 4. Density of woody vegetation by species for quadrats with woody vegetation, and for all quadrats (number stems species A/total number quadrats).

	Least tern		Piping plover	
	Woody vegetation (n = 5)	All quadrats (n = 17)	Woody vegetation (n = 21)	All quadrats (n = 37)
Cottonwood (*Populus deltoides*)	2.2	0.64	2.38	1.35
Plate-leaf willow (*Salix nigra*)	2.2	0.64	2.19	1.24
Interior willow (*S. interior*)	3.0	0.88	0.52	0.29
All woody vegetation	7.4	2.17	5.09	2.89

habitat conditions occurring along the Platte River are not isolated examples and management suggestions may be applicable to other interior populations.

My data suggest that clear visibility such as found along wide stretches of river is an essential habitat component. Williams (1978) demonstrated that reduced peak and annual flow in the Platte River encouraged woody vegetation encroachment on riverbanks and sandbars and reduced overall channel width. Clearing existing colonies of encroaching vegetation has been used successfully by Atwood et al. (1977) in California. Vegetation clearing during the non-nesting season coupled with increased water flows during spring floods can greatly reduce encroachment and sprouting of young vegetation. If encroachment of woody vegetation continues along the Platte River, this alternative must be examined more vigorously.

Most nesting least terns foraged in river channels within 100 m of the nest sites. A continuous water flow that serves as a mammalian predator barrier and supplies a stable source of food items is probably essential. Increased irrigation for crop prodution in upstream reaches of the Platte River has confounded the problem of vegetation encroachment. Continuous flows during the nesting season are also important in reducing human disturbance. During 1978, numerous instances were observed of all-terrain vehicles travelling up channels containing low water. Ducey (1981) attributed abandonment of three least tern nests on the lower Platte River to disturbance that included wading in the river, hiking on sandbars, and limited vehicular disturbance. However, piping plovers at the same location successfully reared young despite these disturbances.

Sufficient height of spring peak flows is required to provide deposition of adequate sandbar sediment (Firth 1974). The appearance of tall, flat sandbars on the neighboring Loup River system (which is not used extensively for irrigation water withdrawal) suggested that excessive water withdrawals and subsequent reduced annual flows in the Platte River have impeded the deposition of sediments on potential sandbars. Swickard (1972) has shown that creation of new nesting habitat by manual deposition of clean sand at existing colonies is beneficial. If the progressive deterioration of sandbar habitat continues because of inadequate flows during critical periods, this alternative may have to be considered.

Least terns demonstrate an ability to partially cope with some of these problems. They will renest after flooding (Wycoff 1960) and may tolerate some vegetation around the nest at coastal locations (Jackson 1976). Terns also nest at alternative sites (Fisk 1978) and are somewhat tolerant of human disturbance (Blodgett 1978). Their behavior and longevity may allow a population to rebound if conditions are improved (Tomkins 1959).

Piping plovers are not as restrictive in their habitat requirements as least terns. Vegetation encroachment is apparently tolerated to a greater extent; they will nest on lower sandbars, and will nest singly. The greater adaptability of plovers is reflected in their wider distribution in the Platte River Valley and by their larger population. However, plovers are similar enough to terns in habitat use that they can be affected by the same problems. Until more information is gathered on the habitat requirements of other inland populations, and until habitat management can be initiated, little can be done to prevent further decline

in quality and quantity of habitat, and population decline of least terns and piping plovers.

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Prairie Nat. 15(4), 1983, pp. 155-156

Lead Shot Incidence in Sandhill Cranes Collected from Alaska, Canada, and Texas

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Although lead poisoning has been well documented in waterfowl (Bellrose 1959), relatively little information exists on ingested lead shot in other birds. Stendell et al. (1980) reported an overall ingested lead shot incidence of 7.4% in sora rails (*Porzana carolina*) from Maryland. Locke and Bagley (1967) found ingested lead shot in four of 62 hunter-killed mourning doves (*Zenaida macroura*) collected from Maryland. Hunter and Rosen (1965) reported a case of lead poisoning in a ring-necked pheasant (*Phasianus colchicus*) found dead in California. Campbell (1950) found 13 lead pellets in a scaled quail (*Callipepla squamata*) found dead on a state game refuge in New Mexico. Westemeier (1966) found four ingested lead pellets in a bobwhite (*Colinus virginianus*) that apparently had died of lead poisoning.

No data have been published on lead shot ingestion in sandhill cranes (*Grus canadensis*). Sandhill cranes are hunted legally in nine states and in parts of Canada and Mexico, primarily in an attempt to reduce cereal crop depredations by migrating flocks (Buller 1979). Texas authorized hunting of sandhill cranes in West Texas and the Texas panhandle in 1961, and plans to extend the hunting zone to include the southern portions of the state in 1984 (Ron George, Texas Parks and Wildlife Department, personal communication). Thus, the potential exists for sandhill cranes to ingest lead shot in a number of areas along their migratory routes. The objective of our study was to determine the incidence of ingested lead shot in sandhill cranes collected from Alaska, Canada, and two areas in Texas.

METHODS

Gizzards ($\underline{N}$ = 125) examined in this study were obtained from sandhill cranes sacrificed with rifles and shotguns for a genetics study (Gaines 1983). Ten cranes were collected near Delta Junction, Alaska, in May and September 1982. Twelve cranes were collected from Kutawagen Lake in Saskatchewan, Canada, in June 1982. Seventy-five cranes were collected near Bull Lake in the Texas panhandle in October, November, and December 1982. Twenty-eight cranes were collected on the Attwater Prairie Chicken National Wildlife Refuge in southern Texas in December 1982 and January 1983. Gizzard contents were removed at necropsy, placed in individually labeled plastic bags, and frozen until analysis. Lead shot was separated from other gizzard contents by means of a hydraulic separator as described by Brewer (1981). Contents from every fifth gizzard were examined under a dissecting microscope to determine if any lead

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shot were missed in the analysis; none was missed. Ingested lead shot was distinguished from "shot-in" lead pellets as described by Bellrose (1959).

RESULTS AND DISCUSSION

In the analysis of 125 sandhill crane gizzards, we observed one ingested lead pellet, or an incidence of only 0.8%. The sole ingested lead pellet observed was obtained from a crane collected near Bull Lake in the Texas panhandle. Thus, ingestion of lead shot by sandhill cranes appears to be an insignificant problem.

The very low incidence of ingested lead shot in sandhill cranes can be attributed to two factors. First, even though this species is hunted over a wide geographical area, it generally has received relatively low hunting pressure (Lewis 1977). Second, sandhill cranes generally feed over a widely dispersed area, covering numerous separate grain fields. As a result, their feeding activity is not concentrated in a few areas where they would be more exposed to spent lead shot, as is the case for waterfowl. In addition, these fields are plowed annually, which significantly reduces the availability of lead shot (Fredrickson et al. 1977).

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Prairie Nat. 15(4), 1983, pp. 157-158

Lead Shot Incidence in Waterfowl Collected from the Texas High Plains

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Bellrose (1959) studied the incidence of ingested lead shot in North American waterfowl and found the Central Flyway to have the lowest average incidence (3.1%); the Mississippi Flyway had the highest incidence (8.7%). He listed Texas as the state within the Central Flyway having the highest incidence (10.7%) of ingested lead shot in mallards (*Anas platyrhynchos*). Further studies by the Texas Parks and Wildlife Department (TP&WD) have shown that 16.7% of the mallards along the Texas Coast had ingested lead shot (TP&WD 1983). Our study was conducted to determine the incidence of ingested lead shot in mallards and American green-winged teal (*Anas crecca*) on the Texas High Plains, which receives little hunting pressure.

The Southern High Plains of Texas contains 17,000-18,000 playa lakes (Bolen and Guthery 1982) which, together with abundant waste grains, attract winter populations of waterfowl that exceed 1 million, and may reach 2 million in favorable years (Curtis and Beierman 1980). Playa lakes of the region are round or oval basins composed of Randall clay soils interspersed among loamy and sandy loam soils (Bolen and Guthery 1982). Because of the large populations of wintering waterfowl and low hunting pressure, the High Plains Mallard Management Unit was formed (Funk et al. 1971) to provide a longer hunting season and more liberal bag limits than other areas of Texas.

METHODS

Gizzards from 379 green-winged teal collected by Baldassarre (1982) and 546 mallards collected by Whyte (1983) between November 1979 and January 1982, near Hart in Castro County, Texas, were analyzed in our study. Gizzard contents were placed in individual glass jars and frozen until analysis. Lead shot was separated from other gizzard contents using a hydraulic separator as described by Brewer (1981). Contents from every fifth gizzard were examined under a dissecting microscope to determine if any lead shot were being missed in the analysis; none was missed. Ingested shot was distinguished from "shot-in" pellets as described by Bellrose (1959). Because of a technician's error, species were not analyzed separately. Therefore, we cannot present species-specific differences in ingested lead shot occurrence.

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RESULTS AND DISCUSSION

Of 925 birds collected, nine contained ingested lead shot. Thus, we observed a total ingested lead shot incidence of 0.97%, which is much less than the 9% reported for all waterfowl species along the Texas coast (TP&WD 1983).

Therefore, the problem of ingested lead shot contamination seems to be less significant in this region of Texas than in other areas of the Central Flyway or in other flyways. The incidence of ingested lead shot for the combined species was very low (less than 1%), which suggests that the incidence for either species was lower than normally found (Bellrose 1959). The low incidence of ingested lead shot in our study may be attributed to the high rates of siltation characteristic of playa lakes in our study area, and possibly to the low hunting pressure within the area.

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Small Mammals of Winter Wheat and Grain Sorghum Croplands in West-Central Kansas

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Agricultural practices result in the destruction and alteration of natural habitats and the establishment of unstable monocultures. The need for research on the ecological effects of croplands on native flora and fauna of North America is an old concept (Hanson 1939), and long overdue, especially in areas already under extensive cultivation (Bowles 1981).

Few studies have been designed to evaluate the effects of agriculture on populations of small mammals (Linduska 1950, Jefferies et al. 1973). Rather, most studies have dealt with the effect of populations of small mammals on crops, particularly in European countries (e.g., Southern and Laurie 1946, Pollard and Relton 1970, Sutova 1970, Jefferies et al. 1973, Zejda 1975, Mann 1976, Sood and Dilber 1977, Wegner and Merriam 1979), or have been concerned with animal damage control (Lantz 1906, 1907, 1918; Sutova 1970; Mann 1976) or biological inventory (Johnson 1926, Whitaker 1967a, Sood and Dilber 1977) or have pertained to agrarian ecology in only one season (Linduska 1942, LoBue and Darnell 1959).

This study was conducted to reveal effects of dry-land farming on populations of small mammals. The specific objectives were to determine: 1) which species of small mammals utilize croplands during the year, 2) the basic ecological characteristics of such populations, and 3) the factors that might be important in regulating populations of small mammals in croplands, including farming practices.

STUDY SITES

The study was conducted in Ellis County, in west-central Kansas. the county encompasses 230,675 ha, of which 117,378 ha were under cultivation and 109,111 ha were pasture and rangeland in 1981. Of the cultivated land, approximately 57,000 ha were planted to winter wheat and 10,500 ha were planted to grain sorghum (Virgil Quint, Agricultural Stabilization and Conservation Service, pers. comm.).

Trapping was conducted on a dry-land farming rotation of winter wheat to grain sorghum to summer fallow. In western Kansas, winter wheat is planted typically in September, and before winter reaches a height of approximately 10 cm. It is dormant until spring, then grows quickly, matures, and is harvested

in late June or early July, depending on local weather conditions. Several subtillage operations of the fallow fields to control weeds are used during the summer and early autumn. No additional cultivation is done until spring, when the field is prepared for planting of grain sorghum in late spring or early summer (typically mid-June). The grain sorghum is harvested in late autumn, and the stubble field remains fallow until the following autumn, when it is planted again to winter wheat. It is sometimes necessary to spray one or both crops with insecticides and herbicides.

Small mammals were trapped from three areas — an undisturbed grassland described by Hulett et al. (1972) and referred to as the relict area, a wheat field, and a grain sorghum field. The wheat field was located on the Fort Hays State University Farm, ¾ miles south and 2 miles west of Hays (T14S, R18W, N ¼ sec. 6), and consisted of 38 ha. The grain sorghum field was ¼ mile north of Yocemento (T13S, R19W, NW ¼ sec. 22), and consisted of 32 ha.

During the study the wheat field progressed from newly planted winter wheat through harvest to wheat stubble. The stubble was grazed by seven head of cattle from October 1981 through January 1982. The grain sorghum field progressed from stubble through the planting of winter wheat. The relict grassland habitat (T14S, R19W, SE ¼ sec. 1) was trapped by S. Valek and data obtained compared to those from the croplands.

The grain sorghum field was bordered on the west and north by narrow roadside ditches, on the east by a fencerow and a grazed pasture, and on the south by riparian habitat. The wheat field was bordered on the south by a roadside ditch, on the west and north by a fencerow and a grazed pasture, and on the east by a fallow grain sorghum field. The roadside ditch adjacent to the grain sorghum field was less heavily vegetated than the ditch adjacent to the wheat field. Because cropfields were asymmetrical, traplines were closer to the field border in some places than in others. The wheat field trapline was more than 300 m from the border at both ends (west and east) of the trapline, about 100 m from the edge of the fallow field to the southeast and ranged from 125 m to 531 m from the north and south borders. The grain sorghum field trapline was approximately 175 m from the west end, 100 m from the east end, and ranged from approximately 200 m to 350 m from the north and south borders.

MATERIALS AND METHODS

Trapping was conducted in the wheat field on 4-7 November 1980, 5-8 February, 3-4 April, 1-4 May, 5-8 June, 6-9 July, 31 July-3 August, 10-13 September 1981, and 30 January-2 February 1982, for a total of nine sampling periods and 2882 trapnights. The grain sorghum field was trapped on 13-16 March, 8-11 June, 11-14 July, 31 July-3 August, 10-13 September, 6-9 December 1981, and 27-30 January 1982, for a total of seven sampling periods and 2520 trapnights. All trapping was during or within a week of the new phase of the moon. Trapping in the relict site resulted in 1800 trapnights.

Sherman live traps (7.6 by 8.9 by 22.9 cm) were baited with a peanut butter, sunflower seeds, and oatmeal mixture, as described by Stout and Sonen-

shine (1973). Traps were set un-opened and un-baited the first night, then were opened, baited, and run three consecutive days and nights.

Traplines in the croplands consisted of 40 stations at 15 m intervals, with three traps per station, for a total of 120 traps per field. In the wheat field the initial two trapping periods consisted of only 20 stations, but this was later increased to 40 for more effective sampling. S. Valek's trapline in the relict area consisted of 20 stations, and was of the same design as the other traplines. All animals were toe-clipped, weighed, and released after the station number, sex, reproductive condition, and presence or absence of molt were recorded. Reproductive data consisted of position of testes (scrotal or not) for males, and condition of the mammary glands (small, enlarged, lactating) and the condition of the pubic symphysis (open/closed) for females. Traps were checked shortly after sunrise and about one hour after sunset.

Diversity values were calculated using the standard Shannon-Wiener Index— $H' = N\log N - \leq n_i \log n_i/N$ (Shannon and Weaver 1949), and the resulting H' values were used to calculate evenness, $J' = H'/J\ max'$. Relative densities represent the number caught per 1000 trapnights and were used to indicate trends in the sizes of populations. Species richness was recorded as the number of species captured at a given site. A Chi-square goodness of fit test was used for some population analyses and to test effects of field disruptions. A two-tailed Mann-Whitney U test was used to test differences between habitats based on diversity. The Kruskal-Wallis test was used to compare differences among all habitats sampled. A significant level of 0.05 was used for all statistical tests.

RESULTS

Eleven species of small mammals were captured in the three areas sampled (Table 1). Relative densities of the more common species in the three areas sampled are shown in Table 2. In the wheat field the relative density of *Peromyscus maniculatus* (deer mice) ranged from a low of 17 in February to a high of 197 per 1000 trapnights three months later; all other species were poorly represented in the wheat field throughout the study period. In addition to deer mice, the only apparent patterns of occurrence were those of *Spermophilus tridecemlineatus* (13-lined ground squirrel) and *Mus musculus* (house mouse). The 13-lined ground squirrel initially was captured after harvest in July but not after subtillage of the field in August, while house mice were taken only in May, June, and July.

Relative densities of small mammals recorded in the grain sorghum field generally were the lowest among the areas studied (Table 2). The most abundant species of small mammal was the deer mouse, ranging from a high of 50 per 1000 trapnights in July to no captures during December. House mice, *Perognathus hispidus* (hispid pocket mouse), and *Onychomys leucogaster* (northern grasshopper mouse) were common but not abundant in the grain sorghum.

The relict area exhibited the greatest relative densities (Table 2). The most abundant species was *Reithrodontomys megalotis* (western harvest mouse), which had high relative densities throughout most of the year, ranging from 233 per 1000 trapnights in December to 22 per 1000 in September. Western harvest

Table 1. The number of males, females, and total of each species caught at the new wheat (2882 trapnights), grain sorghum (2520 trapnights), and relict (1800 trapnights) sites.

SPECIES	NEW WHEAT		TOTAL	GRAIN SORGHUM		TOTAL	RELICT		TOTAL
Peromyscus maniculatus	90	67	157	24	23	47	43	37	80
Reithrodontomys megalotis	1	2	3	0	3	3	50	55	105
Sigmodon hispidus	1	0	1	-	-	-	33	24	57
Perognathus hispidus	2	4	6	7	2	9	5	4	9
Onychomys leucogaster	1	1	2	4	1	5	-	-	-
Spermophilus tridecemlineatus	1	1	2	-	-	-	3	2	5
Mus musculus	1	4	5	11	5	16	1	0	1
Microtus ochrogaster	1	0	1	-	-	-	9	11	20
Reithrodontomys montanus	1	0	1	1	0	1	-	-	-
Peromyscus leucopus	1	0	1	0	1	1	1	0	1
Blarina hylophaga	-	-	-	-	-	-	1	5	6
TOTALS	100	79	179	47	35	82	146	138	284

Table 2. Relative densities (#/1000 trapnights) of the common species captured during each trapping session in the wheat (w), grain sorghum (g), and relict (r) sites. A dash indicates no trapping at the site for the month.

	P. maniculatus			*P. hispidus*			*M. musculus*			*R. megalotis*			*S. hispidus*			*M. orchrogaster*		
	w	g	r	w	g	r	w	g	r	w	g	r	w	g	r	w	g	r
1980 Nov.	44	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-
Dec.	-	-	150	-	-	0	-	-	0	-	-	67	-	-	0	-	-	6
1981 Feb.	17	-	68	0	-	0	0	-	0	0	-	111	0	-	5	2	-	6
Mar.	-	42	-	-	0	-	-	19	-	-	8	-	-	0	-	-	0	-
Apr.	133	-	33	0	-	6	0	-	0	5	-	128	0	-	0	0	-	28
May	197	-	61	8	-	0	5	-	0	2	-	133	0	-	5	0	-	6
June	55	25	83	0	5	0	5	5	0	0	0	139	0	0	22	0	0	17
July	41	50	39	0	17	17	2	5	6	0	0	83	0	0	11	0	0	0
Aug.	69	19	122	2	11	17	0	17	0	0	0	139	2	0	61	0	0	0
Sep.	56	5	61	5	0	28	0	0	0	0	0	22	0	0	78	0	0	0
Nov.	-	-	33	-	-	0	-	-	0	-	-	44	-	-	94	-	-	6
Dec.	-	0	89	-	0	0	-	0	0	-	0	233	-	0	127	-	0	22
1982 Jan.	86	3	-	0	0	-	0	0	-	2	0	-	0	0	-	0	0	-

mice were not abundant in any other study area. Although the relative density of deer mice fluctuated throughout the year, it was common and abundant, ranging from a low of 33 per 1000 trapnights during April and November of 1981 to a peak of 150 per 1000 trapnights in December of 1980. Peak relative densities of deer mice at this site occurred during the winters and in August, whereas lowest abundance occurred in spring. The population of *Sigmodon hispidus* (cotton rats) increased throughout summer to a peak of 127 per 1000 trapnights in December 1981.

The deer mouse was the only species trapped in sufficient numbers to permit detailed analysis. In the wheat field the population of deer mice experienced rapid growth during spring when the wheat also was growing rapidly, and apparently crashed prior to harvest in late June (Fig. 1). Thereafter, the population stabilized and increased slightly throughout summer and autumn. Changes in relative density and vegetational structure of the wheat field are shown in Fig. 1.

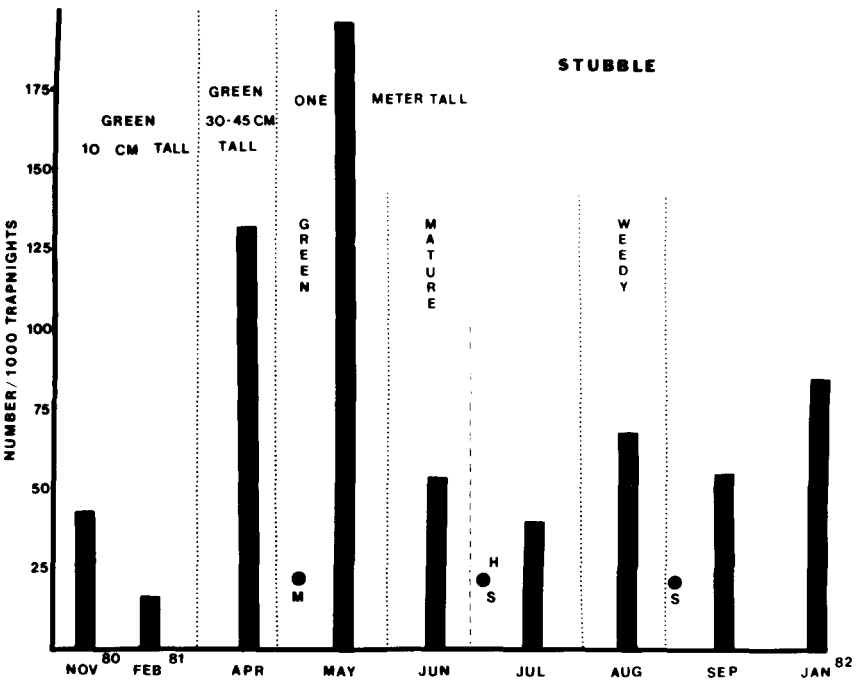

Figure 1. Relative density of *P. maniculatus* and changes in the wheat field structure and farming operations. The 6 axis represents the number caught/1000 trapnights. Circles indicate approximate time of farming operations. M = Malathion spraying, H = harvest, S = sub-tillage.

Three disruptions occurred in the wheat field during the study period (Fig. 1). An insecticide (Malathion) was sprayed at the rate of 1 lb/acre in late April

of 1981. Significantly more individuals of deer mice were caught after the field was sprayed ($P < 0.05$), thereby indicating that there was no immediate negative effect on the population. During late June the wheat was harvested and followed within a week by sub-tillage. The stubble was sub-tilled again in late August to reduce weeds. In both instances there was no significant difference in the number of deer mice caught before and approximately a week after the disruption ($P > 0.05$).

There was no significant difference overall ($P > 0.05$) between numbers of males and females captured in the wheat field, although more males ($P < 0.05$) than females were captured in November of 1980 and in September of 1981; only males were captured in November, when the wheat was dormant. Deer mice were not using the wheat field exclusively from nearby borders of the field as chi-square analysis revealed no significant difference ($P > 0.05$) between captures of mice from portions of the trapline closest to and farthest from the edge of the field.

In the wheat field deer mice were found in breeding condition in every period except winter, although the presence of juveniles in February of 1981 indicates that breeding activity occurred during mid-winter of 1980-81 (Table 3). The highest percentage of females in breeding condition were recorded in spring and again in autumn, whereas males in breeding condition peaked in late summer. The presence of juvenile deer mice in the wheat field also suggests breeding throughout most of the year (Table 3).

Population turnover was expressed as the percentage of new individuals caught in each trapping session. The average monthly turnover for the deer mouse was 48.7%, with averages of 44.4% for males and 44.8% for females. Because of the increased population during spring, turnover percentages were high (Table 3). In July, immediately after harvest of the wheat, the percentage of new males was only 10%, whereas that of females was 67% (Table 3). In June, after the population crash, turnover of both sexes was lowest. The high percentage of new mice caught in January of 1982 was probably a reflection of the longer period of time between the last two trapping sessions.

Mice trapped in the grain sorghum were less numerous (Table 2); therefore, analysis of population parameters was limited. Population turnover was high for all species of small mammals found in the grain sorghum field. This was especially true of females, which had nearly 100% turnover in all species during the study period. Female deer mice exhibited a 100% turnover in June, July, and September, and a 67% turnover in August. No females were captured during December and January, after the field was planted to new winter wheat. Male deer mice exhibited turnovers of 80% in June, 90% in July, 50% in August, 100% during September and January, and were not captured during December. The house mouse had 100% turnover in every trapping session in which they were captured, whereas the hispid pocket mouse exhibited turnovers of 100%, 67%, and 75% during June, July, and August, respectively. The high turnover rate of all species in the grain sorghum suggests that either the type of farming practices used for grain sorghum or the structure of the field and crop itself did not provide the necessities for the establishment of a large permanent population.

Farming techniques had little effect on what few mice were present in the

Table 3. Percent population turnover, percent juveniles, and percent in breeding condition, for prairie deer mice in the wheat field.

MONTH	% TURNOVER			% JUVENILES	% IN BREEDING CONDITION		
	Males	Females	Total		Males	Females	Total
1980 Nov.	-	-	-	25	0	-	0
1981 Feb.	50	0	67	33	0	0	0
Apr.	92	100	96	25	16	48	30
May	69	62	67	5	38	59	49
June	37	25	30	15	38	25	30
July	10	67	47	13	55	33	33
Aug.	53	30	44	4	60	20	44
Sept.	53	40	50	0	47	60	50
1982 Jan.	63	92	74	0	0	0	0

grain sorghum field. The field was sub-tilled in May, June, and late August. Only during the August sub-tillage was there a significant ($P < 0.05$) decrease in number of mice caught. The August operation included simultaneous injection of anhydrous ammonia at 50 lb of actual nitrogen/acre. A fourth sub-tillage of the field occurred just prior to seeding of winter wheat in mid-September. Also, in May, June, and September, a rotary hoe was used during sub-tillage to break soil crust, reduce weeds, and level the land.

Croplands supported fewer species than the relict area. This suggests a greater diversity of habitat in the relict area whereas the structure of habitat in croplands is such that it supports relatively few species in good numbers and additional species in smaller numbers (Table 4).

The evenness index of populations in the wheat field generally was the lowest among all habitats studied (Table 4). Except for the aberrant value in February, evenness was greatest in early summer and through the wheat stubble stage. In the field of grain sorghum evenness was high throughout most of the study period, with the most even distribution in late summer and autumn and zero after the wheat was planted in mid-September (Table 4). The relict area exhibited the highest evenness index throughout most of the study period (Table 4), with a peak in autumn. Therefore, by autumn of 1981, all habitats except the wheat field attained their most nearly even distribution of species. This would imply that the structure of the grain sorghum field and relict area was such that approximate even number of all species present could be supported. This evidently was not true for the wheat field.

The wheat field had the lowest diversity of mammals throughout the study period (Table 4). The diversity value in February was relatively high, but probably is misleading because it was based on a small sample size. Generally, the diversity values were highest during the mature wheat and wheat stubble stages. The peak diversity occurred during July, immediately after harvest of the wheat and was zero in November, when the new wheat was approaching dormancy.

The grain sorghum field maintained a nearly constant diversity from spring through summer, peaked in August, declined sharply thereafter, and reached zero after the field was planted to new winter wheat the following September (Table 4). The relict area had larger diversity values than the other habitats except for August when values for the grain sorghum and relict area were nearly identical.

The Kruskal-Wallis test indicated that there was a significant difference among the diversity values received for the three habitats studied. The Mann-Whitney U test showed no significant difference in the diversities recorded in the wheat field and grain sorghum field nor between the grain sorghum field and relict area. However, there was a significantly greater diversity in the relict area than in the wheat field.

DISCUSSION

Deer mice were the most abundant species of small mammal inhabiting croplands and were the only common residents of the wheat field throughout the study period. An average monthly population turnover of only 48% for the

Table 4. Richness (s), evenness (J′) and diversity (H′) in the wheat, grain sorghum, and relict habitats. A value of zero indicates only one species was captured during the trapping session.

Month	WHEAT			GRAIN SORGHUM			RELICT		
	s	J′	H′	s	J′	H′	s	J′	H′
1980 Nov.	1	0.00	0.00	-	-	-	-	-	-
Dec.	-	-	-	-	-	-	3	0.65	0.31
1981 Jan.	-	-	-	-	-	-	-	-	-
Feb.	2	0.81	0.24	-	-	-	4	0.64	0.39
Mar.	-	-	-	4	0.75	0.45	-	-	-
Apr.	2	0.24	0.07	-	-	-	4	0.69	0.42
May	4	0.25	0.15	-	-	-	4	0.60	0.36
June	2	0.44	0.13	4	0.74	0.45	5	0.72	0.51
July	3	0.53	0.25	4	0.72	0.43	6	0.78	0.60
Aug.	4	0.33	0.20	4	0.98	0.59	6	0.76	0.59
Sep.	3	0.43	0.20	2	1.00	0.30	5	0.90	0.63
Nov.	-	-	-	-	-	-	4	0.80	0.48
Dec.	-	-	-	1	0.00	0.00	5	0.77	0.54
1982 Jan.	3	0.35	0.21	1	0.00	0.00	-	-	-

study period and a high percentage of animals in reproductive condition supports this proposition. Wood (1910) and Johnson (1926) reported that in Illinois these mice were very abundant in croplands in all stages of development, and in the center of the cropfields despite intensive cultivation. In Indiana, Whitaker (1967a) and Houtcooper (1978b) reported that deer mice were prevalent in cultivated situations and permanent residents of the croplands studied, and were successful in adjusting to man and his farming operations. Linduska (1950) stated that in Michigan, deer mice were more common in the center of cropfields than in the edge habitat. The reduced number of females in wheat fields while the wheat was dormant might be due to lack of cover provided by the new wheat. Jefferies et al. (1973) and Houtcooper (1978b) reported more males than females in cropland habitats, whereas Linduska (1950) stated that more males than females were captured at low population levels as, perhaps, might have been the case in this study. Additionally, the higher turnover of females after harvest suggests a lower tolerance or higher mortality of females resulting from harvest.

Other species of small mammals were captured infrequently in croplands, and probably reflect transient populations or at least an inability to establish resident populations. Despite increasing hispid cotton rats and prairie vole populations by autumn, these species did not utilize the wheat field and no captures were recorded at the grain sorghum site. Therefore, cropfields might act as barriers to these species and expanded agricultural development on the Great Plains might have more pronounced effects on their populations.

Other species might require more cover and therefore cropfields might be favorable habitat only during certain periods of the year. This seems to be true of the house mouse (Southern and Laurie 1946, Linduska 1950, Whitaker 1967b, Zejda 1975), which initially was captured after the wheat was almost fully grown. However, the house mouse was most common in the grain sorghum field, which had the least cover; a nearby dairy may have been a factor. Whitaker (1967b), on the other hand, reported that the house mouse was least abundant in cropfields with sparse cover.

Other species, the hispid pocket mouse, the western harvest mouse, and the thirteen-lined ground squirrel, appear able to utilize croplands only to a limited extent. The state of the crop and frequency of cultivation might limit the thirteen-lined ground squirrel (Wood 1910). It is unclear what factors might regulate populations of the hispid pocket mouse and the western harvest mouse, although Scheffer (1924) found *Perognathus* spp. common in cultivated land in Washington. The habitat requirements of the western harvest mouse are reported to vary, but appear to require lush or mesic vegetation (Hill and Hibbard 1943, Andersen and Fleharty 1967, Kaufman and Fleharty 1974). However, these species, and possibly the plains harvest mouse, might be more common than trapping data indicate. Conceivably, these species might be more abundant in different crops, as preference for different crops by other species has been documented (Whitaker 1967a, Sutova 1970, Zejda 1975, Mann 1976).

Hansen and Fleharty (1974) found that deer mice normally are at peak abundance during late autumn and early winter. Results from the relict site of this study support that contention. However, the populations of deer mice in the

wheat field peaked during spring. Small mammals in agricultural lands often exhibit population growth during periods of intensive crop growth (Sutova 1970, Zejda 1975), as was perhaps the case here.

A tentative hypothesis to explain the changes observed in deer mice would involve a rapidly developing source of cover and food in the form of the wheat. Another source of food, insects, is readily available in wheat fields, especially prior to stubble stages and after mild winters (Jones 1976a, 1976b). The deer mouse is known to have a highly flexible diet (Houtcooper 1978a, Whitaker 1966, Flake 1973, Martell and MacCauley 1981). It will consume various kinds of insects and seeds when locally abundant. This flexibility in diet, combined with a greater preference for early succesional habitat types (Johnson 1926), might allow deer mice to utilize cropfields earlier than other species. Additionally, if populations were able to increase their reproduction early in the spring, the wheat field would represent increasingly favorable habitat for the expanding populations. Clearly, it would be adaptive for the deer mouse to exploit a situation such as the one described.

Results indicate that farming practices have no detrimental effect on the populations of deer mice in the wheat field. Conceivably, the insecticide Malathion might have had a delayed effect on the population of deer mice in the wheat field. Stehn (1976) found an increase of insect food in the diet of small mammals after spraying of an insecticide, which might contribute to a large dosage of potentially harmful chemicals. However, the re-occurrence of marked individuals, the increased abundance of deer mice, and the low application rate and low persistence of Malathion, suggest that the insecticide was not responsible for the decline of the population in June.

Although the relict area has been protected from grazing and therefore should not be considered "natural" habitat, and although the differences exhibited by populations inhabiting the relict area and wheat field likely are due to the different natures of the habitats, the close proximity of the two areas served to indicate the local availability of species for both areas. Diversity, evenness, and richness values indicated that wheat, grain sorghum, and stubble fields were different from each other and from uncultivated habitats in their capacity to support populations of small mammals. The uncultivated habitat supported a greater diversity and overall abundance of small mammals than did cropland habitats. Although the grain sorghum field exhibited a higher diversity, evenness, and richness than the wheat field, the low relative densities indicated a sparse community of small mammals. The high turnover of species in the grain sorghum field also indicated that resident populations probably were not established. This might be a property of the crop stage, i.e., a grain sorghum stubble field progressing through fallow and newly planted wheat stages might provide less favorable habitat for populations of small mammals than growing wheat and wheat stubble stages. Studies have shown a prefrence for different crops and crop stages by small mammals. For example, Scheffer (1924) found small mammals to be least abundant in plowed fallow fields, and Mann (1976) found that in addition to a preference for different crops, all species were found more commonly in crops that were closely spaced. Sood and Dilber (1977)

reported that there was a change in burrow intensity during different stages of the crop, i.e., seedling, growth, and maturity.

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Breeding Birds of Wooded Draws in Western North Dakota

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Wooded draws represent a unique vegetative community within the northern Great Plains. Because of their limited extent over broad areas of grasslands, wooded draws offer potentially diverse breeding areas for a large array of birds and mammals. Seabloom et al. (1978) reported that although wooded habitats made up only 8.6% of their area sampled in southwestern North Dakota, nearly 33% of the observed vertebrate fauna occupied wooded habitats.

Little information is available on vertebrate communities in wooded vegetation of western North Dakota. Hopkins (1980) studied the breeding avifaunas of several habitat types in Theodore Roosevelt National Park. Hiemenz and Cassel (1980) reported on bird and mammal communities in west-central North Dakota in 1979 and 1980. Grosz et al. (1981) studied wildlife use of draws in the same general area. Gaines and Kohn (1982) found that wooded draws in western North Dakota surrounded by upland native prairie provided important habitat for nesting Swainson's and red-tailed hawks (scientific names are presented in the Annotated Species Accounts).

One series drawback of these previous investigations has been the lack of integration of plant ecological data with avian population data. Knowledge of the plant and bird data should prove valuable for making predictive estimates of avian use based on plant community physiognomy.

From May to July 1982, I determined the species composition and relative abundance of birds occupying wooded draws in a five-county area of western North Dakota (Fig. 1). My study area was within the Fort Union Coal Planning region administered by the U.S. Bureau of Land Management.

METHODS

Census Plot Selection

Thirty-three plots were originally selected but only 30 were logistically suitable for censusing breeding birds. Site selection involved choosing three draws in each of 11 areas. This selection process included draws set at different aspects and with various slopes and grazing intensities. Attempts were made to select sites with many tree species. However, variation in tree species composition was limited within the study area.

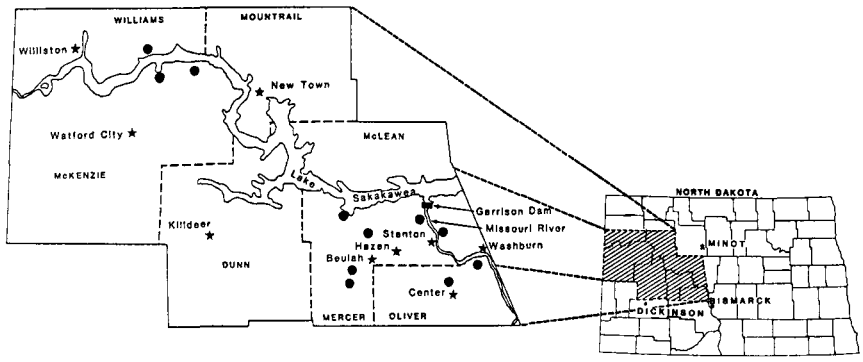

Figure 1. Geographic location of wooded draw study sites in western North Dakota. Each dot represents the location of 1-3 census plots.

Avian Census Methods

I censused breeding bird populations during 2-30 June 1982 using a modified Emlen line transect (Emlen 1971, 1977). Each of the 30 draws was visited three times during this count period. Count times were from local sunrise to 1100. During each count, data were recorded on the location of each male bird of a species encountered (except that for brown-headed cowbirds only females were counted). These locations were marked on field maps and used for later analyses. Each census plot except one was 50 x 400 m in size, covering an area of 2.0 ha. The other census plot was 1.7 ha. The centerline and adjacent edges of each plot were marked with colored plastic surveyor's tape.

In addition to census plots, occasional investigations of habitats adjacent to the wooded draws were made throughout the study area. These data were used to supplement observations made in each area, and to provide further information on the numbers and kinds of birds occupying wooded draws and adjacent habitats.

Vegetation Analysis

The method used for this investigation was a modification of the James and Shugart (1970) circular plot method described by Noon (1981). Vegetation within each draw was sampled in five 0.04-ha circular plots. This allowed me to analyze the vegetation on 0.2 ha of each bird census plot. Vegetation within the draws was sampled beginning at the top of the draw, and then proceeding downslope. Vegetation sample plots were at 0, 50, 150, 250, and 350 m along the bird census transect.

RESULTS AND DISCUSSION

Analysis of the vegetation within each of 30 wooded draws revealed that 17 species made up the plant community. Green ash (*Fraxinus pennsylvanica*) was predominant, occurring in all wooded draws studied, and at 96% of the 150 vegetation sample points. American elm (*Ulmus americana*) was the second most frequently occurring species, found in 92% of the draws studied and at 61% of the vegetation sample points.

Among the typical shrub species, chokecherry (*Prunus virginiana*) and juneberry (*Amelanchier alnifolia*) were the most frequent. In combination, these species were recorded at one-third of the vegetation sample points. The importance values (Curtis and McIntosh 1951) suggest that chokecherry and hawthorn (*Crataegus* sp.) were surprisingly similar in importance. Chokecherry exhibited the greatest importance value in 12 wooded draws, hawthorn in 9 draws, juneberry in 7, and bullberry (*Shepherdia argentea*) in 1. Greatest values were identical for juneberry and hawthorn in one draw.

Forty-seven bird species were recorded from the 30 wooded draws. Twenty-three additional species were recorded in adjacent draws or in native or man-made habitats near the censused draws. The observed total of bird species was about 34% of the known nesting avifauna of North Dakota (Faanes and Stewart 1982). The most frequently occurring species were rufous-sided towhee, brown-headed cowbird, house wren, and American goldfinch.

The richness of the avifauna of western North Dakota wooded draws is exemplified by the diverse mixture of typically eastern and western bird species nesting in proximity to each other. Of particular interest to the avian ecologist are the patterns of distribution of wooded draw breeding bird species during the non-nesting season. Among the 47 species occupying wooded draws, 22 (47%) are neotropical migrants, 20 (43%) migrate to warmer climates in the southern United States and Mexico, and 5 are permanent residents or winter vagrants on the northern Great Plains.

Much useful information remains to be gathered on breeding bird populations and their interactions with vegetation features of wooded draws in western North Dakota and adjacent eastern Montana.

ANNOTATED SPECIES ACCOUNTS

In the following annotated list, the taxonomic order, nomenclature, and terminology follow that of Faanes and Stewart (1982). The status of 70 bird species recorded within the study area is briefly summarized. Included are data on maximum population densities, dates of observations, limited data on clutch or brood size, and habitat occupancy.

FAMILY CATHARTIDAE

Turkey Vulture (*Cathartes aura*):

An uncommon and local nesting species across the study area; apparently oc-

curring in largest numbers in northern McKenzie and southern Williams counties. Turkey vultures were recorded in five wooded draw study sites. A nest containing three half-grown young was found 28 June in Sec. 11, T. 154 N., R. 98 W., Williams County. Stewart (1975) showed no nesting season records for Williams County.

FAMILY ACCIPITRIDAE

Northern Harrier (*Circus cyaneus*):

A regularly encountered nesting species of lightly grazed native prairie habitats associated with several wooded draws.

Sharp-shinned Hawk (*Accipiter striatus*):

One adult was observed hunting in a wooded draw in Sec. 12, T. 153 N., R. 96 W., McKenzie County on 2 June. Stewart (1975) considered this raptor an uncommon nesting species along the Little Missouri River, about 80 km from this site.

Cooper's Hawk (*Accipiter cooperii*):

I recorded one adult at the edge of a wooded draw in Sec. 9, T. 145 N., R. 88 W., McKenzie County, on 23 June. This was the only Cooper's hawk I observed in western North Dakota during the breeding season. Stewart (1975) stated that the Cooper's hawk was an uncommon nesting species along the Little Missouri River, and rare elsewhere in western North Dakota.

Swainson's Hawk (*Buteo swainsoni*):

A fairly common nesting species on native prairie tracts associated with wooded draws. Although not recorded in any of my wooded draw census plots, this species was observed occupying native habitats associated with six draws censused for breeding birds. No active nests were found.

Red-tailed Hawk (*Buteo jamaicensis*):

An uncommon and locally distributed nesting raptor throughout the study area. Red-tailed hawks were recorded in one censused draw, and associated with five additional draw ecosystems. Two nests were found, each containing three young.

FAMILY PHASIANIDAE

Ring-necked Pheasant (*Phasianus colchicus*):

An uncommon nesting species, most regularly encountered in habitats adjacent to wooded draws. Most ring-necked pheasants were found in the eastern portion of the study area, primarily near Beulah-Hazen, and near Center.

Sharp-tailed Grouse (*Tympanuchus phasianellus*):

A fairly common resident of native grasslands adjacent to the wooded draws. One large lek was found 2 June in Sec. 7, T. 153 N., R. 96 W., McKenzie Coun-

ty. This species was encountered less frequently in the eastern half of the study area where cereal grain farming was the predominant land use.

Wild Turkey (*Meleagris gallopavo*):

A fairly common resident, especially adjacent to the Missouri River in the eastern half of the study area. Wild turkeys appeared to be most frequent in large sinuous draws, intermittently connected to extensive lowland forest communities. Turkeys were recorded in two wooded draw census plots, and were found associated with three additional draws.

FAMILY CHARADRIIDAE

Killdeer (*Charadrius vociferus*):

A fairly common nesting species of upland native grasslands and cropland adjacent to wooded draws. No killdeer were recorded in wooded vegetation.

FAMILY SCOLOPACIDAE

Upland Sandpiper (*Bartramia longicauda*):

A fairly common nesting species of upland native grasslands associated with wooded vegetation. No upland sandpipers were recorded in wooded draws.

FAMILY COLUMBIDAE

Mourning Dove (*Zenaida macroura*):

An abundant nesting species in the eastern half of the study area, less common although widespread in the western half. Mourning doves and their nests were usually found at the brushy edge of the wooded draws. The highest breeding density (267 prs/km^2) was recorded in a wooded draw near Zap, Mercer County. Mourning doves were recorded in over 75% of the wooded draws censused.

FAMILY CUCULIDAE

Black-billed Cuckoo (*Coccyzus erythropthalmus*):

An uncommon and locally distributed nesting species on the study area. Most black-billed cuckoos were found in the upper reaches of the wooded draws where the vegetation was made up of dense shrub growth. A breeding density of 50 prs/km^2 was recorded from five draws in Mercer County.

FAMILY STRIGIDAE

Great Horned Owl (*Bubo virginianus*):

A fairly common nesting species throughout the study area. This species was found in one censused draw, and was associated with four additional draws. Great horned owls were found most regularly in small ($<$ 1 ha) draws adjacent to larger draws.

Long-eared Owl (*Asio otus*):

An uncommon and local nesting species of native woodlands throughout the study area. One nest containing three young was found 18 June in a wooded draw in Sec. 18, T. 146 N., R. 88 W., Mercer County.

FAMILY CAPRIMULGIDAE

Common Nighthawk (*Chordeiles minor*):

A fairly common nesting species of xeric native grasslands adjacent to wooded draws on the study area. This species was most frequently encountered on native prairie characterized by exposed rocky areas.

FAMILY PICIDAE

Northern Flicker (*Colaptes auratus*):

A fairly common and well-distributed nesting species throughout the study area. Northern flickers were recorded in 20% of the draws censused. The highest breeding density (50 prs/km^2) was recorded from a wooded draw near Hannover, Oliver County. No records were kept of flicker subspecies; however, apparent hybrids were encountered in McKenzie and Williams counties.

FAMILY TYRANNIDAE

Eastern Wood-pewee (*Contopus virens*):

An uncommon and local nesting species occurring primarily in areas adjacent to the extensive riparian forests along the Missouri River. The highest breeding density (50 prs/km^2) was recorded near Hannover, Oliver County.

Willow Flycatcher (*Empidonax traillii*):

An uncommon and local nesting species, most frequently encountered in the eastern half of the study area. The highest breeding density (50 prs/km^2) was recorded from the Ft. Clark area of Oliver County.

Least Flycatcher (*Empidonax minimus*):

A fairly common although locally distributed nesting species, occurring primarily in the eastern half of the study area. The highest breeding density (167 prs/km^2) was recorded from a wooded draw near Zap, Mercer County. Least flycatchers were recorded in nearly 25% of the wooded draws censused.

Great Crested Flycatcher (*Myiarchus crinitus*):

One male great crested flycatcher was found 30 June in a wooded draw in Sec. 15, T. 146 N., R. 85 W., Mercer County, an area adjacent to the Missouri River. Stewart (1975) reported that nesting great crested flycatchers in North Dakota occurred only east of the Missouri River.

Western Kingbird (*Tyrannus verticalis*):

A fairly common nesting species throughout the study area. The highest breeding density (133 prs/km^2) was recorded from a wooded draw near Zap, Mercer Coun-

ty. Most western kingbirds were associated with the drier upper reaches of wooded draws where shrub densities were highest.

Eastern Kingbird (*Tyrannus tyrannus*):

A common and well-distributed nesting species throughout the study area. Largest densities were associated with dense shrub growth in wooded draws, and those with smaller total area. Eastern kingbirds were recorded in 50% of the wooded draws censused. The highest breeding density (100 prs/km^2) was recorded from four draws south of Zap, Mercer County.

FAMILY ALAUDIDAE

Horned Lark (*Eremophila alpestris*):

A common nesting species of moderately to heavily grazed native grasslands and fallow cropland adjacent to wooded draws. No horned larks were recorded in wooded vegetation.

FAMILY HIRUNDINIDAE

Tree Swallow (*Tachycineta bicolor*):

Individuals and small groups were regularly encountered flying over wooded draws. Although dead trees with natural cavities suitable for nest sites were available in most of the wooded draws investigated, I obtained no evidence of nesting.

Barn Swallow (*Hirundo rustica*):

Individual barn swallows were frequently observed as they foraged over native and man-made habitats adjacent to wooded draws. I obtained no evidence that this species used any wooded vegetation.

FAMILY CORVIDAE

Blue Jay (*Cyanocitta cristata*):

A fairly common nesting species throughout the study area. The highest breeding density recorded was 50 prs/km^2. No vegetative characteristics were consistently associated with the presence of blue jays. Blue jays were recorded in nearly 50% of the wooded draws censused. One nest containing three young was found in a Mercer County wooded draw on 23 July.

Black-billed Magpie (*Pica pica*):

An uncommon and local nesting species, most numerous in the western half of the study area. Black-billed magpies occurred in largest numbers in areas supporting many small draws. One black-billed magpie was recorded on a wooded draw census plot.

American Crow (*Corvus brachyrhynchos*):

A fairly common nesting species throughout the study area. Although no

American crows were recorded from censused wooded draws, they were regularly associated with complexes of draws adjacent to study sites.

FAMILY PARIDAE

Black-capped Chickadee (*Parus articapillus*):

A fairly common nesting species throughout the study area. The highest breeding density (100 prs/km^2) was recorded from a wooded draw in Williams County. Black-capped chickadees were recorded in one-third of the wooded draws censuses.

FAMILY TROGLODYTIDAE

Rock Wren (*Salpinctes obsoletus*):

Individual rock wrens were found in arroyos at the end of three wooded draws in McKenzie County. Arroyo habitat consisted of exposed sedimentary rocks and scoria, interspersed with scattered shrubs. Rock wrens were not found occupying wooded vegetation.

House Wren (*Troglodytes aedon*):

An abundant and well-distributed nesting species in wooded draws throughout the study area. The highest breeding density (233/km^2) was recorded from near Hannover, Oliver County. This species was associated with brushy undergrowth along the margins of wooded draws. House wrens were recorded in 87% of the censused wooded draws.

FAMILY MUSICAPIDAE

Mountain Bluebird (*Sialia currucoides*):

An uncommon and local nesting species in the western half of the study area. Two singing males were recorded during early June from wooded draws near Tobacco Garden Bay, McKenzie County. This species was most frequently encountered in habitats similar to the Little Missouri badlands, where the topography consists of deeply eroded arroyos supporting sparse shrub growth.

Veery (*Catharus fuscescens*):

One male veery was recorded in early June from a wooded draw near Tobacco Garden Bay, McKenzie County. This was the only breeding season record obtained, although Stewart (1975) suggested that the veery was fairly common in similar wooded habitats of the nearby Little Missouri River badlands.

American Robin (*Turdus migratorius*):

A locally common nesting species throughout the study area. The highest breeding density (100 prs/km^2) was recorded near Hannover, Oliver County. This species was associated with wooded draws supporting low shrub density with a high percentage of canopy cover. American robins were recorded in 57% of the wooded draws censused.

FAMILY MIMIDAE

Gray Catbird (*Dumetella carolinensis*):

A fairly common although locally distributed nesting species throughout the study area. The largest breeding density was recorded from a wooded draw near Cussick Springs, Williams County. Wooded draws supporting high shrub density and high tree density were most attractive to this species.

Northern Mockingbird (*Mimus polyglottos*):

One singing male was found 22 July adjacent to a wooded draw in Sec. 27, T. 144 N., R. 89 W., Mercer County. Although singing and displaying within an apparent territory, it appeared to be an unmated, wandering male. Johnsgard (1979) considered northern Nebraska to be the limit of the nesting range of northern mockingbirds on the Great Plains.

Brown Thrasher (*Toxostoma rufum*):

A fairly common nesting species throughout the study area. The largest numbers of brown thrashers occurred in wooded draws supporting high numbers of young trees, high shrub density, and low percent canopy cover. Maximum density (83 prs/km^2) was recorded from a wooded draw near Hannover, Oliver County. Brown thrashers were recorded in one-third of the wooded draws censused.

FAMILY MOTACILLIDAE

Sprague's Pipit (*Anthus spraguei*):

A fairly common nesting species of lightly to moderately grazed native grasslands adjacent to wooded draws. This species was most frequently encountered in the western half of the study area, and in the area near Zap, Mercer County. These two study units supported the largest expanses of undisturbed native grasslands within the study area. No Sprague's pipits were recorded in wooded vegetation.

FAMILY BOMBYCILLIDAE

Cedar Waxwing (*Bombycilla cedrorum*):

A fairly common nesting species throughout the study area. This species appeared to be most numerous in vegetation supporting high shrub densities, usually near the upper reaches of the draws. Cedar waxwings were recorded in 17% of the wooded draws censused. The highest breeding density (50 prs/km^2) was recorded from five draws; three in the eastern and two in the western half of the study area.

FAMILY LANIIDAE

Loggerhead Shrike (*Lanius ludovicianus*):

An uncommon and local nesting species throughout the study area. No loggerhead shrikes were recorded on census plots, but this species occupied habitats adjacent to three wooded draws that I censused.

FAMILY VIREONIDAE

Red-eyed Vireo (*Vireo olivaceous*):

A common nesting species throughout the study area. The largest numbers of breeding red-eyed vireos were associated with wooded draws supporting large trees, a closed canopy, dense herbaceous cover and low shrub density. This species was most numerous in McKenzie and Williams counties; highest density (167 prs/km^2) was recorded near Cussick Springs, Williams County. Red-eyed vireos were recorded in 50% of the wooded draws censused.

FAMILY EMBERIZIDAE

Yellow Warbler (*Dendroica petechia*):

A common nesting species throughout the study area. The largest numbers of yellow warblers were associated with wooded draws supporting high shrub densities and low canopy cover. Yellow warblers were usually most numerous in the upper 100 m of a draw, becoming scarce as the number of shrub stems decreased and the basal area of individual trees increased in lower reaches of the draw. The highest breeding density (150 prs/km^2) was recorded from a wooded draw near Zap, Mercer County. Yellow warblers were recorded in 57% of the wooded draws censused.

Black-and-white Warbler (*Mniotilta varia*):

A common nesting species throughout the study area, with the largest numbers recorded in McKenzie and Williams counties. The highest breeding density (150 prs/km^2) was recorded from three draws near Charleson, McKenzie County, and Cussick Springs, Williams County. Black-and-white warblers occurred in largest breeding densities in wooded draws supporting large trees, a closed canopy, and low shrub density. This species was recorded in 40% of the wooded draws censused.

American Redstart (*Setophaga ruticilla*):

A fairly common nesting species of wooded draws in McKenzie and Williams counties. The highest breeding density (217 prs/km^2) was recorded from a wooded draw near Tobacco Garden Bay, McKenzie County. Their largest numbers were associated with high tree density, moderate shrub density, and moderate canopy cover. American redstarts were recorded in 27% of the wooded draws censused.

Ovenbird (*Seiurus aurocapillus*):

A fairly common and well-distributed nesting species in the western half of the study area; local in the eastern half. The highest breeding density (200 prs/km^2) was recorded from two draws in McKenzie and Williams counties. Their largest numbers were recorded in wooded draws supporting low tree and shrub density and high canopy cover. These conditions are indicative of mature forest. Ovenbirds were recorded in one-third of the wooded draws censused.

MacGillivray's Warbler (*Oporornis tolmiei*):

One male was seen daily 2 to 4 June in a McKenzie County wooded draw in Sec. 8 , T. 153 N., R. 95 W. There are no breeding records for this occasional species in North Dakota (Faanes and Stewart 1982).

Common Yellowthroat (*Geothlypis trichas*):

A fairly common nesting species; most numerous in the eastern half of the study area. The highest breeding density (100 prs/km^2) was recorded from a wooded draw near Zap, Mercer County. This warbler was most numerous in mature wooded draws supporting lush herbaceous ground cover and sparse shrub density. This contrasts somewhat with common yellowthroat habitat in eastern North Dakota. Johnson (1974) found high densities in idle grasslands and Stewart (1975) reported that dense stands of *Symphoricarpos occidentalis* and *Artemesia cana* provided suitable upland nesting habitat in North Dakota. Kantrud and Kologiski (1982) reported highest common yellowthroat densities from stands supporting the shrubs *Rosa woodsii*, *Amorpha canescens*, and *Symphoricarpos occidentalis*.

Yellow-breasted Chat (*Icteria virens*):

A fairly common nesting species; most numerous in the western half of the study area. The highest breeding density (75 prs/km^2) was recorded from a wooded draw near Tobacco Garden Bay, McKenzie County. Yellow-breasted chats were most frequently found in wooded draws supporting high shrub density, few mature trees, and low canpoy cover.

Black-headed Grosbeak (*Pheucticus melancephalus*):

A common and well-distributed nesting species throughout the study area. This species was most frequent in central Mercer County, and in wooded draws near the Missouri River. The highest breeding density (200 prs/km^2) was recorded from a wooded draw near Hannover, Oliver County. Their largest numbers were associated with a high percentage of canopy cover, low shrub density, and high basal area density. Black-headed grosbeaks were recorded in 40% of the wooded draws censused.

Lazuli Bunting (*Passerina amoena*):

A common and well-distributed nesting species of wooded draws throughout the study area. The highest breeding density (217 prs/km^2) was recorded from a draw near Charleson, McKenzie County. Their largest numbers were associated with wooded draws supporting an open canopy, high shrub density, and a high number of trees in the 6-15 cm dbh class. These conditions are indicative of young growth wooded draws. Most territorial male lazuli buntings observed were along the edges of wooded draws.

Rufous-sided Towhee (*Pipilo erythrophthalmus*):

An abundant and well-distributed nesting species throughout the study area. The highest breeding density (383 prs/km^2) was recorded from a wooded draw near Cussick Springs, Williams County. Their largest numbers were associated with young growth wooded draws. Vegetation of these draws was characterized

by low percentage canopy cover, high ground cover and shrub density, and low basal area densities. Rufous-sided towhees were strongly attracted to patches of bullberry (*Shepherdia argentea*) shrubs along the periphery of the draws. Rufous-sided towhees were recorded in 90% of the wooded draws censuses.

Chipping Sparrow(*Spizella passerina*):

An uncommon and local nesting species, recorded only from wooded draws in McKenzie and Williams counties. The highest breeding density (83 prs/km^2) was recorded from near Charlson, McKenzie County. Chipping sparrows were recorded in 7% of the wooded draws censused.

Clay-colored Sparrow (*Spizella pallida*):

An uncommon and local nesting species, most frequent on the Coteau Slope physiographic region east of the Missouri River. The highest breeding density (100 prs/km^2) was recorded from a wooded draw near Cussick Springs, Williams County. Their largest numbers were associated with the upper reaches of the draws where the shrub wolfberry (*Symphoricarpos occidentalis*) was most prevalent. Clay-colored sparrows were recorded in 13% of the wooded draws censused.

Field Sparrow (*Spizella pusilla*):

A common and well-distributed nesting species, most frequent in the western half of the study area. The highest breeding density (150 prs/km^2) was recorded from a wooded draw near Cussick Springs, Williams County. Their highest numbers were in asssociated draws supporting high shrub density and low percentage canopy cover. Field sparrows were recorded in 53% of the draws censused.

Vesper Sparrow (*Pooecetes gramineus*):

A common nesting species of wooded draws and adjacent habitats throughout the study area. The highest breeding density (100 prs/km^2) was recorded from a wooded draw near Beulah, Mercer County. This species is well-known for its use of cropland and edge habitats (Stewart 1975, Faanes 1982). I found two vesper sparrow nests in upland native prairie adjacent to a wooded draw. Vesper sparrows may have only been using the wooded vegetation for song perches.

Lark Sparrow (*Chondestes grammacus*):

An uncommon and local nesting species occurring most frequently in the western half of the study area. The highest breeding density (50 prs/km^2) was recorded from three draws, two in Mercer County and one in Williams County. Lark sparrows were usually found near the upper reaches of the wooded draws, in areas supporting young growth vegetation. This species was recorded in 10% of the draws censused.

Lark Bunting (*Calamospiza melanocorys*):

A common to abundant nesting species of upland native prairie adjacent to wooded draws. Their largest numbers were found in the Beulah-Hazen-Zap region of Mercer County. No lark buntings were recorded in wooded vegetation.

Baird's Sparrow (*Ammodramus bairdii*):

An uncommon and local nesting species of lightly to moderately grazed upland native prairie adjacent to wooded draws. No Baird's sparrows occupied wooded vegetation.

Grasshopper Sparrow (*Ammodramus savannarum*):

A fairly common nesting species of lightly to moderately grazed upland native prairie adjacent to wooded draws. No grasshopper sparrows were recorded in wooded vegetation.

Chestnut-collared Longspur (*Calcarius ornatus*):

A fairly common, although locally occurring, nesting species of moderately to heavily grazed upland native prairie adjacent to wooded draws. No chestnut-collared longspurs were recorded in wooded vegetation.

Bobolink (*Dolichonyx oryzivorus*):

An uncommon and local nesting species of lightly grazed upland native prairie adjacent to wooded draws. No bobolinks were recorded in wooded vegetation.

Red-winged Blackbird (*Agelaius phoeniceus*):

A fairly common nesting species of upland and wet habitats associated with wooded draws. Red-winged blackbirds were recorded from four wooded draws censused. Although this species is common throughout much of the study area (Stewart 1975), it appears that wooded draws provide less than optimal nesting habitat for red-winged blackbirds.

Western Meadowlark (*Sturnella neglecta*):

A common and well-distributed nesting species throughout the study area. Western meadowlarks were found occupying native prairie, cropland, and summer fallow fields adjacent to wooded draws. One singing male was recorded in a wooded draw near Zap, Mercer County. This bird was probably using the wooded vegetation for a song perch at the edge of its territory, rather than occupying the draw for nesting.

Common Grackle (*Quiscalus quiscula*):

An uncommon and local nesting species of wooded draws in the eastern half of the study area. The highest breeding density recorded was 50 prs/km^2. Common grackles were recorded breeding in 7% of the wooded draws censused.

Brown-headed Cowbird (*Molothrus ater*):

An abundant and well-distributed nesting species throughout the study area. The highest breeding density (150 females/km^2) was recorded from two draws in northern Mercer County. No particular vegetation was consistently associated with brown-headed cowbird habitat. This species was recorded in 90% of the wooded draws censused.

Orchard Oriole (*Icterus spurius*):

An uncommon and local nesting species occurring with greatest frequency in

the eastern half of the study area. The highest breeding density recorded was 50 prs/km^2. Orchard orioles were usually associated with young growth wooded draws. This species was recorded in 7% of the wooded draws censused.

Northern Oriole (*Icterus galbula*):

An uncommon and local nesting species of wooded draws in the eastern half of the study area. The highest breeding density recorded was 50 prs/km^2. Most northern orioles were associated with the lower reaches of wooded draws which supported mature trees. Vegetation most frequently associated with northern oriole habitat included low density of trees, high basal area, high percentage canopy cover, and low shrub density. All northern orioles observed were of the Baltimore subspecies.

FAMILY FRINGILLIDAE

Pine Siskin (*Spinus pinus*):

One pine siskin was recorded in a McKenzie County wooded draw on 3 June. This was probably a bird that nested in an adjacent area, because there were no additional observations in the wooded draw where this bird was recorded.

American Goldfinch (*Spinus tristis*):

An abundant and well-distributed nesting species throughout the study area. The highest breeding density (117 prs/km^2) was recorded from a wooded draw near Cussick Springs, Williams County. Their largest numbers were associated with young growth wooded vegetation. American goldfinches were recorded from 80% of the wooded draws censused.

ACKNOWLEDGMENTS

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(continued from p. 192)

Prairie Nat. 15(4), 1983, pp. 188-190

Recent Records of Rare Small Mammal Species in Southwest Minnesota

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ABSTRACT

Since the last published records of harvest mice (*Reithrodontomys megalotis*), grasshopper mice (*Onychomys leucogaster*), pocket mice (*Perognathus flavescens*), and prairie voles (*Microtus ochrogaster*) from southwest Minnesota, major habitat changes have occurred. More recent records are needed to update the status of these species in this region. A mammal survey of the Chippewa Prairie Preserve resulted in the capture of two harvest mice and eight grasshopper mice. No pocket mice nor prairie voles were caught. These findings plus other recent records reported here indicate that the grasshopper mouse and harvest mouse still occur in this region but the existence of the other two species is in doubt.

INTRODUCTION

The western harvest mouse (*Reithrodontomys megalotis*), northern grasshopper mouse (*Onychomys leucogaster*), plains pocket mouse (*Perognathus flavescens*), and prairie vole (*Microtus ochrogaster*) are considered traditional prairie species. They occur widely throughout the prairie states and provinces of the U.S. and Canada. Most accounts show Minnesota as being on the edge of their range (Hazard 1982). However, the last published records of specimens collected from this region were in 1974, 1968, 1952, and 1968 respectively (Ernst and French 1976, Hazard 1982). Since those dates, major habitat changes have occurred in southwest Minnesota. Intense agricultural activity has reduced most original prairie communities to relatively few isolated tracts scattered throughout the area. Most tracts are small and intensively grazed. Only a few are burned periodically to maintain native communities. Because of these extensive changes, published records may no longer reflect the present status of these four species in southwest Minnesota. Compilation of current records would enable assessment of their present distribution and help in determining the effects of habitat alteration on their survival in this region.

In the summer of 1982, I conducted a mammal survey of the Chippewa Prairie Preserve in Chippewa County for personnel of The Nature Conservancy (TNC) (Laundré 1984). One objective of the survey was to determine the status of the grasshopper mouse, harvest mouse, pocket mouse, and prairie vole on the Preserve. This report presents my findings relative to those four species.

METHODS

The Chippewa Preserve is a 343-ha area native prairie community located northwest of Lake Lac qui Parle (Sec. 1, 12, and 13 T119N R43W). The vegetation of the area consists of a combination of native and imported species of grasses and forbs. The dominant native grasses include big bluestem (*Andropogon gerardi*), Indian ricegrass (*Sorghastrum nutans*), and sideoats grama (*Bouteloua curtipendula*). Snap-trapping was conducted from 11 to 18 July and 15 to 22 August 1982. A total of 2,470 trap nights were spent. Most trap nights (1,590) were in areas of the Preserve where native grasses are maintained by prescribed burning; the latest burn was in the spring of 1982. The rest were in areas that had not been burned for at least two years (unpublished data, The Nature Conservancy, Minneapolis, Minn.) and contained a greater density of imported grasses (*Bromus* sp. and *Poa* sp.). Standard rolled oats was used as bait.

Specimens caught were deposited in the Prairie Woods Natural History Museum at Southwest State University, Marshall. Voucher specimens were sent to the Bell Museum of Natural History at the University of Minnesota, Minneapolis.

RESULTS AND DISCUSSION

Trapping resulted in the capture of three male harvest mice and eight grasshopper mice (four males and four females). No specimens of pocket mice nor prairie voles were caught. Two of the harvest mice were caught in burned areas of the Preserve and one in an unburned area. All the grasshopper mice were caught in burned areas. Both species are not common even in the most favorable parts of their range. Thus the number of them caught on the Preserve indicates that they are likely at reasonable densities there.

In order to determine if any other recent records of these two species existed for different sites, I contacted various individuals who have been active in trapping small mammals in this region. Robert Chance from Blue Mound State Park (607 ha, Rock County, T103N R45W) reported live trapping two grasshopper mice and 16 harvest mice in the park in September 1982. He caught both species in prairie communities maintained by burning as well as in unburned areas where imported grasses were more prevalent. All specimens were released. Ann Humphrey, a summer intern with The Nature Conservancy, caught one grasshopper mouse on the Compass Prairie (5.6 ha, Nobles County, Sec. 3 T101N R41W) in summer 1983. It was trapped in an area that had been burned but supported mainly imported grasses and forbs (J. Weigel, TNC, pers. commun.). The specimen was deposited in the Bell Museum. During that summer, Ms. Humphrey also trapped at the Hole in the Mountain Prairie (Lincoln County, Sec. 19 and 20 T109N R45W), Glynn Prairie (Lyon County, Sec. 7 T109N R40W), Blue Gentian Prairie (Jackson County, Sec. 13 T103N R36W), and Wahpeton Prairie (Redwood County, Sec. 29 T110N R38W) but did not catch any of the four species of concern. A check of the most recent records of the Bell Museum turned up a single male grasshopper mouse (MMNH 14624) caught in 1982 at Kilen Woods State Park (81 ha, Jackson County, Sec. 17 T103N R35W). It was caught in an area where prairie grasses are maintained by burning (L. Jaeger,

Kilen Woods St. Pk, pers. commun.). In August 1977, 12 grasshopper mice (eight males and four females) were caught by R. E. Howard on the Department of Natural Resources Research Unit near Madelia (Watonwan County, Sec. 19 T106N R30W) (M. Frydendall, Mankato St. U., pers. commun.). One was caught in a brome field, six in a corn field, and five in an alfalfa field (A. Berner, Minn. DNR-Madelia, pers. commun.). One specimen, a male, was deposited in the museum at Mankato State University (MSU 599).

The presence of grasshopper mice and harvest mice at these other sites indicated that they still occur widely in the region. Most animals were caught in prairie communities that were protected from agricultural activity but varied widely in size and habitat characteristics. Thus these two species may persist in other similar prairie areas in the region. Although little trapping has been conducted in areas not protected from agricultural activities, the specimens caught near Madelia indicate that at least grasshopper mice can survive under a wide variety of land use practices. Further trapping in all habitat types is needed to determine how well these two species have been able to adapt to the extensive habitat changes that are occurring in this region of Minnesota.

No specimens of prairie voles or pocket mice were caught during my study nor during the trapping efforts of others in southwest Minnesota. A prairie vole (Bell Museum MMNH 14625) was caught in 1982 in southeast Minnesota (Houston County, Sec. 1 T103N R5W) and a pocket mouse (MMNH 14284) was caught in 1980 in northwest Minnesota (Clay County, Sec. 23 T139N R46W). Thus these two species still occur in the state. However, the habitat and topography of southwest Minnesota differ markedly from these two regions. One cannot assume that these two species also still occur in this area. Additional trapping efforts are needed to determine their status and, if found, to identify habitat types they may require for continued survival in this region.

ACKNOWLEDGMENTS

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Prairie Nat. 15(4), 1983, pp. 191

Book Review

MANITOBA'S BIG CAT

Manitoba's Big Cat: The story of the Cougar in Manitoba. Robert E. Wrigley and Robert W. Nero. 1982. Manitoba Museum of Man and Nature, Winnipeg, Canada, 68 pages. $6.50 (paper).

Public observations are the major source of circumstantial evidence used in this book on cougar occurrences in Manitoba. Based on 436 reported sightings and 1 actual specimen over the past century, the text establishes the cougar as one of Manitoba's rarest mammals.

The authors, in a popular style of writing, use individual accounts coupled with convincing biological arguments to prove the existence of cougar in the Province. The first three chapters cover historical evidence and provide details of the single specimen, taken in 1973 near the Provincial capital Winnipeg. Other chapters cover breeding activities, black (melanistic) cougars, vocalizations and other behaviour, food habits, preferred habitats, and speculations about the animal's future.

That cougars have existed in Manitoba is established, but there is only weak scientific evidence for a constant or increasing population of the big cats.

The book contains excellent photographs of Idaho cougars by Maurice C. Hornocker and is beautifully illustrated by Saskatchewan artist Dwayne Harty.

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INDEX TO VOLUME 15

(continued on p. 187)

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Book: Green, J. C., and R. B. Janssen. 1975. Minnesota birds: where, when, and how many. University of Minnesota Press, Minneapolis.

Article in Book: Lack, D. 1964. Population dynamics. In: A. L. Thompson, ed., A new dictionary of birds. McGraw-Hill, New York.

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