Minnesota Wolf Population Update 2015

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INTRODUCTION

Since the late 1970's, Minnesota has monitored its statewide wolf population using an approach that combines attributes of territory mapping with an *ad hoc* approach to determine the total area of the state occupied by wolf packs. The methods employed have changed only slightly during this time. Initially, surveys were conducted at approximately 10-year intervals (1978, 1988, 1997), then at approximately 5-year intervals thereafter (2003, 2007, 2012). Results indicated a geographically and numerically expanding population through the 1997-98 survey, with little geographic expansion from 1998 to 2007 (Erb and DonCarlos 2009). These results were generally consistent with separate wolf population trend indicators (annual scent station survey, winter track survey, and number of verified depredations) in Minnesota.

In 2012, wolves in the Western Great Lakes Distinct Population Segment were removed as a listed species under the federal Endangered Species Act. The de-listing coincided with the normally scheduled (every 5th year) wolf survey as well as survey timeline specifications in the Minnesota Wolf Management Plan (i.e., first and fifth year after delisting; Minnesota Department of Natural Resources 2001). The 2012-13 survey (Erb and Sampson 2013) concluded that overall wolf range had expanded along its south and west edge, but with minimal change in the total amount of land occupied by wolf packs.

After federal de-listing in 2012, wolf harvest seasons were established and population surveys have been conducted annually to better inform annual management decisions. In the first two winters post-harvest, wolf population point estimates have varied from approximately 2,200 to 2,400 (Erb and Sampson 2013, Erb et al. 2014). In December 2014, following the third consecutive wolf harvest season, wolves in Minnesota were returned to the list of federally threatened species as a result of a court ruling. This update summarizes the results of the 2014-15 winter survey.

METHODS

The methodology used to estimate wolf population size in Minnesota utilizes three primary pieces of information: 1) an estimate of the number of square kilometers of land occupied by wolf packs; 2) an estimate of average wolf pack territory size; and 3) an estimate of average mid-winter pack size. It is likely that occupied range changes on a comparatively slow timescale compared to fluctuations in average territory and pack size. As such, since the 2012-13 survey we have assumed that occupied range has remained unchanged (i.e., 70,579 km^2; Erb and Sampson 2013) and tentatively plan to re-evaluate occupied range at 5-year intervals.

To radio-collar wolves, we and various collaborators captured wolves using foothold traps (LPC # 4, LPC #4 EZ Grip, or LPC #7 EZ Grip) approved as part of research conducted under the Association of Fish and Wildlife Agencies Best Management Practices for trapping program. Ten wolves have also been captured with the use of live-restraining neck snares, and a few by helicopter dart-gun. Wolves were typically immobilized using a mixture of either Ketamine:Xylazine or Telazol:Xylazine. After various project-specific wolf samples and measurements were obtained, an antibiotic and the antagonist Yohimbine were typically administered to all animals prior to release. Various models of radio-collars were deployed depending on study area and collar availability. Most GPS radio-collars were programmed to take from 3-6 locations per day, while wolves fitted with VHF-only radio-collars

were relocated at approximately 7 to 10 day intervals throughout the year, or in some cases primarily from early winter through spring.

To estimate average territory size, we delineated territories of radio-collared packs using minimum convex polygons (MCP) for consistency with previous surveys. Prior to delineating wolf pack territories, we removed 'outlier' radiolocations using the following guidelines, though subjective deviations were made in some cases as deemed biologically appropriate: 1) for wolves with approximately weekly VHF radiolocations only, locations > 5 km from other locations were excluded as extraterritorial forays (Fuller 1989); 2) for GPS collared wolves with temporally fine-scale movement information, we removed obvious movement paths if the animal did not travel to that area on multiple occasions and if use of the path would have resulted in inclusion of obviously unused areas in the MCP.

In past surveys where all or the majority of territories were delineated using VHF radiolocations, raw territory sizes were increased 37% to account for the average amount of interstitial space between delineated wolf pack territories, as estimated from several Minnesota studies (Fuller et al. 1992:50) where the number of radiolocations per pack typically averaged 30-60. Interstitial spaces are a combination of small voids created by landscape geometry and wolf behavior, but are much more likely to be an artifact of territory underestimation when there are comparatively sparse radiolocations. Hence, for packs with < 100 radiolocations (n=12; mean number of radiolocations = 29), we multiplied each estimated territory size by 1.37 as in the past. For packs with > 100 radiolocations (n = 36; mean number of radiolocations = 1,017), territories were assumed fully delineated and not re-scaled.

To estimate average mid-winter pack size, radio-marked wolves were repeatedly located via aircraft during winter to obtain visual counts of pack size. In some cases where visual observations were insufficient (n = 5 packs), we relied on estimates of pack size based on tracks observed in the snow within the pack territory. If snow-track counts produced uncertain estimates (e.g., 4 to 5 wolves), we used the lower estimate. Overall, counts are assumed to represent minimum known mid-winter pack size.

The estimated number of packs within occupied wolf range is computed by dividing the area of occupied range by average scaled territory size. The estimated number of packs is then multiplied by average mid-winter pack size to produce an estimate of pack-associated wolves, which is then divided by 0.85 to account for an estimated 15% lone wolves in the population (Fuller et al. 1992:46, Fuller et al. 2003:170). Specifically,

N = ((km^2 of occupied range/mean scaled territory size)*mean pack size)/0.85.

Using the accelerated bias-corrected method (Manly 1997), the population size confidence interval (90%) was generated from 9,999 bootstrapped re-samples of the pack and territory size data and does not incorporate uncertainty in estimates of occupied range or percent lone wolves.

RESULTS AND DISCUSSION

Pack and Territory Size

We obtained territory and winter pack size data from 40 radio-marked wolf packs (Figure 1). Eight additional wolf packs had adequate radiolocation data to delineate territories, but we were unable to obtain mid-winter pack counts. Using scaled territory sizes for all packs combined, radio-collared pack territories represented approximately 13% of occupied wolf range.

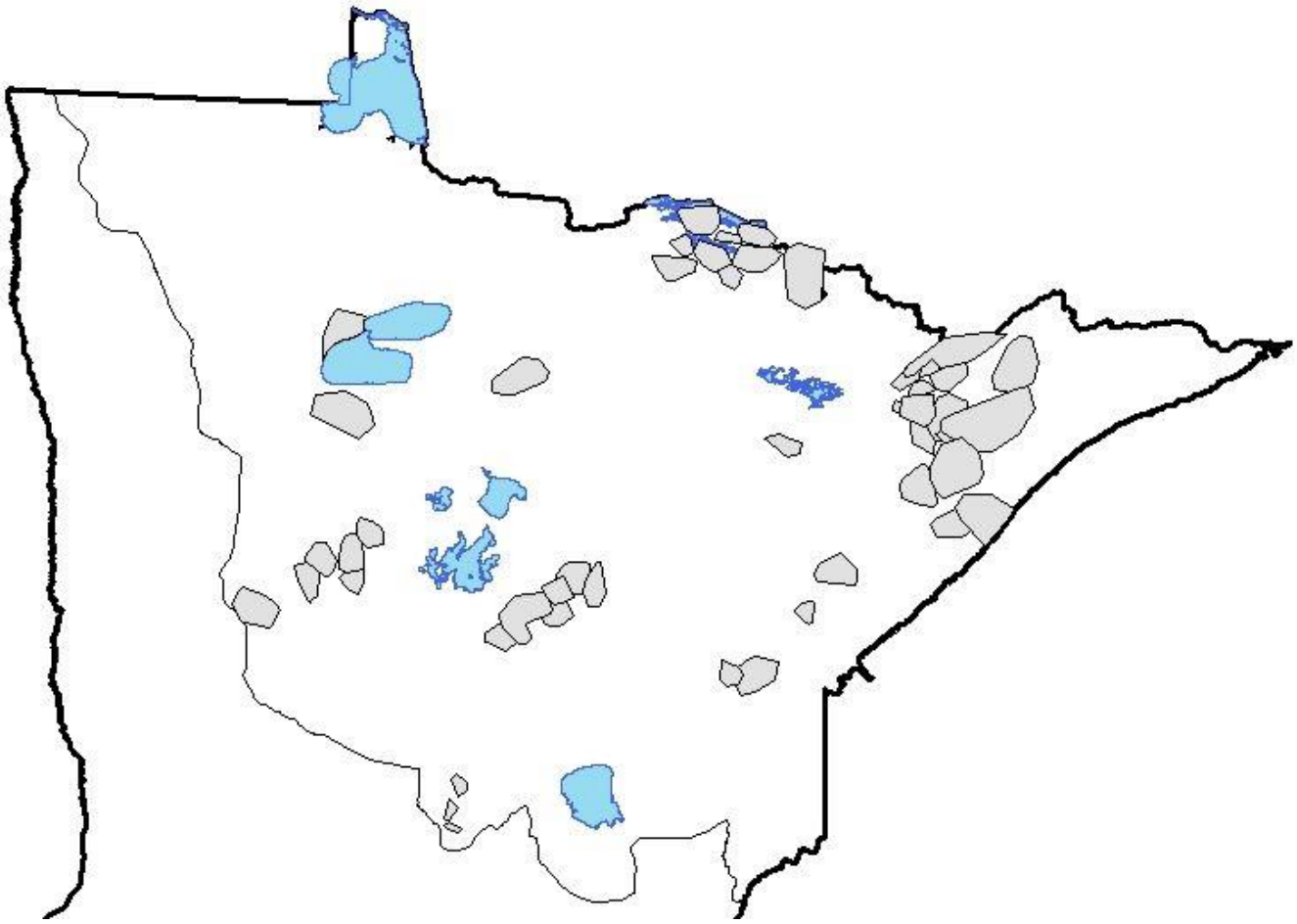

Figure 1. Location of radio-marked wolf packs during the 2014/15 survey.

A land cover comparison using the 2011 National Land Cover Database suggests that land cover within territories of radio-marked packs used in the survey was representative of land cover throughout the entirety of occupied wolf range in Minnesota (Table 1; Chi-square $p = 0.34$). Using spring 2014 deer density data (MNDNR, unpublished data) for deer hunting permit areas, weighted by number of wolf packs in a permit area, we estimate an average of approximately 7.9 deer/mi^2 (pre-fawn) in territories of radio-marked packs at the beginning of the biological year in which the survey was conducted. In comparison, 2014 spring deer density for the entirety of occupied wolf range (weighted by permit area) in Minnesota was approximately 7.3 deer/mi^2 in spring 2014. Collectively, we believe that 'conditions' within marked pack territories closely approximated conditions within overall wolf range.

Table 1. Comparison of land cover[a] in territories of radio-collared wolf packs with land cover in all of occupied wolf range in Minnesota.

	Overall Occupied Wolf range	Radio-collared Wolf Territories
Land Cover Category	% Area	% Area
Woody Wetlands	32.6	27.8
Deciduous Forest	23.6	26.9
Emergent Herbaceous Wetlands	9.9	4.1
Mixed Forest	7.2	9.9
Evergreen Forest	6.9	12.6
Open Water	5.4	8.5
Shrub/Scrub	4.5	5.2
Pasture/Hay	3.4	1.5
Cultivated Crops	2.9	0.3
Developed, Open Space	1.8	1.5
Grassland/Herbaceous	1.4	1.2
Developed, Low Intensity	0.2	0.1
Barren Land (Rock/Sand/Clay)	0.1	0.1
Developed, Medium Intensity	<0.1	<0.1
Developed, High Intensity	<0.1	<0.1

[a] Land cover data derived from the 2011 National Land Cover Database

After applying the territory scaling factors, the average estimated territory size for radio-marked packs during the 2014-15 survey was 188.77 km^2 (range = 27 – 717 km^2). Average territory size was similar to that observed in the 1997-98 survey (Figure 2), which, like this survey, followed 2 sequential severe winters and a notable decline in the deer population. Prey density is often a key determinant of longer-term variation in pack territory sizes (Fuller et al. 2003).

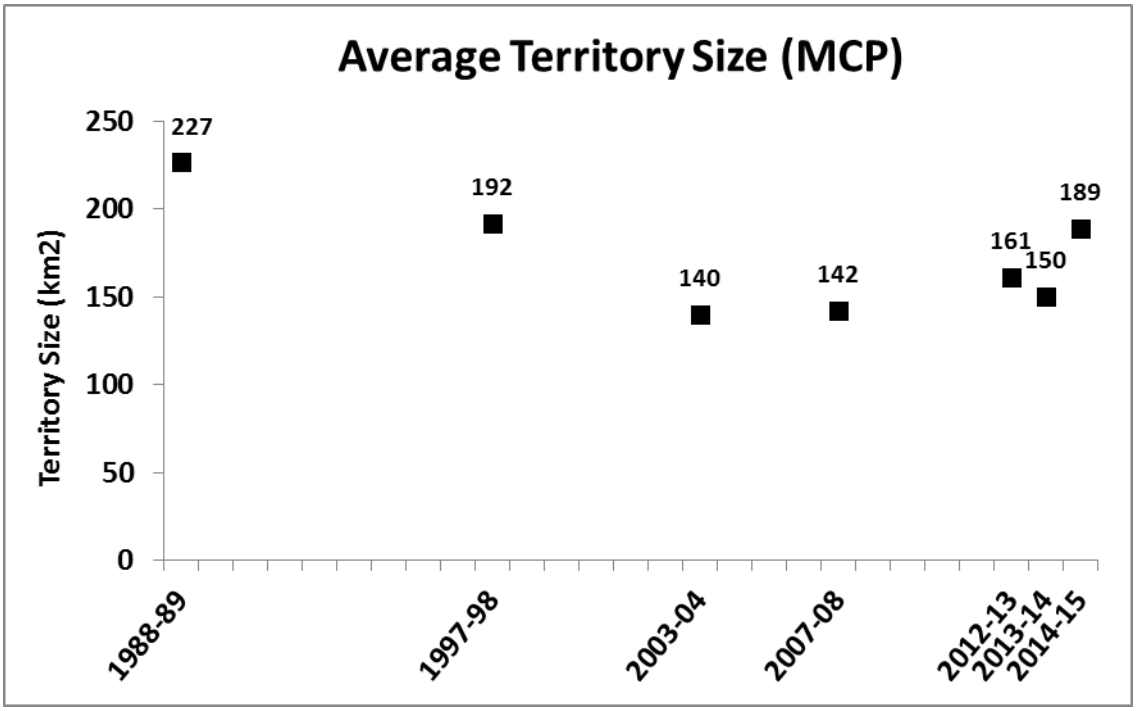

Figure 2. Average scaled territory size for radio-marked wolf packs in Minnesota from 1989 to 2015.

Average pack size had slowly declined from 1988 to 2012, then stabilized the last 2 years. However, average pack size in winter 2014-15 increased 16% to approximately 5.1 (range = 2 – 13, Figure 3).

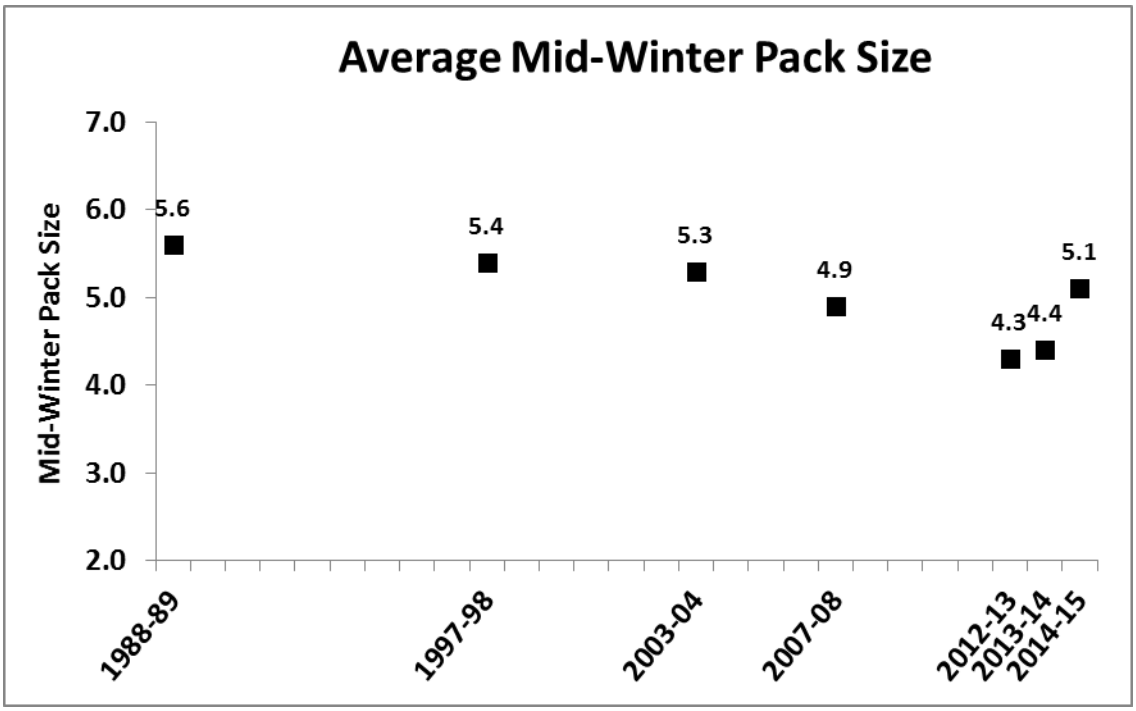

Figure 3. Average mid-winter pack size for radio-marked wolf packs in Minnesota from 1989 to 2015.

Wolf Numbers

Given an average territory size of approximately 189 km^2 and assuming occupied range unchanged since 2013 (70,579 km^2; Erb and Sampson 2013), we estimate a total of 374 wolf packs in Minnesota. Although also influenced by the estimated amount of occupied range, trends in the estimated number of packs (Figure 4) are generally the inverse of trends in estimated territory size (Figure 2).

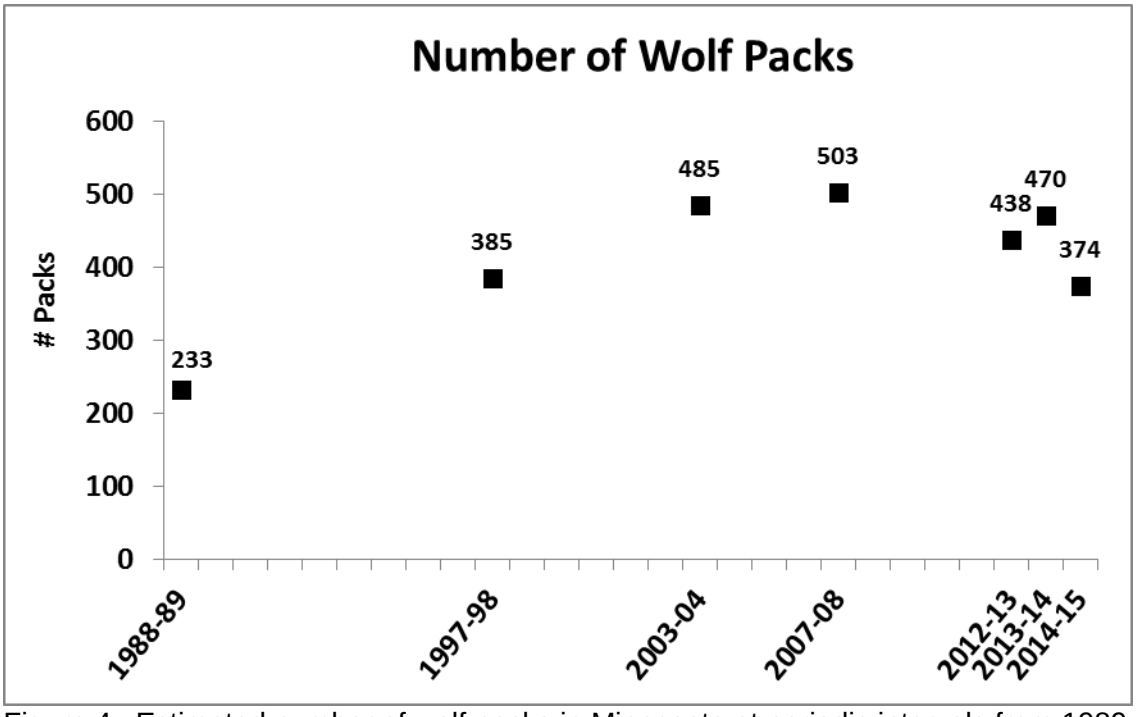

Figure 4. Estimated number of wolf packs in Minnesota at periodic intervals from 1989 to 2015.

After accounting for the assumed 15% lone wolves in the population, we estimate the 2014-15 mid-winter wolf population at 2,221 wolves, or 3.2 wolves per 100 km^2 of occupied range. The 90% confidence interval was approximately +/- 500 wolves, specifically 1,789 to 2,719. Given the substantial overlap with the 2012 and 2013 confidence intervals, we conclude there has been no statistically significant change in the size of the statewide mid-winter wolf population over the past 3 years.

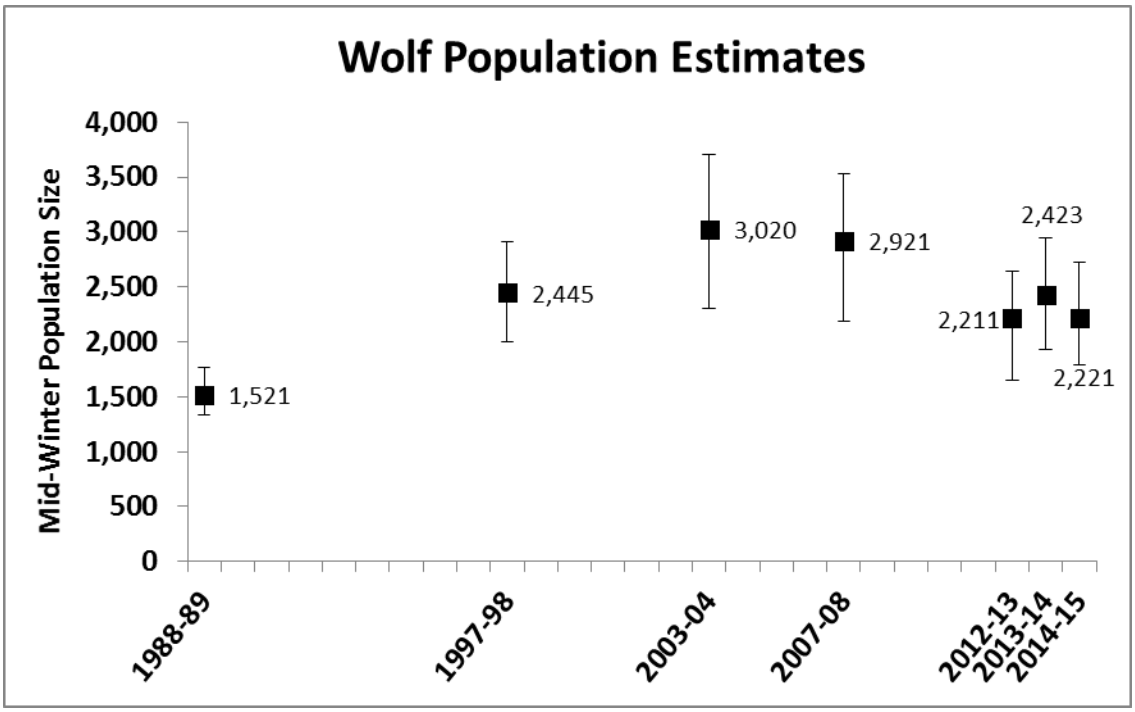

Figure 5. Wolf population estimates from periodic standardized surveys in Minnesota from 1989 to 2015.

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LITERATURE CITED

Erb, J., and M. DonCarlos. 2009. An overview of the legal history and population status of wolves in Minnesota. Pages 49-64 in A. P. Wydeven, T. R. Van Deelen , and E. J. Heske, editors. Recovery of gray wolves in the Great Lakes Region of the United States: an endangered species success story. Springer. New York, New York.

Erb, J., and B. Sampson. 2013. Distribution and abundance of wolves in Minnesota, 2012-13. Minnesota Department of Natural Resources, St. Paul.

Erb, J., C. Humpal, and B. Sampson. 2014. Minnesota wolf population update 2014. Minnesota Department of Natural Resources, St. Paul.

Fuller, T. K. 1989. Population dynamics of wolves in north-central Minnesota. Wildlife Monographs 105.

Fuller, T. K., W. E. Berg, G. L. Radde, M. S. Lenarz, and G. B. Joselyn. 1992. A history and current estimate of wolf distribution and numbers in Minnesota. Wildlife Society Bulletin 20:42-55.

Fuller, T. K., L. D. Mech, and J. F. Cochrane. 2003. Wolf population dynamics. Pages 161-191 *in* L. D. Mech and L. Boitani, editors. Wolves: behavior, ecology, and conservation. University of Chicago Press, Chicago, Illinois.

Manly, B. F. J. 1997. Randomization, bootstrap and Monte Carlo methods in biology. Chapman and Hall, London.

Minnesota Department of Natural Resources. 2001. Minnesota wolf management plan. Minnesota Department of Natural Resources, St. Paul.