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ECOLOGICAL REVIEW OF BLACK-TAILED PRAIRIE DOGS AND ASSOCIATED SPECIES IN WESTERN SOUTH DAKOTA

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ABSTRACT.—Black-tailed prairie dogs (*Cynomys ludovicianus*) once occupied extensive areas throughout the Great Plains. In recent years massive control programs have been initiated to reduce prairie dog populations, primarily to benefit the livestock grazing industry. Currently in western South Dakota most prairie dogs are found on public lands. Control programs using toxicants for prairie dogs have been found to be economically unfeasible when not combined with reductions in livestock grazing. Control programs also have negatively impacted some nontarget species of birds and small mammals. Livestock grazing is directly related to prairie dog densities. Prairie dog and livestock grazing activities are responsible for keeping plant phenological development in a suppressed vegetative stage with higher nutritional qualities that attract greater herbivore use. Prairie dog colonies create and enhance habitat for many wildlife species; in western South Dakota 134 vertebrate wildlife species have been documented on prairie dog towns. Scientific evidence strongly suggests that prairie dogs are valuable components of the prairie ecosystem. They are responsible for maintaining, creating, and regulating habitat biodiversity through soil and vegetative manipulation for a host of vertebrate and invertebrate species dependent upon prairie dog activity for their survival.

Quantified information regarding vertebrate wildlife species living on or closely associated with black-tailed prairie dog (*Cynomys ludovicianus*) colonies is lacking or is only alluded to in scientific literature. To promote a better understanding of the complexity of prairie dogs and their habitat requirements and their importance to vertebrate species of wildlife, we conducted a review of scientific literature regarding prairie dog biology, ecology, and associated biopolitics pertaining to land management practices. Most of the studies and observations reported in this paper were conducted in western South Dakota. Where possible, corroborating studies and literature from other areas are presented and their importance discussed.

HISTORICAL BACKGROUND

Historically, prairie dogs occupied extensive areas on the Great Plains, ranging from Texas to Saskatchewan (Hall 1981) (Fig. 1). Merriam (1902) noted that prairie dogs compete with livestock for forage and are systematically targeted for elimination by livestock producers. The largest areas of land in the United States currently occupied by prairie dogs are federally managed lands (Schenbeck 1982). In South Dakota most black-tailed prairie dogs are found on lands administered by USDA Forest Service, primarily the Buffalo Gap National Grasslands and Fort Pierre National Grasslands (Schenbeck 1982). Storch (1989) estimated that prairie dogs inhabited 3,000 acres on the South Dakota portion of the Nebraska National Forest in the 1960s. In the mid-1970s prairie dogs inhabited approximately 20,000 acres on the Conata Basin portion of the grasslands (Schenbeck 1982); Schenbeck's estimate represents an 87% increase over an eight-year period. The livestock grazing industry claimed estimated losses of up to $10.29 per acre on pasture and rangeland and $30.00 per acre for hayland on a statewide basis (Dobbs 1984) and objected to the increase in prairie dogs.

ECONOMICS OF CONTROL AND LIVESTOCK GRAZING

The South Dakota livestock industry has recommended and instigated widespread wholesale reductions in prairie dog densities on public land, and in 1983 the state legislature listed the prairie dog as a pest and predator (Clarke 1988). Of the 707,000 acres in the Ft. Pierre and Buffalo Gap National Grasslands,

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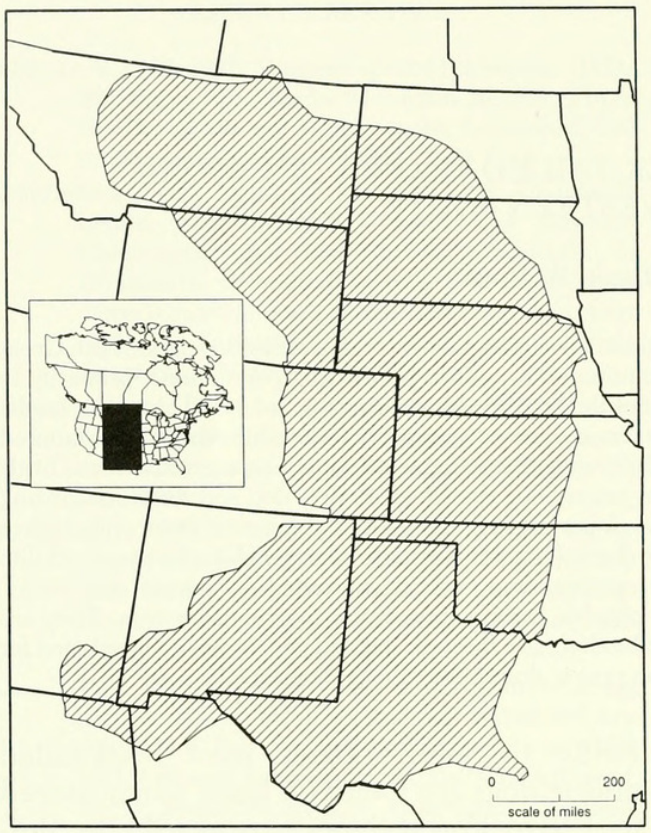

Fig. 1. Distribution of black-tailed prairie dog (*Cynomys ludovicianus*) on the Great Plains (adapted from Hall 1981).

approximately 10,000 acres are currently occupied by prairie dogs (Storch 1989). Control of prairie dogs has usually been initiated without consideration of the value of forage gained (Collins et al. 1984) or the effect on wildlife species associated with prairie dogs and their habitat (Sharps 1988).

An economic analysis of prairie dog control by Collins et al. (1984) found it was not economically feasible to poison prairie dogs in the Conata Basin using zinc phosphide because the annual control costs exceeded the value of forage gained. Also, based on burrow counts, prairie dog densities were significantly less on areas excluded to cattle than on areas grazed by cattle (Uresk et al. 1982). Herbicide applications to reduce forb production and thus reduce prairie dog densities were also found to be an inefficient control method because prairie dogs changed their diets from forbs to grasses (Fagerstone et al. 1977). It has long been known and extensively reported that cattle grazing will influence and is directly proportional to prairie dog densities (Koford 1958, Knowles 1982, Uresk et al. 1982, Cincotta 1985, Snell 1985). Schenbeck (1986) reported that habitat suitability for prairie dogs can be reduced by combining rodenticide use with changes in livestock grazing practices.

The poison bait effects of zinc phosphide- and strychnine-treated oats on nontarget birds, small mammals, and other nontarget species were evaluated by Uresk et al. (1988). The effects on nontarget bird species showed varied losses to Horned Larks, depending upon the density of strychnine-treated oats used, with no losses to other avian seed-eaters. No measurable reductions in Horned Larks were found using zinc phosphide-treated oats, although there were indirect impacts on Horned Larks resulting from habitat changes. Prairie dog towns provide habitat for many seed-eating and insectivorous birds. Significantly, Apa (1985) reported that 50 species of birds were observed using prairie dog towns during the course of his study.

While zinc phosphide may not be detrimental to Horned Larks and the smaller seed-eating birds, it has been reported to be relatively toxic to gallinaceous birds (Record and Swick 1983).

Studies by Koford (1958), Smith (1958), Snell and Hlavacheck (1980), and Uresk et al. (1982) indicated that excluding or decreasing cattle grazing increases cool-season grass density (wheatgrass and needlegrass) and reduces prairie dog colony size on mid- and short-grass rangeland. This method of prairie dog control has historically been opposed or rejected by the livestock grazing community. Although heavily grazed rangelands give rise to very slow forage improvement, prairie dogs alone are generally not responsible for range deterioration (Uresk 1987). Prairie dog expansion is related to livestock grazing (Uresk et al. 1982, Uresk and Bjugstad 1983). Black-tailed prairie dogs usually disperse during May and June and have been reported to move and become established an average of three miles from their original towns (Garrett and Franklin 1981, Cincotta et al. 1987). They will repopulate their towns to initial population numbers in three years (Schenbeck 1982, Cincotta et al. 1987). Economically, control of prairie dogs is not feasible except at very low maintenance levels—below 5%—based on an increase of forage for livestock of only 50 pounds per acre, a 4.4% increase (Uresk et al. 1982, Collins et al. 1984, Uresk 1985, 1986).

ASSOCIATED VERTEBRATE SPECIES

Prairie dogs create a biological niche or habitat for many species of wildlife (King 1955, Reading et al. 1989). Agnew et al. (1986) found that bird species diversity and rodent abundance were higher on prairie dog towns than on mixed-grass prairie sites. The high diversity of bird species was attributed to heterogeneous plant cover and species composition (Agnew et al. 1986, Cincotta et al. 1987). In a survey of prairie dog towns extending through portions of Utah, Colorado, and New Mexico, Clark et al. (1982) recorded 107 vertebrate species and subspecies of wildlife; more species were associated with larger prairie dog towns than with smaller towns. Sixty-four vertebrate wildlife species were recorded by Campbell and Clark (1981) on 25 white-tailed and 21 black-tailed prairie dog colonies in Wyoming. Reading et al. (1989) listed 163 vertebrate species sighted on black-tailed prairie dog colonies. They suggest that "richness of associated vertebrate species on black-tailed prairie dog colonies increases with colony size and regional colony density."

Data pertaining to vertebrate wildlife species associated with black-tailed prairie dog colonies were obtained from an extensive literature review, personal field notes (J. C. Sharps, unpublished), observations while conducting endangered species surveys, or observations incidental to other research on prairie dog colonies. In South Dakota, 600 vertebrate wildlife taxa were found statewide. There are 332 species located west of the Missouri River (excluding fish) (Sharps and Benzon 1984). Of western wildlife species, 40% were found to be associated with prairie dog colonies. This 40% represents 134 vertebrate wildlife species (Table 1) associated with prairie dog colonies in western South Dakota: 88 birds, 36 mammals, 6 reptiles, and 4 amphibians (Agnew 1983, Apa 1985, MacCracken et al. 1985, Agnew et al. 1986, Uresk et al. 1986, Deisch et al. 1989). Whitney et al. (1978) reported that approximately 33 bird species, or 39% of the birds found in South Dakota, are conspicuous on the grasslands. Of those 33 species only 5, or approximately 15%, were not observed or reported on prairie dog colonies.

PLANT-SOIL-ANIMAL INTERACTIONS

Agnew et al. (1986) and Deisch et al. (1989) found five classes of invertebrates on prairie dog colonies located on the Badlands National Park and Buffalo Gap National Grasslands, respectively. The five classes consisted of Insecta (6 orders, 26 families), Arachnida (4 orders, 10 families), Chilopoda, Diplopoda, and Crustacea. Agnew et al. (1988) found that insectivorous rodent species favor prairie dog colonies; these mammals, by consuming arthropods, may reduce localized arthropod outbreaks.

Prairie dog colonies provide habitat diversity in the prairie ecosystem by mixing soils and regulating vegetative species diversity (Koford 1958, Bonham and Lerwick 1976, Agnew et al. 1986, Detling and Whicker 1988, Sieg 1988). This in turn creates interactions and numerous niches, thereby contributing to the food chain for a host of invertebrate and vertebrate wildlife species. Prairie dogs alter soil structure and chemical composition by their burrowing activities, excrement, and addition of plant material, which contribute to vegetation diversity (Gold 1976, Hansen and Gold 1977, O'Meilia et al. 1982, Cincotta 1985, Agnew et al. 1986). Prairie dog activity results in the aeration, pulverization, granulation, and transfer of considerable quantities of soil (Buckman and Brady 1971, Sieg 1988). Soils in prairie dog colonies are richer in nitrogen, phosphorus, and organic matter than soils in adjacent grasslands. Sheets et al. (1971) found prairie dog and cattle feces, grass seeds, stolons, roots, and remains of prairie dogs and mice while excavating 18 prairie dog burrows to retrieve black-footed ferret scats in south central South Dakota. Soil-enrichment activity of the prairie dog is beneficial to the macroarthropods living in the soil. Forbs and grasses in prairie dog colonies are constantly clipped by prairie dogs and remain in a state of regrowth (O'Meilia et al. 1982, Cincotta 1985). Ingham and Detling (1984) reported that prairie dog colonies support higher populations of nematodes than adjacent areas away from the colonies. They also stated that prairie dog activities suppress plant phenological development, thus maintaining the plants in a vegetative state. Young vegetation, which is higher in nutritional qualities than mature plants, attracts cattle, bison, and pronghorn to prairie dog colonies (Uresk and Bjugstad 1983, Coppock et al. 1983, Knowles 1986, Krueger 1986, Detling and Whicker 1988).

TABLE 1. Vertebrate wildlife species associated with black-tailed prairie dog colonies in western South Dakota.

Eastern tiger salamander	*Ambystoma tigrinum tigrinum*
Great plains toad	*Bufo cognatus*
Western chorus frog	*Pseudacris triserata*
Bullfrog	*Rana catesbeiana*
Turtles	Emydidae ukn spp.
Lizards	Iguanidae ukn spp.
Plains garter snake	*Thamnophis radix*
Smooth green snake	*Opheodrys vernalis*
Bullsnake	*Pituophis melanoleucus sayi*
Prairie rattlesnake	*Crotalus viridis viridis*
Great Blue Heron[a]	*Ardea herodias*
Trumpeter Swan[a]	*Cygnus buccinator*
Canada Goose[a]	*Branta canadensis*
Mallard[a]	*Anas platyrhynchos*
Gadwall[a]	*A. strepera*
Northern Pintail[a]	*A. acuta*
Blue-winged Teal[a]	*A. discors*
Northern Shoveler[a]	*A. clypeata*
Canvasback[a]	*Aythya valisineria*
Turkey Vulture[b]	*Cathartes aura*
Red-tailed Hawk[b]	*Buteo jamaicensis*
Swainson's Hawk[b]	*B. swainsoni*
Rough-legged Hawk[c]	*B. lagopus*
Ferruginous Hawk[b]	*B. regalis*
Golden Eagle[b]	*Aquila chrysaetos*
Bald Eagle[d]	*Haliaeetus leucocephalus*
Northern Harrier[b]	*Circus cyaneus*
Prairie Falcon[b]	*Falco mexicanus*
Merlin[c]	*F. columbarius*
American Kestrel[b]	*F. sparverius*
Sharp-tailed Grouse[b]	*Tympanuchus phasianellus*
Ring-necked Pheasant[c]	*Phasianus colchicus*
Sora[a]	*Porzana carolina*
Killdeer[b]	*Charadrius vociferus*
Long-billed Curlew[b]	*Numenius americanus*
Upland Sandpiper[b]	*Bartramina longicauda*
Long-billed Dowitcher[a]	*Limnodromus scolopaceus*
Wilson's Phalarope[a]	*Phalaropus tricolor*
Ring-billed Gull[c]	*Larus delawarensis*
Rock Dove[b]	*Columba livia*
Mourning Dove[b]	*Zenaida macroura*
Great-horned Owl[b]	*Bubo virginianus*
Snowy Owl[d]	*Nyctea scandiaca*
Burrowing Owl[b]	*Athene cunicularia*
Short-eared Owl[b]	*Asio flammeus*
Common Nighthawk[b]	*Chordeiles minor*
Belted Kingfisher[e]	*Ceryle alcyon*
Northern Flicker[b]	*Colaptes auratus*
Red-headed Woodpecker[b,e]	*Melanerpes erythrocephalus*
Downy Woodpecker[e]	*Picoides pubescens*
Eastern Kingbird[b]	*Tyrannus tyrannus*
Western Kingbird[b]	*T. verticalis*
Say's Phoebe[b]	*Sayornis saya*
Horned Lark[b,d]	*Eremophila alpestris*
Violet-green Swallow[b]	*Tachycineta thalassina*
Northern rough-winged Swallow[b]	*Stelgidopteryx serripennis*
Barn Swallow[b]	*Hirundo rustica*
Cliff Swallow[b]	*H. pyrrhonota*
Blue Jay[c]	*Cyanocitta cristata*
Black-billed Magpie[b]	*Pica pica*
Common Raven[b]	*Corvus corax*
American Crow[b]	*C. brachyrhnchos*
Northern Mockingbird[c]	*Mimus polyglottos*
Gray Catbird[b]	*Dumetella carolinensis*
American Robin[b]	*Turdus migratorius*
Eastern Bluebird[c]	*Sialia sialis*
Mountain Bluebird[b]	*S. currucoides*
Water Pipit[c]	*Anthus spinoletta*
Northern Shrike[d]	*Lanius excubitor*
Loggerhead Shrike[b]	*L. ludovicianus*
European Starling[b]	*Sturnus vulgaris*
Yellow Warbler[b]	*Dendroica petechia*
Common Yellowthroat[b]	*Geothlypis trichas*
Yellow-breasted Chat[b]	*Icteria virens*
House Sparrow[b]	*Passer domesticus*
Bobolink[b]	*Dolichonyx oryzivorus*
Western Meadowlark[b]	*Sturnella neglecta*
Yellow-headed Blackbird[c]	*Xanthocephalus xanthocephalus*
Red-winged Blackbird[b]	*Agelaius phoeniceus*
Brewer's Blackbird[b]	*Euphagus cyanocephalus*
Common Grackle[b]	*Quiscalus quiscula*
Brown-headed Cowbird[b]	*Molothrus ater*
Western Tanager[b]	*Piranga ludoviciana*
Dickcissel[b]	*Spiza americana*
Common Redpoll[d]	*Carduelis flammea*
Pine Siskin[b]	*C. pinus*
American Goldfinch[b]	*C. tristis*
Rufous-sided Towhee[b]	*Pipilo erythrophthalmus*
Lark Bunting[b]	*Calamospiza melanocorys*
Grasshopper Sparrow[b]	*Ammodramus savannarum*
Vesper Sparrow[b]	*Pooecetes gramineus*
Lark Sparrow[b]	*Chondestes grammacus*
Slate-colored Junco[d]	*Junco hyemalis*
Oregon Junco[c]	*J. oreganus*
Chipping Sparrow[b]	*Spizella passerina*
White-crowned Sparrow[c]	*Zonotrichia leucophrys*
McCown's Longspur[c]	*Calcarius mccownii*
Chestnut-collared Longspur[b]	*C. ornatus*
Shrews	Soricidae ukn. spp.
Bats	Vespertilionidae ukn. spp.
Eastern cottontail	*Sylvilagus floridanus*
Desert cottontail	*S. auduboni*
White-tailed jackrabbit	*Lepus townsendii*
Black-tailed jackrabbit	*L. californicus*
Thirteen-lined ground squirrel	*Spermophilus tridecemlineatus*
Black-tailed prairie dog	*Cynomys ludovicianus*
Northern pocket gopher	*Thomomys talpoides*
Plains pocket gopher	*Geomys bursarius*
Olive-backed pocket mouse	*Perognathus fasciatus*
Hispid pocket mouse	*P. hispidus*
Ord's kangaroo rat	*Dipodomys ordii*
Plains harvest mouse	*Reithrodontomys montanus*
Western harvest mouse	*R. megalotis*
Deer mouse	*Peromyscus maniculatus*
Northern grasshopper mouse	*Onychomys leucogaster*

TABLE 1 continued.

Prairie vole	*Microtus ochrogaster*
Norway rat	*Rattus norvegicus*
House mouse	*Mus musculus*
Porcupine	*Erethizon dorsatum*
Racoon	*Procyon lotor*
Long-tailed weasel	*Mustela frenata*
Black-footed ferret	*M. nigripes*
Mink	*M. vison*
Badger	*Taxidea taxus*
Spotted skunk	*Spilogale Putorius*
Striped skunk	*Mephitis mephitis*
Coyote	*Canis latrans*
Red fox	*Vulpes vulpes*
Northern swift fox	*Vulpes velox hebes*
Bobcat	*Lynx rufus*
Mule deer	*Odocoileus hemionus*
White-tailed deer	*O. virginianus*
Pronghorn	*Antilocapra americana*
Bison	*Bison bison*

[a]Birds associated with wet years.
[b]Breeding birds.
[c]Transient birds.
[d]Wintering birds.
[e]Birds in riparian habitat adjacent to prairie dog colonies.

IMPORTANCE OF PRAIRIE DOG COLONIES TO ASSOCIATED WILDLIFE

Prairie dog colonies attract many insectivorous and carnivorous birds and mammals because of the concentration of numerous prey species (Clark et al. 1982, Agnew et al. 1986, Agnew et al. 1988). Hillman (1968) reported that prairie dogs are the principal food source of black-footed ferrets. Ferret decline has been attributed to prairie dog control practices and agricultural land use changes (Hillman and Clark 1980). Swift fox were found to have their dens on or within 0.8 km of prairie dog colonies (Hillman and Sharps 1978). The major portion of the swift fox diet is prairie dogs, 49%, and insects, 27% (Uresk and Sharps 1986). Raptors are particularly attracted to South Dakota prairie dog colonies. Juvenile Snowy Owls and Bald Eagles have been observed utilizing prairie dog colonies during the winter months; Golden Eagles can be found near prairie dog colonies all year; Ferruginous Hawks, Red-tailed Hawks, Kestrels, Prairie Falcons, Harriers, Rough-legged Hawks, Short-eared Owls, and Burrowing Owls use prairie dog colonies in the spring, summer, and fall months. Great-horned Owls have been observed hunting for cottontails and jackrabbits on prairie dog colonies at night. The principal mammalian predator species observed on prairie dog colonies are coyote, badger, and bobcat (Hillman and Sharps 1978).

Scientific evidence strongly suggests that prairie dogs are valuable components of the prairie ecosystem. Their burrowing activities and feeding habits are directly responsible for creating habitat diversity and thus providing a niche for 134 vertebrate wildlife species and over 36 families of invertebrate fauna (Agnew 1983, Deisch et al. 1989). Clark (1968) stated:

> prairie dogs have been in the grassland community for at least 1,000,000 years, probably occurring in great numbers; it would seem that if prairie dogs were detrimental they would have long ago destroyed the community of which they are a part.

SUMMARY

Prairie dogs were once significantly more numerous on public lands in South Dakota than they are today. Massive control programs have been initiated with little or no thought to the biological importance and ecological role of the prairie dog in the prairie ecosystem. Studies of prairie dog biology and ecology have shown that prairie dogs are not as detrimental as once believed to the livestock grazing industry. Studies have also shown that prairie dogs are extremely important to the ecosystem because they provide habitat and vegetation diversity in the prairie biome. Field observations and studies found 134 species and subspecies of vertebrate wildlife associated with prairie dog colonies in western South Dakota.

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