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Wolf Population in the Central Superior National Forest, 1967-1985

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Aerial radio-tracking and observation showed total number of wolves per year in 2,060-km^2 area varied from 35 to 87 in winter and from 30 to 78 in spring and generally declined because of a decreasing deer herd. Since winter 1977-1978, the population has remained relatively stable because an increasing proportion of it has switched to preying on moose. The number of wolves preying on deer has continued to decline.

KEY WORDS: Deer, moose, territoriality, home range, radio-tracking, telemetry, predator, prey, Minnesota.

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WOLF POPULATION IN THE CENTRAL SUPERIOR NATIONAL FOREST, 1967-1985

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Large carnivores are long-lived. Wolves (*Canis lupus*), for example, can live some 16 years in captivity (Young 1944) and at least 13 years in the wild (Mech 1981). Thus a complete understanding of their ecology and population dynamics requires long-term investigations. The longest study of wolf numbers has been conducted in Isle Royale National Park, Lake Superior, where wolves have been censused annually since 1959 (Mech 1966, Jordan *et al.* 1967, Peterson 1977, Peterson *et al.* 1984). That study has yielded several new insights into wolf and prey relationships (Allen 1979, Peterson *et al.* 1984). However, Isle Royale is a 544-km^2 island with the wolves living on a moose (*Alces alces*) economy. Thus it is useful to study wolf numbers in a larger, mainland ecosystem with a more complex prey base.

In 1966 such an investigation was begun in the central Superior National Forest of northeastern Minnesota. This area had the added advantage of background data from other studies (Olson 1938, Stenlund 1955). Earlier results of the present study have been reported (Mech 1973, 1977), but the present document summarizes the data from 1967 through 1985.

STUDY AREA

The present study area encompasses some 2,060 km^2 immediately east of Ely in the east-central Superior National Forest (48°N, 92°W). Although somewhat smaller than the areas reported on earlier, this study area encompasses the core of that region in which I have been able to monitor the wolf population during the entire 19-year period (fig. 1). The area represents approximately 3 percent of the total wolf range in Minnesota.

The topography varies from large stretches of swamps to rocky ridges, with altitudes ranging from 325 to 700 meters above sea level. Winter temperatures lower than −35°C are not unusual, and snow depths (usually from about mid-November through about mid-April) generally range from 50 to 75 cm on the level. Summer temperatures rarely exceed +35°C. Conifers predominate in the forest overstory, with the following species present: jack pine (*Pinus banksiana* Lamb.), white pine (*P. strobus* L.), red pine (*P. resinosa*), black spruce (*Picea mariana* (Mill.) B.S.P.), white spruce (*P. glauca* (Moench) Voss), balsam fir (*Abies balsamea* (L.) Mill.), white cedar (*Thuja occidentalis* L.), and tamarack (*Larix laricina* (DuRoi) K. Koch). However, as a result of extensive cutting and fires much of the conifer cover is interspersed with large stands of white birch (*Betula papyrifera* Marsh.) and aspen (*Populus tremuloides* Michx.). Detailed descriptions of the forest vegetation were presented by Ohmann and Ream (1969).

In the northeastern half of this study area, as well as in the region immediately north and east of it, the

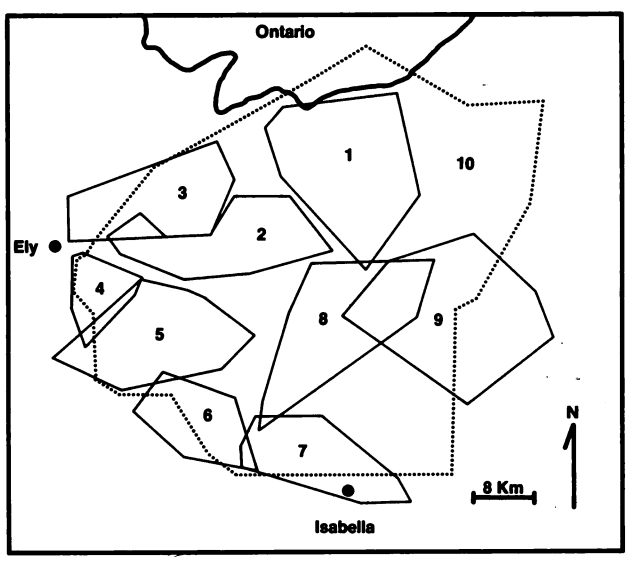

Figure 1.—*Wolf census area (2060 km^2 in the central Superior National Forest of northeastern Minnesota. Outlined, numbered areas represent minimum wolf pack territory boundaries for winter 1984-1985 as follow: 1, Ensign L. Pack; 2, Pagami Pack No. 2; 3, Wood L. Pack; 4, Birch L. Pack; 5, Little Gabbro Pack; 6, Jackpine Pack No. 4; 7, Sawbill Pack; 8, Quadga L. Pack No. 2; 9. Maniwaki L. Pack No. 2; 10, Malberg L. Pack (approximate territory because pack was not radioed in 1984-85).*

overwintering population of white-tailed deer (*Odocoileus virginianus*) were depleted about 1975 by a combination of a series of severe winters, maturing vegetation, and high wolf numbers (Mech and Karns 1977). Moose inhabit the entire study area but occur at a higher density in the northeastern half (Peek *et al*. 1976). In spring, some 32 percent of the deer inhabiting the southwestern half of the study area migrate into the northeastern half or beyond and return in fall (Hoskinson and Mech 1976, Nelson and Mech 1981, 1986). Beaver (*Castor canadensis*) are available throughout the study area, but generally only from about April through November because of ice during the rest of the year. Although all three prey species are consumed by wolves in the region (Frenzel 1974), since about 1975 the primary prey of wolves inhabiting the northeastern half has been moose, whereas those in the southwestern half have consumed primarily deer (Mech, unpublished).

Year-around hunting and trapping of wolves was legal until October 1970 when they were fully protected on federal land within the Superior National Forest by the U.S. Forest Service. In August 1974, wolves were protected by the Endangered Species Act of 1973. In 1978, the wolf in Minnesota was reclassified from endangered to threatened but remains legally protected except when taken by U.S. Fish & Wildlife Service agents reacting to depredations on livestock outside the present study area. However, in parts of the study area adjacent to towns (fig. 1), moderate illegal taking continues, primarily in fall and winter (Mech 1977, and unpublished).

METHODS

The primary technique used in this investigation has been live-trapping wolves, outfitting each with a radio-collar, aerially radio-tracking them at least once per week from April through November and at least twice per week from December through March, and aerially observing and counting them as often as possible, primarily from December through April (Mech 1974). The maximum number of wolves seen in each pack during December through February is considered the winter pack size, and the maximum seen in each pack in March and April represents the spring pack size (Mech 1973).

Pack territories based on radio locations were delineated for each radioed pack in the study area each year. The existence of nonradioed packs in the study area in any year were inferred from voids in the maps of the territorial mosaic. Incidental observations of nonradioed packs in these voids were used to represent sizes of these nonradioed packs. If such data were unavailable in a given year, pack-size estimates were made subjectively based on previous and later year's data for radioed packs occupying those territories. Data from before 1968 were based solely on observations of nonradioed packs during intensive aerial observation of the area.

In this estimate of wolf population trend, the number of lone wolves was considered inconsequential because their proportion of the population was low. During the earlier part of the present study, lone wolves were estimated at 7-14 percent of the population (Mech 1973), and loners comprised 16 percent of 282 wolves captured in and around the present study area (Mech unpublished).

Some data pertaining to individual pack years in the present article may differ from data presented previously (Mech 1973, 1977) because of reinterpretation of the data based on additional experience with these packs. Furthermore the wolf population trend may also vary slightly from previous publications because of the difference in the precise boundaries of the study areas considered. Nevertheless, the earlier results remain basically the same in the present study.

RESULTS

Some 250 wolves representing up to 13 packs in this study area were radio-tagged and studied from 1968 through 1985 (table 1). The number of radioed packs in the study area each winter and spring ranged from 1 to 8. Each radioed wolf was located an average of approximately 38 times per year, and they and their pack members were observed an average of approximately 18 times per year. Pack sizes varied from 2 to 15 during winter and from 2 to 11 during spring. Some packs disappeared as determined by the individual histories of radioed members of those packs (Mech unpublished). Sometimes their places were taken by new colonizing packs which may or may not have settled in precisely the same territories. A pack occupying a general area inhabited earlier by a radioed pack was usually listed under the same name (table 1) even though continuity via overlapping radio tenures was not always documented.

Generally the wolf population increased each year up to 86 percent from spring to winter as a result of reproduction, although during two summers wolf numbers actually decreased (table 2). From winter to spring the population decreased as much as 40 percent per winter as a result of mortality (Mech 1977) and dispersal (Mech in press).

The total number of wolves in the census area in winter varied from 35 to 87 and in spring, from 30 to 78 over the 19-year period, and generally declined (fig. 2). However, about 1978 wolves began recoloniz-

Table 1.—*Number of wolves in each pack in the east-central Superior National Forest study area*

	Packs																										Totals			
	Birch Lake		Ensign Lake		Little Gabbro		Greenstone Lake		Harris Lake		Jackpine		Manitwaki		Malberg Lake		Pagami Lake		Quadga Lake		Sawbill		Sumpet Lake		Thomas Lake		Wood Lake		Entire study area		On deer economy only	
Winter	W	S[1]	W	S	W	S	W	S	W	S	W	S	W	S	W	S	W	S	W	S	W	S	W	S	W	S	W	S	W	S
1966-1967	(6)[2]	6	7	–	0	0	(4)	–	(5)	–	(6)	–	8	8	0	0	6	–	(6)	–	(4)	–	(9)	–	(5)	–	5	–	71	–	71	–
1968	(6)	–	(11)	–	0	0	(4)	–	(5)	–	(6)	–	6	–	0	0	(6)	–	(6)	–	(4)	–	(9)	–	5	–	(6)	–	74	–	74	–
1969	(6)	–	(11)	–	0	0	4	–	5[3]	5	(6)	–	10	7	0	0	(6)	–	(6)	–	6	–	(10)	–	6	–	6	–	82	–	82	–
1970	(6)	–	(11)	–	0	0	(4)	–	(7)	4	6	5	14	(7)	0	0	(6)	–	(6)	–	(4)	–	(10)	–	(6)	–	(6)	–	87	–	87	–
1971	(6)	(6)	(11)	11	2	2	5	5	9	6	7	6	7	(7)	0	0	6	6	6	6	3	2	(10)	(10)	(6)	6	(6)	5	84	78	84	78
1972	(6)	(5)	15	9	0	0	4	3	3	2	9	6	9	7	0	0	5	3	5	4	5	3	(10)	(9)	5	5	(6)	(4)	82	60	82	60
1973	6	(6)	10	5	0	0	6	3	4	4	7	6	9	3	0	0	0	0	2	2	4	(4)	(9)	(6)	7	0	(6)	3	70	42	70	42
1974	6	(6)	8	4	0	0	6	(4)	4	2	10	3	8	(6)	0	0	0	0	3	3	6	5	8	6	0	0	6	(3)	65	42	65	42
1975	(6)	(6)	3	2	0	0	7	5	2	2	1	1	9	9	0	0	0	0	6	5	3	3	(5)	3	0	0	2	2	44	38	44	38
1976	(6)	(6)	2	2	0	0	3	(2)	5	5	1	1	13	11	0	0	0	0	6	5	9	7	2	1	0	0	9	8	56	48	56	48
1977	6	5	4	2	0	0	0	0	5	3	(1)	(1)	9	(7)	0	0	0	0	4	4	6	5	0	0	0	0	8	6	45	33	45	33
1978	4	3	(8)	2	2	2	0	0	5	4	(1)	(1)	(9)	(7)	2	3	0	0	7	6	9	6	0	0	0	0	3	3	50	37	48	34
1979	3	2	(8)	(6)	5	(3)	0	0	2	2	(1)	(1)	(9)	(7)	(7)	(7)	0	0	0	0	(7)	(5)	0	0	0	0	4	(3)	46	35	39	29
1980	2	2	12	11	7	3	0	0	2	2	2	2	(9)	(7)	(7)	(6)	0	0	0	0	(7)	(5)	0	0	0	0	(6)	(6)	54	44	47	38
1981	3	3	(7)	(7)	2	2	0	0	2	2	5	2	9	(7)	(7)	(6)	0	0	0	0	5	4	0	0	0	0	8	8	48	41	41	35
1982	2	2	2	(2)	2	2	0	0	2	2	2	2	8	(7)	11	11	0	0	3	(3)	(6)	(5)	0	0	0	0	9	8	47	44	36	33
1983	2	2	6	(4)	5	(4)	0	0	2	2	(4)	2	3	1	12	11	0	0	(3)	3	6	(3)	0	0	0	0	7	5	50	37	38	26
1984	2	2	3	(2)	4	4	0	0	(2)	(2)	2	2	(0)	(0)	12	10	0	0	3	2	5	4	0	0	0	0	2	2	35	30	23	20
1985	5	4	7	(6)	5	4	0	0	0	0	4	3	6	7	(6)	(5)	6	3	5	3	(5)	(4)	0	0	0	0	5	(4)	54	43	30	22

[1]W = winter; S = spring.

[2]Numbers in parenthesis are subjective estimates.

[3]Underlined numbers indicate radio-tagged packs. Other figures are based on observations or tracks of non-radioed packs.

Table 2.—*Wolf population changes in the central Superior National Forest, based on data from table 1*

Year	Percent change in total numbers in study area				Percent change in wolf numbers on deer economy in study area			
	Winter to spring	Spring to next winter	Winter to winter	Spring to spring	Winter to spring	Spring to next winter	Winter to winter	Spring to spring
1967-1968	–	–	+4	–	–	–	+4	–
1969	–	–	+11	–	–	–	+11	–
1970	–	–	+6	–	–	–	+6	–
1971[1]	-7	+5	-3	–	-7	+5	-3	–
1972	-27	+17	-2	-23	-27	+17	-2	-23
1973	-40	+55	-15	-30	-40	+55	-15	-30
1974	-35	+5	-7	00	-35	+5	-7	00
1975	-14	+47	-32	-10	-14	+47	-32	-10
1976	-14	-6	+27	+26	-14	-6	+27	+26
1977	-27	+52	-20	-31	-27	+45	-20	-31
1978	-26	+24	+11	+12	-29	+15	+7	+3
1979	-24	+54	-8	-5	-26	+62	-19	-15
1980	-19	+9	+17	+26	-19	+8	+21	+31
1981	-15	+15	-11	-7	-15	+3	-13	-8
1982	-6	+14	-2	+7	-8	+15	-12	-6
1983	-26	-5	+6	-16	-32	-12	+6	-21
1984	-14	+80	-30	-19	-13	+50	-39	-23
1985	-20	–	+54	+43	-27	–	+30	+10

[1]Insufficient data available before this time because packs were not radioed.

ing the northeastern part of the study area in which overwintering deer and deer-killing wolves were then absent (Mech and Karns 1977). The newly colonizing Malberg L. Pack increased to 12 members by 1983, preyed exclusively on moose during winter, and occupied some 20 percent of the study area.

In spring 1984, four members of the Malberg L. Pack, including radioed 2-year-old wolf 6417, apparently split from the remainder of the pack and colonized the southeastern half of the previous winter's territory, expanded southeastward, and increased to seven; this pack was renamed "Maniwaki L. Pack" because it occupied the territory of the former Maniwaki L. Pack which had died out the previous year.

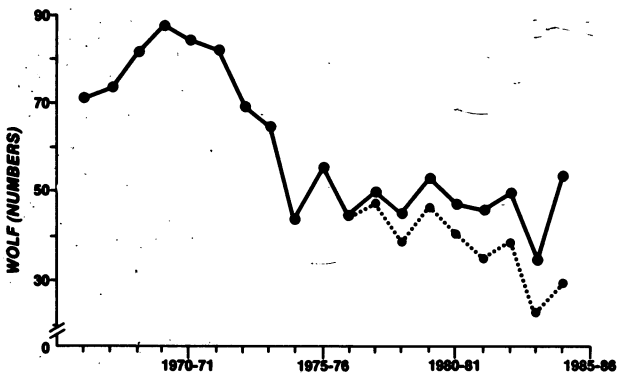

Figure 2.—*Wolf population trend in the central Superior National Forest during winter. Solid line indicates total population in the 2,060-km² study area. About 1976-1977, part of the population began preying primarily on moose during winter. The dotted line represents the trend in number of wolves continuing to prey on deer.*

The fate of the other six members of the original Malberg L. Pack is unknown, except that pups were produced in the north end of the territory, so the pack probably persisted.

Meanwhile by winter 1984-1985, a pack of five including pups, was colonizing the southwestern 20 percent of the 1983-1984 Malberg L. Pack territory and expanding southwestward (Quadga Lake Pack). In addition, the Ensign L. Pack, radioed in spring 1984, numbered seven animals by winter 1984-1985, and preyed primarily on moose. The last time a pack in that area had been radio-tagged (winter 1979-1980) they had migrated out of their territory during winter and preyed on deer several miles westward.

The result of the wolf population's partial switch to a moose economy from 1978 through 1985 was to allow the total population of the study area to remain relatively stable during that period (fig. 2). Meanwhile, the number of deer-killing wolves in the study area continued to decline, although both this subpopulation and the entire population of the study area increased from 1984 to 1985 (fig. 2).

DISCUSSION AND CONCLUSION

The wolf population decline in this study area resulted from a decrease in the wolf's main prey, the white-tailed deer (Mech and Karns 1977). The deer decline ended about 1977, and since then the population has remained low although relatively stable (Nelson and Mech 1986). Nevertheless the wolf population on a deer economy continued to decline for several more years (fig. 2). This fact seems to indi-

cate that at low deer numbers wolves are unable to kill enough deer to enable the wolves to maintain their numbers. Further evidence is found in the switching of part of the wolf population to a moose economy which allowed the wolf population to stabilize in the study area at a density of about 2.3 per 100 km ^{2} for several years (fig. 2).

It is unknown whether the wolves colonizing the deer-free area in 1978 dispersed from packs on a deer economy and then learned to exploit moose, or whether they came from a moose-killing population to the north. Wolves can disperse distances of at least 866 km (Fritts 1983), but it apparently took several years for wolves to fill the void in the northeastern part of the study area (Mech unpublished) even though dispersers were available from deer-killing wolves to the west and south (Mech in press). The second alternative seems more likely. Although wolves that prey primarily on deer can learn to kill moose (Mech unpublished), there was no indication that this process took place in the northeastern part of the study area.

The wolf population trend in this study area does not necessarily apply to surrounding regions or to the remaining 97 percent of Minnesota wolf range. Because the deer decline itself was localized to the immediate vicinity of the study area (Mech and Karns 1977), wolves throughout most of the rest of their Minnesota range almost certainly were not similarly affected.

Switching of part of the wolf population to a moose economy minimized the effects of a drastic deer decline on wolf numbers. Although extreme fluctuations in both wolves and prey can occur in wolf-moose systems (Peterson *et al*. 1984), the presence of the white-tailed deer as an alternate prey in this study area should help stabilize wolf numbers.

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LITERATURE CITED

Allen, D. L. Wolves of Minong. Boston: Houghton Mifflin Co.; 1979. 499 p.

Frenzel, L. D. Occurrence of moose in food of wolves as revealed by scat analyses: a review of North American studies. Naturaliste Can. 101: 467-479; 1974.

Fritts, S. H. Record dispersal by a wolf from Minnesota. J. Mammal. 64: 166-167; 1983.

Hoskinson, R. L.; Mech, L. D. White-tailed deer migration and its role in wolf predation. J. Wildl. Manage. 40: 429-441; 1976.

Jordan, P. A.; Shelton, P. C.; Allen, D. L. Numbers, turnover, and social structure of the Isle Royale wolf population. Am. Zool. 7: 233-252; 1967.

Mech, L. D. The wolves of Isle Royale. Fauna ser. 7. Washington, DC: U.S. National Park Service, 1966. 210 p.

Mech, L. D. Wolf numbers in the Superior National Forest of Minnesota. Res. Pap. NC-97. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station; 1973. 10 p.

Mech, L. D. Current techniques in the study of elusive wilderness carnivores. Int. Conf. Game Biol. Proc. 11: 315-322; 1974.

Mech, L. D. Natality, mortality, and population trend of wolves in northeastern Minnesota. J. Mammal. 58: 559-574; 1977.

Mech, L. D. A decade of data from a single wolf. Endangered Species Tech. Bull. 6: 4; 1981.

Mech, L. D. Age, season, and social aspects of wolf dispersal from a Minnesota pack. In: Chepko-Sade, B. D.; Halpin, Z., eds. Proceedings, Symposium on patterns of dispersal among mammals and their effects on the genetic structure of populations; in press.

Mech, L. D.; Karns, P. D. Role of the wolf in a deer decline in the Superior National Forest. Res. Pap. NC-148. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station; 1977. 23 p.

Nelson, M. E.; Mech, L. D. Deer social organization and wolf predation in northeastern Minnesota. Wildl. Monogr. 77; 1981. 53 p.

Nelson, M. E.; Mech, L. D. Deer population in the central Superior National Forest, 1967-1985. Res. Pap. NC-271. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station; 1986. 7 p.

Ohmann, L. F.; Ream, R. R. Vegetation studies in the BWCA - a brief report on plant communities. Naturalist 20: 20-29; 1969.

Olson, S. F. A study in predatory relationship with particular reference to the wolf. Sci. Monthly 46: 323-336; 1938.

Peek, J. M.; Urich, D. L.; Mackie, R. J. Moose habitat selection and relationship to forest management in north-eastern Minnesota. Wildl. Monogr. 48: 65 p.; 1976.

Peterson, R. O. Wolf ecology and prey relationships on Isle Royale. Sci. Monogr. Ser. II. U.S. National Park Service; 1977. 210 p.

Peterson, R. O.; Page, R. E.; Dodge, K. M. Wolves, moose, and the allometry of population cycles. Science 224: 1350-1352; 1984.

Stenlund, M. H. 1955. A field study of the timber wolf (Canis lupus) on the Superior National Forest, Minnesota. Tech. Bull. 4. St. Paul, MN: Minnesota Department of Conservation, 1955. 55 p.

Young, S. P. The wolves of North America, Part I. Washington, DC: Am. Wildl. Inst.; 1944. 385 p.