# 1996
# EMERGENCY DEER FEEDING PROGRAM EVALUATION

MINNESOTA DEPARTMENT OF NATURAL RESOURCES
Section of Wildlife
December, 1997

## Introduction

The 1996 legislature directed the DNR to "... study the costs associated with emergency deer feeding .... (to) include the effect that the feeding project has on the deer population." A steering committee was appointed (see below) to oversee development of the evaluation. The committee held three public roundtables in Thief River Falls, Hibbing, and Park Rapids to obtain input from more than 100 advocates of deer feeding on what analyses they wanted included in the evaluation. A summary of those meetings is found in Appendix 1.

This evaluation is not a policy document. It does not take a position for or against feeding, and its purpose is not to communicate any position by the DNR on deer feeding. Rather, it is the best possible information that we were able to compile from the 1995-96 feeding program; much of the information that was used in the report was received directly from deer feeders. It is our hope that the report will provide information and analysis that can be used in the future by the DNR, legislators, deer hunters, conservation organizations, and deer feeders to help determine the appropriate role that emergency deer feeding should have in Minnesota's deer management program.

The report focuses on the effect that the feeding program had on deer populations, rather than the effect that feeding generally has on the health of individual deer. There are a number of studies that document that individual deer, when fed a proper ration of supplemental feed, will benefit. However, the purpose of this evaluation is to report on the effect that a publicly-funded feeding program across large landscapes in northern Minnesota has on deer populations. Also, the evaluation is limited by the available data. Without a very expensive and long-term study of the effect that emergency feeding has on deer populations in various parts of the state, it will be difficult to fully address how effective this management technique might be.

The committee would like to thank all of the individuals across the northern part of the state who provided information for this evaluation and worked so hard to try to make the feeding program a success. We would also like to thank the members of the public who showed up for the public input meetings we held to help us develop this report, and who provided comments on the public review draft. Your insights and thoughts were very helpful as this report was developed. Finally, we would like to thank the many DNR Section of Wildlife staff across the state who spent long hours administering the feeding program and submitting data for this report, and who dealt with a very difficult situation in a professional manner throughout the winter.

**Deer Feeding Evaluation Steering Committee:**

Dave Schad, DNR Forest Wildlife Program Leader (Chair)
Mark Lenarz, DNR Forest Wildlife Populations and Research Group
Glenn DelGiudice, DNR Forest Wildlife Populations and Research Group
Jay McAninch, DNR Farmland Populations and Research Group
Jim Breyen, DNR Regional Wildlife Supervisor-Bemidji
Stan Wood, DNR Manager-Roseau River State Wildlife Management Area
Jeff Lightfoot, DNR Regional Wildlife Supervisor-Grand Rapids
Tom Rusch, DNR Assistant Area Wildlife Manager-Eveleth
Dave Dickey, DNR Area Wildlife Manager-Aitkin
Steve Benson, DNR Geographic Information Systems Coordinator
Joe Wood, Executive Director-Minnesota Deer Hunters Association

# Table of Contents

## EXECUTIVE SUMMARY

In response to one of the most severe winters ever recorded across much of northern Minnesota, an emergency deer feeding program was conducted during the winter of 1995-96. The program was funded by a $260,000 biennial appropriation to the Department of Natural Resources (DNR), and an additional $750,000 emergency appropriation from the 1996 state legislature. Pelleted deer feed was purchased by DNR wildlife managers and distributed to the public at 55 distribution sites. A total of 8,277 individuals obtained feed from the program.

The following is a summary of the 1996 program, and a comparison to a similar 1989 program:

| | 1989 | 1996 |
|---|---|---|
| Feed Costs | $744,536 | $975,713 |
| Total Game and Fish Fund Costs | $1,071,492 | $1,176,922 |
| Amount of Feed Purchased | 3,955 Tons | 5,115 Tons |
| Size of Feeding Area (Square Miles) | 46,000 $mi^2$ | 38,000 $mi^2$ |
| Estimated Maximum Number of Deer Fed | 72,332 | 92,223 |
| Cost/Deer Fed | $14.69 | $12.76 |
| Section of Wildlife Staff Hours | 13,754 | 8,381 |

Based on the Recommended Daily Amount (RDA) of 2.5 pounds of feed/deer/day, a maximum of 92,223 deer could have been adequately fed by the program at a cost of $12.76/deer. Using the estimated winter deer density in each Deer Management Unit (DMU), the maximum proportion of deer fed the RDA was:

| | 1989 | 1996 |
|---|---|---|
| Red River DMU | 36% | 30% |
| Agassiz DMU | 26% | 42% |
| Big Woods DMU | 10% | 26% |
| Farmland DMU Total | 22% | 37% |
| | | |
| Rainy River DMU | 4% | 11% |
| Itasca DMU | 10% | 24% |
| Superior DMU | 13% | 23% |
| Mille Lacs DMU | 10% | 23% |
| Forest DMU Total | 9% | 21% |
| | | |
| Total | 11% | 23% |

Based on the observations of feeders, 50.7% of deer were reportedly reached by the program (86.4% in farmland units and 45.4% in forest areas). If these observations were correct, each deer was fed an average of 1.1 pounds of feed/day, significantly less than the RDA.

**Summary and Conclusions:** The evaluation concluded the following:

1) Analysis of deer populations and 1996 deer harvest indicate that deer populations declined throughout the feeding area as a result of the winter of 1995-96. Of the estimated 396,000 deer present in the feeding area at the start of winter, over 100,000 deer were estimated to have died by the spring of 1996. Declines were greatest in the forested areas and the northwest farmland where reductions of 30% to 40% were projected to have occurred in many locales. Buck harvests declined by an average of 32% in the feeding area from 1995

to 1996, a reflection of reduced deer numbers (and probably reduced hunting pressure as well as self-restraint from some hunting parties in response to lower deer populations). Analysis of two antlerless permit areas in the northwest where feeding was very intensive indicated that over-winter mortality and spring fawning losses were similar to what would have been projected if no feeding had taken place.

2) It is impossible to determine the number of deer that were "saved" by the emergency feeding program. Many deer that would have died survived as a result of the program, but many deer were not reached by the program, many consumed an inadequate feed ration and died, and many likely perished in spite of ready access to emergency food. Thus, while the feeding program provided benefits to deer in local areas, it was unable to prevent significant deer losses across all Deer Management Units in the feeding area.

3) No other states have engaged in a publicly funded feeding program similar to that adopted by Minnesota in 1989 and 1996. With the exception of Manitoba, where some feeding has been done to prevent crop depredations and to help prevent local "extinctions" of deer in agricultural areas, Canadian provinces where 25-40% of the deer are commonly lost to winter mortality, do not consider feeding to be a viable management tool.

4) Because deer unnaturally concentrate at feeding sites, there is increased potential for disease and parasite transmission, adverse impacts to natural vegetation at feeding sites, concentration of predators, and changes to deer movements and habitat use.

5) There is a lack of understanding by the public regarding how the DNR uses indices, such as the Winter Severity Index, and other measures of winter severity and deer condition to evaluate the effect of winter on deer.

6) The effectiveness of future feeding programs may be improved by targeting feed to specific, high-priority sites; providing additional flexibility for preparing feed rations; and attempting to get state-purchased feed to deer that have not had access to privately funded feeding programs. However, these measures may be politically unpopular.

7) There is a need to reduce waste during future deer feeding programs, and a need to re-consider whether state feed should be used in areas where high deer populations exceed desired levels.

8) There is interest from the public to start state feeding programs earlier based on the perception that additional deer could be saved during severe winters. However, this would dramatically increase costs, could result in unnecessary feeding in years when weather moderates in late winter, and would likely result in few additional deer being saved during the most severe winters.

9) Deer feeding programs are expensive and planning for and funding such programs is difficult because severe winters can not be predicted and can occur during several consecutive years. For example, the severe winter of 1995-96 was followed by an equally severe winter in 1996-97. State funds were not available for this emergency because all available funds had been expended during the previous winter. A new, dedicated account has been established to fund feeding programs and to re-pay the Game and Fish Fund for the $750,000 emergency appropriation for the 1996 program. This dedicated account will generate approximately $225,000 annually for deer feeding purposes (based on $.50 per deer license and projected sales of approximately 450,000 deer licenses sold each year), but will adversely impact deer and bear management activities that were previously funded from this account.

10) Since work on deer feeding is not eligible for reimbursement by federal aid funds, reimbursements may be affected if significant DNR staff time is required for future feeding programs. This would result in reduced federal funds available for other state wildlife programs.

11) More than 8,300 hours of DNR staff time was required to administer the 1996 program. As a result, many high-priority wildlife programs that provide long-term benefits to deer and other wildlife suffered.

12) The involvement of the public in the 1996 program provided important social benefits to individuals and communities. The evaluation documented that private, recreational deer feeding is widespread across the north, and likely contributed to the increased public interest. Approximately 66% of feeders reported that they had been feeding deer prior to obtaining state feed.

13) About 23% of feeding sites were established by individuals who obtained state feed only once, and consequently deer at these sites were likely fed an insufficient ration. The report also found that 70% of feed was used on private lands, which comprised about 58% of the land base in the feeding area.

14) Feeding took place for 38 days in most forest areas, and 51 days in northwest farmland. Access was one factor limiting the distribution of the feed, resulting in large, inaccessible areas where little or no feed was distributed. Assuming each feeding site would influence deer within one-half mile, feed was available on 11% of the landscape.

15) There were significant differences in the number of deer potentially fed the RDA among deer management units. Some of this was due to differences in accessibility of deer and availability of interested feeders, but was also due to the fact that feed had to be rationed in most areas because funding was insufficient to meet demands from feeders. It is not possible to formulate conclusions regarding the potential number of deer that could be reached by an emergency feeding program in most deer management units, because a program has never been funded sufficiently to determine the maximum number of feeders that could be mobilized.

16) If additional dollars, manpower (both public and DNR staff), and access were available, 50% of the deer population could be fully fed for the same length of time as in 1996 at a cost of between $2.3 and $3 million. However, because more inaccessible areas would have to be reached with an expanded feeding program, the total cost would likely be 3 to 5 times the cost of the 1996 program.

**Recommendations:** The report identified additional information needed to address important questions raised by the 1989 and 1996 feeding programs and evaluation processes, including: 1) an assessment of private deer feeding efforts; 2) assessments of public support for feeding programs; 3) additional study of measures of winter severity and deer condition during winter; and 4) a study of the population impact of deer feeding.

The report also recommends that policy be developed to determine the long-term role of emergency deer feeding in Minnesota's deer management program. This will require involvement of the public and legislature. The process should identify whether state-funded feeding should be conducted, and if so, the goal of future emergency feeding programs and the most appropriate strategies to meet the goal. Strategic options that should be investigated include: 1) privatizing deer feeding and eliminating state agency involvement; 2) establishing a block grant program to administer deer feeding funds; and 3) targeting deer feeding to specific sites rather than distributing to the general public.

Finally, the report points out the need for improving information and education efforts on aspects of deer ecology and adaptation to winter, the DNR's deer management approach and philosophy, and the role of long-term habitat protection and improvement.

## SUMMARY OF 1989 FEEDING EVALUATION AND EMERGENCY DEER FEEDING POLICY

Prior to 1996, the last large-scale emergency feeding program conducted in the state occurred in the winter of 1988-89. An extensive evaluation of that feeding program found that $1,071,492 was spent by the DNR to purchase and distribute 3,955 tons of pelleted deer feed across 46,000 square miles of northern Minnesota. The program required 17,000 hours of DNR staff time to implement, and an estimated 8,000 feeders contributed 230,000 hours to support the feeding program.

To estimate the benefit to deer populations, the 1989 evaluation projected the maximum number of deer fed in each DMU. The DMUs (Fig. 1) are large areas with relatively uniform land-use and habitats, and are the basis for much of the DNR's population modeling and management programs. The number of deer fed was calculated by determining the amount of feed distributed in each DMU per week, and by assuming that each deer reached consumed 2.5 pounds of feed per day (this was based on research that shows a deer requires between 2 and 3 pounds of feed each day to maintain good physical condition). For reasons discussed earlier, the actual number of deer that consumed an adequate ration of feed was probably much lower.

This analysis found that a potential maximum of 54,038 deer (9.3%) in forest DMUs, and 18,294 deer (22.3%) in farmland DMUs, were reached by the feeding program. The cost per deer fed averaged $.235 per deer per day or $14.69 for the duration of the program. Computer simulation models were then used to evaluate how feeding benefited deer populations. These models assumed that deer without access to feed had lower survival and produced fewer fawns the following spring. Results indicated that deer populations declined in both farmland and forest areas in spite of the feeding program. There were a maximum of 3.1% more deer available in forest DMUs the following fall than if no feeding had taken place, and a maximum of 7.2% more deer available in farmland DMUs.

The DNR developed deer feeding guidelines based on the results of this evaluation(Appendix 2). These guidelines restricted future state-funded feeding programs to farmland areas where a higher proportion of deer could be reached, and where other natural browse is not available to deer in some winters. The DNR would provide technical assistance for feeding efforts in forested areas to individuals or groups interested in feeding local populations of deer. State funds would not be used to purchase feed because significant benefits to deer populations across the forest could not be realized.

## DEER FEEDING POLICIES AND PROGRAMS OF OTHER STATES AND PROVINCES

The focus of this evaluation is on emergency feeding. Emergency feeding is providing artificial feed during severe winter conditions because availability of natural food is low, generally at the end of long, severe winters. Emergency feeding should not be confused with supplemental or recreational feed programs. Efforts by private individuals and groups to supplementally feed deer have led agencies to offer guidelines for feeding deer and for managing food plots and forest openings. Supplemental feeding has been growing in popularity and generally begins in late fall or early winter, after the end of the deer hunting seasons. Feeding commonly continues through winter and often extends into late spring or summer. In most of the northeastern states, the Great Lakes states and the central and eastern Canadian provinces, privately-funded supplemental feeding is common where access is not limiting and where second homes or recreational

properties exist.

Manitoba has attempted programs in some parts of that province in recent years. The primary intent of Manitoba's feeding has been to alleviate crop damage (see below), but some funds have also been used to feed deer in agricultural areas where deer are completely cut-off from natural foods or crops to prevent local "extinctions" and maintain open hunting seasons. Manitoba's total winter deer population is estimated at 155,000 deer. The province spent approximately $225,000 in 1995-96 and $300,000 in 1996-97 for feeding, 80-90% of which was for depredation purposes.

No other state or province in the range of white-tailed deer has used public funds and wildlife agency staff to artificially feed deer for the purposes of preventing winter mortality. In the Great Lakes region, Michigan, Wisconsin, and Ontario report widespread, privately-funded supplemental feeding, but classify emergency feeding as a high-cost, short-term deer management activity where the high costs far exceed the long-term benefits. These agencies do not use public funds for emergency feeding, but they do not discourage supplemental or emergency feeding if efforts are privately funded and used in conjunction with habitat and harvest management programs.

New York, the New England states, Quebec and the Maritime provinces have all determined that winter feeding of deer is not a solution to winter food shortage problems. Currently, populations are above the carrying capacity of winter deer yards or agricultural wintering areas in many portions of these states, and thus, mortality is expected and works to align winter deer numbers with the amount and distribution of natural food and cover. In many agricultural situations, shooting permits are issued to allow local farmers/land managers to reduce deer concentrations that are causing depredation. Supplemental feeding of deer and the use of food plots and forest openings on private lands has been increasing in these states, creating significant pressure on hunting programs to control populations.

Minnesota and several other states (North Dakota, South Dakota, Nebraska, Montana and Wyoming) and provinces (Saskatchewan, Ontario, and Manitoba) commonly use winter feeding to reduce or eliminate deer depredation on stored forage and crops. This practice, called "short-stopping", consists of placing quantities of grain (usually corn and/or oats) and hay (usually alfalfa) in a location where winter concentrations of deer will consume the supplemental feed instead of devouring stored grain, hay or silage belonging to a private landowner. These programs often are considered the only means of preventing local deer herds in agricultural areas from being reduced. Without short-stopping, local herds would be reduced by the use of depredation shooting permits. In addition, short-stopping in combination with permanent barrier fencing, is the only means for farmer/ranchers to protect feed intended for livestock herds confined in winter.

## SCIENTIFIC LITERATURE OF DEER FEEDING

Previous studies have demonstrated that deer with access to emergency feed in severe winters tend to have higher survival and improved fawn production. These benefits occur only when the deer have frequent and ready access to a proper type of food for a sufficiently long period of time. Thus, small, localized populations may benefit from emergency feeding but unless a major proportion of deer within a DMU are reached, it is unlikely that differences in survival or improved fawn production will be measurable. There also are several adverse impacts that have been documented at feeding sites. These include the possibility that feeding sites may become over-browsed and this could result in a diminished carrying capacity. There is also the possibility that disease and parasites may be transmitted among deer feeding from the same container. Deer at feeding sites are much more concentrated than would normally occur in natural situations, and close

physical contact with other deer becomes common. Michigan has documented bovine tuberculosis in deer herds in areas where winter feeding and baiting during the hunting season are common. Because of the mode of transmission of this disease, it is thought that this feeding is contributing to the spread of this important wildlife and livestock disease. Some deer feeders have also observed that deer concentrated at feeding sites are more vulnerable to wolf predation, and that feeding may provide opportunities for surplus killing by wolves. In this context, the feeding sites represent "predator traps".

Finally, it is likely that there are potential long-term consequences of artificial feeding on deer movements and use of habitat, impacts on natural vegetation, and the overall health of deer. A more thorough discussion of these topics is presented in Appendix 3.

## THE 1996 EMERGENCY DEER FEEDING PROGRAM

The winter of 1995-96 was one of the most severe ever recorded in much of the northern part of the state. Snow arrived early and remained late, with many areas of the north having snow on the ground by early November which persisted into May. Snow depths exceeded 40" in many areas for much of the winter. Unusually cold temperatures also occurred throughout much of the winter, and temperatures of minus 40 degrees F were common.

As concern increased regarding the effect of the weather on deer, the DNR increased monitoring efforts. Initially, the Winter Severity Index (WSI) was evaluated, which measures the cumulative sum of days with snow depths of at least 15" and the number of days with a temperature at or below 0 degrees F. While the WSI is not a reflection of deer condition, it is a measure of the conditions faced by deer and is used to determine whether more intensive monitoring is necessary. In general, year-end totals over 140 are considered severe and in 1996 the WSI exceeded 140 at eight stations by March 1. By the end of winter, the WSI was 190 or higher at 10 of the 15 stations (Table 1).

As the WSI increased, the DNR accelerated monitoring efforts. Funds were made available in late December for managers to conduct aerial surveys to locate deer concentrations and to observe deer use of cover, deer mobility, and physical condition. In January, a sample of deer were shot and necropsied by DNR staff in parts of northwestern Minnesota to assess deer condition (i.e., fat reserves), and managers across the north were asked to inspect as many dead deer as possible. Managers solicited observations of deer and deer behavior from foresters, loggers, and others spending time in the woods. Detailed information on deer condition was also collected as part of a long-term deer research study that was being conducted by the DNR in north-central Minnesota, including information on winter severity, deer movements and habitat use, and condition and mortality compared to previous years of the study.

By January, public pressure to begin a deer feeding program was building. Several sportsman's groups began organized feeding programs in January, and on January 29 the state House of Representatives passed a resolution requesting the DNR begin a deer feeding program immediately across a large portion of Minnesota. The next day, a bill was introduced to appropriate funds to the DNR for an emergency deer feeding program.

A feeding program using existing DNR funds was initiated by the DNR on February 10 in the Red River, Agassiz, and northern Big Woods DMUs (Figure 1). Funding came from the Deer/Bear/Computerized Licensing Account. This account is generated by a $1 surcharge on each resident deer license. About one-half of these funds are used to pay for the computerized antlerless deer and bear quota drawings. Remaining funds are available for other deer and bear management activities, including emergency deer feeding. During

**Table 1.** Minnesota Winter Severity Index (WSI) values, 1995-96.

| Week Ending | Aitkin | | | Brainerd | | | Bemidji | | | Cloquet | | | Ely | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Temp | Snow | Total | Temp | Snow | Total | Temp | Snow | Total | Temp | Snow | Total | Temp | Snow | Total |
| 12-Nov-95 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 3 | 0 | 3 |
| 26-Nov-95 | 0 | 0 | 0 | 1 | 0 | 1 | 2 | 0 | 3 | 1 | 0 | 1 | 5 | 0 | 8 |
| 10-Dec-95 | 5 | 0 | 5 | 7 | 0 | 8 | 9 | 2 | 14 | 8 | 0 | 9 | 11 | 0 | 19 |
| 24-Dec-95 | 2 | 0 | 7 | 5 | 0 | 13 | 5 | 14 | 33 | 6 | 12 | 27 | 7 | 12 | 38 |
| 31-Dec-95 | 1 | 0 | 8 | 2 | 0 | 15 | 0 | 7 | 40 | 2 | 7 | 36 | 0 | 7 | 45 |
| 07-Jan-96 | 6 | 0 | 14 | 6 | 0 | 21 | 7 | 7 | 54 | 6 | 7 | 49 | 6 | 7 | 58 |
| 14-Jan-96 | 1 | 0 | 15 | 1 | 0 | 22 | 1 | 7 | 62 | 3 | 7 | 59 | 2 | 7 | 67 |
| 21-Jan-96 | 5 | 4 | 24 | 5 | 4 | 31 | 6 | 7 | 75 | 5 | 7 | 71 | 5 | 7 | 79 |
| 28-Jan-96 | 7 | 7 | 38 | 7 | 7 | 45 | 7 | 7 | 89 | 7 | 7 | 85 | 7 | 7 | 93 |
| 04-Feb-96 | 7 | 7 | 52 | 7 | 7 | 59 | 7 | 7 | 103 | 7 | 7 | 99 | 7 | 7 | 107 |
| 11-Feb-96 | 2 | 7 | 61 | 1 | 7 | 67 | 1 | 7 | 111 | 2 | 7 | 108 | 2 | 7 | 116 |
| 18-Feb-96 | 2 | 7 | 70 | 4 | 7 | 78 | 4 | 7 | 122 | 3 | 7 | 118 | 3 | 7 | 126 |
| 25-Feb-96 | 0 | 7 | 77 | 1 | 7 | 86 | 1 | 7 | 130 | 0 | 7 | 125 | 2 | 7 | 135 |
| 03-Mar-96 | 4 | 7 | 88 | 5 | 7 | 98 | 6 | 7 | 143 | 5 | 7 | 137 | 6 | 7 | 148 |
| 10-Mar-96 | 6 | 7 | 101 | 6 | 7 | 111 | 6 | 7 | 156 | 6 | 7 | 150 | 5 | 7 | 160 |
| 17-Mar-96 | 0 | 7 | 108 | 0 | 7 | 118 | 0 | 7 | 163 | 0 | 7 | 157 | 0 | 7 | 167 |
| 24-Mar-96 | 0 | 7 | 115 | 0 | 5 | 123 | 1 | 7 | 171 | 0 | 7 | 164 | 1 | 7 | 175 |
| 31-Mar-96 | 1 | 7 | 123 | 2 | 5 | 130 | 2 | 7 | 180 | 2 | 7 | 173 | 2 | 7 | 184 |
| 07-Apr-96 | 0 | 7 | 130 | 0 | 0 | 130 | 0 | 7 | 187 | 0 | 7 | 180 | 0 | 7 | 191 |
| 14-Apr-96 | 0 | 1 | 131 | 0 | 0 | 130 | 0 | 7 | 194 | 0 | 7 | 187 | 0 | 7 | 198 |
| 21-Apr-96 | 0 | 0 | 131 | 0 | 0 | 130 | 0 | 3 | 197 | 0 | 3 | 190 | 0 | 4 | 202 |
| 28-Apr-96 | 0 | 0 | 131 | 0 | 0 | 130 | 0 | 0 | 197 | 0 | 0 | 190 | 0 | 0 | 202 |

| Week Ending | Eveleth | | | Grand Marais | | | Grand Rapids | | | Hinckley | | | Internat'l Falls | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Temp | Snow | Total | Temp | Snow | Total | Temp | Snow | Total | Temp | Snow | Total | Temp | Snow | Total |
| 12-Nov-95 | 2 | 0 | 2 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 2 | 0 | 2 |
| 26-Nov-95 | 3 | 0 | 5 | 1 | 0 | 1 | 2 | 0 | 3 | 0 | 0 | 0 | 4 | 0 | 6 |
| 10-Dec-95 | 10 | 0 | 15 | 4 | 0 | 5 | 5 | 0 | 8 | 6 | 0 | 6 | 10 | 7 | 23 |
| 24-Dec-95 | 7 | 12 | 34 | 5 | 11 | 21 | 9 | 14 | 31 | 5 | 0 | 11 | 7 | 14 | 44 |
| 31-Dec-95 | 3 | 7 | 44 | 1 | 7 | 29 | 3 | 7 | 41 | 3 | 0 | 14 | 2 | 7 | 53 |
| 07-Jan-96 | 6 | 7 | 57 | 5 | 7 | 41 | 6 | 7 | 54 | 5 | 0 | 19 | 7 | 7 | 67 |
| 14-Jan-96 | 2 | 7 | 66 | 1 | 7 | 49 | 3 | 7 | 64 | 1 | 5 | 25 | 3 | 7 | 77 |
| 21-Jan-96 | 5 | 7 | 78 | 4 | 7 | 60 | 6 | 7 | 77 | 5 | 7 | 37 | 6 | 7 | 90 |
| 28-Jan-96 | 7 | 7 | 92 | 6 | 7 | 73 | 7 | 7 | 91 | 6 | 7 | 50 | 7 | 7 | 104 |
| 04-Feb-96 | 7 | 7 | 106 | 7 | 7 | 87 | 7 | 7 | 105 | 7 | 7 | 64 | 7 | 7 | 118 |
| 11-Feb-96 | 2 | 7 | 115 | 1 | 7 | 95 | 2 | 7 | 114 | 2 | 7 | 73 | 1 | 7 | 126 |
| 18-Feb-96 | 4 | 7 | 126 | 2 | 7 | 104 | 3 | 7 | 124 | 2 | 7 | 82 | 4 | 7 | 137 |
| 25-Feb-96 | 1 | 7 | 134 | 0 | 7 | 111 | 1 | 7 | 132 | 0 | 7 | 89 | 3 | 7 | 147 |
| 03-Mar-96 | 7 | 7 | 148 | 2 | 7 | 120 | 6 | 7 | 145 | 5 | 7 | 101 | 6 | 7 | 160 |
| 10-Mar-96 | 6 | 7 | 161 | 4 | 7 | 131 | 7 | 7 | 159 | 7 | 7 | 115 | 6 | 7 | 173 |
| 17-Mar-96 | 0 | 7 | 168 | 0 | 7 | 138 | 0 | 7 | 166 | 0 | 7 | 122 | 0 | 7 | 180 |
| 24-Mar-96 | 0 | 7 | 175 | 0 | 7 | 145 | 0 | 7 | 173 | 0 | 2 | 124 | 0 | 7 | 187 |
| 31-Mar-96 | 1 | 7 | 183 | 1 | 7 | 153 | 2 | 7 | 182 | 2 | 5 | 131 | 3 | 7 | 197 |
| 07-Apr-96 | 0 | 7 | 190 | 0 | 7 | 160 | 0 | 7 | 189 | 0 | 0 | 131 | 0 | 7 | 204 |
| 14-Apr-96 | 0 | 7 | 197 | 0 | 7 | 167 | 0 | 7 | 196 | 0 | 0 | 131 | 0 | 7 | 211 |
| 21-Apr-96 | 0 | 6 | 203 | 0 | 3 | 170 | 0 | 0 | 196 | 0 | 0 | 131 | 0 | 5 | 216 |
| 28-Apr-96 | 0 | 0 | 203 | 0 | 0 | 170 | 0 | 0 | 196 | 0 | 0 | 131 | 0 | 0 | 216 |

| Week Ending | Mille Lacs WMA | | | Park Rapids | | | Red Lake WMA | | | Roseau WMA | | | Thief Lake | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Temp | Snow | Total | Temp | Snow | Total | Temp | Snow | Total | Temp | Snow | Total | Temp | Snow | Total |
| 12-Nov-95 | 0 | 0 | 0 | 2 | 0 | 2 | 3 | 0 | 3 | 4 | 0 | 4 | 2 | 0 | 2 |
| 26-Nov-95 | 1 | 0 | 1 | 1 | 0 | 3 | 2 | 0 | 5 | 3 | 0 | 7 | 1 | 0 | 3 |
| 10-Dec-95 | 8 | 0 | 9 | 8 | 3 | 14 | 10 | 13 | 28 | 13 | 3 | 23 | 9 | 3 | 15 |
| 24-Dec-95 | 4 | 5 | 18 | 2 | 14 | 30 | 8 | 14 | 50 | 8 | 14 | 45 | 5 | 13 | 33 |
| 31-Dec-95 | 2 | 0 | 20 | 1 | 7 | 38 | 1 | 7 | 58 | 4 | 7 | 56 | 1 | 7 | 41 |
| 07-Jan-96 | 6 | 0 | 26 | 6 | 7 | 51 | 6 | 7 | 71 | 6 | 7 | 69 | 6 | 7 | 54 |
| 14-Jan-96 | 2 | 0 | 28 | 2 | 7 | 60 | 1 | 7 | 79 | 2 | 7 | 78 | 1 | 7 | 62 |
| 21-Jan-96 | 5 | 4 | 37 | 4 | 7 | 71 | 6 | 7 | 92 | 7 | 7 | 92 | 7 | 7 | 76 |
| 28-Jan-96 | 7 | 7 | 51 | 7 | 7 | 85 | 7 | 7 | 106 | 7 | 7 | 106 | 7 | 7 | 90 |
| 04-Feb-96 | 7 | 7 | 65 | 7 | 7 | 99 | 7 | 7 | 120 | 7 | 7 | 120 | 7 | 7 | 104 |
| 11-Feb-96 | 2 | 7 | 74 | 1 | 7 | 107 | 1 | 7 | 128 | 2 | 7 | 129 | 2 | 7 | 113 |
| 18-Feb-96 | 4 | 7 | 85 | 3 | 7 | 117 | 4 | 7 | 139 | 4 | 7 | 140 | 3 | 7 | 123 |
| 25-Feb-96 | 0 | 7 | 92 | 0 | 7 | 124 | 4 | 7 | 150 | 4 | 7 | 151 | 3 | 7 | 133 |
| 03-Mar-96 | 6 | 7 | 105 | 5 | 7 | 136 | 7 | 7 | 164 | 7 | 7 | 165 | 7 | 7 | 147 |
| 10-Mar-96 | 6 | 7 | 118 | 6 | 7 | 149 | 6 | 7 | 177 | 7 | 7 | 179 | 7 | 7 | 161 |
| 17-Mar-96 | 0 | 4 | 122 | 0 | 7 | 156 | 0 | 7 | 184 | 0 | 7 | 186 | 0 | 7 | 168 |
| 24-Mar-96 | 0 | 0 | 122 | 0 | 7 | 163 | 0 | 7 | 191 | 0 | 7 | 193 | 0 | 7 | 175 |
| 31-Mar-96 | 3 | 5 | 130 | 2 | 7 | 172 | 3 | 7 | 201 | 5 | 7 | 205 | 2 | 7 | 184 |
| 07-Apr-96 | 0 | 0 | 130 | 0 | 7 | 179 | 1 | 7 | 209 | 1 | 7 | 213 | 0 | 7 | 191 |
| 14-Apr-96 | 0 | 0 | 130 | 0 | 7 | 186 | 0 | 7 | 216 | 0 | 7 | 220 | 0 | 7 | 198 |
| 21-Apr-96 | 0 | 0 | 130 | 0 | 4 | 190 | 0 | 4 | 220 | 0 | 0 | 220 | 0 | 2 | 200 |
| 28-Apr-96 | 0 | 0 | 130 | 0 | 0 | 190 | 0 | 3 | 223 | 0 | 0 | 220 | 0 | 0 | 200 |

31-Jan-97

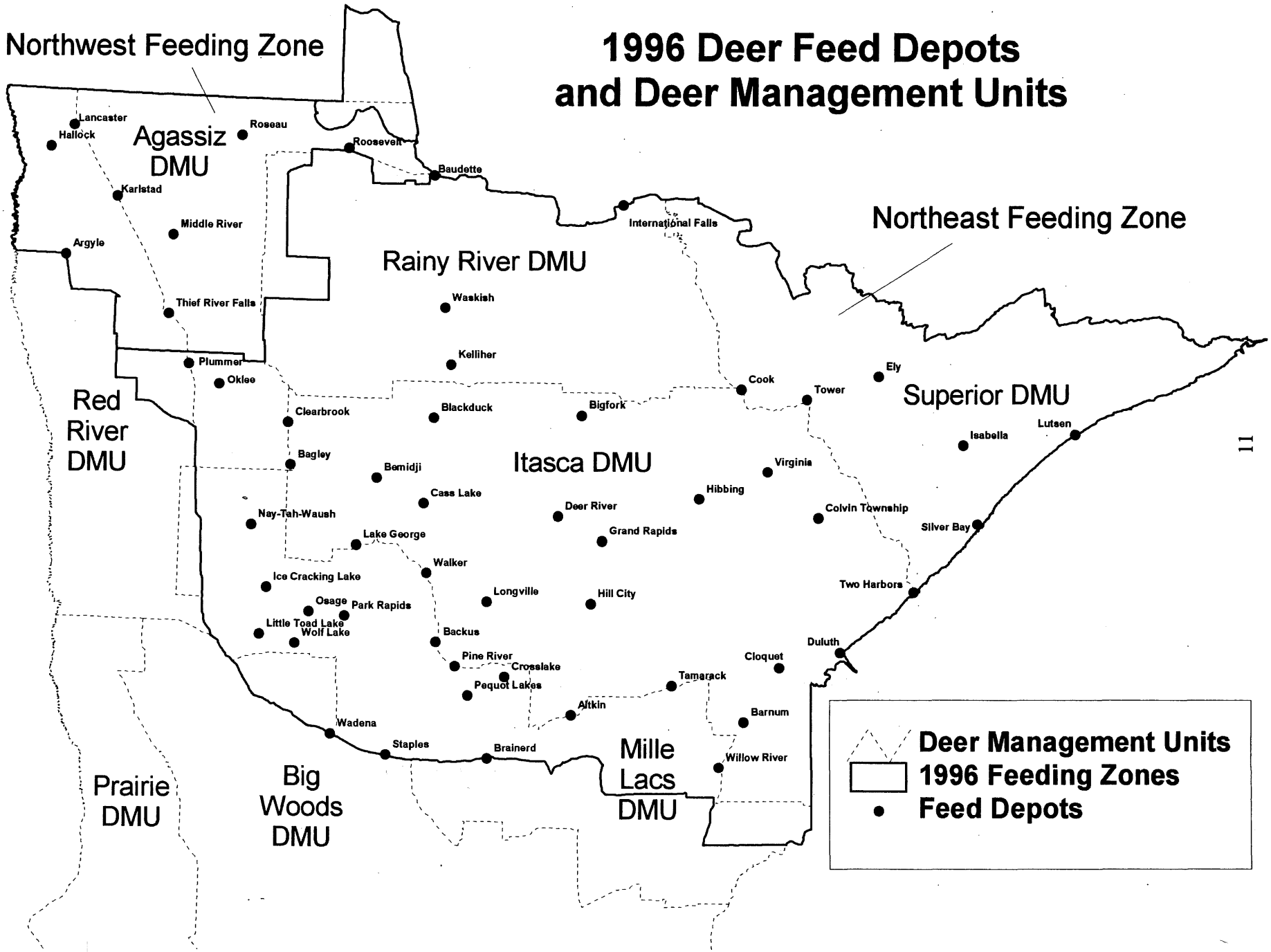



**Figure 1.** 1996 deer feeding areas, feed distribution sites, and Deer Management Units (DMUs).

the 1996-97 biennium (that ran from July 1, 1995 to June 30, 1997), the department was appropriated $130,000 each year for deer and bear management to include emergency deer feeding. If the appropriation for either year was insufficient for deer feeding purposes, the appropriation for the other year was available. Since the winter of 1995-96 occurred during the first year of the biennium, a total of $260,000 was available and was used primarily in northwest agricultural areas (Table 2).

On February 27, a $750,000 appropriation from the Game and Fish Fund "for emergency deer feeding in areas of the state affected by severe weather" was given final legislative approval and was signed into law by the Governor on March 1. Feed distribution from this $750,000 appropriation was primarily restricted to Rainy River, Superior, Itasca, and Mille Lacs DMUs (Fig. 1) and began on March 9.

The chronology of emergency feeding differed between the northwestern farmland and northern forest areas:

Northwestern Farmland Areas: The feeding program in the northwest followed guidelines established after the 1989 feeding program (Appendix 2). A single bid package, by county of delivery, was prepared in mid-January for the northwest feeding area, which initially included Kittson, Pennington, and parts of Roseau, Marshall and Lake of the Woods counties. The bid specified the standard DNR deer feed ration, with a bid deadline of January 31. Supersweet Feeds of Glencoe, Minnesota was the successful bidder in all counties.

The feeding area (Figure 1) was delineated based on winter severity indices and deer condition assessments. The feeding area was eventually expanded to include small parts of Polk, Red Lake, Clearwater, and Beltrami counties, as well as large portions of Roseau and Lake of the Woods counties. In addition, there were considerable efforts to adhere to the DNR's deer feeding guidelines that recommended against distribution of feed to antlerless permit areas that were above goal and to forest deer management units. However, strong public demand to feed in these areas eventually resulted in their inclusion for feed distribution.

Twelve feed distribution depots were established, most of them at sites that were already distributing feed from local MDHA or other privately-funded feeding efforts. Distribution centers were operated primarily by volunteers, and would have been impossible or prohibitively expensive to operate without the volunteer effort. Area wildlife managers coordinated feed ordering and delivery, identified sites with large concentrations of deer, and attempted to direct feed to those sites whenever possible.

The amount of deer feed provided to each person was based on the reported number of deer being fed each week (three, 50 pound bags for every 10 deer up to a maximum of 20 bags per person unless rationing was needed to insure that all feeders were able to obtain feed). Individuals experiencing deer depredation on stored farm crops were given additional feed if it was available after other feeders had obtained their feed.

The DNR began distributing feed on February 10, 1996. Emergency feeding guidelines (Appendix 2) required that feeding start as late as possible to "... minimize costs of the feeding program and maintain volunteer efforts, while still ensuring that deer can utilize the feed." Managers used information from deer condition assessments, observations of deer behavior, reports from the public, and an assessment of available funds to determine the start date consistent with these guidelines.

Distribution was reduced or terminated from west to east and from south to north beginning in early

March. The Crookston wildlife office received their last shipment on March 9, Karlstad office on March 16, Thief Lake WMA and Thief River Falls wildlife offices on March 23, Roseau River WMA on March 30, and the Baudette wildlife office on April 6 (some re-distribution of feed between depots may have occurred after the indicated last shipment date).

Northern Forest Areas: After the emergency appropriation was passed to expand the feeding effort, two bids were prepared for feeding in northern forest areas--one for DNR Region 2 (northeast) and a separate bid for forested portions of DNR Regions 1 (northwest) and 3 (central). The standard DNR deer ration was used for the bid, except that Region 2 chose to allow vendors to bid based on either a pelleted or non-pelleted feed in an effort to allow some smaller, local mills to compete for the bid. The same vendor (Supersweet Feeds) was awarded both bids.

A feeding area (Figure 1) was delineated using the WSI, and 45 feed distribution sites were identified. Distribution sites were generally at non-DNR facilities. Managers identified feed distribution sites, and most facilities donated their services. Sites were staffed by both DNR staff and volunteers, and each distribution site had DNR staff present for most distribution times. Some managers had deer feeders sign up for feed prior to distribution in an effort to speed-up the distribution process. This resulted in thousands of phone calls to DNR offices, disrupting DNR business at these offices for several weeks. Some volunteer help was solicited to help with this sign-up process, but it still consumed much DNR staff time.

The bill providing the emergency appropriation was signed by the Governor on March 1. The availability of funding dictated the starting date for feeding in the forest, and the first delivery occurred on March 9. Deliveries continued on a weekly basis through April 6 (5 deliveries). However, feed distribution sites were shut down from south to north starting on March 30 in an attempt to feed longer in northern areas with deeper, more extensive snow cover. An effort was made to direct the distribution of some of the feed to priority sites. Although managers identified significant deer concentration areas, there was little response to a request for volunteers to feed in these areas.

Guidelines were established that called for individual feeders to receive one bag of feed (50 pounds) for each 3 deer per week, with a limit of 10 bags per individual. However, generally, there was insufficient feed to meet demand, and feed quantities were limited even further in an effort to provide feed to as many individuals as possible. For example, most offices in DNR Region 2 restricted feed as follows: 1-5 deer, one 50-pound bag/week; 6-10 deer, 2 bags/week; 11-15 deer, 3 bags/week; etc. In some cases, individuals who were feeding larger numbers of deer were given priority for feed.

A total of 8,277 individuals picked up feed at least one time in 1996 and placed it on 8,988 sites. In addition, most managers indicated that other individuals were turned away because insufficient quantities were available to meet demand. Considerable volunteer help was also provided to help with feeder sign-up and feed distribution.

In 1989, there was no formal sign-up process, but managers estimated 8,000 individuals participated in the feeding program. This effort declined during the later weeks of the 1989 feeding program. This was not the case in 1996, as demand for feed remained high throughout the program. The 1989 report also indicated that availability of individuals interested in feeding, along with the difficulty of finding and accessing deer, limited the potential effectiveness of a feeding program in most forested areas. In 1996, demand for feed was

much greater than in 1989. Managers believe that this may be due, in part, to the increase in supplemental deer feeding that many of them have observed in recent years. In 1996, 66% of individuals who obtained state feed reported that they had previously been feeding deer, an indication of the tremendous amount of private feeding that was taking place. Since feed supplies were not able to meet demand, it is unknown how many potential feeders could be expected for future feeding programs.

A summary of expenditures from both the Deer/Bear/Computerized Licensing and the emergency appropriation is shown in Table 2.

**Table 2.** Summary of Expenditures for Emergency Deer Feeding Appropriations, 1995-96.

| Activity | Deer/Bear Account Expenditures | Leg. Appropriation Expenditures* | Total Expenditures |
|---|---|---|---|
| Feed Purchase, Storage | $244,268 | $731,445 | $975,713 |
| Feed Storage | $2,855 | $2,831 | $5,686 |
| Deer Surveys | $8,566 | $3,866 | $12,432 |
| Communication, Travel | $3,313 | -- | $3,313 |
| Feed Testing | $172 | $49 | $221 |
| Equipment | $405 | $107 | $512 |
| Total | $259,579 | $738,298 | $997,877 |

* Remaining funds from this $750,000 appropriation were used to fund development of this report.

The feed purchase and delivery expenditures include approximately $60,000 in state sales tax that state agencies are required to pay.

In addition to the direct expenditures for deer feeding listed in Table 2, a total of 8,381 hours of DNR Section of Wildlife staff time was used to support the feeding program. The cost of this staff time was $185,901 (including fringe benefits). Total expenditures (including fleet costs and other expenditures) from the Game and Fish Fund were $1,176,922 (note that the Deer/Bear/Computerized Licensing Account is a dedicated portion of the Game and Fish Fund). A total of 5,115 tons of pelleted deer feed was purchased and distributed across a 38,000 square mile area of the state in the 1996 program. This compares to 3,955 tons of feed distributed across a 46,000 square mile area in 1989. Feeding occurred for about 9-weeks in both years.

## BIOLOGY AND ECONOMICS OF THE 1996 EMERGENCY DEER FEEDING PROGRAM

The following are analyses of deer population data and information reported by feeders for the 1996 feeding program. Summary tables in the text include information at the Deer Management Unit (DMU) level, and appendices include this same information at the Permit Area level.

Most of the data used in these analyses were provided by feeders. All assumptions used to generate estimates relating to the effectiveness of feed distribution derived from these data have maximized the potential benefits of an emergency feeding program. For example, it was assumed that all feed was distributed in the

field and consumed by deer. It is likely, however, that a portion of feed was placed in areas without deer, consumed by other animals, or destroyed by weather. It was also assumed that all deer (adults and fawns) had equal access to feed at feeding sites and that deer consumed no more than the Recommended Daily Amount (RDA) of 2.5 pounds per day. Many feeders noted that all deer did not receive an adequate ration and that fawns (which would benefit most from the feed) were often excluded from the feed by larger, stronger deer. Finally, it was assumed that the number of deer reported by feeders was accurate and no double-counting or inflation occurred. However, it is known that the reported number of deer fed has been over-estimated because of duplication (neighboring feeders reporting the same deer). It was found that some one-square mile sections had as many as 12 different feeders providing feed, and 29% of sections had more than one feeding site in them.

It should also be noted that the analysis includes only state-purchased feed. There were extensive private feeding efforts before, during, and after the state feeding program, and this evaluation is not intended to reflect the total feeding effort in the state during the 1995-96 winter. While this information would have been useful, the committee had neither the time nor the resources to determine the extent of private feeding.

**Analysis of Feed Distribution:** Data regarding the distribution of feed and location of feeding sites was collected at all distribution depots. Information included name, address, and telephone number of the feeder; number of bags distributed to each individual; amount of previous supplemental feeding; number of deer being fed; and the location of the feeding site to the nearest section or to the nearest 40-acre parcel. A Geographic Information System (GIS) was used to plot township, range, section and permit area information. GIS points were located at the center of the smallest unit area given in the feeding site description. For example, if the smallest descriptive parcel consisted of township and range, the program placed a point in the center of the township. If, however, the description was to the nearest 40-acre parcel, the point would be placed in the center of the 40-acre parcel.

Data were recorded for 9,146 feeding sites, of which 8,748 were useable records. Feeders reported that 200,946 deer were fed 9,445,100 lbs of feed at these sites. The analysis found that 23% of the 8,784 sites received food only once. Food going to these sites totaled 456,000 pounds of feed. Since most (1,675) of these sites received 300 pounds or less of feed, it is very likely that deer were not present at these sites or deer at these sites did not benefit significantly from the additional food.

Thirty percent of feed was distributed on public lands across the feeding area, while public lands comprised 42% of the land area (Table 3). This trend was most pronounced in the forest DMUs which contain a higher proportion of public land. There are no data on relative numbers of deer on public vs. Private lands, but managers reported limited interest from individuals to feed deer on public lands.

The feeding program was conducted for 4-5 weeks in forest DMUs and for 6-8 weeks in farmland DMUs (Table 4). The number of days feed was available varied from a low of 14 in permit area 214 to a high of 77 in permit area of 211-212 (Appendix 5).

A total of 9,445,100 lbs of feed were distributed into the designated northwestern farmland and northern forest feeding areas (Table 4). Slightly more than 25% of the feed was distributed into the northwest farmland area which resulted in an average of 46,962 lbs of feed available on a daily basis. Forested areas had 183,600 lbs of feed available to deer on a daily basis.

**Table 3.** Proportion of feeding sites on public lands compared to public land base, by DMU.

| Deer Management Units | % Feed Sites on Public Land | % Public Land in DMU |
|---|---|---|
| Red River | 3% | 2% |
| Agassiz | 22% | 18% |
| Rainy River | 57% | 57% |
| Superior | 36% | 79% |
| Itasca | 35% | 49% |
| Mille Lacs | 20% | 25% |
| **Farmland Total** | **16%** | **9%** |
| **Forest Total** | **32%** | **51%** |
| GRAND TOTAL | 30% | 42% |

**Table 4.** Summary of the amount and duration of feeding by DMU in the feeding area. For detailed information about each permit area within each DMU see Appendix 5.

| Deer Management Units | Bags of feed | Pounds of feed distributed | Days of feed availability | Average lbs of feed available per day |
|---|---|---|---|---|
| Red River | 14,239 | 711,950 | 42-49 | 15,371 |
| Agassiz | 34,823 | 1,741,150 | 49-63 | 29,652 |
| Rainy River | 20,391 | 1,019,550 | 14-77 | 17,295 |
| Superior | 19,269 | 963,450 | 35-42 | 25,930 |
| Itasca | 73,775 | 3,688,750 | 28-42 | 103,216 |
| Mille Lacs | 25,048 | 1,252,400 | 28-35 | 37,159 |
| Big Woods North | 1,357 | 67,850 | 35 | 1,939 |
| **Farmland Total** | **50,419** | **2,520,950** | **35-63** | **46,962** |
| **Forest Total** | **138,483** | **6,924,150** | **14-77** | **183,600** |
| GRAND TOTAL | 188,902 | 9,445,100 | 14-77 | 230,562 |

Approximately 200 tons of feed/week was available through the first week of March (Figure 2). By the week of March 8, the amount of feed distributed increased by nearly 5 times to almost 1,000 tons as the emergency appropriation became available. From March to April feeding declined, until slightly less than 500 tons were distributed the week of April 5.

Access was one of the factors limiting the distribution of feed in all permit areas. The number of roads open

for travel dictated the location of many feeding sites, and large roadless areas in most DMUs had little or no feed available. An analysis of the distance of feeding sites from maintained roads found that 96% of sites were within 1 mile of such roads, 86% within ½ mile, and 57% within 1/4 mile (Figure 3). While information is not available to determine the distribution of deer compared to roads (or feeding sites), this analysis does indicate that relatively few deer in remote locations far from roads received feed.

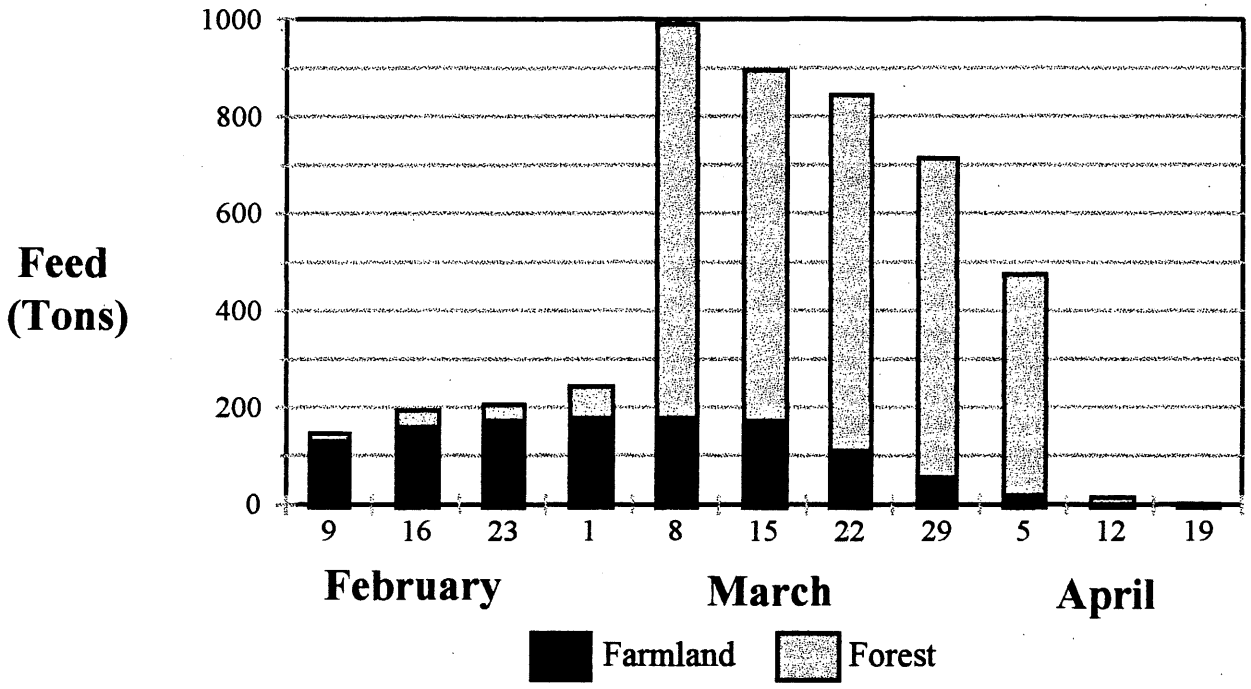


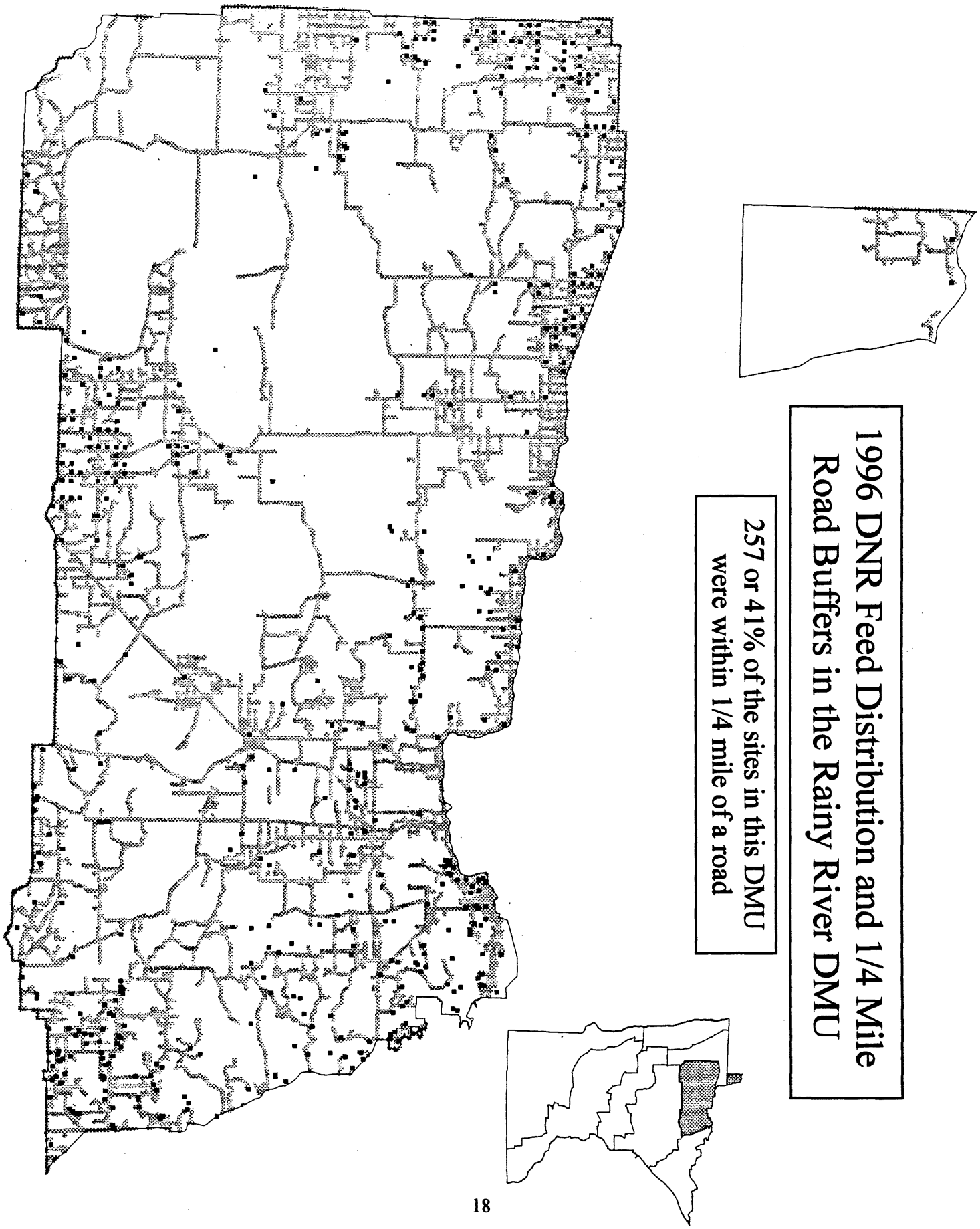

**Figure 2.** Distribution of feed in farmland and forest areas in tons per week.

If it is assumed that a feeding site is available to deer residing within a ½ mile radius of the site, 11.4% of the land in the feeding area had feed available in 1996. In most severe winters, deer become relatively immobile, and unless there are roads or trails nearby that are used be vehicles, it is unlikely that deer would be able to travel far. Consequently, this ½ mile radius is probably generous, but serves to illustrate the large amount of land in the designated feeding area that did not have feed available to deer.

**Analysis of Deer Fed:** Two separate estimates were made of the number of deer potentially reached by the 1996 feeding program.

A. Calculated Deer Fed: The potential maximum number of deer fed the RDA in each permit area was calculated from the amount of feed distributed and the number of days feed was provided. It assumes each deer consumed the RDA during each day of the feeding period, that no deer reported by feeders visited more than 1 feeding site, and that the number of deer reported feeding at each site consumed an equal portion of the feed available over the feeding period. For reasons discussed earlier, the actual number of deer that consumed the RDA was probably much lower. The RDA of 2.5 lbs. per deer per day was also used in the 1989 evaluation, and reflects the amount of feed needed to keep a deer in good condition during winter.

**Figure 3.** Feed distribution and 1/4 mile road buffers, Rainy River DMU.



Individual deer could consume much more feed than this (up to 5-6 lbs.), and some deer (especially fawns) are often prevented from obtaining a full ration by larger deer. Some deer may benefit from a smaller ration, especially if they have access to natural browse. Further, it may not be necessary to keep deer in good condition; rather, feeding can be used to slow down the rate of deterioration of deer. Considering all of these factors, the committee decided to use the 2.5 lbs per deer per day RDA, but believes it over-estimates the number of deer reached with and benefitted by feed.

Overall, the estimated percent of deer that could have been fed the RDA of food was 23.3% of the calculated 396,000 deer (Table 5). As expected, a higher proportion of deer was potentially fed the RDA in farmland (36.3%) than in the forest areas (21.3%). The maximum percent of deer potentially receiving the RDA in farmland permit areas ranged from 0.4% to 80.2% and in the forest ranged from 0.6% to 82.2% (Appendix 6).

**Table 5.** Summary of the post-hunt deer populations by DMU and the maximum percent of deer that could have been fed the RDA. For detailed information about each permit area within each DMU, see Appendix 6.

| Deer Management Unit | Pounds of feed available per day | Post-hunt deer population | Estimated number of deer fed* | Percent of post-hunt population fed 2.5 lbs. per day |
|---|---|---|---|---|
| Red River | 15,371 | 20,475 | 6,149 | 30.0 |
| Agassiz | 29,652 | 28,325 | 11,860 | 41.9 |
| Rainy River | 17,295 | 63,962 | 6,917 | 10.8 |
| Superior | 25,930 | 45,195 | 10,371 | 22.9 |
| Itasca | 103,216 | 170,063 | 41,287 | 24.3 |
| Mille Lacs | 37,159 | 64,978 | 14,863 | 22.9 |
| Big Woods North | 1,939 | 3,002 | 776 | 25.8 |
| **Farmland Total** | **46,962** | **51,802** | **18,785** | **36.3** |
| **Forest Total** | **183,600** | **344,198** | **73,438** | **21.3** |
| GRAND TOTAL | 230,562 | 396,000 | 92,223 | 23.3 |

B. Reported Deer Fed: Data were also collected on the number of deer fed as reported by feeders. There was no field verification of the numbers of reported deer fed so these values appear as they were given to the DNR field staff. Overall, feeders reported reaching 201,000 deer (50.7% of available deer) in the designated feeding area in 1996 (Table 6). In the farmland, feeders reported feeding 44,700 deer (86.4% of available deer), while feeders in the forest reportedly fed 156,200 deer (45.4% of available deer). These values ranged from a low of 23.8% in Rainy River DMU to 104.6% in the Agassiz DMU (feeders reported feeding more deer than were estimated to be alive in the unit after the hunting season). Wide variation was observed among permit areas for the portion of the post-hunt populations reportedly fed (Appendix 7).

**Table 6.** Summary of the number of deer reported fed, the amount of feed consumed per day per deer reported fed and the portion of the 1995 post-hunt deer population reported fed. These estimates assume all feed was available to deer and that no deer fed at more than 1 feeding site. For detailed information about each permit area within each DMU, see Appendix 7.

| Deer Management Unit | Pounds of feed available per day | Post-hunt deer population | Reported deer fed | Pounds of feed per reported deer fed per day | Percent of post-hunt deer population reported fed |
|---|---|---|---|---|---|
| Red River | 15,371 | 20,475 | 13,216 | 1.2 | 64.5 |
| Agassiz | 29,652 | 28,325 | 29,633 | 1.0 | 104.6 |
| Rainy River | 17,295 | 63,962 | 20,987 | 0.8 | 23.8 |
| Superior | 25,930 | 45,195 | 16,776 | 1.5 | 37.1 |
| Itasca | 103,216 | 170,063 | 79,699 | 1.3 | 46.9 |
| Mille Lacs | 37,159 | 64,978 | 38,732 | 1.0 | 59.6 |
| Big Woods North | 1,939 | 3,002 | 1,903 | 1.0 | 63.4 |
| **Farmland** | **46,962** | **51,802** | **44,752** | **1.0** | **86.4** |
| **Forest** | **183,600** | **344,198** | **156,194** | **1.2** | **45.4** |
| GRAND TOTAL | 230,562 | 396,000 | 200,946 | 1.1 | 50.7 |

Based on the reported numbers of deer fed, the average deer fed received an estimated 40% (1.0 lbs per day) to 50% (1.25 lbs per day) of the RDA required to maintain good health (Table 6, Appendix 7). The average amount of feed consumed by each deer ranged from 32% of the RDA in Rainy River DMU to 60% in the Superior DMU. Of the 82 permit areas in the feeding area, 3 reported deer had access to at least the recommended 2.5 lbs per day, while only 4 (5%) had access to at least 80% of the RDA (Appendix 7).

**Deer Population Analysis:** The number of deer available to be fed in each permit area was considered to be the 1995 post-hunt deer population. Estimates of the 1995 post-hunt deer population were calculated using the deer population models developed for the farmland and forest portions of the state. Estimates of the 1996 prefawn deer populations were also calculated using the model.

As the winter of 1996 began, there were an estimated 396,000 deer in the northern area of the state where feed was distributed (Figure 1, Table 7, Appendix 4). About 13% of these deer (51,802) were located in the northwestern farmland, while the remaining 344,198 (87%) were in the northern forested area of the state. Deer densities ranged from 1.9 to 15.8 deer per square mile in the northwest farmland, and from 1.2 to 25.6 deer per square mile in the forest.

Projections indicate that more than 100,000 deer died in the feeding area during the 1995-96 winter (Table 7). As should be expected with an emergency feeding program, many of these deer likely died fairly early in winter before state feed was made available. Because an emergency program is intended to help prime breeding-age deer (primarily adult does), it is expected that many fawns and older deer will not be helped by

emergency feeding.

**Table 7.** Summary of the calculated deer populations after the 1995 hunting season and prior to fawning in spring 1996. Population density goals for each DMU are listed. For detailed information on permit areas within each DMU, see Appendix 4.

| Deer Management Unit | Non-water area ($mi^2$) | 1995 Post-hunt | | 1996 Prefawn | | Deer population goal range (deer/$mi^2$) |
|---|---|---|---|---|---|---|
| | | Calculated deer density (deer/$mi^2$) | Calculated total deer | Calculated deer density (deer/$mi^2$) | Calculated total deer | |
| Red River | 5,264 | 1.9-7.5 | 20,475 | 2.0-7.0 | 19,070 | 1-4 |
| Agassiz | 3,986 | 4.0-15.8 | 28,325 | 4.0-14.0 | 25,372 | 2-17 |
| Rainy River | 6,004 | 4.6-25.6 | 63,962 | 3.0-16.0 | 37,772 | 10-20 |
| Superior | 5,714 | 1.2-19.0 | 45,195 | 1.0-17.0 | 28,183 | 3-20 |
| Itasca | 11,671 | 11.1-25.0 | 170,063 | 7.0-17.0 | 119,693 | 18-27 |
| Mille Lacs | 4,955 | 6.1-23.7 | 64,978 | 5.0-19.0 | 58,661 | 10-30 |
| Big Woods North | 417 | 7.2 | 3,002 | 7.0 | 2,919 | 6-7 |
| **Farmland Total** | **9,667** | **1.9-15.8** | **51,802** | **2.0-14.0** | **47,361** | **1-17** |
| **Forest Total** | **28,344** | **1.2-25.6** | **344,198** | **1.0-19.0** | **244,309** | **3-30** |
| GRAND TOTAL | 38,011 | 1.2-25.6 | 396,000 | 1.0-19.0 | 291,670 | 1-30 |

In northern forest DMUs, this represented a 29% population decline (Table 7). The northwestern farmland DMUs experienced a projected 9% decline over the same period. In the northwestern farmland 14 of 18 (78%) permit areas had projected deer densities at or above density goals (Appendix 4) and only 4 permit areas had projected densities that fell below the goal levels. In contrast, 17 of 22 (77%) of the forest permit areas where population projections were calculated were below the density goal.

For permit areas 201 and 202 in the northwest, we analyzed the potential impact of feeders reaching reportedly high portions of winter deer populations, but where deer would have had available only 40% to 50% of the RDA.

Permit area 201 is the Roseau River Wildlife Management Area, and feeders reported reaching 6% more deer than were estimated to exist in the unit (note: managers report that this area serves as a wintering area for deer from surrounding areas and Canada, which may partially account for the fact that feeders here reported feeding more deer than models projected). Each deer was estimated to have received 0.9 lbs of feed per day. Analysis of sex and age data from the firearms hunting seasons from 1990 through 1996 indicated that losses of fawns during the 1996 winter were approximately 49% for males and 54% for females. While adult male and female losses were only slightly higher than normal, the reduction in fawns produced in spring 1996 was estimated to be 46%. This result was confirmed by the low numbers of fawns (particularly of female fawns) in the 1996 check station reports. While the area experienced severe flooding during the

spring of 1996 which may have contributed to some of these projected losses, most are likely due to the severity of winter.

Permit area 202 is the Thief Lake Wildlife Management Area, and feeders reported reaching 85.4% of the post hunt deer population, with an estimated daily ration of 1.2 lbs of feed per day. Hunting season sex and age data from 1993 through 1996 revealed losses in the 1995 fawn group of approximately 33% for males and 10% for females. Adult losses were within the normal range of 10-15%, and a 10% reduction in the 1996 fawning rate was observed.

The pattern of events in permit areas 201 and 202 indicated that, although relatively high numbers of deer were reportedly fed at the feeding sites, mortality rates were still as high as have been observed for unfed deer in the most severe winters. This analysis suggests that given the severity of the 1995-96 winter, feeding in areas where a high percentage of the deer can be reached may contribute to increased adult deer survival, but does not reduce widespread and substantial losses of fawns born the previous year. In addition, reductions in fawns produced after the winter also were substantial, indicating adult females were suffering from stress that was great enough to impact the outcome of individual pregnancies and fawn survival.

**Cost Analysis:** Costs were recorded for the farmland and forest areas separately. Cost data included the cost of feed per 50 lb bag, the cost of all feeding operations, the cost for all staff time spent in feeding activities and the costs associated with monitoring deer winter condition.

A total of 1,260 tons (50,419 bags) of feed was distributed from depots in the northwestern farmland area to the feeding area, and 3,462 tons (138,483 bags) to the forest area (Table 8). Total feeding costs for the farmland were $303,457, whereas the total feeding costs in the forest area were $776,890. The farmland costs represented 28% of the $1,080,346 spent to feed deer in 1996. Permit Area 180-184 reported the highest total cost to feed deer ($98,045.97) while Permit Area 407 had the lowest feed cost ($84.42, Appendix 8).

The cost per deer potentially fed the RDA was $11.71, and the cost per deer reported fed by feeders was 45% of that total or $5.38 (Table 9). The cost per deer potentially fed the RDA was slightly more than twice the cost per deer reported fed by feeders in both the farmland and forested permit areas, and the difference in all areas was due to the higher number of deer reported fed by individuals feeding deer (Appendix 9). Cost per reported deer fed varied from a high of $14.07 in Permit Area 407 to a low of $2.35 in Permit Area 247.

Potentially, the $1,080,346.26 spent on the program could have fully fed an estimated 23.3% of the posthunt deer population in the feeding zone. The costs to fully feed 50% of the posthunt deer population were estimated to be $2,297,928.00 but were dependent on the costs to feed an additional 25% being identical to the costs to feed the first 25% of populations. In addition, feeding another 25% of the population assumed access was not limiting and that staff and feed distribution logistics could be accommodated.

**A Comparison of 1989 and 1996 Feeding Programs:** In 1996, over $975,000 was spent to purchase deer feed, an increase of 31% over 1989 (Table 10). A much higher proportion of the program costs went to feed in 1996 (83%) than in 1989 (70%). This increased efficiency is a product of a smaller feeding area, a shorter feeding interval, increased public interest and involvement, and reduced hours by DNR staff. As a result, the 1996 program was potentially able to feed the RDA to 27% more total deer than in 1989, and the proportion of deer potentially fed increased in all DMUs except the Red River DMU. A higher proportion of deer was reached in farmland units compared to forest DMUs in 1996, as occurred in 1989.

**Table 8.** Summary of the costs for feed and associated feeding activities by DMU in the feeding zone. For detailed information about each permit area within each DMU, see Appendix 8.

| Deer Management Unit | Number of bags distributed | Feed cost | Associated feeding costs* | Total feeding costs |
|---|---|---|---|---|
| Red River | 14,239 | $53,253.86 | $32,607.31 | $85,861.17 |
| Agassiz | 34,823 | $130,238.02 | $79,744.67 | $209,982.69 |
| Rainy River | 20,391 | $82,991.37 | $31,402.14 | $114,393.51 |
| Superior | 19,269 | $78,424.83 | $29,674.26 | $108,099.09 |
| Itasca | 73,775 | $300,264.25 | $113,613.50 | $413,877.75 |
| Mille Lacs | 25,048 | $101,945.36 | $38,573.92 | $140,519.28 |
| Big Woods North | 1,357 | $5,522.99 | $2,089.78 | $7,612.77 |
| **Farmland Total** | **50,419** | **$189,014.87** | **$114,441.76** | **$303,456.63** |
| **Forested Total** | **138,483** | **$563,625.81** | **$213,263.82** | **$776,889.63** |
| GRAND TOTAL | 188,902 | $752,640.68 | $327,705.58 | $1,080,346.26 |

* Associated feeding costs include staff time, equipment, and other feeding costs.

**Table 9.** Summary of the cost per estimated deer fed and cost per reported deer fed by DMU in the feeding zone. For detailed information about each permit area within each DMU, see Appendix 9.

| Deer Management Unit | Total feeding cost | Estimated number of deer fed* | Cost per estimated deer fed | Reported deer fed* | Cost per reported deer fed |
|---|---|---|---|---|---|
| Red River | $85,861.17 | 6,149 | $13.96 | 13,216 | $6.50 |
| Agassiz | $209,982.69 | 11,860 | $17.71 | 29,633 | $7.09 |
| Rainy River | $114,393.51 | 6,917 | $16.54 | 20,987 | $5.45 |
| Superior | $108,099.09 | 10,371 | $10.42 | 16,776 | $6.44 |
| Itasca | $413,877.75 | 41,287 | $10.02 | 79,699 | $5.19 |
| Mille Lacs | $140,519.28 | 14,863 | $9.45 | 38,732 | $3.63 |
| Big Woods North | $7,612.77 | 776 | $9.81 | 1,903 | $4.00 |
| **Farmland Total** | **$303,456.63** | **18,785** | **$16.15** | **44,752** | **$6.78** |
| **Forest Total** | **$776,889.63** | **73,438** | **$10.58** | **156,194** | **$4.97** |
| GRAND TOTAL | $1,080,346.26 | 92,223 | $11.71 | 200,946 | $5.38 |

* Estimated deer fed is the number of deer that could consume the RDA. Reported deer fed is the number reported by feeders.

**Table 10.** Comparison of 1989 and 1996 Feeding Programs.

| | 1989 | 1996 |
|---|---|---|
| Feed Expenditures | $744,536 | $975,713 |
| Total Game and Fish Fund Costs | $1,071,492 | $1,176,922 |
| Amount of Feed Purchased | 3,955 Tons | 5,115 Tons |
| Size of Feeding Area (Square Miles) | 46,000 $mi^2$ | 38,000 $mi^2$ |
| Estimated Maximum Number of Deer Fed | 72,332 | 92,223 |
| Cost/Deer Fed | $14.69 | $12.76 |
| Section of Wildlife Staff Hours | 13,754 | 8,381 |
| Maximum Potential % of Deer Fed By DMU Based on RDA of 2.5 pounds of feed/deer/day. | | |
| Red River DMU | 36% | 30% |
| Agassiz DMU | 26% | 42% |
| Big Woods DMU | 10% | 26% |
| Farmland DMU Total | 22% | 37% |
| Rainy River DMU | 4% | 11% |
| Itasca DMU | 10% | 24% |
| Superior DMU | 13% | 23% |
| Mille Lacs DMU | 10% | 23% |
| Forest DMU Total | 9% | 21% |
| Total | 11% | 23% |

## SUMMARY AND DISCUSSION

**Deer Feeding Programs and Policies of Other States and Provinces:** With the exception of Manitoba, no other state or province has implemented a publicly-funded deer feeding program similar to that adopted by Minnesota in 1989 or 1996, and according to biologists from other states, there is little public demand for such state-funded programs. However, private feeding (both supplemental and emergency feeding) is very common and has been increasing elsewhere, as it has in Minnesota. Most states offer technical assistance to private individuals or clubs interested in supplemental or emergency feeding to ensure that the practice is done correctly.

**Problems Related to Deer Feeding:** Problems to deer health and behavior related to feeding (disease transmission, predator impacts, altering deer movements) and impacts to vegetation at feeding sites are important issues that could threaten the future health and viability of deer populations. In addition, there is concern that feeding may disrupt natural selection processes by allowing less-fit deer to survive severe winters along with deer that are better-adapted to surviving the rigors of winter.

**Deer Monitoring and Winter Severity Assessment:** Determining whether winter conditions warrant emergency deer feeding has been controversial and difficult. The WSI is widely known by the public and reported by the media. Because past experience has shown that the WSI is not always a good indicator of deer condition, managers also use observations of deer behavior, results of necropsies of dead deer, and other information to augment WSI findings. There has been interest from the public in using the WSI as a trigger to determine feeding program starting dates. While the WSI may be a good index to alert managers that deer are experiencing severe conditions, research has not documented that it is useful in predicting deer condition.

The department's approach to winter deer monitoring has been a multi-staged approach. The first stage is monitoring WSI values. If WSI indicates the potential for a severe winter, additional monitoring such as field observations of deer behavior, mobility, and use of food resources, as well as inspection of dead deer is implemented. The final stage includes shooting and necropsy of deer in selected areas to determine physical condition. In addition, results and observations of deer from ongoing deer research studies is used throughout the monitoring process to augment other monitoring findings.

There is a need to improve public understanding of the WSI and other deer monitoring activities. There is also a need to assess the value of the WSI and other measures as an indicator of deer condition in farmland areas of the state, as is currently being done as part of an ongoing DNR deer research study in north-central Minnesota. Finally, there is interest from the public in an easily understood "trigger" for determining the need for (and starting dates of) future feeding programs if dedicated funds for deer feeding continue to be provided.

**Feeding in Areas With High Deer Populations:** Although DNR feeding guidelines recommended that emergency deer feeding not be conducted in antlerless permit areas that were above goal levels, there was little public support for this approach. Some individuals from forested areas questioned why deer were being fed in areas where the DNR was attempting to reduce deer populations, but there was very little local support for withholding deer feed from these areas to help achieve population management objectives. The DNR was accused of using "starvation as a management tool", when in fact, the restriction on use of state funds to feed deer in these areas was an attempt to direct deer feed into those permit areas where feeding could be used for attaining population objectives. Additional discussion with stakeholders is necessary on this aspect of feeding policy.

**Program Start Date:** In 1996, the DNR was generally criticized for starting the state feeding program too late. Most organized private feeding programs started much earlier than state-funded programs, and as these private programs ran low on funds there was increasing pressure to initiate state feeding. Reports and observations of dead deer, mostly smaller fawns, also brought pressure to feed earlier than the department's monitoring indicated was necessary.

The DNR's approach has been to use winter feeding as an emergency measure, with the primary intent of maintaining the condition of adult does, which is important to helping deer herds recover from winter losses. Since adult does enter winter in better condition than either fawns or adult bucks, feeding programs have started later than they would if the intent was to save fawns. There is not a good understanding of this approach by the public, and at roundtable meetings interest was expressed in designing state feeding programs to prevent mortality in all segments of the deer herd. This would require a much earlier starting date and significantly more money, and likely would save few additional deer.

Later start dates are also preferred to avoid spending deer feeding funds in years when an early thaw or moderate late-winter weather results in easing of winter stress for deer. Finally, with limited funding, later start dates ensure that available funds do not run out before the end of winter.

**Cost of Feeding:** Deer feeding is a very expensive management technique. Despite complaints that the state feeding program started too late, ended too early, was not available in a large enough area of the state, and did not provide adequate feed to meet demand, nearly $1 million of state funds was expended for feed purchase, and total state expenditures exceeded $1.175 million. Thus, the potential costs of an expanded feeding program that would meet all expectations of deer feeders are extremely high. If there were additional dollars and manpower (both public and DNR staff), it would cost in excess of $2.5 to $3 million to feed 50%

of the deer the RDA. This assumes that the number of feeders could be doubled, substantially more DNR staff time could be diverted, and that feeders could access this increased proportion of deer. Analyses indicate that while some feeders (especially in the forest) were turned away because of insufficient food, their numbers were only a fraction of those that did distribute food. Diversion of additional DNR staff would only exacerbate problems and would likely reduce funds available from federal aid. Finally, because most feeding in 1996 occurred within 1 mile of a road, it is highly unlikely that feeders would have access to significantly more deer.

Based on past history, the frequency of severe winters can not be predicted, and it is possible that such an expenditure might be necessary for several consecutive years. For these reasons, it is difficult to plan and develop deer management program budgets that include emergency feeding programs as a component.

There was a widely held misconception that a portion of the $1 Deer/Bear/Computerized Licensing surcharge was dedicated exclusively to emergency deer feeding. This was not the case, and the State Legislative Auditor's Office determined that the DNR has administered this account properly. The 1996 emergency appropriation bill did established a dedicated feeding account for the first time. Starting on July 1, 1997, $.50 from each deer license will be deposited in an account that can only be used for feeding deer. The funds in the account are available immediately, and any unused funds carry over to succeeding years. (Note: When or if the balance of this dedicated feeding account reaches $750,000, the entire $750,000 transfers over to the Game and Fish Fund to re-pay the Fund for the 1996 feeding program, and the account will again begin accruing funds for deer feeding, but at a rate of $.25 per deer license.) It is expected that this account will generate approximately $200,000-$250,000 annually for deer feeding programs until the $750,000 emergency appropriation is repaid, at which time the account will generate approximately one-half that amount.

This new dedication of deer feeding funds will result in a corresponding decrease in funds available to the Section of Wildlife for other deer and bear management programs. Previously, the funds were set-aside for deer feeding, but if they were not used for that purpose they could be used for other deer and bear management activities. Important deer and bear research and management programs that have long-term benefits to these and other species will be cut back as a result.

**Impacts to Other DNR Wildlife Management Programs:** The more than 8,300 hours of staff time (valued at $186,000) for emergency feeding is equivalent to 4 full-time positions for one year. Much of this time was spent on activities that would not require professional wildlife expertise such as ordering feed, monitoring feed sign-up processes, mobilizing volunteers, and answering public inquiries about the feeding program. Important work did not get accomplished due to the feeding program, including many activities that would provide long-term benefits to deer and other wildlife.

Feeding programs are short-term, and the benefits rarely extend beyond one or two years. In addition, feeding benefits a very small group of species (deer and perhaps some predators that rely on deer as prey). Most wildlife management programs have evolved to employ a more comprehensive approach that focuses on managing landscapes to address the needs of all species and to focus on long-term habitat management programs that provide benefits for a number of years. Important programs that provide these long-term benefits to multiple species were compromised as a result of the time that professional staff spent on the deer feeding program, and as a result of the diversion of funds from other management activities that occurred in 1995-96. This also will occur in future years as deer license fees are dedicated to deer feeding.

The possible future impact on federal aid reimbursement as a result of time spent on deer feeding is also

cause for concern. Federal aid funds are returns of federal excise taxes on hunting equipment and ammunition, but they can be provided only for qualifying wildlife management activities. Because the U.S. Fish and Wildlife Service has determined that feeding is not a reimbursable activity, the Section could have difficulty in qualifying for the maximum allowed payments if significant time is spent on feeding programs in the future. The net result would be reduced federal funds into the Game and Fish Fund for all wildlife management programs in the state.

**Public Involvement:** There was very strong demand and support for emergency feeding across the northern part of the state, and the feeding program allowed interested individuals to get involved and participate in a wildlife program. Interest by the public in the feeding emergency was tremendous. Individuals and conservation organizations assisted with depot selection, feeder sign-up, and feed distribution. This helped to reduce the amount of time spent by wildlife staff on the feeding program compared to 1989, and reduced the total cost per deer reached. Both the 1989 and 1996 evaluations have demonstrated that without a strong public involvement, emergency feeding programs would be impossible.

Interest in deer feeding increased in 1996, likely a result of the high numbers of recreational feeders. Many individuals interested in obtaining feed had to be turned away from the program because of insufficient funds. Approximately two-thirds of feeders reported that they had previously been feeding deer. It appeared that state funds were used in many cases to offset costs for individuals that feed deer every winter for recreation or personal enjoyment. Some local feed mills reported that the state feeding program negatively impacted sales of their deer feed.

Reliance on the public to distribute feed also makes it difficult to direct feed to priority sites. In 1996, 70% of feed went to private lands even though public lands comprised 42% of the land base. Managers reported that there was generally little interest from the public to feed in areas identified by managers, especially on public lands, and most feeders wished to feed deer in the most accessible areas of specific interest to them (near homes, cabins, hunting sites, etc.). The fact that such a high proportion of individuals distributed feed only once (23% of sites) is problematic, and feed distributed by these individuals likely provided very little benefit to deer.

**Deer Population Analysis:** Of the estimated 396,000 deer in the feeding area at the start of the 1995-96 winter, 104,000 (29%) were estimated to have died during the winter. Declines were greatest in forested and northwestern farmland areas where reductions of 30% to 40% were projected to have occurred in many locales. Areas in the rest of the farmland and transition areas experienced losses of 5%-10%. Harvest also declined significantly throughout the feeding area. Buck harvest declined 24% from 1995 to 1996 in northwest agricultural areas and 34% in forest areas, while total harvest declined 28% and 55% in farmland and forest feeding areas respectively.

In some northwestern areas, over-winter losses (especially of fawns), and reductions in fawn recruitment the following year, were significant in spite of extensive feeding and, given the severity of the winter, similar to what would have been expected even if no feeding had occurred. Although some adult deer were undoubtedly saved by feeding, many fawns consumed feed and still died, many did not have access to feed, many were provided an inadequate ration to survive, and many likely perished in spite of ready access to artificial food.

These numbers indicate that the feeding program was not able to prevent significant deer population declines across the northern part of the state. A more difficult question is the effect that deer feeding may have had in preventing even greater losses in different areas of the state. Because of variations in winter severity, hunting

pressure, distribution of feed within permit areas, and other factors it was not possible to determine the number of deer that were "saved" by the feeding program. The committee looked at the maximum proportion of deer fed compared to the decline in buck harvest from 1995 to 1996 by permit area (to determine if buck kill declined less in permit areas where feeding was reported more intensive), and found that there was no relationship. Without a specific research study that would track the fate of both fed and un-fed deer, this type of analysis is not possible.

**Feed Distribution:** Access was the major limiting factor in the distribution of the feed. This resulted in large, inaccessible areas where little or no feed was distributed. The study documented that in many cases, feeders were providing feed in close proximity to each other, creating situations where the same deer were being fed by a number of feeders.

Participants in the deer feeding roundtables urged the DNR to improve planning for future deer feeding programs to enhance their effectiveness. Some specific suggestions included: 1) targeting feed to priority deer concentration areas; 2) providing more flexibility in feed ration specifications to obtain feed at a cheaper cost; and 3) generally attempting to get state-funded feed to deer that are not being fed with private funds. However, there was not total agreement on these points, and additional discussions with stakeholders are necessary before a long-term strategy for administering dedicated deer feeding funds is developed. For example, DNR wildlife managers generally agree that it would be very difficult and politically unpopular to prevent individuals who are feeding deer with private funds from obtaining state-purchased feed.

As in 1989, wildlife managers reported instances of waste associated with the emergency deer feeding program. Documented examples included: feed distributed along roads or in areas not being used by deer; feed stored by individuals for future winters; and feed provided to deer outside of the designated deer feeding zone (about 300,000 pounds or 3% of feed that was distributed). It is also likely that most of the feeding sites where feed was only obtained once (23% of all sites) probably represent sites where no or few deer were present. Increased monitoring of feeding sites and additional restrictions or direction concerning who may obtain feed and where feed may be distributed would be necessary to limit these types of problems in the future.

**Estimates of Number of Deer Fed:** Since some deer were double-counted, some feeders likely over-estimated the number of deer being fed in an effort to obtain additional feed, and in light of the difficulties feeders reported in accurately estimating the number of deer fed, it is not possible to determine the number of deer that were reached. However, because of these difficulties, it is likely that the reported number of deer fed is biased high.

There were significant differences in the estimated number of deer reached with feed between deer management units. Some of this was due to differences in accessibility of deer and availability of feeders, but much of the difference was also due to the fact that feed had to be rationed in most forest areas because funding was insufficient to meet demands from feeders. It is not possible to make any conclusions regarding the potential maximum number of deer that can be reached by an emergency feeding program in most deer management units, because a program has never been funded sufficiently to determine the maximum number of feeders and feed that could be distributed.

**Individual Deer vs. Deer Populations:** Participants in the deer feeding roundtables indicated that the concern of many feeders is with individual deer or deer populations in small areas near where the feeders live or recreate. While deer are certainly not uniformly distributed in winter, the fact that feed was available to deer on less than 11% of the landscape indicates that there were large areas (many on public lands) where no

feed was available to deer. Other areas (often near lakes and larger communities) had very intensive feeding, and it is likely that some of these areas saw reduced winter deer losses because of the intensity of feeding (both private and state-funded). This evaluation is not able to assess the feeding program effects at this reduced spatial scale, and instead focused the analysis on larger Permit Areas and DMUs that are the basis of the DNR's deer management program.

## RECOMMENDATIONS

### Information Needs

The department's experience during the 1989 and 1996 deer feeding programs and evaluations of each of these efforts have pointed out the need for additional research if publicly funded feeding programs are to continue in the future. The following are some examples:

Assessment of Private Feeding: Circumstantial information indicates that private feeding has increased across the northern deer range. The committee considered a survey of feed retailers or of 1996 feeders to help assess the extent of private feeding, but funding was not available for such a survey. This is needed to determine the extent of private feeding during both "normal" and severe winters. In addition, the degree to which private feeding may influence deer hunting opportunities, deer winter movements, deer health, and behavior need to be investigated.

Deer Feeder Profiles: Surveys would be useful to determine demographic and economic profiles of deer feeders. There is also a need to determine support for deer feeding among various sectors of the public, especially hunters who have provided most of the funds for past deer feeding efforts.

Deer Condition/Winter Severity Assessment: Ongoing research being conducted by the DNR will provide useful information in correlating various measurements of winter severity with deer condition and survival in forest areas. Similar research is necessary in farmland and transition areas. The DNR also needs to assess current techniques used to assess deer condition and develop improved assessment techniques that are easily used by management staff, inexpensive to implement across large geographic areas, and that allow wildlife managers to track the progression of winter effects on local deer populations.

Population Impact of Emergency Deer Feeding: The impact of previous emergency feeding programs on deer populations has been estimated through modeling and evaluation of harvests in following years. Research is needed to assess the impact that feeding has on deer populations in several local areas that vary in the degree of access for feeding, winter habitat availability, and the factors affecting deer populations on a routine basis. Extrapolation of the impact of feeding across large geographic areas will require study sites in several locations in agricultural and transition areas where there has never been research information developed. In addition, forest research sites would need to continue to produce data, with added focus on examination of the feeding issue.

### Policy Development

Long-term policies are needed regarding the role that emergency feeding will have in future deer management programs in the state. The legislation that provided the $750,000 Game and Fish Fund appropriation for deer feeding in 1996 also created a dedicated deer feeding account. The presence of this new account makes long-term policy development very necessary, as it will require that the DNR determine when and where funds will be allocated for deer feeding, and how these programs will be administered and

applied. Development of these policies will require the active involvement of deer feeders and other members of the public with an interest in the state deer management program. It will also require coordination with legislators and conservation organizations.

The process should determine whether state funds should be used for deer feeding, and if so, it should identify the goals of future feeding programs and strategies for meeting those goals. The following represent some alternative strategies, based on discussions at the deer feeding roundtables and at meetings of the DNR's deer feeding evaluation committee:

Privatization Option: Although private deer feeding is very common in other Great Lakes states, state funds are not used for feeding deer. Individuals and conservation organizations in these states have taken on the responsibility to feed deer that they have a personal interest in, allowing state wildlife managers to focus their efforts and limited funds on research and long-term habitat and population management programs. There is certainly strong interest in privately funded deer feeding in Minnesota, as evidenced by the high number of individuals involved in private recreational feeding in recent years and the very substantial efforts by MDHA chapters and other organizations to raise and use funds for deer feeding in 1996. While the new dedicated account that has been created for deer feeding will ensure that there will be at least a limited amount of state funds available for deer feeding each winter, it establishes deer hunters as the sole contributors to future state feeding efforts. It also requires deer hunters from southern areas to pay for deer feeding programs that will likely never be necessary in their part of the state. A privately funded feeding program would allow those individuals with an interest in feeding to contribute their money and feed deer that they have a direct interest in, without the involvement of the state as a "pass-through" for deer feeding funds.

Grant Program: Under this option, the department would provide block grants from dedicated deer feeding funds to organizations with an interest in deer feeding. Each organization would then be responsible for all aspects of feeding including feed ordering, distribution, and monitoring. The department would continue to provide technical assistance, assess winter severity and deer condition, determine where and when feeding funds can be used, and administer the feeding account. A matching requirement on the part of organization receiving feed could help increase feeding efforts by stretching limited state funds dedicated towards feeding. An important benefit of this approach would be to reduce the direct involvement and time commitment to deer feeding by state wildlife managers. It would also allow organizations to tailor feed distribution strategies to their area.

Directed Program: Under this option, state-purchased feed would be used only at deer concentration areas identified by area wildlife managers, and general distribution of feed to the public would not occur. Managers would identify large deer concentrations and attempt to receive commitments from individuals or organizations to feed deer at these sites. Feed would only be provided to these approved feeders for use at the priority sites. This option could help to ensure that state funds are used to feed deer that are not already being fed with private funds, and could increase the effectiveness of future feeding programs. However, there may not be sufficient wildlife staff or willing volunteers available to support and monitor this approach.

**Information and Education**

There is a need for long-term efforts to educate the general public on aspects of the winter ecology of deer, including physiological and behavioral adaptations of deer to winter weather, the importance of natural selection in long-term health of deer populations, mortality of deer under various winter severity conditions, and other aspects of their ecology. There is poor understanding of the department's overall deer management

philosophy, deer goal-setting and modeling processes, and roles and activities of wildlife managers and researchers at area, region, and St. Paul levels. There is also a need to explain the importance of long-term habitat protection and improvement in mitigating the effects of winter. These education efforts need to be focused, continuous, and aimed at changing strongly-held, long-time beliefs.

**Appendix 1.** Summary of Deer Feeding Evaluation Roundtables

**Thief River Falls (July 31):** About 50 people attended from Baudette, Thief Lake, Thief River, Karlstad, and Crookston work areas. Since the DNR agreed to use state funds to feed deer in most of this area, the discussion centered more on how to feed (when to start, what to use for feed, etc.) rather than whether to feed. However, there was a concern with the department's desire to not feed where deer populations were significantly above goal levels. Participants felt that high deer numbers should be addressed by changes in season frameworks, and that winter starvation should not be a management tool. When asked what their objective for a feeding program was, several stated that they desired to prevent any deer from dying. There was not a lot of interest in helping shape the evaluation--the process used in 1989 seemed to meet their needs. Participants suggested that feeding sites should be pre-determined, and that feed should go where it will reach the greatest number of deer. They also suggested that additional or better-managed food plots would reduce the need to feed in this area of the state.

**Hibbing (August 28):** Over 50 people attended from the Ely, Cloquet, Eveleth, and Grand Rapids work areas. At this meeting, there were extensive questions on modeling and population estimates, the WSI, and mortality assessments. There was also a lot of concern expressed about wolf numbers and the effect that feeding has on wolf predation. There was a lot of interest in documenting the impact of feeding at local areas within deer management units or antlerless permit areas, and that these local benefits to deer were the reasons why people were feeding in the first place. There was also a request to document the social and economic benefits of the feeding program, and another suggestion to document the cost to feed additional numbers of deer (25%, 50%, and 100% was suggested). Many individuals suggested the need to plan for future feeding programs, but the desired approach varied. There were suggestions to focus feeding on major wintering areas (to reach the most number of deer with the least possible effort), to distribute feed only to those people already feeding (to ensure that feed would actually get to deer), or to distribute feed to permit areas based on the number of hunters within each area. There was interest in doing "local" bidding and purchasing of state deer feed to ease logistics and provide benefits to local businesses in the area. In addition, a letter received from the International Falls MDHA Chapter in lieu of attendance at the meeting expressed concerns related to the lack of sufficient feed to address demand by interested feeders, payment to some distribution facilities (while others donated this service), cost of state-purchased feed, and cooperation between the department and conservation organizations.

**Park Rapids ( September 24):** About 30 people from the Park Rapids, Detroit Lakes, Brainerd, Aitkin, and Bemidji areas attended this meeting. This crowd was very interested in discussing funding issues, and there was a lot of sentiment that the $.50/license currently allotted for feeding (and the $.25/license allotted once the $750,000 is paid off) is insufficient and that additional dedication is necessary. As in Hibbing, there was a strong suggestion to address local benefits of feeding in addition to the deer management unit evaluation. Attendees agreed that feeding programs could not reach and save all deer, and there were suggestions to use future feeding programs to reach the greatest possible number of deer, to direct feed away from recreational feeders and to deer wintering areas, and to help out deer feeders that were spending more than they anticipated due to severe winter conditions. One individual pointed out the need to compare and evaluate the costs of the program to other habitat and research work, and there was support to increase the effectiveness of food plot and timber management programs to reduce future deer feeding needs. Finally, there was a great deal of concern about feeding deer in agricultural areas with high deer populations and management and intensive harvest permits available.

**Appendix 2.** DNR Deer Feeding Guidelines.

## EMERGENCY DEER WINTER FEEDING GUIDELINES

MINNESOTA DEPARTMENT OF NATURAL RESOURCES
Section of Wildlife

### PURPOSE

To guide implementation of state-funded emergency deer feeding programs in Minnesota.

### NEED

Emergency winter deer feeding has been controversial because of the high cost of past programs, questionable effects on deer populations, and the emotional nature of the feeding issue. Clear and objective guidelines are necessary to assure that management efforts in severe winter situations are appropriate biologically, economically, and socially.

### BACKGROUND

State-funded emergency feeding programs were conducted in various areas of the state in 1969, 1975, 1978, 1982, 1984, 1986, 1989, and 1994. An analysis of the 1989 program documented, for the first time, the true costs of a large-scale feeding program, and the effects on deer populations over large areas. This analysis (see Executive Summary, Appendix I) found significant differences in costs and effects between farmland and forest areas.

In farmland areas (primarily Deer Zone 4) where deer are easily located and accessible and where sufficient volunteer help is available, a high proportion of deer can be reached by emergency feeding and benefits to the deer population may be significant. Feeding can also prevent depletion of local breeding populations in farmland areas where deer from a relatively large geographic area are concentrated and isolated from food resources. From 1975 to 1995, feeding has been necessary in one or more farmland DMUs during four winters.

In forest and transition areas (primarily Deer Zones 1, 2, and 3) where deer concentrations are more difficult to locate and access, and where volunteers cannot reach a high proportion of deer, state-funded emergency feeding programs are not effective or feasible. Feeding was also found to be only one-third as cost effective in forest areas as in farmland areas. Although private feeding efforts may benefit small forest deer populations in local hunting or viewing areas, feeding provides no general population benefit.

### POLICY

State-funded emergency deer feeding programs will not be conducted except in those areas and during those winters where feeding would be effective in maintaining viable breeding populations of deer.

### GUIDELINES

The following guidelines outline actions the Section of Wildlife will undertake to implement the emergency deer feeding policy.

A. POPULATION AND HABITAT MANAGEMENT-STATEWIDE

The Section will manage summer and winter deer habitat to minimize deer winter feeding needs. The Section will also establish deer population goals based on quantity and quality of habitat, landowner tolerance, public safety, and recreational demand, and will use harvest during the deer season to manage populations at or near goals.

B. MONITORING AND ASSESSMENT

The Section will annually monitor winter weather to determine severity. If funds are available, monitoring and assessment activities will be accelerated in those areas where there is the potential for significant deer losses. Activities may include aerial or ground surveys to locate deer concentrations, and collecting data related to indicators of winter severity and deer survival such as snow conditions (depths, extent, chronology, crusting), temperature, food availability, deer movements and concentrations, and deer physiology. Area wildlife managers will be responsible for assessing winter severity in their work areas.

C. EMERGENCY FEEDING- FARMLAND

Emergency deer feeding programs funded by the Section of Wildlife may be conducted in farmland areas (primarily Deer Zone 4) when the following conditions are met:

1) deer are isolated and unable to move from scattered winter cover;

2) adequate food supplies are generally unavailable to deer;

3) the Section determines there is potential for significant deer mortality;

4) feeding is necessary and would be effective in maintaining viable breeding populations; and

5) deer concentrations can be located and are accessible.

Final approval of any decision to feed will be made by the Section Management Team based on information provided by area and region wildlife staff. The following guidelines will be followed:

1) **Feeding area:** State-funded emergency feeding programs will only be implemented on aggregations of antlerless permit areas on sub-DMU sized areas or larger, and only in those areas where warranted by food, weather, and deer population conditions.

2) **Feed distribution:** Distribution of feed to volunteers will be coordinated by area wildlife managers. DNR staff will work with volunteers to locate deer concentrations, and to improve access if funding permits. Area staff will direct distribution of feed to known deer concentrations and priority will be given to deer on public lands.

3) **Feeding on State Wildlife Management Areas:** Area wildlife staff will assist with feeding deer

on State Wildlife Management Areas, but the Section will rely on volunteers to feed deer on other public and private lands.

4) **Initiation of feeding:** The date when feeding is initiated will be determined by the Section based on deer condition. Feeding will start as late in winter as possible to minimize costs of the feeding program and maintain volunteer efforts, while still ensuring that deer can utilize the feed.

5) **Urban areas, refuges, and permit areas above goal:** State-funded feed will not be provided for urban areas, refuges, and other areas where hunting or other appropriate deer population control measures are not being implemented. Feeding will also not be undertaken in those antlerless permit areas where deer populations are above goal levels, unless feeding is necessary to maintain a viable breeding population of deer.

D. EMERGENCY FEEDING-FOREST AND TRANSITION AREAS

The Section of Wildlife will not undertake state-funded emergency feeding programs in forest areas, or in transition areas where the above conditions are not met (primarily Deer Zones 1, 2, and 3). However, area wildlife staff will provide technical advice and guidance to individuals and groups interested in developing or initiating privately-funded feeding programs to benefit small, local deer populations.

Appendix 3. The Status of Knowledge of Artificial Deer During Winter.

Glenn D. Del Giudice 10 December 1996

**The Status of Knowledge of**

**Artifical Feeding of Deer During Winter**

**Background**

Winter feeding of free-ranging deer may be categorized into two basic types, emergency and supplementary feeding (Voigt 1990). Emergency feeding involves providing artificial food (e.g., pellets, corn, hay, oats, or cut browse) to deer towards the end of a severe winter when availability or accessibility of natural foods are extremely low. The goal is to decrease winter losses to chronic undernutrition and to reduce losses of neonatal and post-natal fawns the following spring and summer (Voigt 1990). Pregnancy of does coincides with winter, and there is a relationship between their winter nutrition and birth weights and probabilities of survival of the spring-born fawns (Verme 1962, 1967).

Supplementary feeding is characterized as the provision of artificial food to deer to supplement their natural diet; generally, it occurs throughout the winter regardless of weather conditions and the availability of natural foods. "Recreational feeding" by private citizens would be classified as supplementary feeding. Voigt (1990) has summarized information addressing the different types of feed that may be fed to deer during emergency or supplementary efforts, as well as some of the physiological and nutritional consequences of feeding inappropriate diets.

Here, we are addressing emergency feeding specifically. Before discussing the current knowledge of emergency feeding efforts for deer during winter and its potential implications, it is important to provide a brief understanding of their winter nutritional ecology and adaptive responses to winter conditions.

Nutrition is centrally related to all other aspects of deer ecology, including behavior, movements, habitat use, reproduction, and survival. Thus knowledge of their nutrition is critical to a more complete understanding of their ecology and to sound management (Robbins 1983). For northern deer, winter is the most nutritionally challenging season of the year, and for the past million years, these animals have evolved adaptations to a diminished quality, quantity, and availability of food resources, as well as to the increased energetic costs of mobility in deep snow during this season (Short et al. 1966, Moen 1976, Mautz 1978). These adaptations are morphological, behavioral, and physiological in nature. For example, with respect to morphology (i.e., physical characteristics), the deer's winter coat provides increased insulation against cold temperatures, and thus reduces the loss of heat energy (Sauer 1984; Moen 1968, 1973). Further, deer attain peak body weights and accumulate greatest fat reserves by late fall (Moen and Severinghaus 1981, DelGiudice et al. 1992). Body protein and fat serve as alternate sources of energy during the natural nutritional restriction of winter (Torbit et al. 1985, DelGiudice et al. 1990). Behaviorally, most forest deer migrate to winter ranges in late fall where food resources are more concentrated and conifer stands provide protection as thermal cover, again allowing deer to more efficiently maintain energy balance (i.e., energy intake versus energy loss), conserve energy, and consequently, slow the rate of body fat and protein depletion (Ozoga 1968; Rongstad and Tester 1969; Ozoga and Gysel 1972; Moen 1973, 1976). Most forest deer rely on a very diverse diet of browse (24 species or more) during winter as opposed to the ground forage and leaves primarily consumed during spring, summer, and fall (Wetzel et al. 1975, Rogers et al. 1981, DelGiudice et al. 1989).

On winter range, deer use smaller areas (home ranges) than on spring-summer-fall ranges and voluntarily reduce feeding activity, which lowers the energy costs associated with movement and digestion (French et al. 1955, Rongstad and Tester 1969, Moen 1973, Nelson and Mech 1981). The decrease in

feeding appears to be triggered by the shortening photoperiod of late fall-early winter sensed by the pineal gland and hormonally mediated (Brown et al. 1978, Abbott et al. 1984). Finally, associated with the winter decline in digestible energy intake is a concomitant reduction in metabolism and thyroid activity, which are physiological mechanisms facilitating energy conservation (Bahnak et al. 1981; Newsholme and Leech 1983; DelGiudice et al. 1987, 1994; Mautz et al. 1992). Body condition and survival of deer as winter progresses depends on such factors as their condition (i.e., repleteness of fat reserves) entering winter, severity of weather conditions, habitat quantity and quality, deer densities (i.e., competition for food), and predator densities.

**Status of Knowledge of Artificial Feeding**

From ecological and management perspectives, there are many issues that must be considered before an emergency winter feeding program is initiated for free-ranging deer. Three primary considerations are: (1) what are the deer population management goals (i.e., numbers of deer) for the area where artificial feeding is being contemplated; (2) what are the expectations of feeding in a particular area(s); and (3) what are the implications of feeding deer an artificial, high quality diet in selected areas with respect to other aspects of their ecology (e.g., reproduction, survival, movements, disease transmission). Information formulated from studies of feeding deer artificial diets during winter and of deer ecology can assist us in addressing considerations 2 and 3. The intention of this section is to provide a summary of this information, not to address the question of artificial feeding as a management practice.

Initially, the results of emergency feeding will depend on whether the deer find the artificial food provided; once discovered, whether they will consume it; and how much is available per deer and for what length of time. Clearly, deer must find the source of artificial food to have the opportunity to consume it, and this will depend on how many and where on winter ranges they are concentrating. Evidence indicates that this will be directly influenced by the severity of winter weather conditions (Ozoga and Gysel 1972; Lewis 1990; Nelson 1995; Doenier 1996; G. D. DelGiudice, unpublished data). Once aware of the food source, again, its use and the degree of consumption appear to depend on winter severity, alternate sources of natural food available in the area, the physical condition of deer at the time of discovering emergency feed, and the type of food being fed (Doman and Rasmussen 1944, Schmitz 1990, Doenier 1996, DelGiudice, unpublished data). In a detailed study, Doenier (1996) has observed deer bed next to and travel by (repeatedly) sources of high quality feed without consumption when weather conditions were mild to moderate. Further, it has been well documented that deer will continue to consume natural foods (e.g., woody browse) while making use of artificial feeders (Doman and Rasmussen 1944, Hubert et al. 1980, Schmitz 1990, Doenier 1996), and in some cases, the degree of consumption of feed, as well as the pressure on natural foods in the area, has been related to the severity of winter conditions (e.g., snow depth). There has been little study of browsing in areas where deer are artificially concentrated at high densities during emergency feeding efforts; however, it is reasonable to speculate that in such cases, the natural carrying capacity of these areas could be adversely affected (diminished) for an indefinite period of time. This issue requires further study.

Increased potential for transmitting disease and parasites among deer artificially concentrated around feeders has been reported as a concern of artificial feeding during winter. Recently, in Michigan, 16 deer were identified as infected with Mycobacterium bovis, the causative agent of bovine tuberculosis (TB) (Schmidt 1995, 1996). The disease was detected in one deer during the 1994 hunting season; during a limited followup survey, it was not detected in any additional deer. However, during the next hunting season (1995), it was detected in 15 additional deer. This is an extremely rare disease in white-tailed deer. All of these deer wintered in an area called the "Country Club," where hunting clubs have been artificially supporting a high density deer population with winter-long supplemental feed for many years. This disease requires close contact for transmission. Although emergency feeding efforts tend to be of shorter duration, the evidence described above suggests that the concern of increasing the potential for disease transmission

with artificially supported high deer concentrations should be afforded serious consideration.

Research has documented that emergency feeding will decrease winter mortality losses due to undernutrition during severe winters in local areas when deer have ready access to feed (Damon and Rasmussen 1944, Baker and Hobbs 1985). However, these studies reported that even when artificial food was provided ad libitum (unlimited supply) during most of the winter, significant losses occurred (up to 24%). In addition to the direct effect nutrition has on the survival of wintering deer and other ungulates, it also may positively influence a female's reproductive success (survivability of neonate fawns) during the subsequent spring and summer (Verme 1962, 1967; Ozoga and Verme 1982; Singer and Coughenour 1997). It would be difficult to quantify the effects of emergency feed on the reproductive success of does without conducting intensive research in areas where those deer give birth; however, it is reasonable to expect that the reproductive success of some individuals that benefited nutritionally from the emergency feed would be enhanced.

There is clear evidence that at the individual and local population or subpopulation (i.e., specific sites) levels, emergency feeding will reduce, but not eliminate, winter losses of deer due to severe, chronic undernutrition. However, as one considers applying such efforts at a larger scale, both with respect to area and to the greater numbers of deer occupying larger areas, the issues of economics and practicality require more serious consideration. A modeling study by Lenarz (1991) demonstrated that at the spacial or area-scale of a forested deer management unit (6,991 $km^2$) in Minnesota with more than 34,000 deer, the numeric effect of emergency feeding efforts is minimal. Specifically, Lenarz (1991) estimated that if 10% of the deer population in this forested management unit received emergency feed, the population would only be 0.8% larger than normally expected just prior to the following fawning season, and the following preharvest population would only be 3.1% larger, which translates into 0.02 additional bucks or 0.13 additional deer per $km^2$. Examining a best-case-scenario, this studied reported that if 30% of the deer received feed, the prefawning population would still only be 2.4% larger than if no feed were provided. It is very important to note, that wherever there was doubt regarding the accuracy of data-input for the model (e.g., quantity of feed actually provided in the field, found by deer, and consumed by deer), the maximum benefit of those doubts were levied in favor of the feeding effort. In other words, all emergency feed was provided in the field, found by deer, and consumed by deer; these assumptions were made despite field observations to the contrary. Lenarz (1991) reported that emergency feeding only began to approach cost-effectiveness if willingness-to-pay for a harvested buck was about $1,318, approximately $700 more than the actual willingness-to-pay.

A final note addresses the possible influence that emergency feeding may have on predator-deer interactions and other sources of mortality of deer. During the historically severe winter of 1995-96, predation rates of deer by wolves and bobcats were higher than normal, and "excessive-killing" or "surplus killing" were documented (DelGiudice 1996; G. D. DelGiudice, unpublished data). Observations of excessive and surplus killing of deer by predators was particularly apparent where deer gathered in atypical, high concentrations, including at active logging sites and where large-scale emergency feeding efforts occurred.

Clearly, ignoring the significant economic and opportunity costs, as well as the logistical constraints associated with emergency feeding, it likely has immediate, positive nutritional benefits for local deer that have frequent and ready access to a proper type of food for a sufficiently long period of time. However, inadequate study has addressed the indirect and more long-term consequences emergency feeding may have on deer movements, use of habitat, impacts on natural vegetation, predator relationships, overall health, and ultimately, on the "natural" carrying capacity of the winter ranges of deer.

## LITERATURE CITED

Abbott, M. J., D. E. Ullrey, P. K. Ku, S. M. Schmitt, D. R. Romsos, and H. A. Tucker. 1984. Effect of photoperiod on growth and fat accretion in white-tailed fawns. J. Wildl. Manage. 48:776-787.

Bahnak, B. R., J. C. Holland, L. J. Verme, and J. J. Ozoga. 1987. Effects of winter fasting and refeeding on white-tailed deer blood profiles. J. Wildl. Manage. 51:865-873.

Baker, D. L., and N. T. Hobbs. 1985. Emergency feeding of mule deer during winter: tests of a supplemental ration. J. Wildl. Manage. 49:934-942.

Brown, R. D., R. L. Cowan, and J. F. Kavanaugh. 1978. Effect of pinealectomy on seasonal androgen titers, antler growth, and feed intake in white-tailed deer. J. of Animal Sci. 47:435-440.

DelGiudice, G. D. 1996. Factors associated with surplus killing of white-tailed deer in northcentral Minnesota. J. Mammal. Submitted.

DelGiudice, G. D., L. D. Mech, K. E. Kunkel, E. M. Gese, and U. S. Seal. 1992. Seasonal patterns of weight, hematology, and serum characteristics of free-ranging female white-tailed deer in Minnesota. Can. J. Zool. 70:974-983.

DelGiudice, G. D., L. D. Mech, and U. S. Seal. 1989. Browse diversity and physiological status of white-tailed deer. Trans. North Am. Wildl. and Nat. Resour. Conf. 54:134-145.

DelGiudice, G. D., L. D. Mech, and U. S. Seal. 1990. Effects of winter undernutrition on body composition and physiological profiles of white-tailed deer. J. Wildl. Manage. 54:539-550.

DelGiudice, G. D., L. D. Mech, and U. S. Seal. 1994. Undernutrition and serum and urinary urea nitrogen of white-tailed deer during winter. J. Wildl. Manage. 58:430-436.

DelGiudice, G. D., L. D. Mech, U. S. Seal, and P. D. Karns. 1987b. Effects of winter fasting and refeeding on white-tailed deer blood profiles. J. Wildl. Manage. 51: 865-873.

Doenier, P. B. 1996. Effects of providing supplemental feed to wintering white-tailed deer on standing browse, foraging strategies, and chemistry profiles of deer urine in snow. M.S. Thesis. Univ. Minnesota. 132pp.

Doman, E. R., and D. I. Rasmussen. 1944. Supplemental winter feeding of mule deer in northern Utah. J. Wildl. Manage. 8:317-338.

French, C. E., L. C. McEwen, N. D. Magruder, R. H. Ingram, and R. W. Swift. 1955. Nutritional requirements of white-tailed deer for growth and antler development. Pennsylvania Agric. Exp. Stn. Bull. 600, University Park. 50pp.

Hubert, G. F., Jr., A. Woolf, and G. Post. 1980. Food habits of a supplementary-fed captive deer herd. J. Wildl. Manage. 44:740-746.

Lewis, T. L. 1990. The effects of supplemental feeding on white-tailed deer in northwestern Wisconsin. Ph.D. Dissert. Univ. Wisconsin-Madison, Madison. 79pp.

Lenarz, M. S. 1991. Simulation of the effects of emergency winter feeding of white-tailed deer. Wildl. Soc. Bull. 19:171-176.

Mautz, W. W. 1978. Nutrition and carrying capacity. Pages 321-348 in J. L. Schmidt and D. L. Gilbert, eds. Big game of North America: ecology and management. Stackpole Books, Harrisburg, Pa.

Mautz, W. W., J. Kanter, and P. J. Pekins. 1992. Seasonal metabolic rhythms of captive female white-tailed deer: a reexamination. J. Wildl. Manage. 56:656-661.

Moen, A. N. 1968. Surface temperatures and radiant heat loss from white-tailed deer. J. Wildl. Manage. 32:338-344.

Moen, A. N. 1973. Wildlife ecology, an analytical approach. W. H. Freeman and Company, San Francisco, Calif. 458pp.

Moen, A. N. 1976. Energy conservation by white-tailed deer in the winter. Ecology 56:192-198.

Moen, A. N., and C. W. Severinghuas. 1981. The annual weight cycle and survival of white-tailed deer in New York. N. Y. Fish and Game J. 28:162-177.

Nelson, M. E. 1995. Winter range arrival and departure of white-tailed deer in northeastern Minnesota. Can. J. Zool. 73:1069-1076.

Nelson, M. E., and L. D. Mech. 1981. Deer social organization and wolf predation in northeastern Minnesota. Wildl. Monogr. No. 77.

Newsholme, E. A., and A. R. Leech. 1983. Biochemistry for the medical sciences. John Wiley & Sons, New York, N.Y. 952pp.

Ozoga, J. J. 1968. Variations in microclimate in a conifer swamp deeryard in northern Michigan. J. Wildl. Manage. 32: 574-585.

Ozoga, J. J., and L. W. Gysel. 1972. Response of white-tailed deer to winter weather. J. Wildl. Manage. 36:892-896.

Ozoga, J. J., and L. J. Verme. 1982. Physical and reproductive characteristics of a supplementally-fed white-tailed deer herd. J. Wildl. Manage. 46:281-301.

Robbins, C. T. 1983. Wildlife feeding and nutrition. Academic Press, New York, N.Y. 343pp.

Rogers, L. L., J. J. Mooty, and D. Dawson. 1981. Foods of white-tailed deer in the Upper Great Lakes region--a review. U.S. For. Serv. Gen. Tech. Rep. NC-65. 24pp.

Rongstad, , O. J., and J. R. Tester. 1969. Movements and habitat use of white-tailed deer in Minnesota. J. Wildl. Manage. 33:366-379.

Sauer, P. R. 1984. Physical characteristics. Pages 73-90 in L. K. Halls, ed. White-tailed deer: ecology and management. Stackpole Books, Harrisburg, Pa.

Schmidt, S. 1995. Mysterious TB case in a Michigan whitetail. Page 1 in G. L. Doster, ed. Southeastern Cooperative Wildlife Disease Study Briefs. Univ. Georgia, Athens. 11:1.

Schmidt, S. 1996. TB in Michigan whitetails. Page 1 in G. L. Doster, ed. Southeastern Cooperative Wildlife Disease Study Briefs. Univ. Georgia, Athens. 11:1.

Schmitz, O. J. 1990. Management implications of foraging theory: evaluating deer supplemental feeding. J. Wildl. Manage. 54:522-532.

Short H. L., D. R. Dietz, and E. E. Remmenga. 1966. Selected nutrients in mule deer browse plants. Ecology 47:222-229.

Singer, F. J., A. Harting, K. K. Symonds, and M. B. Coughenour. 1997. Density-dependence, compensation, and environmental effects on elk calf mortality in Yellowstone National Park. J. Wildl. Manage. 61:12-25.

Torbit, S. C., L. H. Carpenter, D. M. Swift, and A. W. Aldredge. 1985. Differential loss of fat and protein by mule deer during winter. J. Wildl. Manage. 49:80-85.

Van Soest, P. J. 1982. Nutritional ecology of the ruminant. O & B Books, Inc. Corvallis, Oreg. 374pp.

Verme, L. J. 1962. Mortality of white-tailed deer fawns in relation to nutrition. Pages 15-38 in Proceedings of the First White-Tailed Deer Disease Symposium, February 13-15, 1962, University of Georgia, Athens.

Verme, L. J. 1967. Influence of experimental diets on white-tailed deer reproduction. Trans. North Am. Wildl. Nat. Resour. Conf. 32:405-419.

Wetzel, J. F., J. R. Wambaugh, and J. M. Peek. 1975. Appraisal of white-tailed deer winter habitats in northeastern Minnesota. J. Wildl. Manage. 39:59-66. 383pp.

Appendix 4. 1995 post-harvest and 1996 pre-fawn deer populations by DMU and Permit Area.

| Sub-DMU | Permit area | Non-water area (mi²) | 1995 Post-harvest | | 1996 Prefawn | | Goal (deer/mi²) |
|---|---|---|---|---|---|---|---|
| | | | Estimated deer density (deer/mi²) | Estimated total deer | Estimated deer density (deer/mi²) | Estimated total deer | |
| Red River West | 401 | 1,040 | 1.9 | 1,976 | 2 | 2,080 | 1 |
| | 402 | 1,023 | 2.5 | 2,558 | 2 | 2,046 | 2 |
| | Total | 2,063 | | 4,534 | | 4,126 | |
| Red River East | 403 | 396 | 5.6 | 2,218 | 5 | 1,980 | 2-3 |
| | 404 | 631 | 4.9 | 3,092 | 5 | 3,155 | 3 |
| | 405 | 651 | 4.3 | 2,799 | 4 | 2,604 | 2-3 |
| | 406 | 413 | 7.5 | 3,098 | 7 | 2,891 | 3 |
| | 407 | 618 | 3.6 | 2,225 | 3 | 1,854 | 4 |
| | 408 | 492 | 5.1 | 2,509 | 5 | 2,460 | 4 |
| | Total | 3,201 | | 15,940 | | 14,944 | |
| Red River Total | | 5,264 | | 20,475 | | 19,070 | |
| Agassiz | 201 | 155 | 6.5 | 1,008 | 5 | 775 | 9-11 |
| | 202 | 156 | 13.7 | 2,137 | 11 | 1,716 | 10-12 |
| | 203 | 106 | 15.8 | 1,675 | 14 | 1,484 | 14-17 |
| | 204 | 715 | 7.3 | 5,220 | 7 | 5,005 | 5-6 |
| | 205 | 579 | 7.9 | 4,574 | 7 | 4,053 | 6-7 |
| | 206 | 471 | 8.7 | 4,098 | 7 | 3,297 | 5-6 |
| | 207 | 299 | 7.3 | 2,183 | 7 | 2,093 | 8-9 |
| | 208 | 443 | 5.1 | 2,259 | 5 | 2,215 | 3 |
| | 209 | 576 | 4.0 | 2,304 | 4 | 2,304 | 2-3 |
| | 210 | 486 | 5.9 | 2,867 | 5 | 2,430 | 2-3 |
| Agassiz Total | | 3,986 | | 28,325 | | 25,372 | |
| Rainy River West | 211-212 | 1,895 | 12.0 | 22,740 | 8 | 15,160 | 10-15 |
| | 214[a] | 128 | 6.0 | 768 | 5 | 640 | n/a |
| | Total | 2,023 | | 23,508 | | 15,800 | |

| Sub-DMU | Permit area | Non-water area (mi²) | 1995 Post-harvest | | 1996 Prefawn | | Goal (deer/mi²) |
|---|---|---|---|---|---|---|---|
| | | | Estimated deer density (deer/mi²) | Estimated total deer | Estimated deer density (deer/mi²) | Estimated total deer | |
| Rainy River Central | 104-106 | 1,899 | 4.6 | 8,735 | 3 | 5,697 | 10-12 |
| | 110 | 189 | 25.6 | 4,838 | 16 | 3,024 | 10-15 |
| | Total | 2,088 | | 13,573 | | 8,721 | |
| Rainy River East | 107-109, 195 | 1,893 | 14.2 | 26,881 | 7 | 13,251 | 15-20 |
| **Rainy River Total** | | **6,004** | | **63,962** | | **37,772** | |
| Superior West | 119-121 | 1,235 | 16.6 | 20,501 | 10 | 12,350 | 15-20 |
| Superior Wilderness | 115[a] | 198 | 19.0 | 3,762 | 17 | 3,366 | n/a |
| | 116[a] | 359 | 14.0 | 5,026 | 12 | 4,308 | n/a |
| | 117[a] | 910 | 1.2 | 1,092 | 1 | 910 | n/a |
| | 118[a] | 71 | 1.2 | 85 | 1 | 71 | n/a |
| | Total | 1,538 | | 9,965 | | 8,655 | |
| Superior Central | 122-125 | 1,045 | 8.1 | 8,465 | 3 | 3,135 | 10-20 |
| Grand Portage I.R. | 194[a] | 71 | 1.2 | 85 | 1 | 71 | n/a |
| Superior East | 126, 128-129 | 1,125 | 3.7 | 4,163 | 2 | 2,250 | 3-8 |
| | 127a | 511 | 3.5 | 1,789 | 3 | 1,533 | n/a |
| | 130[a] | 189 | 1.2 | 227 | 1 | 189 | n/a |
| | Total | 1,825 | | 6,179 | | 3,972 | |
| **Superior Total** | | **5,714** | | **45,195** | | **28,183** | |
| Itasca NW | 167-169 | 1,367 | 15.7 | 21,462 | 10 | 13,670 | 22-24 |
| Itasca SW | 170-171 | 1,006 | 15.8 | 15,895 | 10 | 10,060 | 22-24 |
| | 172 | 451 | 15.7 | 7,081 | 11 | 4,961 | 22-24 |
| | 173-174 | 879 | 16.6 | 14,591 | 14 | 12,306 | 22-24 |
| | Total | 2,336 | | 37,567 | | 27,327 | |
| Itasca NE | 175-179 | 2,535 | 11.1 | 28,139 | 7 | 17,745 | 18-20 |
| Itasca SE | 180-184, 199 | 2,887 | 11.9 | 34,355 | 9 | 25,983 | 25-27 |
| Leech Lake I.R. | 197, 198 | 974 | 8.4 | 8,182 | 7 | 6,818 | 18-20 |

| Sub-DMU | Permit area | Non-water area ($mi^2$) | 1995 Post-harvest | | 1996 Prefawn | | Goal (deer/$mi^2$) |
|---|---|---|---|---|---|---|---|
| | | | Estimated deer density (deer/$mi^2$) | Estimated total deer | Estimated deer density (deer/$mi^2$) | Estimated total deer | |
| Bemidji | 284-286 | 1,526 | 25.0 | 38,150 | 17 | 25,942 | 20-22 |
| | 287 | 46 | 48.0 | 2,208 | 48 | 2,208 | n/a |
| | Total | 1,572 | | 40,358 | | 28,150 | |
| Itasca Total | | 11,671 | | 170,063 | | 119,693 | |
| Mille Lacs West | 244 | 584 | 23.7 | 13,841 | 19 | 11,096 | 15-25 |
| | 245 | 582 | 20.7 | 12,047 | 15 | 8,730 | 15-25 |
| | 251 | 55 | 20.7 | 1,139 | 17 | 946 | 28-30 |
| | Total | 1,221 | | 27,027 | | 20,772 | |
| Mille Lacs Central | 246 | 1,007 | 15.0 | 15,105 | 16 | 16,112 | 16-18 |
| | 247 | 522 | 12.5 | 6,525 | 14 | 7,308 | 16-18 |
| | Total | 1,529 | | 21,630 | | 23,420 | |
| Mille Lacs East | 154-156 | 1,148 | 8.6 | 9,873 | 8 | 9,184 | 10-15 |
| White Earth I.R. | 297-298 | 1,057 | 6.1 | 6,448 | 5 | 5,285 | 14-16 |
| Mille Lacs Total | | 4,955 | | 64,978 | | 58,661 | |
| Big Woods North | 409 | 417 | 7.2 | 3,002 | 7 | 2,919 | 6-7 |
| | | | | | | | |
| Farmland Total | | 9,250 | | 48,800 | | 44,442 | |
| Forest Total | | 28,761 | | 347,200 | | 247,228 | |
| Grand Total | | 38,011 | | 396,000 | | 291,670 | |

[a]Population density was estimated (not modeled) for this permit area.

**Appendix 5.** Summary of the amount and duration of feeding by Deer Management Permit Area in the feeding zone.

| Deer Management Unit | Permit area | Bags of feed | Pounds of feed distributed | Days of feed availability | Pounds of feed available per day |
|---|---|---|---|---|---|
| Red River West | 401 | 1,592 | 79,600 | 42 | 1,895 |
| | 402[a] | 0 | 0 | 0 | 0 |
| | Total | 1,592 | 79,600 | | 1,895 |
| Red River East | 403 | 3,246 | 162,300 | 42 | 3,864 |
| | 404 | 6,076 | 303,800 | 49 | 6,200 |
| | 405 | 2,302 | 115,100 | 49 | 2,349 |
| | 406 | 929 | 46,450 | 49 | 948 |
| | 407 | 14 | 700 | 35 | 20 |
| | 408 | 80 | 4,000 | 42 | 95 |
| | Total | 12,647 | 632,350 | 44 | 13,476 |
| **Red River Total** | | **14,239** | **711,950** | **43** | **15,371** |
| Agassiz | 201 | 1,237 | 61,850 | 63 | 982 |
| | 202 | 2,358 | 117,900 | 56 | 2,105 |
| | 203 | 336 | 16,800 | 49 | 343 |
| | 204 | 5,477 | 273,850 | 56 | 4,890 |
| | 205 | 9,592 | 479,600 | 70 | 6,851 |
| | 206 | 6,907 | 345,350 | 56 | 6,167 |
| | 207 | 3,176 | 158,800 | 49 | 3,241 |
| | 208 | 1,509 | 75,450 | 49 | 1,540 |
| | 209 | 2,473 | 123,650 | 63 | 1,963 |
| | 210 | 1,758 | 87,900 | 56 | 1,570 |
| **Agassiz Total** | | **34,823** | **1,741,150** | **57** | **29,652** |
| Rainy River West | 211-212 | 11,370 | 568,500 | 77 | 7,383 |
| | 214 | 90 | 4,500 | 14 | 321 |
| | Total | 11,460 | 573,000 | 46 | 7,704 |
| Rainy River Central | 104-106 | 3,271 | 163,550 | 63 | 2,596 |

| Deer Management Unit | Permit area | Bags of feed | Pounds of feed distributed | Days of feed availability | Pounds of feed available per day |
|---|---|---|---|---|---|
| | 110 | 1,081 | 54,050 | 35 | 1,544 |
| | Total | 4,352 | 217,600 | 49 | 4,140 |
| Rainy River East | 107-109, 195 | 4,579 | 228,950 | 42 | 5,451 |
| **Rainy River Total** | | **20,391** | **1,019,550** | **46** | **17,295** |
| Superior West | 119-121 | 6,612 | 330,600 | 42 | 7,871 |
| Superior Wilderness | 115 | 90 | 4,500 | 42 | 107 |
| | 116 | 50 | 2,500 | 35 | 71 |
| | 117 | 1,572 | 78,600 | 35 | 2,246 |
| | 118[a] | 0 | 0 | 0 | 0 |
| | Total | 1,712 | 85,600 | 37 | 2,424 |
| Superior Central | 122-125 | 4,930 | 246,500 | 35 | 7,043 |
| Grand Portage I.R. | 194[a] | 0 | 0 | 0 | 0 |
| Superior East | 126, 128-129 | 4,889 | 244,450 | 35 | 6,984 |
| | 127 | 866 | 43,300 | 35 | 1,237 |
| | 130 | 260 | 13,000 | 35 | 371 |
| | Total | 6,015 | 300,750 | 35 | 8,592 |
| **Superior Total** | | **19,269** | **963,450** | **37** | **25,930** |
| Itasca NW | 167-169 | 9,181 | 459,050 | 42 | 10,930 |
| Itasca SW | 170-171 | 6,004 | 300,200 | 35 | 8,577 |
| | 172 | 4,224 | 211,200 | 35 | 6,034 |
| | 173-174 | 4,094 | 204,700 | 35 | 5,849 |
| | Total | 23,503 | 1,175,150 | 35 | 31,390 |
| Itasca NE | 175-179 | 12,706 | 635,300 | 35 | 18,151 |
| Itasca SE | 180-184, 199 | 17,477 | 873,850 | 35 | 24,967 |
| Leech Lake I.R. | 197, 198 | 3,965 | 198,250 | 35 | 5,664 |
| Bemidji | 284-286 | 16,097 | 804,850 | 35 | 22,996 |
| | 287 | 27 | 1,350 | 28 | 48 |

| Deer Management Unit | Permit area | Bags of feed | Pounds of feed distributed | Days of feed availability | Pounds of feed available per day |
|---|---|---|---|---|---|
| | Total | 16,124 | 806,200 | 33 | 23,044 |
| **Itasca Total** | | **73,775** | **3,688,750** | **35** | **103,216** |
| Mille Lacs West | 244 | 4,732 | 236,600 | 35 | 6,760 |
| | 245 | 3,858 | 192,900 | 35 | 5,511 |
| | 251 | 227 | 11,350 | 28 | 405 |
| | Total | 8,817 | 440,850 | 33 | 12,676 |
| Mille Lacs Central | 246 | 5,002 | 250,100 | 35 | 7,146 |
| | 247 | 3,628 | 181,400 | 28 | 6,479 |
| | Total | 8,630 | 431,500 | 32 | 13,625 |
| Mille Lacs East | 154-156 | 5,150 | 257,500 | 35 | 7,357 |
| White Earth I.R. | 297-298 | 2,451 | 122,550 | 35 | 3,501 |
| **Mille Lacs Total** | | **25,048** | **1,252,400** | **33** | **37,159** |
| **Big Woods North** | 409 | **1,357** | **67,850** | **35** | **1,939** |
| | | | | | |
| **Farmland Total** | | **50,419** | **2,520,950** | **51** | **46,962** |
| **Forested Total** | | **138,483** | **6,924,150** | **38** | **183,600** |
| **GRAND TOTAL** | | **188,902** | **9,445,100** | **43** | **230,562** |

[a]No feed was distributed in this permit area.

**Appendix 6.** Summary of the post-hunt deer populations by Deer Management Permit Area and the estimated percent of deer that could have been fed the recommended daily amount of feed (2.5 lbs.) for each day feed was available. These estimates assume all feed was available to deer and all deer had access to feed.

| Deer Management Unit | Permit area | Pounds of feed available per day | Post-hunt deer population | Estimated number of deer fed | Percent of post-hunt population fed 2.5 lbs per day |
|---|---|---|---|---|---|
| Red River West | 401 | 1,895 | 1,976 | 758 | 38.4 |
| | 402[b] | 0 | 2,558 | 0 | 0.0 |
| | Total | 1,895 | 4,534 | 758 | 16.7 |
| Red River East | 403 | 3,864 | 2,218 | 1,546 | 69.7 |
| | 404 | 6,200 | 3,092 | 2,480 | 80.2 |
| | 405 | 2,349 | 2,799 | 940 | 33.6 |
| | 406 | 948 | 3,098 | 379 | 12.2 |
| | 407 | 20 | 2,225 | 8 | 0.4 |
| | 408 | 95 | 2,509 | 38 | 1.5 |
| | Total | 13,476 | 15,940 | 5,391 | 33.8 |
| Red River Total | | 15,371 | 20,475 | 6,149 | 30.0 |
| Agassiz | 201 | 982 | 1,008 | 393 | 39.0 |
| | 202 | 2,105 | 2,137 | 842 | 39.4 |
| | 203 | 343 | 1,675 | 137 | 8.2 |
| | 204 | 4,890 | 5,220 | 1,956 | 37.5 |
| | 205 | 6,851 | 4,574 | 2,740 | 59.9 |
| | 206 | 6,167 | 4,098 | 2,467 | 60.2 |
| | 207 | 3,241 | 2,183 | 1,296 | 59.4 |
| | 208 | 1,540 | 2,259 | 616 | 27.3 |
| | 209 | 1,963 | 2,304 | 785 | 34.1 |
| | 210 | 1,570 | 2,867 | 628 | 21.9 |
| Agassiz Total | | 29,652 | 28,325 | 11,860 | 41.9 |
| Rainy River West | 211-212 | 7,383 | 22,740 | 2,953 | 13.0 |
| | 214[a] | 321 | 768 | 128 | 16.7 |

| Deer Management Unit | Permit area | Pounds of feed available per day | Post-hunt deer population | Estimated number of deer fed | Percent of post-hunt population fed 2.5 lbs per day |
|---|---|---|---|---|---|
| | Total | 7,704 | 23,508 | 3,081 | 13.1 |
| Rainy River Central | 104-106 | 2,596 | 8,735 | 1,038 | 11.9 |
| | 110 | 1,544 | 4,838 | 618 | 12.8 |
| | Total | 4,140 | 13,573 | 1,656 | 12.2 |
| Rainy River East | 107-109, 195 | 5,451 | 26,881 | 2,180 | 8.1 |
| **Rainy River Total** | | **17,295** | **63,962** | **6,917** | **10.8** |
| Superior West | 119-121 | 7,871 | 20,501 | 3,148 | 15.4 |
| Superior Wilderness | 115[a] | 107 | 3,762 | 43 | 1.1 |
| | 116[a] | 71 | 5,026 | 28 | 0.6 |
| | 117[a] | 2,246 | 1,092 | 898 | 82.2 |
| | 118[ab] | 0 | 85 | 0 | 0.0 |
| | Total | 2,424 | 9,965 | 969 | 9.7 |
| Superior Central | 122-125 | 7,043 | 8,465 | 2,817 | 33.3 |
| Grand Portage I.R. | 194[ab] | 0 | 85 | 0 | 0.0 |
| Superior East | 126, 128-129 | 6,984 | 4,163 | 2,794 | 67.1 |
| | 127[a] | 1,237 | 1,789 | 495 | 27.7 |
| | 130[a] | 371 | 227 | 148 | 65.2 |
| | Total | 8,592 | 6,179 | 3,437 | 55.6 |
| **Superior Total** | | **25,930** | **45,195** | **10,371** | **22.9** |
| Itasca NW | 167-169 | 10,930 | 21,462 | 4,372 | 20.4 |
| Itasca SW | 170-171 | 8,577 | 15,895 | 3,431 | 21.6 |
| | 172 | 6,034 | 7,081 | 2,414 | 34.1 |
| | 173-174 | 5,849 | 14,591 | 2,340 | 16.0 |
| | Total | 31,390 | 37,567 | 8,185 | 21.8 |
| Itasca NE | 175-179 | 18,151 | 28,139 | 7,260 | 25.8 |
| Itasca SE | 180-184, 199 | 24,967 | 34,355 | 9,987 | 29.1 |
| Leech Lake I.R. | 197, 198 | 5,664 | 8,182 | 2,266 | 27.7 |

| Deer Management Unit | Permit area | Pounds of feed available per day | Post-hunt deer population | Estimated number of deer fed | Percent of post-hunt population fed 2.5 lbs per day |
|---|---|---|---|---|---|
| Bemidji | 284-286 | 22,996 | 38,150 | 9,198 | 24.1 |
| | 287 | 48 | 2,208 | 19 | 0.9 |
| | Total | 23,044 | 40,358 | 9,217 | 22.8 |
| Itasca Total | | 103,216 | 170,063 | 41,287 | 24.3 |
| Mille Lacs West | 244 | 6,760 | 13,841 | 2,704 | 19.5 |
| | 245 | 5,511 | 12,047 | 2,204 | 18.3 |
| | 251 | 405 | 1,139 | 162 | 14.2 |
| | Total | 12,676 | 27,027 | 5,070 | 18.8 |
| Mille Lacs Central | 246 | 7,146 | 15,105 | 2,858 | 18.9 |
| | 247 | 6,479 | 6,525 | 2,592 | 39.7 |
| | Total | 13,625 | 21,630 | 5,450 | 25.2 |
| Mille Lacs East | 154-156 | 7,357 | 9,873 | 2,943 | 29.8 |
| White Earth I.R. | 297-298 | 3,501 | 6,448 | 1,400 | 21.7 |
| Mille Lacs Total | | 37,159 | 64,978 | 14,863 | 22.9 |
| Big Woods North | 409 | 1,939 | 3,002 | 776 | 25.8 |
| | | | | | |
| Farmland Total | | 46,962 | 51,802 | 18,785 | 36.3 |
| Forest Total | | 183,600 | 344,198 | 73,438 | 21.3 |
| Grand Total | | 230,562 | 396,000 | 92,223 | 23.3 |

[a]Population density was estimated (not modeled) for this permit area.
[b]No feed was distributed in this permit area.

**Appendix 7.** Summary of the number of deer reported fed, the amount of feed consumed per deer reported fed per day and the portion of the 1995 post-hunt deer population reported fed. These estimates assume all feed was available to deer and that no deer fed at more than 1 feeding site.

| Deer Management Unit | Permit area | Pounds of feed available per day | Post-hunt deer population | Reported deer fed | Pounds of feed per reported deer fed per day | Percent of post-hunt deer population reported fed |
|---|---|---|---|---|---|---|
| Red River West | 401 | 1,895 | 1,976 | 2,016 | 0.9 | 102.0 |
| | 402[b] | 0 | 2,558 | 0 | 0.0 | 0.0 |
| | Total | 1,895 | 4,534 | 2,016 | 0.9 | 44.5 |
| Red River East | 403 | 3,864 | 2,218 | 3,530 | 1.1 | 159.2 |
| | 404 | 6,200 | 3,092 | 5,065 | 1.2 | 163.8 |
| | 405 | 2,349 | 2,799 | 1,762 | 1.3 | 63.0 |
| | 406 | 948 | 3,098 | 725 | 1.3 | 23.4 |
| | 407 | 20 | 2,225 | 6 | 3.3 | 0.3 |
| | 408 | 95 | 2,509 | 112 | 0.8 | 4.5 |
| | Total | 13,476 | 15,941 | 11,200 | 1.2 | 70.3 |
| **Red River Total** | | **15,371** | **20,475** | **13,216** | **1.2** | **64.5** |
| Agassiz | 201 | 982 | 1,008 | 1,072 | 0.9 | 106.3 |
| | 202 | 2,105 | 2,137 | 1,825 | 1.2 | 85.4 |
| | 203 | 343 | 1,675 | 340 | 1.0 | 20.3 |
| | 204 | 4,890 | 5,220 | 6,429 | 0.8 | 123.2 |
| | 205 | 6,851 | 4,574 | 5,105 | 1.3 | 111.6 |
| | 206 | 6,167 | 4,098 | 5,685 | 1.1 | 138.7 |
| | 207 | 3,241 | 2,183 | 2,705 | 1.2 | 123.9 |
| | 208 | 1,540 | 2,259 | 1,399 | 1.1 | 61.9 |
| | 209 | 1,963 | 2,304 | 2,927 | 0.7 | 127.0 |
| | 210 | 1,570 | 2,867 | 2,146 | 0.7 | 74.9 |
| **Agassiz Total** | | **29,652** | **28,325** | **29,633** | **1.0** | **104.6** |
| Rainy River West | 211-212 | 7,383 | 22,740 | 10,992 | 0.7 | 48.3 |
| | 214[a] | 321 | 768 | 70 | 4.6 | 9.1 |

| Deer Management Unit | Permit area | Pounds of feed available per day | Post-hunt deer population | Reported deer fed | Pounds of feed per reported deer fed per day | Percent of post-hunt deer population reported fed |
|---|---|---|---|---|---|---|
| | Total | 7,704 | 23,508 | 11,062 | 0.7 | 47.1 |
| Rainy River Central | 104-106 | 2,596 | 8,735 | 2,996 | 0.9 | 34.3 |
| | 110 | 1,544 | 4,838 | 1,541 | 1.0 | 31.9 |
| | Total | 4,140 | 13,573 | 4,537 | 0.9 | 33.4 |
| Rainy River East | 107-109, 195 | 5,451 | 26,881 | 5,388 | 1.0 | 20.0 |
| **Rainy River Total** | | **17,295** | **63,962** | **20,987** | **0.8** | **23.8** |
| Superior West | 119-121 | 7,871 | 20,501 | 6,802 | 1.2 | 33.2 |
| Superior Wilderness | 115[a] | 107 | 3,762 | 95 | 1.1 | 2.5 |
| | 116[a] | 71 | 5,026 | 30 | 2.4 | 0.6 |
| | 117[a] | 2,246 | 1,092 | 1,164 | 1.9 | 106.6 |
| | 118[ab] | 0 | 85 | 0 | 0.0 | 0.0 |
| | Total | 2,424 | 9,965 | 1,289 | 1.9 | 12.9 |
| Superior Central | 122-125 | 7,043 | 8,465 | 4,359 | 1.6 | 51.5 |
| Grand Portage I.R. | 194[ab] | 0 | 85 | 0 | 0.0 | 0.0 |
| Superior East | 126, 128-129 | 6,984 | 4,163 | 3,738 | 1.9 | 89.8 |
| | 127[a] | 1,237 | 1,789 | 368 | 3.4 | 20.6 |
| | 130[a] | 371 | 227 | 220 | 1.7 | 96.9 |
| | Total | 8,592 | 6,179 | 4,326 | 2.0 | 70.0 |
| **Superior Total** | | **25,930** | **45,195** | **16,776** | **1.5** | **37.1** |
| Itasca NW | 167-169 | 10,930 | 21,462 | 7,827 | 1.4 | 36.5 |
| Itasca SW | 170-171 | 8,577 | 15,895 | 4,859 | 1.8 | 30.6 |
| | 172 | 6,034 | 7,081 | 7,204 | 0.8 | 101.7 |
| | 173-174 | 5,849 | 14,591 | 5,135 | 1.1 | 35.2 |
| | Total | 31,390 | 37,567 | 17,198 | 1.8 | 45.8 |
| Itasca NE | 175-179 | 18,151 | 28,139 | 12,046 | 1.5 | 42.8 |
| Itasca SE | 180-184, 199 | 24,967 | 34,355 | 16,317 | 1.5 | 47.5 |
| Leech Lake I.R. | 197, 198 | 5,664 | 8,182 | 4,578 | 1.2 | 56.0 |

| Deer Management Unit | Permit area | Pounds of feed available per day | Post-hunt deer population | Reported deer fed | Pounds of feed per reported deer fed per day | Percent of post-hunt deer population reported fed |
|---|---|---|---|---|---|---|
| Bemidji | 284-286 | 22,996 | 38,150 | 21,697 | 1.1 | 56.9 |
| | 287 | 48 | 2,208 | 36 | 1.3 | 1.6 |
| | Total | 23,044 | 40,358 | 21,733 | 1.1 | 53.9 |
| Itasca Total | | 103,216 | 170,063 | 79,699 | 1.3 | 46.9 |
| Mille Lacs West | 244 | 6,760 | 13,841 | 4,309 | 1.6 | 31.1 |
| | 245 | 5,511 | 12,047 | 3,610 | 1.5 | 30.0 |
| | 251 | 405 | 1,139 | 350 | 1.2 | 30.7 |
| | Total | 12,676 | 27,027 | 8,269 | 1.5 | 30.6 |
| Mille Lacs Central | 246 | 7,146 | 15,105 | 11,175 | 0.6 | 74.0 |
| | 247 | 6,479 | 6,525 | 8,673 | 0.7 | 132.9 |
| | Total | 13,625 | 21,630 | 19,848 | 0.7 | 91.8 |
| Mille Lacs East | 154-156 | 7,357 | 9,873 | 7,076 | 1.0 | 71.7 |
| White Earth I.R. | 297-298 | 3,501 | 6,448 | 3,539 | 1.0 | 54.9 |
| Mille Lacs Total | | 37,159 | 64,978 | 38,732 | 1.0 | 59.6 |
| Big Woods North | 409 | 1,939 | 3,002 | 1,903 | 1.0 | 63.4 |
| | | | | | | |
| Farmland Total | | 46,962 | 51,802 | 44,752 | 1.0 | 86.4 |
| Forest Total | | 183,600 | 344,198 | 156,194 | 1.2 | 45.4 |
| GRAND TOTAL | | 230,562 | 396,000 | 200,946 | 1.1 | 50.7 |

[a]Population density was estimated (not modeled) for this permit area
[b]No feed was distributed in this permit area.

**Appendix 8.** Summary of the costs for feed and associated feeding activities by Deer Management Permit Area in the feeding zone.

| Deer Management Unit | Permit area | Number of bags distributed | Feed cost per bag | Associated feeding costs | Total feeding costs | Feeding cost per bag |
|---|---|---|---|---|---|---|
| Red River | 401 | 1,592 | $5,954.08 | $3,645.68 | $9,599.76 | $6.03 |
| | 402[a] | 0 | $0.00 | $0.00 | $0.00 | $0.00 |
| | Total | 1,592 | $5,954.08 | $3,645.68 | $9,599.76 | $6.03 |
| Red River East | 403 | 3,246 | $12,140.04 | $7,433.34 | $19,573.38 | $6.03 |
| | 404 | 6,076 | $22,724.24 | $13,914.04 | $36,638.28 | $6.03 |
| | 405 | 2,302 | $8,609.48 | $5,271.58 | $13,881.06 | $6.03 |
| | 406 | 929 | $3,474.46 | $2,127.41 | $5,601.87 | $6.03 |
| | 407 | 14 | $52.36 | $32.06 | $84.42 | $6.03 |
| | 408 | 80 | $299.20 | $183.20 | $482.40 | $6.03 |
| | Total | 12,647 | $47,299.78 | $28,961.63 | $76,261.41 | $6.03 |
| **Red River Total** | | **14,239** | **$53,253.86** | **$32,607.31** | **$85,861.17** | **$6.03** |
| Agassiz | 201 | 1,237 | $4,626.38 | $2,832.73 | $7,459.11 | $6.03 |
| | 202 | 2,358 | $8,818.92 | $5,399.82 | $14,218.74 | $6.03 |
| | 203 | 336 | $1,256.64 | $769.44 | $2,026.08 | $6.03 |
| | 204 | 5,477 | $20,483.98 | $12,542.33 | $33,026.31 | $6.03 |
| | 205 | 9,592 | $35,874.08 | $21,965.68 | $57,839.76 | $6.03 |
| | 206 | 6,907 | $25,832.18 | $15,817.03 | $41,649.21 | $6.03 |
| | 207 | 3,176 | $11,878.24 | $7,273.04 | $19,151.28 | $6.03 |
| | 208 | 1,509 | $5,643.66 | $3,455.61 | $9,099.27 | $6.03 |
| | 209 | 2,473 | $9,249.02 | $5,663.17 | $14,912.19 | $6.03 |
| | 210 | 1,758 | $6,574.92 | $4,025.82 | $10,600.74 | $6.03 |
| **Agassiz Total** | | **34,823** | **$130,238.02** | **$79,744.67** | **$209,982.69** | **$6.03** |
| Rainy River West | 211-212 | 11,370 | $46,275.90 | $17,509.80 | $63,785.70 | $5.61 |
| | 214 | 90 | $366.30 | $138.60 | $504.90 | $5.61 |
| | Total | 11,460 | $46,642.20 | $17,648.40 | $64,290.60 | $5.61 |
| Rainy River Central | 104-106 | 3,271 | $13,312.97 | $5,037.34 | $18,350.31 | $5.61 |

| Deer Management Unit | Permit area | Number of bags distributed | Feed cost per bag | Associated feeding costs | Total feeding costs | Feeding cost per bag |
|---|---|---|---|---|---|---|
| | 110 | 1,081 | $4,399.67 | $1,664.74 | $6,064.41 | $5.61 |
| | Total | 4,352 | $17,712.64 | $6,702.08 | $24,414.72 | $5.61 |
| Rainy River East | 107-109,195 | 4,579 | $18,636.53 | $7,051.66 | $25,688.19 | $5.61 |
| **Rainy River Total** | | 20,391 | $82,991.37 | $31,402.14 | $114,393.51 | $5.61 |
| Superior West | 119-121 | 6,612 | $26,910.84 | $10,182.48 | $37,093.32 | $5.61 |
| Superior Wilderness | 115 | 90 | $366.30 | $138.60 | $504.90 | $5.61 |
| | 116 | 50 | $203.50 | $77.00 | $280.50 | $5.61 |
| | 117 | 1,572 | $6,398.04 | $2,420.88 | $8,818.92 | $5.61 |
| | 118[a] | 0 | $0.00 | $0.00 | $0.00 | $0.00 |
| | Total | 1,712 | $6,967.84 | $2,636.48 | $9,604.32 | $5.61 |
| Superior Central | 122-125 | 4,930 | $20,065.10 | $7,592.20 | $27,657.30 | $5.61 |
| Grand Portage I.R. | 194[a] | 0 | $0.00 | $0.00 | $0.00 | $0.00 |
| Superior East | 126, 128-129 | 4,889 | $19,898.23 | $7,529.06 | $27,427.29 | $5.61 |
| | 127 | 866 | $3,524.62 | $1,333.64 | $4,858.26 | $5.61 |
| | 130 | 260 | $1,058.20 | $400.40 | $1,458.60 | $5.61 |
| | Total | 6,015 | $24,481.05 | $9,263.10 | $33,744.15 | $5.61 |
| **Superior Total** | | 19,269 | $78,424.83 | $29,674.26 | $108,099.09 | $5.61 |
| Itasca NW | 167-169 | 9,181 | $37,366.67 | $14,138.74 | $51,505.41 | $5.61 |
| Itasca SW | 170-171 | 6,004 | $24,436.28 | $9,246.16 | $33,682.44 | $5.61 |
| | 172 | 4,224 | $17,191.68 | $6,504.96 | $23,696.64 | $5.61 |
| | 173-174 | 4,094 | $16,662.58 | $6,304.76 | $22,967.34 | $5.61 |
| | Total | 14,322 | $58,290.54 | $22,055.88 | $80,346.42 | $5.61 |
| Itasca NE | 175-179 | 12,706 | $51,713.42 | $19,567.24 | $71,280.66 | $5.61 |
| Itasca SE | 180-184, 199 | 17,477 | $71,131.39 | $26,914.58 | $98,045.97 | $5.61 |
| Leech Lake I.R. | 197, 198 | 3,965 | $16,137.55 | $6,106.10 | $22,243.65 | $5.61 |
| Bemidji | 284-286 | 16,097 | $65,514.79 | $24,789.38 | $90,304.17 | $5.61 |
| | 287 | 27 | $109.89 | $41.58 | $151.47 | $5.61 |

| Deer Management Unit | Permit area | Number of bags distributed | Feed cost per bag | Associated feeding costs | Total feeding costs | Feeding cost per bag |
|---|---|---|---|---|---|---|
| | Total | 16,124 | $65,624.68 | $24,830.96 | $90,455.64 | $5.61 |
| **Itasca Total** | | **73,775** | **$300,264.25** | **$113,613.50** | **$413,877.75** | **$5.61** |
| Mille Lacs West | 244 | 4,732 | $19,259.24 | $7,287.28 | $26,546.52 | $5.61 |
| | 245 | 3,858 | $15,702.06 | $5,941.32 | $21,643.38 | $5.61 |
| | 251 | 227 | $923.89 | $349.58 | $1,273.47 | $5.61 |
| | Total | 8,817 | $35,885.19 | $13,578.18 | $49,463.37 | $5.61 |
| Mille Lacs Central | 246 | 5,002 | $20,358.14 | $7,703.08 | $28,061.22 | $5.61 |
| | 247 | 3,628 | $14,765.96 | $5,587.12 | $20,353.08 | $5.61 |
| | Total | 8,630 | $35,124.10 | $13,290.20 | $48,414.30 | $5.61 |
| Mille Lacs East | 154-156 | 5,150 | $20,960.50 | $7,931.00 | $28,891.50 | $5.61 |
| White Earth I.R. | 297-298 | 2,451 | $9,975.57 | $3,774.54 | $13,750.11 | $5.61 |
| **Mille Lacs Total** | | **25,048** | **$101,945.36** | **$38,573.92** | **$140,519.28** | **$5.61** |
| **Big Woods North** | 409 | **1,357** | **$5,522.99** | **$2,089.78** | **$7,612.77** | **$5.61** |
| | | | | | | |
| **Farmland Total** | | **50,419** | **$189,014.87** | **$114,441.76** | **$303,456.63** | **$6.03** |
| **Forested Total** | | **138,483** | **$563,625.81** | **$213,263.82** | **$776,889.63** | **$5.61** |
| **GRAND TOTAL** | | **188,902** | **$752,640.68** | **$327,705.58** | **$1,080,346.26** | **$5.72** |

[a]No feeding took place in this permit area.

**Appendix 9.** Summary of the cost per estimated deer fed and cost per reported deer fed by Deer Management Permit Area in the feeding zone.

| Sub-DMU | Permit area | Total cost | Estimated deer fed | Cost/Estimate deer fed | Report deer fed | Cost/Report deer fed | Cost 50%estimated deer fed |
|---|---|---|---|---|---|---|---|
| Red River West | 401 | 9,599.76 | 758 | 12.66 | 2,016 | 4.76 | 12508.08 |
| | 402[b] | 0.00 | 0 | 0.00 | 0 | 0.00 | 0.00 |
| | Total | 9,599.76 | 758 | 12.66 | 2,016 | 4.76 | 12,508.08 |
| Red River East | 403 | 19,573.38 | 1,546 | 12.66 | 3,530 | 5.54 | 14,039.94 |
| | 404 | 36,638.28 | 2,480 | 14.77 | 5,065 | 7.23 | 22,834.42 |
| | 405 | 13,881.06 | 940 | 14.77 | 1,762 | 7.88 | 20,670.62 |
| | 406 | 5,601.87 | 379 | 14.78 | 725 | 7.73 | 22,878.73 |
| | 407 | 84.42 | 8 | 10.55 | 6 | 14.07 | 11,736.88 |
| | 408 | 482.40 | 38 | 12.69 | 112 | 4.31 | 15,919.61 |
| | Total | 76,261.41 | 5,391 | 14.15 | 11,200 | 6.81 | 108,080.20 |
| **Red River Total** | | **85,861.17** | **6,149** | **13.96** | **13,216** | **6.50** | **120,588.28** |
| Agassiz | 201 | 7,459.11 | 393 | 18.98 | 1,072 | 6.96 | 9,570.96 |
| | 202 | 14,218.74 | 842 | 16.89 | 1,825 | 7.79 | 18,046.97 |
| | 203 | 2,026.08 | 137 | 14.79 | 340 | 5.96 | 12,369.88 |
| | 204 | 33,026.31 | 1,956 | 16.88 | 6,429 | 5.14 | 44,056.80 |
| | 205 | 57,839.76 | 2,740 | 21.11 | 5,105 | 11.33 | 48,278.57 |
| | 206 | 41,649.21 | 2,467 | 16.88 | 5,685 | 7.33 | 34,587.12 |
| | 207 | 19,151.28 | 1,296 | 14.77 | 2,705 | 7.08 | 16,124.36 |
| | 208 | 9,099.27 | 616 | 14.77 | 1,399 | 6.50 | 1,682.72 |
| | 209 | 14,912.19 | 785 | 19.00 | 2,927 | 5.09 | 21,876.48 |
| | 210 | 10,600.74 | 628 | 16.88 | 2,146 | 4.94 | 24,197.48 |
| **Agassiz Total** | | **209,982.69** | **11,860** | **17.71** | **29,633** | **7.09** | **245,791.34** |
| Rainy River West | 211-212 | 63,785.70 | 2,953 | 21.60 | 10,992 | 5.80 | 245,592.00 |
| | 214[a] | 504.90 | 128 | 3.93 | 70 | 7.21 | 1,509.12 |
| | Total | 64,290.60 | 3,081 | 20.87 | 11,062 | 5.81 | 247,101.12 |
| Rainy River Central | 104-106 | 18,350.31 | 1,038 | 17.68 | 2,996 | 6.12 | 77,173.73 |

| Sub-DMU | Permit area | Total cost | Estimated deer fed | Cost/Estimate deer fed | Report deer fed | Cost/Report deer fed | Cost 50%estim deer fed |
|---|---|---|---|---|---|---|---|
| | 110 | 6,064.41 | 618 | 9.81 | 1,541 | 3.94 | 23,754.58 |
| | Total | 24,414.72 | 1,656 | 14.74 | 4,537 | 5.38 | 100,928.31 |
| Rainy River East | 107-109, 195 | 25,688.19 | 2,180 | 11.78 | 5,388 | 4.77 | 158,329.09 |
| Rainy River Total | | 114,393.51 | 6,917 | 16.54 | 20,987 | 5.45 | 506,358.52 |
| Superior West | 119-121 | 37,093.32 | 31.48 | 11.78 | 6,802 | 5.45 | 120,750.89 |
| Superior Wilderness | 115[a] | 504.90 | 43 | 11.74 | 95 | 5.31 | 22,195.80 |
| | 116[a] | 280.50 | 28 | 10.02 | 30 | 9.35 | 24,828.44 |
| | 117[a] | 8,818.92 | 898 | 9.82 | 1,164 | 7.58 | 5,361.72 |
| | 118[ab] | 0.00 | 0 | 0.00 | 0 | 0.00 | 0.00 |
| | Total | 1,604.32 | 969 | 9.91 | 1,289 | 7.45 | 52,385.96 |
| Superior Central | 122-125 | 27,657.30 | 2,817 | 9.82 | 4,359 | 6.34 | 41,563.15 |
| Grand Portage I.R. | 194[ab] | 0.00 | 0 | 0.00 | 0 | 0.00 | 0.00 |
| Superior East | 126, 128-129 | 27,427.29 | 2794 | 9.82 | 3,738 | 7.34 | 20,440.33 |
| | 127[a] | 4,858.26 | 495 | 9.81 | 368 | 13.20 | 8,783.99 |
| | 130[a] | 1,458.60 | 148 | 9.86 | 220 | 6.63 | 1,11[illegible]1 |
| | Total | 33,744.15 | 3,437 | 9.82 | 4,326 | 7.80 | 30,340.03 |
| Superior Total | | 108,099.09 | 10,371 | 10.42 | 16,776 | 6.44 | 245,040.03 |
| Itasca NW | 167-169 | 51,505.41 | 4,372 | 11.78 | 7,827 | 6.58 | 126,411.18 |
| Itasca SW | 170-171 | 33,682.44 | 3,431 | 9.82 | 4,859 | 6.93 | 78,044.45 |
| | 172 | 23,696.64 | 2,414 | 9.82 | 7,204 | 3.29 | 34,767.71 |
| | 173-174 | 22,967.34 | 2,340 | 9.82 | 5,135 | 4.47 | 7,141.81 |
| | Total | 80,346.42 | 8,185 | 9.82 | 17,198 | 4.67 | 184,453.97 |
| Itasca NE | 175-179 | 71,280.66 | 7,260 | 9.82 | 12,046 | 5.92 | 138,162.49 |
| Itasca SE | 180-184, 199 | 98,045.97 | 9,987 | 9.82 | 16,317 | 6.01 | 168,683.05 |
| Leech Lake I.R. | 197, 198 | 22,243.65 | 2,266 | 9.82 | 4,578 | 4.86 | 40,173.62 |
| Bemidji | 284-286 | 90,304.17 | 9,198 | 9.82 | 21,697 | 4.16 | 187,316.50 |
| | 287 | 151.47 | 19 | 7.97 | 36 | 4.21 | 8,710.56 |
| | Total | 90,455.64 | 9,217 | 9.81 | 21,733 | 4.16 | 196,027.06 |

| DMU | Permit area | Total cost | Estimated deer fed | Cost/Estimate deer fed | Report deer fed | Cost/Report deer fed | Cost 50%estimated deer fed |
|---|---|---|---|---|---|---|---|
| Itasca Total | | 413,877.75 | 41,287 | 10.02 | 79,699 | 5.19 | 853,911.37 |
| Mille Lacs West | 244 | 26,546.52 | 2,704 | 9.82 | 4,309 | 6.16 | 6.00<br>7959.31 |
| | 245 | 21,643.38 | 2,204 | 9.82 | 3,610 | 6.00 | 59,150.77 |
| | 251 | 1,273.47 | 162 | 7.86 | 350 | 3.64 | 4,476.27 |
| | Total | 49,463.37 | 5,070 | 9.76 | 8,269 | 5.98 | 131,586.35 |
| Mille Lacs Central | 246 | 28,061.22 | 2,858 | 9.82 | 11,175 | 2.51 | 74,165.55 |
| | 247 | 20,353.08 | 2,592 | 7.85 | 8,673 | 2.35 | 25,610.63 |
| | Total | 48,414.30 | 5,450 | 8.88 | 19,848 | 2.44 | 99,776.18 |
| Mille Lacs East | 154-156 | 28,892.50 | 2,943 | 9.82 | 7,076 | 4.08 | 48,476.43 |
| White Earth I.R. | 297-298 | 13,750.11 | 1,400 | 9.82 | 3,539 | 3.89 | 31,659.68 |
| Mille Lacs Total | | 140,519.28 | 14,863 | 9.45 | 38,732 | 3.63 | 311,498.64 |
| Big Woods North | 409 | 7,612.77 | 776 | 9.81 | 1,903 | 4.00 | 14,739.82 |
| | | | | | | | |
| land Total | | 303,456.63 | 18,785 | 16.15 | 44,752 | 6.78 | 381,119.44 |
| Forest Total | | 776,889.63 | 73,438 | 10.58 | 156,194 | 4.97 | 1,916,808.56 |
| Grand Total | | 1,080,346.26 | 92,223 | 11.71 | 200,946 | 5.38 | 2,297,928.00 |

aPopulation density was estimated (not modeled) for this permit area.
bNo feed was distributed in this permit area.