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Gray Wolf (*Canis lupus*) Occurrences in the Dakotas

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ABSTRACT.—Gray wolves (*Canis lupus*) were extirpated in North and South Dakota in the 1920–1930s and rarely reported from the mid-1940s to late 1970s. From 1981 to 1992, 10 wolves were killed in the Dakotas, five of them in 1991–1992. Mortality sites were 46–561 km from the nearest known wolf population, and four were within a single 1175 km² area. **Eight of the 10 animals were ≤ 2 years old, suggesting dispersing individuals.** Mortality occurred in agrarian prairie areas with mean road densities of 0.71 km/km² and human densities of 3.5/km². Habitat at mortality sites was radically different from where these wolves apparently originated, demonstrating extreme flexibility in dispersal behavior of wolves. Further increase in wolf occurrences in the Dakotas is likely, related to wolf population increases and range expansion in adjacent states and provinces, especially Minnesota.

INTRODUCTION

In the lower 48 states the gray wolf (*Canis lupus*) is usually thought of as an animal of forested wilderness, although the species historically occupied nonforested habitats including the vast grasslands in the center of the continent. The journals of Lewis and Clark are rich with records of wolves in the region that would become North and South Dakota (Dakotas) (Burroughs, 1961). As Europeans settled the Dakotas the endemic wolves were persecuted, resulting in extirpation by the 1920s or 1930s (Young, 1994). Lack of forest cover probably made eradication easier than in heavily forested parts of the U.S. Individual wolves were killed in the Dakotas in 1944, 1945, 1946 and 1970 (R. M. Nowak, pers. comm.). The records from the 1940s are probably the result of a brief range expansion (Nowak, 1983); the 1970 specimen was from southeastern South Dakota and remains an anomaly. The long-term trend during this period was a reduction in wolf distribution in the U.S. and Canada.

In 1974 the Endangered Species Act of 1973 protected wolves throughout the conterminous 48 states. Subsequently, the neighboring Minnesota population increased from 736–950 in 1971–1972 to an estimated 1500–1750 in 1989 (Fuller *et al.*, 1992), with specific increases and range expansion occurring near the western and southwestern edge of the species' range (Berg and Kuehn, 1982; Fritts and Mech, 1981; Fritts *et al.*, 1992; Fuller *et al.*, 1992; U.S. Fish and Wildlife Service, 1992). In addition, a small population of wolves recolonized Montana during this period (Ream *et al.*, 1991). In 1980 wolves in Manitoba were afforded big game status, providing them partial protection. This paper documents the occurrence of wolves in the nonforested regions of the Dakotas and the potential for recolonization of the region.

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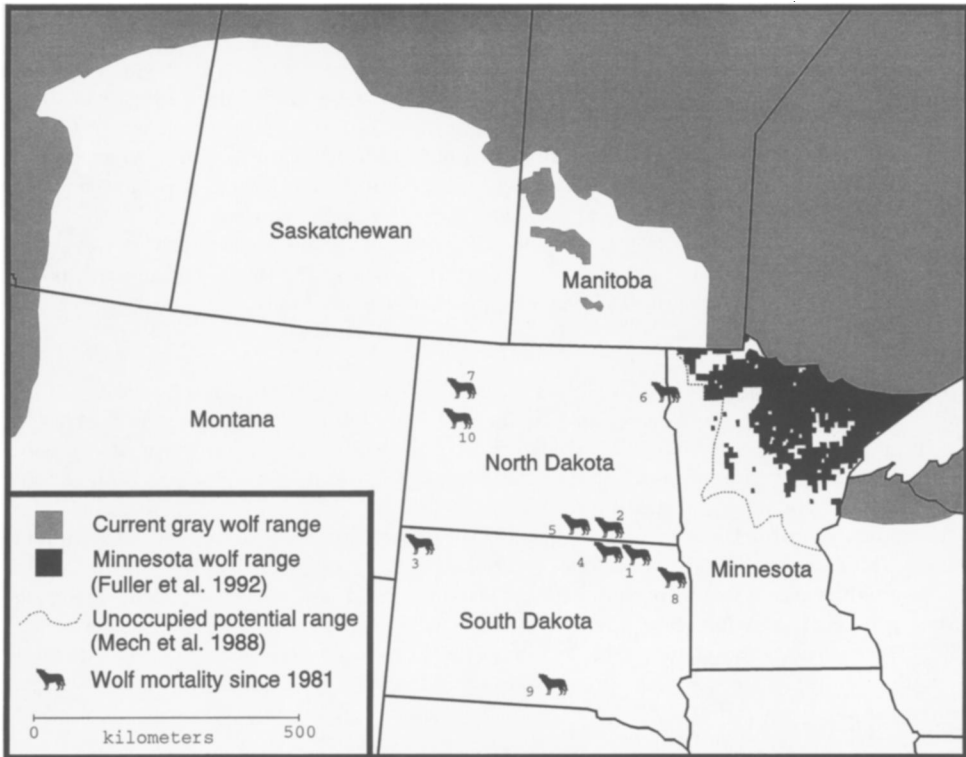


FIG. 1.—Known gray wolf mortality in the Dakotas since 1981 and nearest wolf populations

STUDY AREA

The Dakotas are characterized by a sparse human population, predominately flat to rolling topography, dry climate with hot summers and cold winters, and a landscape that is 51% cropland, 40% rangeland (U.S. Bureau of Census, 1988) and only about 4% woodland (*see Methods*). Excluding the Black Hills in extreme southwestern South Dakota, the Dakotas are <1% forested. There are about 5,080,000 domestic cattle and 555,000 (1.5/km²) wild ungulates (J. McKenzie, pers. comm.; K. McPhillips, pers. comm.) in the Dakotas. Most cropland is in the eastern half of the region and most rangeland in the western half. Human density averages 3.7/km² (U.S. Bureau of Census, 1988) and road density 0.72 km/km² (North Dakota Department of Transportation, pers. comm.; South Dakota Department of Transportation, pers. comm.; *see Methods*). Both road and human density are higher in the eastern half of the area.

The distance from the Dakotas to the closest known wolf packs is approximately 28 km, *i.e.*, from the northeastern corner of North Dakota to northwestern Minnesota (Fuller *et al.*, 1992) (Fig. 1). The land between these two points is primarily cropland. The sizable wolf population in Minnesota and its proximity seems to hold the greatest potential for emigration to the Dakotas.

Manitoba has a small disjunct population of wolves (<10) in the Spruce Woods Reserve approximately 66 km from the North Dakota border and another population (50–75 wolves)

ca. 160 km from the North Dakota border in Riding Mountain Provincial Park (Stardom, 1983; D. Pastuk, pers. comm.). The continuous population of Manitoba wolves extends into the extreme southeastern corner of the province where it is within 100 km of North Dakota. Wolf populations in Manitoba appear to have remained stable (Stardom, 1983) or possibly increased in recent years (D. Pastuk, pers. comm.).

The nearest wolf population in Saskatchewan is 340 km from the North Dakota border. The land between the Saskatchewan wolf distribution and North Dakota is primarily agrarian, with little likelihood of traverse by wolves (R. Seguin, pers. comm.).

The Montana wolf population consists of ≤ 50 wolves in the mountainous western region of the state and is increasing (Pletscher *et al.*, 1991; Ream *et al.*, 1991). Distance from the nearest known wolf pack to the Dakotas is approximately 650 km.

METHODS

All mortalities of suspected gray wolves in the Dakotas were investigated by the U.S. Fish and Wildlife Service. Skulls were sent to the Service's Office of Endangered Species in Washington, D.C., where they were analyzed for pure wolf ancestry, evidence of captivity, age and probable region of origin (Nowak, *in press*; R. M. Nowak, pers. comm.). Body weight was confirmed for only one specimen.

Wolf distribution and survival in adjacent Minnesota are related to road and human density (Mech *et al.*, 1988). Therefore, we looked for any obvious relationship that these factors might have to wolf mortalities in the Dakotas. Road densities were calculated using only improved roads that were open to two-wheel-drive vehicles year-round (Fuller *et al.*, 1992; Mech *et al.*, 1988; Thiel, 1985). Human densities were derived from 1986 estimates (U.S. Bureau of Census, 1988). Land-use data came from the U.S. Bureau of Census (1988), except for the cropland acreage for McIntosh County (U.S. Bureau of Census, 1989) and the woodland data. Woodland acreage estimates were calculated from U.S. Geological Survey 1:250,000 topographic maps. Woodland estimates do not include shelterbelts, shrubland and other small woody tracts.

RESULTS

Since 1981, 10 mortalities of wolves were documented, five of them in 1991–1992 (Table 1; Fig. 1). Eight of the 10 were mistakenly shot as coyotes (*Canis latrans*) according to law enforcement reports. One wolf was apparently beaten to death after being chased by dogs and the remaining wolf was shot by a hunter after it allegedly attacked the horse he was riding. Based on skull analyses, eight of the 10 animals were ≤ 2 yr old (R. M. Nowak, pers. comm.). Eight were gray and one (wolf 10; Table 1) was black; the color of the remaining wolf (wolf 3; Table 1) was not recorded. The one wolf for which a credible weight was recorded weighed 46.4 kg (wolf 10; Table 1). All but one were killed in winter, and all were believed to be alone when killed. Six were male and four were female.

The animals were killed 46–561 km ($\bar{x} = 297$) from the nearest known breeding range. Seven wolves were believed to have come from Minnesota and one from Canada, based on skull morphometrics. The probable region of origin of two wolves (wolves 3 and 10; Table 1) was not determined. However, wolf 10 was large (46.4 kg) and of a black color phase, characteristics common of wolves in Manitoba and Montana. These two wolves were killed 561 km and 343 km from the Manitoba wolf distribution, 644 km and 474 km from the Minnesota distribution, and 756 km and 740 km from the Montana distribution, respectively.

The 10 mortalities occurred in nine different counties. Four of the mortalities were concentrated in a relatively small area in southeastern North Dakota/northeastern South Da-

TABLE 1.—Known gray wolf mortality in the Dakotas, 1981–1992. Characteristics of the 10 gray wolves shot since 1981. MAN = Manitoba; MN = Minnesota; ND = North Dakota; SD = South Dakota; Unk = unknown

	Date of mortality	State	County	Est age	Sex	Distance to nearest wolf range km	Likely region of origin	Percent cropland ¹	Percent pasture ¹	Percent woodland	Km of road per km ²	Human density per km ²
1	3/15/81	SD	Brown	2	F	223	MN	72.1	22.9	0.6	1.03	8.2 ²
2	10/13/85	ND	Dickey	1.5	F	248	MN	66.1	18.4	0.3	0.93	2.4
3	6/4/86	SD	Harding	2	F	561	Unk	12.3	80.2	0.3	0.18	0.3
4	11/10/89	SD	Brown	1.5	M	254	MN	72.1	22.9	0.6	1.03	8.2 ²
5	2/27/90	ND	McIntosh	2	M	298	MN	64.7	25.4	0.2	0.84	1.8
6	2/2/91	ND	Walsh	2	M	46	MN	82.4	10.4	2.4	1.13	4.6
7	2/27/91	ND	Mountrail	2	F	268	MAN	58.9	38.6	0.2	0.66	1.7
8	12/1/91	SD	Grant	2	M	203	MN	64.2	21.1	1.8	0.84	5.0
9	12/22/91	SD	Tripp	4	M	530	MN	43.4	47.2	0.8	0.24	1.7
10	1/6/92	ND	Dunn	3.5	M	343	Unk	35.2	74.3	2.4	0.23	0.9
Mean						297		57.1	36.1	0.9 ³	0.71 ³	3.5 ³

¹ Percentages may exceed 100% due to sampling methods (U.S. Bureau of Census, 1989)

² Mean human density is 2.4 per km² when Aberdeen (Brown Co.) is excluded

³ Mean values calculated from sum of county values

kota (1174 km²; Fig. 1). Counties where wolves were killed averaged 57% cropland, 36% pastureland, and 1% woodland (Table 1) and had road densities averaging 0.71 km/km² and human densities averaging 3.5/km².

DISCUSSION

We cannot be certain that the wolves killed in the Dakotas were true wild wolves rather than released or escaped captive wolves. In addition to the animals described in this paper, two wolflike animals shot in the Dakotas since 1970 were subsequently determined to be a wolf-dog hybrid in one case and a released captive wolf in the other. However, the most reasonable conclusion is that all 10 of the animals reported here were pure wild wolves and were long-range dispersers from breeding populations outside the Dakotas. The possibility that the animals were the product of local reproduction does not seem plausible as a breeding pair or pack would not have escaped detection and publicity for long in the type of habitat where the mortalities occurred.

Age of these wolves agrees with the primary dispersal age in nearby Minnesota (Berg and Kuehn, 1982; Fritts and Mech, 1981; Fuller, 1989; Gese and Mech, 1991). The fact that all of the wolves were solitary further suggests dispersing individuals. Rates and distances of dispersal in the region do not vary appreciably by sex (*see* Fritts and Mech, 1981; Fuller, 1989; Gese and Mech, 1991). Therefore, the presence of six males and four females in a sample of dispersed wolves was not surprising.

The minimum distances these wolves had to have traveled are great, yet consistent with known dispersal distances. Van Camp and Gluckie (1979) reported that a young male wolf traveled at least 670 km before it was killed. A minimum dispersal of 732 km by a group of 2–4 wolves occurred in Alaska (Ballard *et al.*, 1983). Ream *et al.* (1991) reported a 840-km dispersal by a female yearling. A 886-km dispersal of a young adult male from Minnesota

to Saskatchewan is the longest documented dispersal for a wolf (Fritts, 1983). Actual distance traveled by the wolves described in this paper was no doubt greater than reported because (1) the origin of the dispersing wolves may have been well within the area of current wolf distribution, and (2) the distances reported are straight-line distances.

The fact that most animals were killed in winter suggests they had dispersed then. Dispersal peaks in the breeding season (late winter) or autumn to early winter but can occur any time of the year (Gese and Mech, 1991). The only summer mortality occurred in the county with the lowest human density ($0.3/\text{km}^2$) and road density ($0.18 \text{ km}/\text{km}^2$). This animal may have dispersed into the county during the prior winter, as local citizens reported it had been present for several months. If the wolf had indeed settled there, some degree of contentment with the local area can be inferred, since lone wolves and dispersers usually continue traveling until they find a mate and/or an area to their liking (Fritts and Mech, 1981; Gese and Mech, 1991; Rothman and Mech, 1979).

The forest-prairie interface generally defines the present southern edge of the gray wolf range in central North America (Carbyn, 1983). Each of the wolves we report on was far from the nearest forest in distinctly different surroundings than where they apparently originated. The counties where the wolves were killed averaged 1% woodland, 93% cropland and pastureland, $0.71 \text{ km roads}/\text{km}^2$, and $3.5 \text{ humans}/\text{km}^2$. In contrast, the primary wolf range in adjacent Minnesota is 77% forested with a maximum of 5% cropland and pastureland (10% is water), whereas the peripheral range segments average 62% forested with roughly 27% cropland and pastureland (Mech *et al.*, 1988; G. L. Radde, pers. comm.). In Minnesota, wolves generally survive only where both road densities and human densities are low; 88% of packs and 81% of single wolves were in townships with $<0.70 \text{ km roads}/\text{km}^2$ and $<4 \text{ humans}/\text{km}^2$ or with $<0.50 \text{ km roads}/\text{km}^2$ and $<8 \text{ humans}/\text{km}^2$ (Fuller *et al.*, 1992). Mech *et al.* (1988) described the primary wolf range in Minnesota as having a mean road density of $0.36 \text{ km}/\text{km}^2$, and the peripheral and disjunct parts of the range having a road density of $0.54 \text{ km}/\text{km}^2$. Overall, data from Minnesota and Wisconsin indicate that wolves have difficulty surviving where road densities exceed about $0.58 \text{ km}/\text{km}^2$ (Mech *et al.*, 1988; Thiel, 1985). The effect of roads would seemingly be exacerbated in the absence of forest cover. Interestingly, at least seven of the wolves we report on must have crossed 4-lane interstate highways during dispersal.

Selection of any particular habitat type in the Dakotas by the wolves described in this paper seems unlikely. Habitat characteristics of the counties where the wolves were killed were not appreciably different from the mean for the Dakotas, except for wolf 3 which was killed in a county with very low human and road density and a high percentage of rangeland (Table 1).

The concentration of four wolf mortalities in a 1174-km^2 area in the E-central region of the Dakotas that was approximately 250 km from the nearest known breeding population may be more than coincidence. A tendency for wolves to disperse along the same travel routes or to recolonize recently vacated areas has been implied by others. In Minnesota, Fritts (1983) reported that a dispersing wolf appeared to generally follow the route of an earlier dispersing wolf described by Berg and Kuehn (1982). A wolf in Montana dispersed 200 km from its natal pack and recolonized an area outside contiguous wolf range that had previously been recolonized by other wolves that were no longer present; since the time between recolonizations was over a year it seems unlikely that pheromones were involved (J. A. Fontaine, pers. comm.).

If the four wolves that occurred in the E-central region of the Dakotas had survived, it seems likely that they would have found one another. The home range of a solitary wolf in

unoccupied habitat in British Columbia was 816 km² (Ream *et al.*, 1985), which is not appreciably less than the 1175 km² area in which the four mortalities occurred.

Studies of wolves outside the Dakotas have not documented dispersal into the Dakotas or even any long distance movements in that direction, although wolves in northeastern Minnesota did show a slight tendency to disperse southwestward (Gese and Mech, 1991). Studies in the southern (Berg and Kuehn, 1982) and western portions of the Minnesota wolf range (Fritts and Mech, 1981) have reported that many of the wolves that moved long distances tended to travel northwestward or southeastward and thus paralleled the edge of the species' range [one notable exception reported by Berg and Kuehn (1982) moved southwestward]. Translocated problem wolves also avoided leaving the main species range (Fritts *et al.*, 1984). Minnesota wolves seem to strongly prefer the cover of a forested environment (Fritts and Mech, 1981). Most are reluctant to traverse large areas of open cropland and pastureland, and when they have been known to do so, movement was rapid (Fritts, pers. observ.). Occupied habitat at the edge of the species' range consists of "islands" of forest (Berg and Kuehn, 1982; Fritts, pers. observ.; Fuller *et al.*, 1992; W. J. Paul, pers. comm.). Minnesota wolves that traveled as far as the Dakotas therefore were very atypical dispersers in the sense that large expanses of open landscape did not deter them.

Our data indicate that radically different habitat types are not necessarily a hindrance to dispersal and gene flow in wolves. This is consistent with the newest subspecific arrangement that places wolves from the Great Lakes to the west coast of the U.S. in the same subspecies (Nowak, *in press*—compare with Hall, 1981) and with the view that significant local differentiation of characteristics in wolf populations is unlikely because of the high mobility of the species, at least historically (Brewster and Fritts, *in press*; Wayne *et al.*, 1992).

These data, when combined with other records of wolves taken outside forested habitat in the northern U.S. and southern Canada in the last half-century, demonstrate that wolves have considerable plasticity in dispersal strategies to adjust to new environmental opportunities (Gese and Mech, 1991). If not for killing by humans, wolves would eventually recolonize the prairie regions of the Dakotas. Realistically, however, the high road and human densities in the eastern portion of the Dakotas suggests that the rate of human-caused wolf mortality will remain high. The western portion of the Dakotas provides low road and human densities; however, the nonforested habitat throughout makes wolves highly vulnerable to humans. In addition, the high cattle densities create an environment with a high potential for conflicts (Fritts *et al.*, 1992), increasing the likelihood of human-caused wolf mortality. For these reasons, pack formation and colonization are unlikely throughout the prairie regions of the Dakotas despite the regular occurrence of wolves dispersing into the region from adjoining states and provinces.

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