Lesser Prairie-chicken Use of Harvested Corn Fields during Fall and Winter in Southwestern Kansas

GREGORY C. SALTER, ROBERT J. ROBEL[1] and KENNETH E. KEMP

Division of Biology, Kansas State University,
Manhattan, KS 66506-4901 (GCS, RJR)
Department of Statistics, Kansas State University,
Manhattan, KS 66506-0802 (KEK)

ABSTRACT -- The lesser prairie-chicken (*Tympanuchus pallidicinctus*) has declined in numbers in Kansas primarily due to the conversion of sand sagebrush (*Artemisia filifolia*) prairie to cropland. The lesser prairie-chicken in Finney County, Kansas exists primarily in large fragments of sand sagebrush prairie, and it forages during fall and winter on waste grain in harvested corn *(Zea mays)* fields adjacent to prairie fragments. We used radio-telemetry to monitor lesser prairie-chicken locations and found no significant relationship between numbers of bird locations and amounts of waste grain on the ground in harvested corn fields. Even the harvested fields with the least amount of waste grain seemed to have sufficient amounts of food available for foraging lesser prairie-chicken. There appeared to be no need to develop supplemental food sources for wintering lesser prairie-chicken populations that have access to harvested fields of irrigated corn in Finney County.

Key words: corn fields, foraging, Kansas, lesser prairie-chicken, *Tympanuchus pallidicinctus*.

The lesser prairie-chicken *(Tympanuchus pallidicintus)* is a prairie grouse restricted to the south-central plains of North America. It inhabits rangelands dominated by shinnery oak (*Quercus harvardii*), sand sagebrush (*Artemisia filifolia*), and mid-grass prairie. Habitat deterioration combined with intensive

[1]E-mail address: rjrobel@ksu.edu

grazing, human disturbances, and conversion of rangelands to cropland have reduced lesser prairie-chicken populations greatly since the early 1900's (Giesen 1998). The lesser prairie-chicken was petitioned in 1995 for listing as threatened under the Endangered Species Act. The U.S. Fish and Wildlife Service determined that listing was "warranted but precluded" (U.S. Department of the Interior, Fish and Wildlife Service 1998) and the status of the lesser prairie-chicken population is being monitored closely across its current range (Mote et al. 1999).

Conversion of sand sagebrush rangeland to center-pivot irrigated cropland has destroyed and fragmented much of that habitat in southwestern Kansas. Initially the development of irrigated cropland, primarily corn *(Zea mays)* and grain sorghum *(Sorghum vulgare)*, resulted in increased numbers, or greater concentrations, of lesser prairie-chicken (Rodgers 1995). However, as the conversion of sand sagebrush habitat to cropland became more widespread, lesser prairie-chicken numbers declined drastically in Kansas (Jensen et al. 2000). The lesser prairie-chicken in Finney County of southwestern Kansas commonly forages in harvested fields of irrigated corn during fall and winter (Jamison 2000). These harvested fields now might be instrumental in maintaining isolated lesser prairie-chicken populations where suitable fragments of sand sagebrush remain. We initiated our research to determine if lesser prairie-chicken preferentially foraged in harvested corn fields with higher amounts of waste grain on the ground versus fields with less waste grain available.

STUDY AREA

We conducted our study in Finney County of southwestern Kansas (37° 52' N, 100° 59' W), primarily on a 5,760-ha fragment of sand sagebrush prairie surrounded by agricultural fields irrigated by center-pivot systems. Average annual precipitation was 48 cm with 75% of it falling between March and August; mean annual temperature was 12.7° C, ranging from means of -6.1° C in January to 26.0° C in July.

The sand sagebrush prairie was dominated by sand sagebrush interspersed with grasses such as blue grama (*Bouteloua gracilis*), sand dropseed (*Sporobolus cryptandrus*), prairie sandreed (*Calamovilfa longifolia*), sand bluestem (*Andropogon hallii*), and little bluestem (*Schizachyrium scoparium*). Other plants common on the area included western ragweed (*Ambrosia psilostachya*), annual eriogonum (*Eriogonum annum*), plains yucca (*Yucca glauca*), plains prickly pear (*Opuntia polyacantha*), and Russian thistle (*Salsola iberica*) (Hulett et al. 1988). Over 90% of the study area was grazed seasonally by cattle *(Bos taurus)*.

Surrounding cropland was devoted predominantly to the production of corn, wheat *(Triticum aestivum)*, and alfalfa *(Medicago savita)*. We confined our efforts to irrigated corn fields and the adjacent sand sagebrush areas. Corn fields were harvested with six- to eight-row self-propelled corn combines in late September and early October. Corn stalks were left standing after harvest and the fields remained untilled until spring planting time.

METHODS

We estimated the amount of waste grain on the ground in six harvested corn fields at monthly intervals during October through January 1998-1999 and November through February 1999-2000. We subjectively selected the corn fields for our study from fields that historically had been used for foraging by lesser prairie-chicken resident in adjacent sand sagebrush prairie (Jamison 2000). Two pairs (fields adjacent to each other) plus two isolated fields were included in the study during 1998-1999 and three pairs in 1999-2000, but those were not necessarily the same fields each year. The fields were square quarter sections of land (64.8 ha) with elevated sprinkler booms extending from central water sources to the outer edges of the fields. The circular rotation of the booms provided surface water to the entire field when in operation, primarily during spring and summer.

In each corn field, four 350-m transects, radiating outwardly from the center of the field, were established. The azimuth bearing (0° = north) of the first transect was determined randomly whereas the other three were established 90°, 180°, and 270° from the first. Each month we collected the surface material and top 1.3 cm of soil from eight randomly located 20- x 20-cm plots along each transect. We collected the top 1.3 cm of soil because corn kernels in that soil stratum might be available to foraging lesser prairie-chicken. We pooled the material from the eight plots as the sample for the transect. Monthly samples from the four transects in each field constituted the basis for estimating the amount of grain available to foraging lesser prairie-chicken. We recovered waste corn from our samples by using a sieve to separate corn kernels from soil and debris. Corn kernels were oven-dried at 40° C for 7 days prior to determining their mass; waste grain abundance is reported as g/m^2. Differences in waste corn abundance in harvested fields were detected by subjecting the monthly waste corn mass (g/m^2) data to a randomized block analysis of variance with $P < 0.05$ for significance.

We determined corn fields in which the lesser prairie-chicken was foraging by monitoring transmitter-equipped birds. Lesser prairie-chickens were trapped on breeding areas (leks) in the sand sagebrush rangeland during spring and fall and equipped with 11-g necklace-style transmitters with a life expectancy of 6 to 12 months. These birds where thereafter located daily (locations determined equally during three daytime periods: morning, mid-day, and afternoon/evening) by triangulation at a distance of 1 to 2 km (Jamison 2000). Generally, after corn fields adjacent to the sand sagebrush rangeland were harvested, lesser prairie-chicken in those rangelands made daily foraging flights to those fields in the early morning and late afternoon. We had 23 and 19 individual lesser prairie-chicken equipped with transmitters on our study area in the fall of 1998 and 1999, respectively. The number of daily locations of the birds in the corn fields was our measure of use with the higher numbers of locations reflecting higher use. We determined if the use of corn fields by lesser prairie-chicken each month was related to available waste grain by correlating the number of recorded telemetry locations in corn fields with biomass of waste grain in those fields. The 1998-1999 field layout included two pairs (adjacent) of fields and two individual fields whereas the 1999-2000 field layout included three pairs. For 1998-1999 there were four experimental units: the two individual fields and two pairs (each field pair was considered as an experimental unit). Similarly, for 1999-2000 there were three experimental units, which were the three field pairs. Field and year means were compared by using analysis of variance with a significance level of 0.05 and Fisher's protected LSD was used for field mean comparisons, as appropriate. We used Spearman rank correlation coefficients to quantify the linear relationship between the amount of waste grain and the number of bird locations in the individual fields. The year-month-field means were computed for each field for both the amount of waste grain and the number of bird locations. The year-month-field means for these two variables were used in the correlation analysis and year-month means were based on the average of six fields. Correlations were computed by month within years and by month over both years.

RESULTS

During the two-year study, 1,536 ground samples were collected from 12 harvested corn fields. Biomass ranged from 13.4 to 321.2 g/m^2 within fields throughout the 1998-1999 sampling period (Table 1) and from 11.1 to 137.6 g/m^2 within fields throughout the 1999-2000 field season (Table 2). The amount of waste corn biomass varied among fields ($F = 3.33$, df = 5, 15, $P = 0.03$) and decreased ($F = 8.77$, df = 1, 15, $P = 0.01$) over time during both winters.

We recorded 1,633 and 1,411 locations of transmitter-equipped lesser prairie-chicken during the 1998-1999 and 1999-2000 field seasons, respectively. Of the total locations, 321 and 295 were in corn fields in which waste grain abundance was measured during 1998-1999 and 1999-2000, respectively.

During 1998-1999 the highest number of lesser prairie-chicken locations (165) in corn fields occurred in October whereas the lowest number (47) was recorded in January (Table 1). The numbers of lesser prairie-chicken locations in 1998-1999 were not related significantly to the amount of waste grain in those fields during October ($n = 6$, $r^2 = 0.57$, $P = 0.08$), November ($n = 6$, $r^2 = 0.36$, $P = 0.21$), December ($n = 6$, $r^2 = 0.16$, $P = 0.42$), or January ($n = 6$, $r^2 = 0.07$, $P = 0.62$). The number of lesser prairie-chicken locations in the six fields was not related significantly to the

Table 1. Amount of waste grain (g/m^2) on the ground in harvested corn fields and number of locations of lesser prairie-chicken in those fields, 1998-1999, Finney Country, Kansas.

	October		November		December		January	
Field[1]	Corn	Locations	Corn	Locations	Corn	Locations	Corn	Locations
A_1	91.5	2	93.7	4	14.0	2	20.9	2
A_2	57.2	38	48.5	13	50.2	2	36.8	2
B_1	251.8	3	67.7	2	13.4	11	17.6	13
B_2	321.2	11	219.6	25	131.0	8	23.2	14
C	72.0	30	53.6	55	28.6	15	13.8	10
D	114.1	12	81.7	33	143.7	16	101.1	4
$\bar{x}$ (total)	151.3a[2]	(96)	94.1a	(132)	66.6a	(54)	35.6b	(39)

[1] Fields identified by the same letter were adjacent to each other.
[2] Means sharing the same letter do not differ ($P > 0.05$).

Table 2. Amount of waste grain (g/m^2) on the ground in harvested corn fields and number of locations of lesser prairie-chicken in those fields, 1999-2000, Finney County, Kansas.

	November		December		January		February	
Field[1]	Corn	Locations	Corn	Locations	Corn	Locations	Corn	Locations
A_1	34.7	1	26.6	0	49.9	1	21.9	0
A_2	42.7	22	32.4	2	11.1	10	12.5	17
B_1	42.2	7	33.3	22	16.1	3	14.7	1
B_2	27.6	0	27.9	12	11.1	14	11.8	7
C_1	24.0	7	15.0	20	14.7	7	14.6	13
C_2	126.2	40	137.6	27	40.1	43	21.2	33
$\bar{x}$ (total)	49.6a[2]	(77)	45.5a	(83)	23.8a	(78)	16.1b	(57)

[1] Fields identified by the same letters were adjacent to each other.
[2] Means sharing the same letter do not differ ($P > 0.05$).

amount of waste grain in the fields when October to January data were pooled for 1998-1999 ($n = 24$, $r^2 = 0.03$, $P = 0.42$).

During fall and winter 1999-2000, we recorded 83 locations of lesser prairie-chicken in corn fields in December, whereas in February we located those birds in corn fields only 57 times (Table 2). The number of locations of lesser prairie-chickens in harvested corn fields was not related significantly to the biomass of waste grain during November (n = 6, $r^2 = 0.36$, $P < 0.21$), December (n = 6, $r^2 = 0.01$, P = 0.87), January (n = 6, $r^2 = 0.02$, P = 0.78), or February (n = 6, $r^2 = 0.01$, P = 0.74). When all months and locations were pooled for the 1999-2000 field season, the number of locations of transmitter-equipped birds was not correlated significantly with the amount of waste grain on the corn fields (n = 24, $r^2 = 0.02$, P = 0.54).

DISCUSSION

We expected to find some differences in the amount of waste grain on the ground in the harvested corn fields but we were surprised at the magnitude of the differences encountered. A five to six fold difference existed in the biomass of waste grain on the ground of our six fields at the start of our 1998-1999 and 1999-2000 field seasons. These differences probably reflected different efficiencies of the combines used to harvest the corn. Well maintained corn combines generally were 95 to 98% efficient at removing corn kernels from cobs on corn stalks, but could be much less efficient if the corn head and snapping bars were adjusted improperly (Johnson and Lamb 1966). Maturity and moisture content of the corn, ground speed of the combine, header height and auger positioning, weedy fields and lodged stalks, and other variables affected the efficiency of the combine in separating kernels from corn cobs (Griffin 1973). We had no control over these variables in our study and could not estimate the contribution of each to the amount of waste grain in the harvested corn fields studied.

The amount of waste corn on the ground of harvested fields decreased over time, as observed previously by Baldassarre et al. (1983) and Warner et al. (1989). Foraging by lesser prairie-chicken was not the sole cause of the temporal decrease in waste grain because other animals foraged on waste grain in the harvested corn fields. Ring-necked pheasant (*Phasianus colchicus*), American crow (*Corvus brachyrhynchos*), and other seed-eating birds commonly were observed feeding in the fields during our study. Tracks, trails, and additional sign of Ord's kangaroo rat (*Dipodomys ordii*) and other rodents were abundant in the harvested corn fields. The combined foraging activity of this mix of avian and mammalian species doubtlessly caused the amount of waste grain in the fields to decline from October to February. Even so, the amount of waste grain remaining on the ground towards the end of winter was substantial.

In January 1999 and February 2000, our harvested corn fields had an average of 35.6 and 16.1 g/m^2 of waste grain left in them, respectively. A 100-g sample of corn from our fields contained 280 kernels. Thus, at the end of our 1998-1999 field season, approximately 100 corn kernels were present on each m^2 of ground surface and approximately 45 per m^2 were available in February 2000 (equates to approximately 12 and 5 bushels of waste corn/hectare, respectively). Even fields with the least amount of waste grain at the end of our field seasons (field C in January 1999 and B_2 in February 2000) had 39 and 33 corn kernels/m^2 (approximately 5 and 4 bushels/ha), respectively.

Generally, lesser prairie-chicken use of fields with more waste grain on the ground was not greater than fields with less. These results were unexpected as we hypothesized that harvested fields with more waste grain would be more attractive to foraging lesser prairie-chicken, which is what long-standing optimal foraging theory would predict (Emlen 1966, Schoener 1971). However, we think the amount of waste grain in our harvested corn fields was above the threshold that would elicit preferential use of fields with higher amounts of waste grain (i.e., the least amount of waste grain in any of our fields appeared sufficient to meet the foraging demands of lesser prairie-chicken). Food scarcity commonly is associated with increased expenditures of time spent foraging by birds resulting in increased mortality (Lima 1986, Brittingham and Temple 1988, Newton 1998). We did not measure time-budgets of lesser prairie-chicken on our study area during late fall through early winter but did monitor survival. Mortality of lesser prairie-chicken was low during the October to February period (Hagen 2003), which suggested that foraging activity did not increase sufficiently to cause an increase in mortality as a result of depleted food supplies.

MANAGEMENT IMPLICATIONS

Management plans for improving habitat for declining prairie chicken populations often include developing winter food supplies (Horak 1985, Giesen 1998). However, apparently waste grain in harvested corn fields surrounding fragments of sand sagebrush prairie habitat provided an adequate source of winter food for lesser prairie-chicken in Finney County. Because nest success and brood survival of lesser prairie-chicken are associated closely with amounts of remaining sand sagebrush prairie habitat in Finney County (Pitman 2003, Hagen 2003), attempts to convert any of that sand sagebrush prairie to food plots would be counter productive.

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