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ROLE OF MACROINVERTEBRATES IN SPRING DIET AND HABITAT USE OF SANDHILL CRANES

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ABSTRACT

In the springs of 1989 and 1990, we collected 15 lesser sandhill cranes from native grasslands along the Platte River. Macroinvertebrates constituted 89% of the diet, whereas plants constituted 11%. Scarab beetles were the predominant macroinvertebrate food. Other foods included earthworms, snail shells, sedge tubers, ground beetles, and crane fly larvae. Cranes exhibited differential use patterns on the study area; they extensively used areas composed of wet meadow and lowland grassland, but minimally used areas composed entirely of lowland grassland. Macroinvertebrate numbers and biomass were significantly different between areas extensively used by cranes and areas minimally used. Recommendations for management of native grasslands for sandhill cranes are given.

† † †

Native grasslands along the Platte River in central Nebraska play an important role in the ecology of lesser sandhill cranes (*Grus canadensis* subsp. *canadensis*). Cranes spend about 36% of their diurnal time during spring foraging and socializing in native grasslands (Krapu et al., 1984). Reinecke and Krapu (1986) determined that native grasslands provide an important source of macroinvertebrates (e.g., earthworms, snails, beetles) for cranes. These macroinvertebrates apparently contain essential proteins and calcium not obtained from other sources and are the foods in shortest supply for the birds (Reinecke and Krapu, 1986).

During the last 125 years, 75% of the original native grasslands that bordered the Platte River has been lost to agricultural conversion and commercial development (Currier and Ziewitz, 1986; Williams, 1978). Presently, nearly 80% of the mid-continental population of sandhill cranes use the Platte River during spring (Tacha et al., 1984). Therefore, the continued loss of native grasslands could place this population of cranes in jeopardy by crowding the birds on smaller and smaller areas, making them more vulnerable to natural and human-induced catastrophes (e.g., diseases, weather, starvation) (USFWS, 1981). Thus, a better understanding of the relations between sandhill cranes and macroinvertebrates inhabiting these lands must be developed. Our objectives were to determine sandhill crane use of macroinvertebrates and to evaluate sandhill crane use of native grasslands relative to macroinvertebrate availability and abundance.

METHODS

Study area

This study was conducted on Mormon Island Crane Meadows (MICM) in Hall County, Nebraska. MICM (827 ha) is owned by the Platte River Whooping Crane Habitat Maintenance Trust (Fig. 1). The area is mostly on subirrigated (Wann soil series) and wetland (Barney soil series) range sites (Yost et al., 1962). Predominant plant species are big bluestem (*Andropogon gerardii*), sedges (*Carex* spp.), switchgrass (*Panicum virgatum*), and Kentucky bluegrass (*Poa pratensis*) (Nagel and Kolstad, 1987). Topography is level to gently rolling, and elevations range from 575 to 580 m. Management practices include prescribed burning, rotational grazing, and haying.

Data collection

We collected sandhill cranes during March and April 1989 and 1990. Prior to collection, we observed the birds probing the soil for ≥ 40 minutes in an attempt to ensure that the birds had fed where collected. The esophagus of each bird was immediately removed and placed in 80% ethanol for later analysis. During March and April 1990, we also recorded the daily locations of birds using MICM, estimated the densities of birds within flocks using MICM (light/moderate = mean distance between individual birds within the flock was

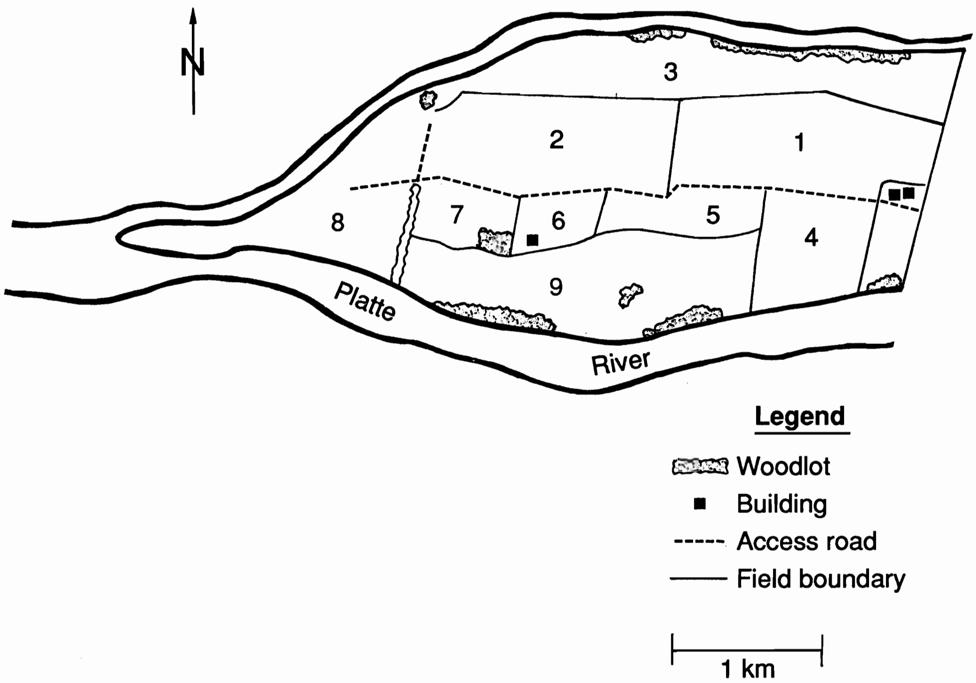

Figure 1. Mormon Island Crane Meadows study area with fields designated by numerals.

≥ 1 m; heavy = mean distance between individual birds within the flock was < 1 m) (Tacha, 1988), and estimated the total number of birds using MICM.

We established 13 north-south transects at random locations throughout the study area. A random numbers table was used to determine locations of 42 permanent macroinvertebrate sampling sites on the transects.

We collected macroinvertebrates, defined as invertebrates retained by a 1.00-mm mesh sieve, from the permanent sampling sites during two 3-week sampling periods from 1 March to 21 April 1990. We also collected macroinvertebrates from four locations within areas where collected birds had been foraging.

We extracted 84 soil blocks (25 × 25 × 20 cm) from the permanent sampling sites for collection of macroinvertebrates. We also extracted 56 soil blocks from within crane foraging areas. Blocks were taken in plastic bags to a field laboratory where the blocks were broken apart and visible macroinvertebrates removed. Soil from each block was placed in a tub of water and stirred to suspension. The suspension was poured through a 1.00 mm mesh sieve, and macroinvertebrates, except earthworms, were removed and placed in 80% ethanol. Earthworms were preserved using the technique of Fender (1985).

Macroinvertebrates from soil and esophageal samples were identified to family or genus level (Chu, 1949; Peterson, 1979a, 1979b), oven-dried at 100°C for 24 hr, and weighed to the nearest 0.0001 g. Cranes frequently foraged in corn fields prior to using grasslands. Therefore, esophageal samples with corn were sorted only to the corn layer. Macroinvertebrates in the corn layer were identified, but not included as food items obtained from grasslands.

Macroinvertebrate biomass was transformed ($MACRBIO = \sqrt{MACRBIO+.375}$) to correct for nonnormality (Zar, 1984: *241*). We compared macroinvertebrate biomass and numbers within areas heavily used and minimally used (i.e., moderate to light use) by cranes using analysis of variance (SAS Institute Inc., 1985).

RESULTS

Food habits

Two sandhill cranes were collected in 1989 and 13 in 1990. Three contained no food. Macroinvertebrates accounted for the greatest proportion in the diet (Table I). Scarab beetle (Scarabaeidae) larvae occurred in 60% of the esophageal samples, and snail (Gastropoda) shells occurred in 42%. The primary plant food con-

Table I. Frequency of occurrence and percentage of total dry weight of food items found in the esophageal samples of 12 sandhill cranes collected from Mormon Island Crane Meadows March–April 1989 and 1990.

Food	Frequency of occurrence	% of total dry wt.
Plants	7	11.1
Sedge tubers	5	9.5
Grass leaves/stems	1	1.2
Miscellaneous	2	0.4
Animals	9	88.9
Snail shells	5	17.6
Earthworms	3	2.3
Insects	7	69.0
Beetles	7	68.7
Scarab beetle larvae	7	67.7
Ground beetle adults	1	1.0
Fly larvae	1	0.3
Crane fly larvae	1	0.3

sumed by cranes was sedge (*Carex* spp.) tubers (Table I).

Crane distribution

An average of 7,500 sandhill cranes used MICM daily from 3 March to 13 April 1990. Sandhill cranes had different use patterns of areas within MICM. More than 80% of the birds used fields 1 and 2 within MICM. Crane use of these two fields was considered heavy; large, concentrated flocks of 5,000 to 15,000 cranes were commonly observed. Fields 1 and 2 were predominantly composed of wet meadow habitat interspersed with lowland grassland habitat. Wet meadow habitats were on wet, low-lying areas characterized by wetland plants (e.g., sedges (*Carex* spp.), rushes (*Juncus* spp.), switchgrass (*Panicum virgatum*), spikerush (*Eleocharis* spp.), while lowland grassland habitats were on dry, higher areas chararacterized by grasses (Kentucky bluegrass, wheatgrasses (*Agropyron* spp.), and brome grasses (*Bromus* spp.) (Davis, 1991).

Fields 3 and 7 were used moderately by sandhill cranes. Small- to medium-sized flocks (100–500 birds) were observed. Fields 4, 5, 8, and 9 (entirely lowland grassland) were used minimally by sandhill cranes.

Sandhill cranes most often used fields 1, 2, and 3 during late morning and early afternoon, and fields 4, 5, 7, 8, and 9 during early morning. Cranes generally made brief stops at fields 4, 5, 7, 8, and 9 while enroute from roost sites on the river to agricultural fields. Few cranes were observed in these fields after midmorning.

Macroinvertebrate densities and biomass within use areas

Total macroinvertebrate densities and biomass were significantly different between heavy-use and moderate to light-use areas (density: F = 12.62; 1, 82 df; P = 0.0006; biomass: F = 28.38; P = 0.0001). The mean number of macroinvertebrates collected from heavy-use areas was 62.29 ± 23.66 (SE) per m^2, whereas the mean for moderate/light-use areas was 148.86 ± 37.97 per m^2. The mean biomass for heavy-use areas was 0.96 ± 0.26 (SE) g/m^2 and 7.32 ± 1.89 g/m^2 for medium to light-use areas.

The most abundant taxa in heavy-use areas were ants (Formicidae), crane fly larvae (Tipulidae), click beetles (Elateridae), and long-legged fly larvae (Dolichopodidae), whereas the most abundant in moderate to light-use areas were ants, earthworms (Oligochaeta), click beetles, and scarab beetles (Table II). Earthworms and scarab beetles constituted the greatest biomass in both use areas (Table II). However, earthworm and scarab beetle biomass in moderate to light-use areas was significantly greater than those in heavy-use areas (earthworm: F = 29.13; 1, 82 df; P = 0.0001; scarab beetle: F = 6.04; P = 0.016).

Snail shells were collected from 88% of the sampling sites in heavy-use areas and 54% of the sampling sites in moderate to light-use areas. Snail shell densities differed between the two use areas (F = 14.42; 1,82 df; P = 0.0003). The mean snail shells in heavy-use areas were 198.29 ± 39.67 (SE) per m^2 and 39.43 ± 13.71 shells/m^2 in the medium to light-use areas.

Fourteen of the 15 cranes collected were from the heavy-use areas. Macroinvertebrate numbers and biomass where these birds were foraging were not different from macroinvertebrate numbers and biomass in heavy-use areas (number: F = 0.05; 1, 110 df; P = 0.829; biomass: F = 3.34; P = 0.07). Scarab beetle numbers and biomass where these birds foraged, however, were greater than in heavy-use areas (number: F = 4.32; 1, 110 df; P = 0.04; biomass: F = 6.32; 1, 110 df; P = 0.013).

DISCUSSION

Food habits

In our study, sandhill cranes in native grasslands consumed predominantly macroinvertebrates. Reinecke and Krapu (1986) also found that sandhill cranes in native grasslands predominantly consumed macroinvertebrates; they reported that animal foods made up 98–99 percent of the diet. Composition of animal foods, however, varied between our study and their study. We recorded only five macroinvertebrate foods in the diet, which was less than the 11 reported by Reinecke and Krapu. We found that scarab beetle larvae (68%)

Table II. Mean density (no./m²) and biomass (g/m²) of selected macroinvertebrates collected from permanent sampling sites within areas of heavy crane use (N = 56) and moderate to light crane use (N = 28) at Mormon Island Crane Meadows, March and April 1990.

	Heavy		Moderate to light	
Macroinvertebrates	**Density**	**Biomass**	**Density**	**Biomass**
Earthworms	2.57	0.53	46.29	6.08
Scarab beetles	3.14	0.22	9.14	0.91
Crane fly larvae	8.00	0.08	8.00	0.04
Click beetles	7.71	0.06	9.71	0.07
Lepidoptera larvae	2.29	0.02	5.71	0.04
Soldier fly larvae	3.43	0.02	0	0
Ants	24.29	0.01	47.43	0.10
Ground beetles	0.86	0.01	2.86	0.02
Spiders	2.00	0.01	3.43	0.01
Long-legged fly larvae	3.71	0.005	2.29	0.01
Leaf beetle larvae	0.29	0.0004	5.14	0.01
Weevils	0	0	2.29	0.01
Muscid fly larvae	0	0	1.14	0.004

and snail shells (18%) constituted the greatest portion of the macroinvertebrate part of the diet, whereas in the study by Reinecke and Krapu (1986), earthworms (39–56%) and snail shells (23–26%) composed the greatest portion.

Differences in macroinvertebrates consumed by cranes in our study and their study probably resulted from differing availabilities of macroinvertebrates due to variations in environmental conditions. During our study, drought conditions occurred from spring 1988 to summer 1989, whereas during the study by Reinecke and Krapu (1986), precipitation and air temperatures were near normal; precipitation in 1978 was 4 cm below normal, but precipitation in 1979 was 11 cm above normal (USFWS, 1981). As a result of low soil moisture from the drought in 1988 and 1989, distributions and abundances of macroinvertebrates within the top 20 cm of soil were reduced (Davis, 1991). During the Reinecke and Krapu study under more normal conditions (i.e., wetter), macroinvertebrates in the upper soil strata were likely more available and more diverse.

Sandhill cranes have evolved an opportunistic foraging strategy that allows them to adapt to changes in food availability (Guther, 1976; Mullins and Bizeau, 1978; Reinecke and Krapu, 1986). Cranes search for and locate prey by making exploratory probes into the soil while walking (Tacha, 1988; C. A. Davis, pers. observ.). When they locate or capture prey from an area, the cranes begin to probe intensively for additional prey. This foraging strategy may allow cranes to exploit prey that are aggregated (Rabe et al., 1983). For example, sandhill cranes consumed great amounts of scarab beetle larvae, which were less abundant than earthworms in 1989 and 1990. However, scarab beetle larvae are relatively immobile and occur in aggregates (Richter, 1958) that may make them more susceptible to detection and capture than earthworms. Satchell (1955) and Edwards and Lofty (1977) reported that earthworms commonly occur in aggregates close to the surface, but we did not detect earthworm aggregates. Earthworms may have been too widely distributed for cranes to easily detect and to capture efficiently under the moisture conditions existing during our study.

Crane habitat use

Native grasslands with an interspersion of wet meadow and lowland grassland were used extensively by sandhill cranes. Crane use within these areas of interspersion was mostly concentrated near water-filled sloughs and shallow depressions. On numerous occasions, large flocks (>5,000 birds) landed in the sloughs and depressions after mid-morning and remained there until departure to the roost near dusk. These sloughs and depressions are important to cranes for pair-formation activities (Tacha, 1988), drinking, and loafing (Iverson et al., 1987), whereas the lowland grassland immediately adjacent to the sloughs and depressions are important for acquisition of needed macroinvertebrates that are scarce in the sloughs and depressions.

MANAGEMENT IMPLICATIONS

Management of existing native grasslands along the Platte River for sandhill cranes should focus on maintaining complexes with interspersed wet meadow and lowland grassland habitats. The key to providing essential habitat attractive to cranes is to maintain water in the sloughs and shallow depressions that traverse the native grasslands. High populations of earthworms and scarab beetles have been found to be related to moderate water table depths (i.e., 40–80 cm) (Davis and Vohs, 1993). By maintaining water in the sloughs and shallow depressions during spring, moderate water table depths can be maintained in adjacent lowland grassland habitats. Thus, macroinvertebrates such as earthworms and scarab beetles will be more available and abundant for sandhill cranes because the higher water table depths in the lowland grassland habitats will force the macroinvertebrates closer to the surface. Habitat essential to cranes for drinking, loafing, and conducting pair formation activities also will be enhanced by maintaining water in sloughs and shallow depressions within the native grasslands (Iverson et al., 1987; Tacha, 1988).

Presently, remaining native grasslands not in public ownership are threatened by agricultural conversion or commercial development; protection of existing grasslands and reclamation of lands that were converted should be a high priority. Protection can be accomplished by acquisition or easements, whereas providing water in sloughs and shallow depressions in existing native grasslands or grassland reclamation may involve manipulating groundwater levels through changing in-stream flow rates or using groundwater recharge and re-establishing native prairie and wet meadow plant species.

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LITERATURE CITED

Chu, H. F. 1949. *How to know the immature insects.* Dubuque, Iowa, William C. Brown Company Publishers: 234 pp.

Currier, P. J., and J. W. Ziewitz. 1986. Application of a sandhill crane model to the management of habitat along the Platte River. *In* J. Lewis (ed.), *Proceedings of 1985 Crane Workshop (Grand Island, Nebraska)* 4: 315–325.

Davis, C. A. 1991. *The ecology of macroinvertebrates inhabiting native grasslands and their role in the feeding ecology of sandhill cranes.* M.S. thesis, Iowa State University, Ames: 88 pp.

__________, and P. A. Vohs. 1993. Availability of earthworms and scarab beetles to sandhill cranes in native grasslands along the Platte River. *Prairie Naturalist* 25: 199–212.

Edwards, C. A., and J. R. Lofty. 1977. *Biology of earthworms.* New York, John Wiley and Sons: 333 pp.

Fender, W. M. 1985. Earthworms of the western United States. Part I. Lumbricidae. *Megadrilogica* 4: 94–123.

Guthery, F. S. 1976. Foods and feeding habitat of sandhill cranes in southern Texas. *Proceedings of the 1975 International Crane Workshop (Baraboo, Wisconsin)* 1: 117–125.

Iverson, G. C., P. A. Vohs, and T. C. Tacha. 1987. Habitat use by mid-continent sandhill cranes during spring migration. *Journal of Wildlife Management* 51: 448–458.

Krapu, G. L., D. E. Facey, E. K. Fritzell, and D. H. Johnson. 1984. Habitat use by migrant sandhill cranes in Nebraska. *Journal of Wildlife Management* 48: 407–417.

Mullins, W. H., and E. G. Bizeau. 1978. Summer foods of sandhill cranes in Idaho. *Auk* 95: 175–178.

Nagel, H. G., and O. A. Kolstad. 1987. Comparisons of plant species composition of Mormon Island Crane Meadows and Lillian Annette Rowe Sanctuary. *Transactions of the Nebraska Academy of Sciences* 15: 37–48.

Peterson, A. 1979a. *Larvae of insects: an introduction to Nearctic species-Part I, Lepidoptera and plant infesting Hymenoptera*, 6th. Ed. Ann Arbor, Michigan, Edwards Brothers, Incorporated: 315 pp.

__________. 1979b. *Larvae of insects: an introduction to Nearctic species-Part II, Coleoptera, Diptera, Neuroptera, Siphonaptera, Mecoptera, Trichoptera*, 6th. Ed. Ann Arbor, Michigan, Edwards Brothers, Incorporated: 416 pp.

Rabe, D. L., H. H. Prince, and D. L. Beaver. 1983. Feeding-site selection and foraging strategies of

American woodcock. *Auk* 100: 711–716.

Reinecke, K. J., and G. L. Krapu. 1986. Feeding ecology of sandhill cranes during spring migration in Nebraska. *Journal of Wildlife Management* 50: 71–79.

Richter, P. O. 1958. Biology of Scarabaeidae. *Annual Review of Entomology* 3: 311–334.

SAS Institute, Incorporated. 1985. *SAS user's guide: Statistics Version 5 edition*. Cary, North Carolina, SAS Institute, Incorporated: 1290 pp.

Satchell, J. E. 1955. Some aspects of earthworm ecology. *In* D. Kevan (ed.), *Soil Zoology*. London, Butterworth: 180–201.

Tacha, T. C., P. A. Vohs, and G. C. Iverson. 1984. Migration routes of sandhill cranes from mid-continental North America. *Journal of Wildlife Management* 48: 1028–1033.

____________. 1988. Social organization of sandhill cranes from midcontinental North America. *Wildlife Monographs* 99: 1–37.

U.S. Fish and Wildlife Service. 1981. *The Platte River ecology study*. Jamestown, North Dakota, U. S. Fish and Wildlife Service: 187 pp.

Williams, G. P. 1978. The case of the shrinking channels–the North Platte and Platte rivers in Nebraska. *U.S. Geological Survey Circular* 781: 1–48.

Yost, D. A., H.E. Paden, F. Matanzo, F. L. Bean, H. L. Hill, and R. S. Pollock. 1962. *Soil survey of Hall County, Nebraska*. Washington, D.C., U. S. Government Printing Office: 141 pp.

Zar, J. 1984. *Biostatistical analysis*. Englewood Cliffs, New Jersey, Prentice-Hall, Incorporated: 718 pp.