United States
Department of
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North Central
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Research
Paper NC-271

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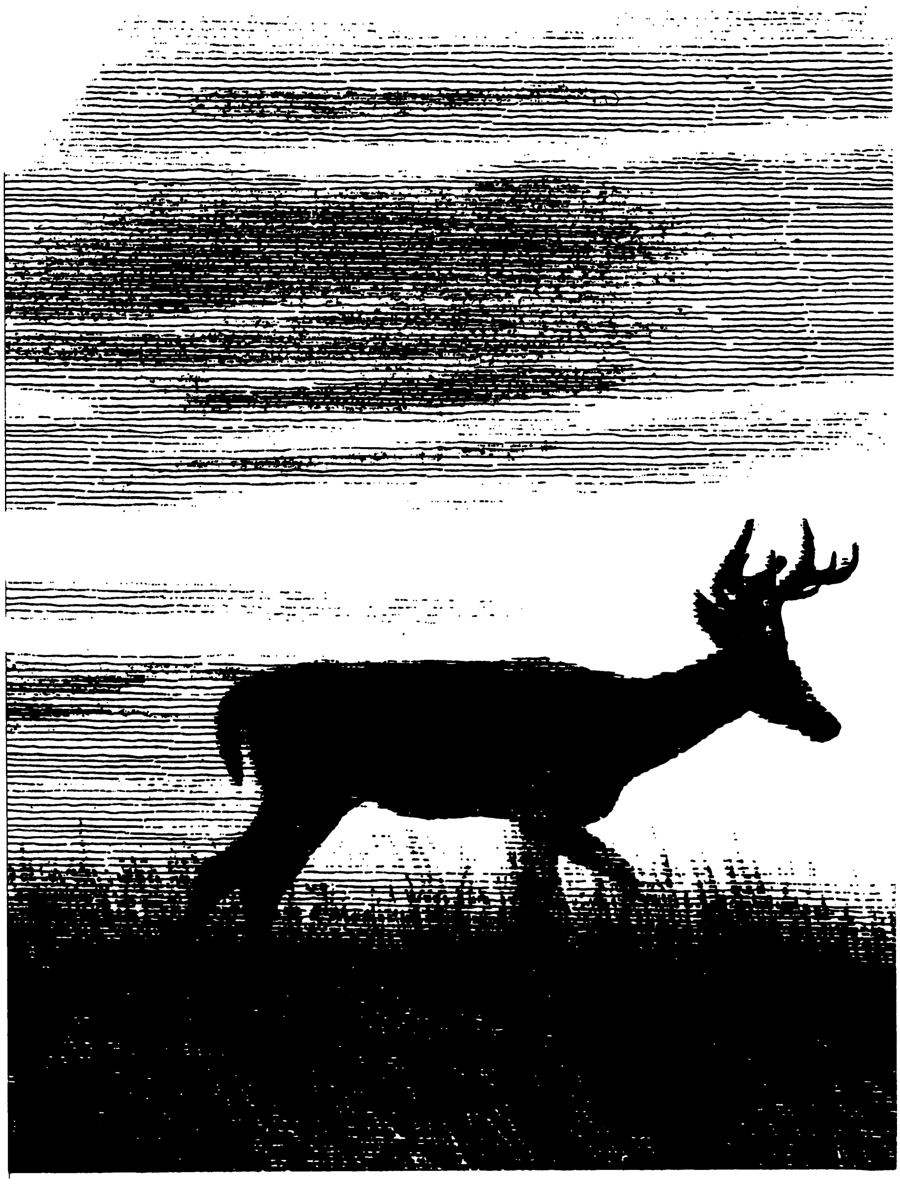

North Central Forest Experiment Station
Forest Service—U.S. Department of Agriculture
1992 Folwell Avenue
St. Paul, Minnesota 55108
Manuscript approved for publication February 6, 1986
1986

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

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White-tailed deer (*Odocoileus virginianus*) are an important wildlife resource of the Superior National Forest (SNF). They are not only prized as a game animal by hunters but also highly valued as part of the outdoor experience when viewed by tourists (Lime and Cushwa 1969). Also, deer in this area are the primary prey of the wolf (*Canis lupus*) (Mech and Frenzel 1971), a species classified by the Federal government as threatened in Minnesota. Thus it is important to monitor deer numbers and population trend in the SNF. It is not technically or economically feasible to census deer over large areas of mixed forest, so smaller areas must be used. This report documents the deer population trend from 1976 through 1985 in a part of the central region of the SNF and compares the recent trend with past estimates.

THE STUDY AREA

A main winter concentration area for deer in the central part of the Superior National Forest is the 27 km² Isabella deeryard located 6 km northwest of

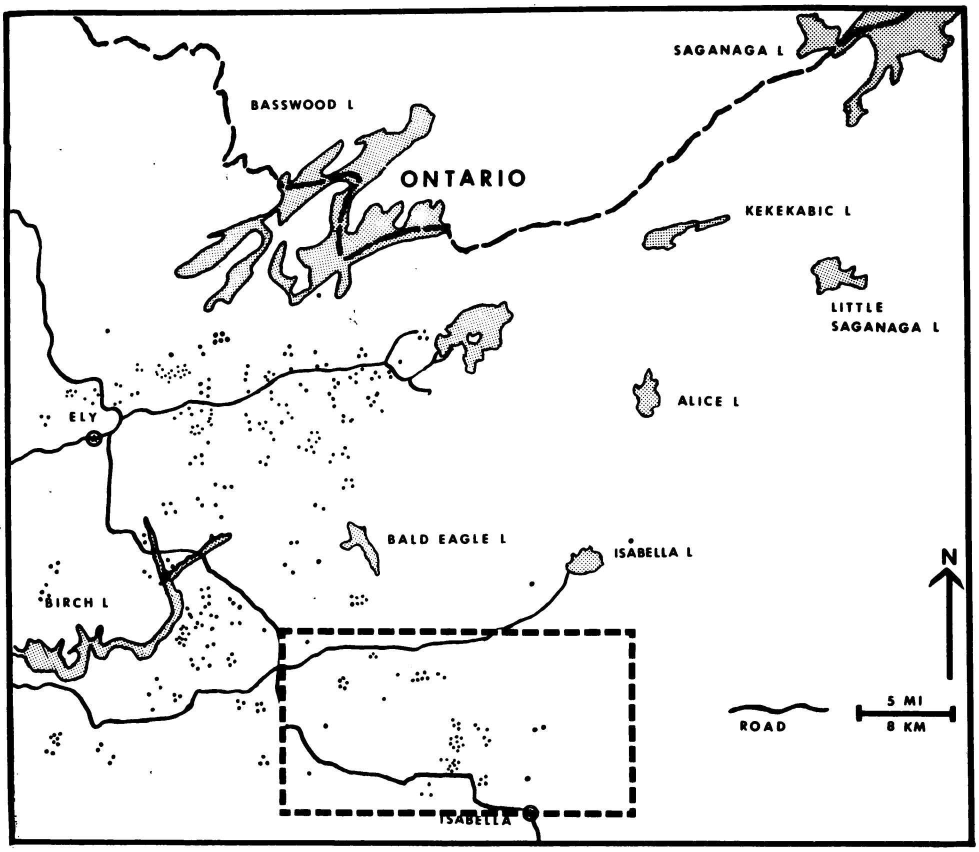

Figure 1.—*Approximate deer distribution, winters 1975-1976 through 1977-1978 based on deer observed from aircraft during wolf radio-tracking. Each dot represents one deer sighting. Dashed zone is the deer census area. Deer seen during censuses are not shown.*

the town of Isabella (Nelson and Mech 1981, In press). In 1976 a 400-km^2 study area was delineated in this region for monitoring deer numbers (fig. 1). The area is characterized by gently rolling terrain (400 to 700 m elevation). The climate is cool-temperate (Hovde 1941), and snowfall averages more than 150 cm during the 5 months of winter, which begins in November. Snow depths range up to 1.1 m.

The vegetation of the study area is a mixture of maturing coniferous-deciduous forests, various aged conifer plantations and clear-cuts from ongoing logging. Aspen (*Populus* spp.), paper birch (*betula papyrifera*), balsam fir (*Abies balsamea*), red pine (*Pinus resinosa*), and jack pine (*Pinus banksiana*) predominate in the uplands. White and black spruce (*Picea glauca* and *mariana*) dominate the lowlands, which comprise less than 30 percent of the area. Much of the area has been logged since 1935 (Peek *et al*. 1976) and is still being logged intensively.

The forests within the Isabella deeryard are predominately aspen-balsam fir and provide an estimated 75 percent of the available winter cover. Mature jackpine (15 percent) and lowland spruce and cedar (*Thuja occidentalis*) (10 percent) comprise the remaining winter cover. During the last 10 years clear-cutting within the deeryard has removed at least 50 percent of the winter cover.

Since 1968, wolf numbers in the "wolf census area" (includes the deer study area and a larger region to the west, north, and northeast) have declined from about 4.2 to 1.7 per 100 km^2 (fig. 1). The 1984-1985 density was 2.6 per 100 km^2 (Mech 1986). Beginning about 1978, the wolves in the northeastern half of the wolf census area switched to killing moose (*Alces alces*), at least in winter. Excluding those animals, the wolves still eating deer in the wolf census area dropped to a density of 2.3 per 100 km^2 in 1978, and reached 1.5 per 100 km^2 in 1984-1985. About 19 percent of adult deer were preyed upon by wolves annually from 1973 through 1984 in this and surrounding areas, and annual yearling recruitment averaged about 30 percent (Nelson and Mech 1986b).

Deer have been hunted legally in the study area throughout the study, but only bucks have been legal since 1974. Mean annual hunting loss of yearling and adult bucks from 1973 through 1984 ranged from 28 to 34 percent (Nelson and Mech 1986b).

METHODS

The method used to census deer in this area since 1976 employed aerially observing deer on 1.6-km^2 sample plots during late winter combined with aerially tracking radio-collared deer to determine deer observability under census conditions (Floyd *et al*. 1979). From 1976 to 1980, we used the sampling procedure outlined by Floyd *et al* (1979), but from 1981 to 1985 all 1.6-km^2 plots containing deer in the study area were counted, generally from 13 to 18 plots comprising the Isabella deeryard. We attempted to use the same aircraft, pilot, and observer for as many years as possible. However, separate observers were used from 1976 to 1978, 1979, and 1980 to 1985, and seven pilots were employed during the study.

Observability factors were determined each year, except 1985, by using known numbers of radio-collared deer observable from the air within the study area or in similar areas nearby. We applied the observability factors in three ways: (1) using each annual factor with that year's data, (2) using the mean observability factors for all years with each individual year, and (3) using the mean observability factor for each observer with all of their respective observations. To gain some idea of how well the deer population trend in the study area represented the trend in the general region, we examined records of deer observed during radio-tracking of wolves in the wolf census area for each year of the study.

RESULTS

During the study, the number of deer observed ranged from 79 to 225 (appendix A) and observability ranged from 35 to 71 percent (table 1). Projected number of deer based on three measures of observability ranged from 158 in 1978 to 457 in 1984 (table 2).

All the deer in the study area concentrated in the Isabella deeryard during the winter (fig. 1), so the

Table 1.—*Correction factors for aerial censuses of deer in the Superior National Forest, Minnesota*

Year	Observer	Known collared deer	Collared deer seen	Proportion seen	Correction factor
		- - - - *Number*	- - - -		
1975-1976	A	16	9	0.56	1.78
1976-1977	A	8	4	.50	2.00
1977-1978	A	16	8	.50	2.00
1978-1979	B	31	11	.35	2.82
1979-1980	C	24	17	.71	1.41
1980-1981	C	10	4	.40	2.50
1981-1982	C	24	11	.46	2.17
1982-1983	C	9	6	.67	1.50
1983-1984	C	17	11	.65	1.54
1984-1985	C	no test done	-	-	-

Table 2.—*Aerial deer census of the Isabella study area, winters 1975-1976 through 1984-1985*[1]

Winter	Observer	Counted[2]	Observability Seen	Observability Correction	Projected number of deer Method[3] A	B	C
		Number	*Percent*				
1975-1976	A	155	56	1.78	276	315	298
1976-1977	A	131	50	2.00	262	266	251
1977-1978	A	79	50	2.00	158	161	186
1978-1979	B	91	35	2.82	258	185	258
1979-1980	C	118	71	1.41	166	240	204
1980-1981	C	112	40	2.50	283	228	194
1981-1982	C	99	46	2.18	216	202	171
1982-1983	C	115	67	1.50	173	234	200
1983-1984	C	225	65	1.54	346	457	389
1984-1985	C	125	-	-	-	254	216

[1]Sampled according to Floyd *et al.* (1979) from 1975-1976 through 1979-1980. All plots containing deer were counted from 1980-1981 through 1984-1985.

[2]First 5 years are projected from sample plots counted; last 5 years include all deer seen because complete count was made.

[3]A = number of deer counted x correction for the same year.
B = number of deer counted x mean correction for all observers for all years.
C = number of deer counted x mean correction for observer.

winter counts apply only directly to the 27-km^2 deeryard area. Winter densities ranged from 5.8 to 16.9 deer km^2 within the yard. During spring, the deer migrate out of the Isabella deeryard to summer ranges, generally northeast, north and northwest (Nelson and Mech 1981). About one-third of the radioed deer left the study area. We have no evidence that deer from other areas migrate into this study area. Thus an approximate summer density for the entire study area is from 0.3 to 0.7 deer km^2 during the study.

DISCUSSION

We are confident that most deer in the study area wintered in the Isabella deeryard even during mild winters. Radio-collared deer migrated to the deeryard during mild and severe winters alike, and weekly reconnaisance flights did not discover wintering deer elsewhere. Observations by loggers, foresters, and other biologists working in the area supported our observations. Radio-collared deer from two nearby deeryards also migrated from summer ranges each year regardless of severity of winter (Nelson and Mech 1981, and unpubl. data).

It is debatable which of our observability calculations best estimate the deer population. Regardless of whichever is used, however, the results are reasonably similar (table 2). They indicate that the deer decline in the late 1960's and early 1970's (Mech and Karns 1977) ended about winter 1977-1978 and that the deer population remained stable from then until it increased substantially in winter 1983-1984. Further evidence of the increase came from general observations at private artificial feeding operations in the Isabella deeryard and in the Garden Lake deeryard 38 km to the northwest; at the Garden Lake yard approximately twice as many deer were observed in 1984 as in any recent previous year.

The 1985 census probably underestimated deer because a new, less experienced pilot was used and snow conditions were marginal for counting. Thus the apparent decline from 1984 to 1985 may not have been as great as the data suggest.

Private artificial feeding began in the Isabella deeryard in 1982 and still continues. It is not known to what extent this has contributed to the increase in deer numbers. Artificial feeding increased productivity, body weights, and deer numbers in a semi-captive Michigan herd subject to similar climatic conditions (Ozoga and Verme 1982). However, in 1983 deer populations also increased outside our study area and in areas with no artificial feeding.

Conceivably, the mild winter of 1982-1983 could have contributed substantially to the deer increase the following year. Improved fetal development and thus increased fawn weights and survival are direct results of mild winters (Verme 1977). In addition, adult survival would have increased because wolves kill fewer deer in mild winters Nelson and Mech 1986a). Mortality from malnutrition would have been less also, although that was not a major cause of death during our study (Nelson and Mech 1986b).

The first quantitative data concerning deer numbers in the study area come from drive censuses conducted from 1936 through 1939 (Olson 1938, Fredine 1940). Drive counts of 2.6-km^2 plots by crews of 100 men ranged from 4 to 9 deer/km^2. Later, estimates for the surrounding area indicated that the population may have been approximately 3.5 deer/km^2 in 1953 (Stenlund 1955) and that it remained at about that order of magnitude through 1967-1968 (Mech, unpubl. data). The herd then declined drastically, and the present census apparently records the last few years of the decline. A gross approximation of the deer population trend in the study area for 1967-1985 is given in figure 2.

In the region northwest of the deer census area, the trend in complete loss of overwintering deer documented by Mech and Karns (1977) from 1968 through 1974 apparently continued for several more years. By winter 1977-1978, the few individuals left northeast of Bald Eagle Lake were gone as were those in the northern half of the Isabella study area

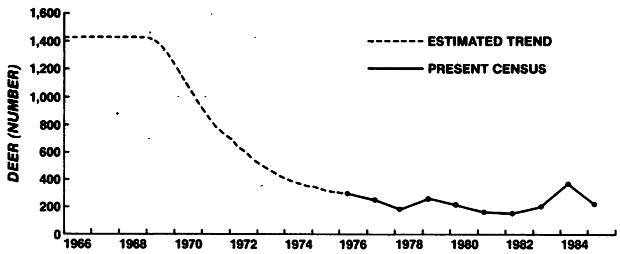

Figure 2.—*Approximate trend in deer population of the census area.*

(cf. fig. 8 in Mech and Karns 1977 with fig. 1 this publication). From then through winter 1980-1981, several deer northwest of Bald Eagle Lake were lost (cf. fig. 1 and fig. 3). Between then and winter 1984-1985 overwintering deer disappeared from the area within 13 km north to northwest of Bald Eagle Lake, (cf. fig. 3 and fig. 4). As documented earlier (Mech and Karns 1977), these deer were killed by wolves, with severe winters as an underlying factor.

The continuing disappearance of deer in the region after winter 1977-1978 seems to contradict the trend in the Isabella deer herd, which apparently stabilized after that winter and eventually increased (fig. 2). This inconsistency could represent intrinsic individual variation because individual deer herds within the general population of the region are basically discrete and variable in many important respects (Nelson and Mech In press). However, the main reason the Isabella herd persists probably is because of its migratory and yarding behavior and the fact that the Isabella deeryard is located within a few kilometers of human habitations, both of which reduce the risk of wolf predation (Nelson and Mech 1981). The deer herds still being decimated are those that are more dispersed, nonyarded deer living in remote areas.

The interactions between wolf predation, snow accumulation, yarding, and proximity to human habitations, are complex and still under study (Nelson and Mech 1981, 1986a,b).

ACKNOWLEDGMENTS

This study was funded by the U.S. Department of Agriculture, Superior National Forest; U.S. Depart-

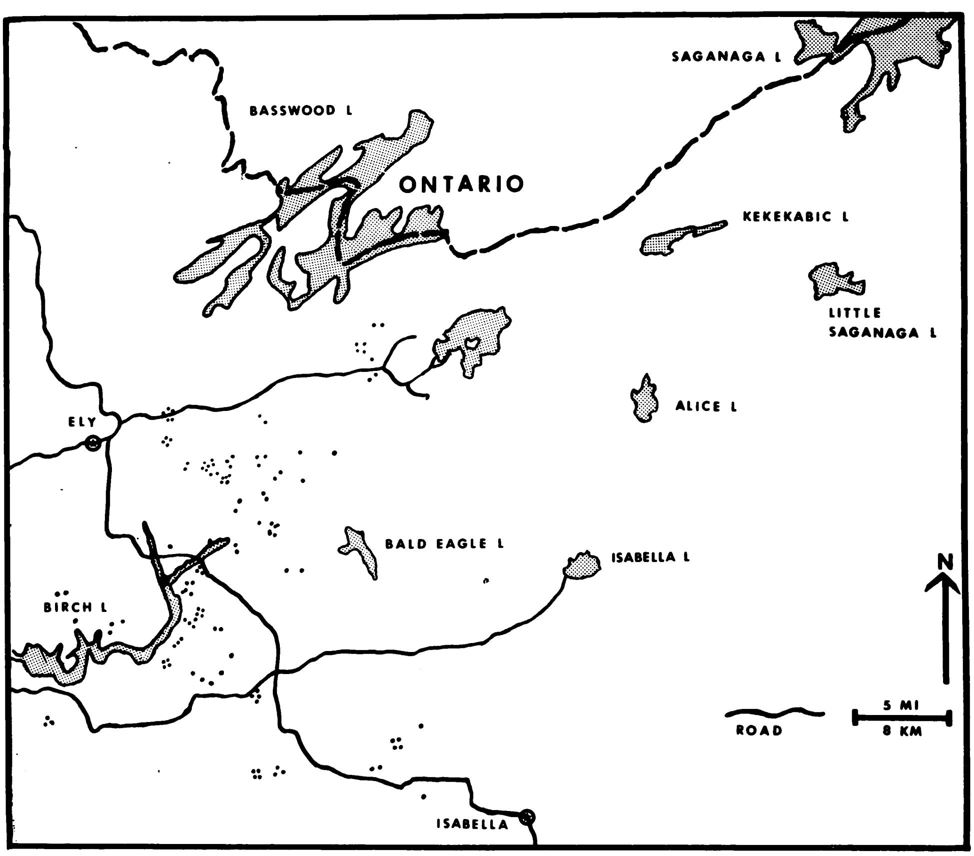

Figure 3.—*Approximate deer distribution, winters 1978-1979 through 1980-1981 based on deer observed from aircraft during wolf radio-tracking. Each dot represents one deer sighting.*

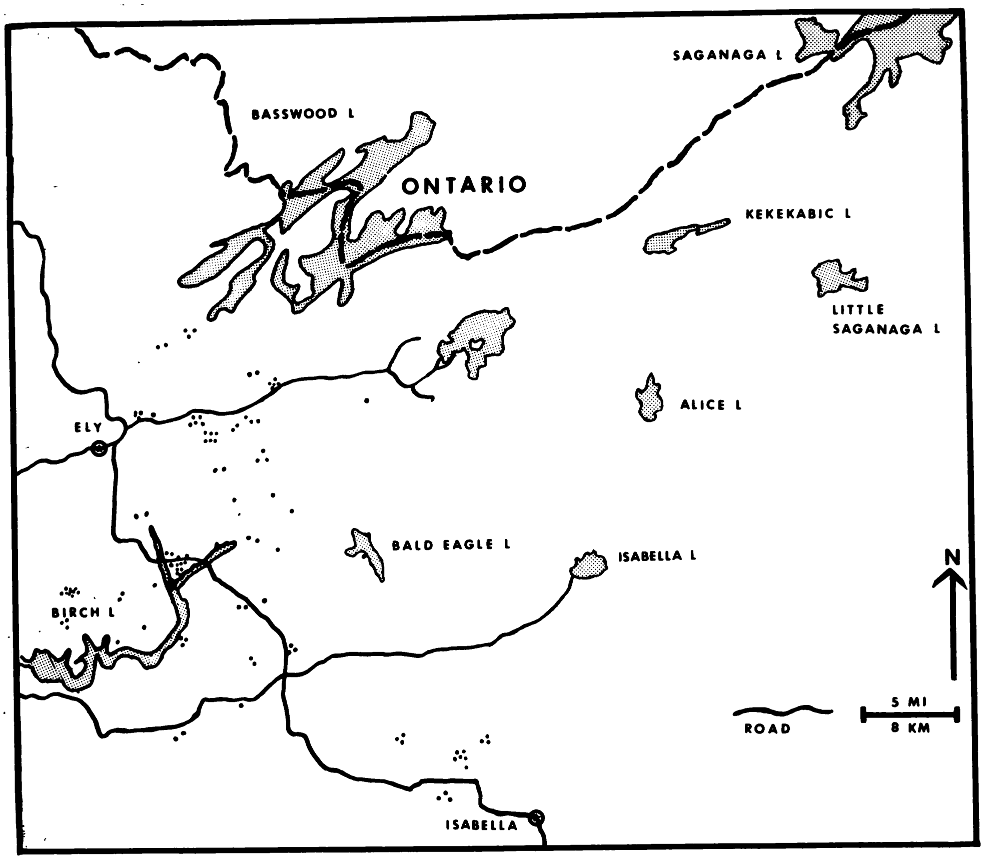

Figure 4.—*Approximate deer distribution, winter 1981-1982 through 1984-1985 based on deer observed from aircraft during wolf radio-tracking. Each dot represents one deer sighting.*

ment of Interior, Fish and Wildlife Service; and the U.S. Department of Agriculture North Central Forest Experiment Station. We especially appreciate the support of Clay G. Beal, Forest Supervisor, and Ed Lindquist, forest biologist. Numerous technicians, volunteers, and students assisted with live-trapping and radio-tagging the deer, and many bush pilots provided skillful flying. We especially appreciate the help of J. Renneberg, S. T. Knick, J. Burch, D. Mahl, J. Ortmann, Jr., K. Jouppi, D. Glaser, and D. Monson. The Minnesota Department of Natural Resources granted approvals, permits, and miscellaneous support and encouragement. J. M. Sweeney made several helpful suggestions for improving the manuscript.

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Appendix A.—*Number of deer observed according to plot in the Isabella deer census area, 1976-1985*[1]

Plot			Inside (I) or adjacent (A) to deeryard	Census data									
Range	Township	Section		1976[2]	1/25-2/11 1977	2/13-3/3 1978	2/8-3/16 1979	2/12-28 1980	2/25-3/4 1981	3/9-22 1982	2/17-25 1983	2/21-3/16 1984	2/19-3/12 1985
61	9	24		2									
61	10	25		1				0					
61	9	31		4									
61	9	34		5	0								
61	8	31		3	3	0	0	0					
61	8	33		0	3			0	0				
60	10	5		5	0	1							
60	10	4				7							
60	10	1			2		0	0					
60	9	1		3	4			0					
60	10	11		4									
60	10	12		2	4		0						
60	10	14			6								
60	10	13			3							1	
60	9	18				0		1	0				
60	9	17				0	0	9					
60	9	16				0	1						
60	9	15	A				2	2				7	
60	9	19				0		6	0				
60	9	20	A		2	0		3				5	0
60	9	21	A			3		2			10	0	
60	9	22	I		8	9	14	3	10	15	9	30	24
60	9	23	I	0		4	0	3	11	0	7	13	6
60	9	24	A				0						2
60	8	19		2			0						
60	8	21		2									
60	10	25				1	1		0				
60	9	29	A		2	0			4			3	0
60	9	28	I			7		9	13	8	7	3	11
60	9	27	I	0			18	16	17	37	22	48	46
60	9	26	I		5	25	23	15	12	0	20	44	2
60	9	25	A		0			0	0		5	6	6
60	9	32	A			3						20	1
60	9	33	I			7		4	15	6	8	20	11
60	9	34	I			0	5	16	23	23	14	23	3
60	9	35	I	9		2	0	8	4	5	5	0	0
60	9	36	A		0	0	0	2	1		8	2	6
60	8	31		3	1	0	0			5			7
60	8	32					1	0					
60	8	33		6									
59	9	1	A		12				2			0	
Number of plots				45	45	40	40	35	21	9	11	17	15
Number of deer seen				51	55	69	65	99	112	99	115	225	125

[1]Population estimates for 1976-1980 based on sampling, according to Floyd *et al.* (1979); 1981-1985, total count of all plots containing deer; 1976-1978 observer T. Floyd; 1979 observer J. Renneberg; 1980-1985 observer M. Nelson.

[2]Census date 12/7/75 to 4/1/76.

ADDENDUM

The 1985-1986 deer census was conducted from 18 February 1986 through 1 March 1986 by Thomas J. Meier a new observer, and John T. McMilion a new pilot. Some 254 deer were observed, and 7 of 11 (64%) radio-collared deer were seen during the observability test, yielding an overall correction factor of 1.56. Applying that factor gives an estimate of 397 deer via methods A and C and 451 by method B. By any method this was the highest deer population counted since the study began, and indicates that the strong increase first measured during winter 1983-1984 has continued.

Nelson, Michael E.; Mech, L. David.
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. 8 p.

Deer were aerially censused each winter from 1976 through 1985 in a 400-km^2 area near Isabella, Minnesota, in the central Superior National Forest; a correction factor based on aerial observability of radio-tagged deer in the same region was then applied to the census figures. Deer numbers, which had reached an estimated 3.5/km^2, declined drastically in the early 1970's, fluctuated between about 0.43 and 0.97/km^2 from 1976 through 1985, and began increasing in 1983.

KEY WORDS: Aerial census, radio-tracking, observability, telemetry, Minnesota, wolves.