Relationship between Winter Severity and Wolf Depredations on Domestic Animals in Minnesota

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Source: *Wildlife Society Bulletin (1973-2006)*, Vol. 16, No. 3 (Autumn, 1988), pp. 269-272
Published by: Wiley on behalf of the Wildlife Society
Stable URL: https://www.jstor.org/stable/3782098
Accessed: 14-06-2019 15:29 UTC

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Appendix B. Age-class ratios of reported human-caused mortality of grizzly bears in the Northern Continental Divide Ecosystem, Montana, 1967–1986.

Cause of death	Age class	Year																			
		67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	Total
Hunting	Adult	0	1	15	5	8	9	5	7	6	5	2	3	7	9	5	8	2	6	2	1	106
	Subadult	0	4	8	4	5	5	9	9	7	6	3	4	4	2	6	9	5	6	3	4	103
	Unknown	22	4	5	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	33
Illegal	Adult	1	1	0	0	1	2	1	2	4	0	0	2	2	2	2	1	1	2	1	1	26
	Subadult	0	1	1	1	0	3	1	1	2	3	1	2	2	0	0	2	1	3	1	2	27
	Unknown	0	0	0	2	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	4
Mistaken identity	Adult	0	0	0	0	0	0	1	0	0	1	0	0	1	1	1	0	2	0	0	0	7
	Subadult	0	0	0	0	0	0	1	1	0	1	0	0	0	0	0	1	2	0	1	0	7
Control	Adult	6	4	3	1	2	3	1	0	0	3	3	1	2	6	0	0	0	1	3	1	40
	Subadult	0	2	4	4	3	6	1	4	1	2	2	1	1	3	3	2	0	1	2	3	45
	Unknown	7	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	9
Accident	Adult	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	2
	Subadult	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	1	1	2	1	7
Native	Adult	0	0	1	0	0	0	1	7	0	0	0	0	0	0	0	0	0	0	0	0	9
	Subadult	0	0	2	0	0	1	1	5	1	0	0	0	0	0	0	0	0	0	0	0	10
	Unknown	4	0	0	0	3	0	2	0	0	0	1	0	0	0	0	0	0	0	0	0	10
Total		40	17	39	18	22	30	24	37	22	23	12	13	19	23	17	24	15	20	16	14	445

***Wildl. Soc. Bull.* 16:269–272, 1988**

RELATIONSHIP BETWEEN WINTER SEVERITY AND WOLF DEPREDATIONS ON DOMESTIC ANIMALS IN MINNESOTA

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Wolves (*Canis lupus*) prey on domestic animals in Minnesota primarily from May through October, and the extent of depredation varies considerably from year to year (Fritts 1982). However, no reason for this variation has yet been apparent.

White-tailed deer (*Odocoileus virginianus*) fawns are the primary summer prey of wolves in Minnesota (Frenzel 1974, Van Ballenberghe et al. 1975, Fritts and Mech 1981, Nelson and Mech 1986). Vulnerability of fawns is at least partly a direct function of the previous winter's

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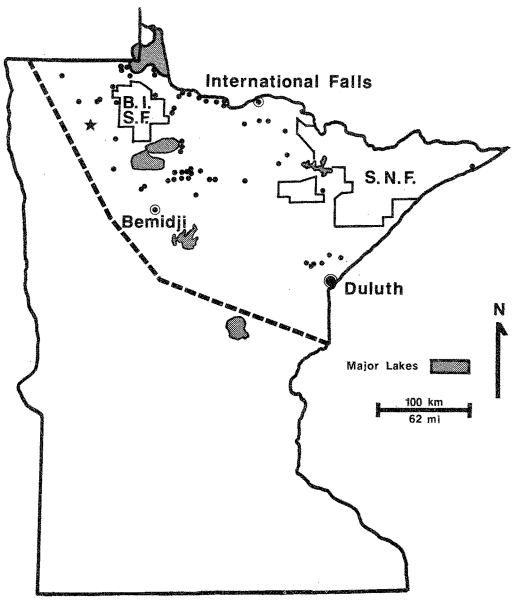

Fig. 1. Minnesota wolf range (north of dashed line), distribution of wolf depredations on livestock (dots), and locations for winter severity indexes (Int. Falls and Agassiz Natl. Wildl. Refuge [star]), 1979–1986. B.I.S.F. indicates the Beltrami Island State Forest, and S.N.F. the Superior National Forest.

severity (Mech and Karns 1977, Mech et al. 1987) because of prenatal nutritional influences (Verme 1962). Beavers (*Castor canadensis*) are a secondary prey of wolves, and the number taken is also related inversely to severity of the previous winter (L. D. Mech, unpubl. data). Wolves likely resort to secondary prey when primary prey is less available or vulnerable. If so, domestic animals may constitute secondary prey, and may be killed at a higher frequency when deer fawns are less available. No direct data on fawn vulnerability are available to test this idea, but data are available for winter severity.

Our hypothesis was that wolf depredation on domestic animals is inversely related to winter severity. A significant inverse relationship between measures of domestic animal depredation and winter severity would support this hypothesis and would be consistent with our explanation that wolves take domestic animals inversely to the availability of deer fawns. Another explanation would be that snow remains longer after severe winters, and farmers keep livestock confined later, reducing losses to wolves. To distinguish between these 2 explanations, we separated measures of depredation into different periods and tested the relationship between data for each period and severity of the previous winter. Because fawns are born in late May and early June, negative relationships for months before June would support the alternative explanation; those found for June and following months would support the original hypothesis.

STUDY AREA AND METHODS

Wolves prey on domestic animals throughout the 59,900-km^2 wolf range in the northern third of Minnesota, but most depredations occur in north-central and northwestern Minnesota (Fig. 1). In much of the region, farms are surrounded by forests, and many pastures are brushy or wooded. In 1979 there were approximately 12,230 farms, 234,000 cattle, 91,000 sheep, and other miscellaneous livestock within the wolf range (Fritts 1982). The last estimate of wolf numbers indicated about 1,200 (Berg and Kuehn 1982).

We correlated several related measures of wolf depredation on domestic animals in northern Minnesota with severity of the previous winter from 1979 through 1986. Measures of wolf depredations included (1) complaints of depredation involving both livestock and pets received by the federal government each year, (2) complaints received for depredations on livestock only, (3) confirmed wolf depredations on livestock and pets, (4) confirmed wolf depredations on livestock only, (5) number of individual complainants, (6) number of farms where livestock losses were confirmed, (7) number of cattle and sheep reported lost to wolves, (8) number of cattle and sheep confirmed lost to wolves, and (9) compensation paid for livestock lost to wolves. The winter severity index (WSI; Verme 1968) computed by the Minnesota Department of Natural Resources was averaged for 2 locations in the livestock-depredation region, International Falls and Agassiz National Wildlife Refuge at opposite ends of the region (Fig. 1).

RESULTS AND DISCUSSION

Results of correlation analyses supported our hypothesis that wolf depredation on domestic animals was inversely related to severity of the previous winter. Correlation coefficients (r) ranged from -0.71 ($P < 0.05$) to -0.84 ($P <$

Table 1. Number of confirmed complaints of wolf depredations on domestic animals in Minnesota and relationships with severity of previous winters, 1979–1986.

Year	WSI[a]	Jan–Apr	May	Jun	Jul	Aug	Sep	Oct–Dec	Total
1979	147	0	5	2	1	4	2	2	16
1980	124	1	5	5	4	8	1	4	28
1981	91	4	5	6	13	14	12	6	60
1982	132	1	5	3	6	7	7	5	34
1983	89	6	7	9	5	5	6	2	40
1984	118	0	6	7	8	9	2	3	35
1985	108	5	2	5	11	5	5	6	39
1986	140	3	5	3	2	8	5	4	30
r		−0.74	−0.14	−0.86	−0.72	−0.36	−0.56	−0.24	−0.84
P		0.02	0.76	0.01	0.04	0.38	0.14	0.56	0.01

[a] Mean of winter severity index (WSI) at International Falls and Agassiz National Wildlife Refuge (Fig. 1).

0.01) for the 9 variables tested. The strongest relationship was for total confirmed complaints of wolf depredations on domestic animals (Table 1), 93% of which were livestock; other losses involved pets. The *r*-values for periods throughout the year supported both of our explanations. For January–April the strongest inverse relationship (Table 1) could have resulted from the known dependence between last snow melt and the release of livestock onto open range. After May, *r*-values are consistent with the explanation that wolves kill domestic animals inversely to the availability or vulnerability of deer fawns. The lack of a significant relationship in May also is consistent with both explanations because livestock are always on open range in May regardless of winter severity, and deer fawns are not born until late May and early June.

Further evidence for the fawn-vulnerability explanation was found in the decreasing *r*-values after June (Table 1), because deer fawns are most vulnerable immediately after birth in late May and June. Thus the influence of the previous winter's severity would become increasingly diluted as each month passes, and the degree of the relationship would dwindle.

We recognize that our analyses do not confirm cause and effect. Conceivably some other factor, related or unrelated to vulnerability of deer fawns, could be the actual cause of the relationship. Regardless of the explanation, the relationship we have found allows agencies responsible for the control of wolf depredation to anticipate the relative magnitude of wolf depredations in a given year and plan their programs and personnel accordingly.

Acknowledgments.—This study was supported by the U.S. Fish and Wildlife Service. We thank R. M. McRoberts for statistical advice, P. D. Karns of the Minnesota Department of Natural Resources for use of the winter severity index, and the Department of Agriculture (APHIS) for use of the 1986 data.

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Received 22 January 1987.
Accepted 26 April 1988.

***Wildl. Soc. Bull.* 16:272–277, 1988**

CHANGES IN WINTER DISTRIBUTION OF THE ROCKY MOUNTAIN CANADA GOOSE POPULATION

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Sixteen Canada goose (*Branta canadensis*) populations are recognized in North America; 14 either are stable or have increased in recent years (Can. Wildl. Serv. [CWS] and U.S. Fish and Wildl. Serv. [FWS] 1986). The dusky (*B. c. occidentalis*) and cackling (*B. c. minima*) populations of the Pacific Flyway are exceptions as both have declined recently. The North American Waterfowl Management Plan currently states goals for Canada goose management primarily in terms of winter population indices (2 populations have goals for breeding birds) without reference to winter distribution (CWS and FWS 1986:7). However, major changes in the distribution of Canada goose populations have occurred. For example, Raveling (1978) showed that changes in winter distribution of giant Canada geese (*B. c. maxima*) nesting in southern Manitoba resulted from overharvest of birds that migrated the farthest south. A study of Atlantic Flyway Canada geese emphasized the importance of social behavior and traditional use of habitats and documented a shift in winter distribution (Trost and Malecki 1985). Recent studies in the Mississippi Flyway (Humburg et al. 1985, Rusch et al. 1985) focused on the importance of social ties in geese, demonstrated the values of monitoring distribution, and described the difficulties of redistributing geese in fall and winter.

Krohn and Bizeau (1980) analyzed >19,000 band recoveries to define the range of the Rocky Mountain Canada goose population (RMP) of the western Canada goose (*B. c. moffitti*), but were unable to examine temporal changes in population size and distribution. Delineation of the RMP and reference areas (Krohn and Bizeau 1980) created a format for tabulating winter counts that allows distribution changes to be detected. We now examine the winter distribution and size of the RMP from 1966 to 1984 using an approach similar to that of Trost and Malecki (1985). We also reviewed information on all North American Canada goose populations to assess changes in winter distribution.

METHODS

We obtained estimates of retrieved harvest, immature to adult ratios in the harvest, and January counts of geese wintering within the RMP's range, 1966–1984,