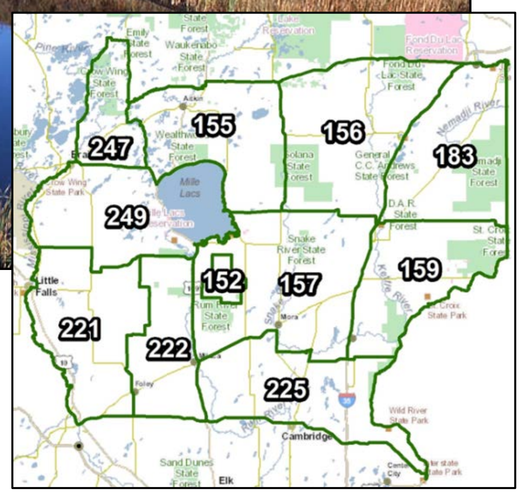
Minnesota Deer Population Goal Setting Team Information Packet

Central MN: East Central Uplands Goal Block   2015



Minnesota DNR – Wildlife Section, January 27, 2015

MNDNR

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Executive Summary

Between 2005 and 2007, the Minnesota DNR used a public participation process to determine population goals for deer permit areas (DPAs) across the state. Goals for portions of the state were revisited in 2012 and 2014. Goals for the remainder of the state will be revisited, using a similar public process, in 2015 and 2016. The new process emphasizes collecting public input (mail surveys, online questionnaires and public meetings) prior to convening stakeholder teams selected to represent the diversity of perspectives related to deer management. Stakeholder advisory teams will provide the MN DNR direction regarding deer population goals in each permit area. In 2015, goals will be revisited for permit areas 152, 155, 156, 157, 159, 183, 221, 222, 225, 247 and 249 in the *East Central Uplands* goal-setting block in addition to revisiting goals for permit areas within four other regional goal setting blocks. Population goal recommendations will advance for approval by the DNR Commissioner after a final public comment period. If necessary, any adjustments to team recommendations will be communicated to the team and public.

The *Minnesota Deer Population Goal Setting Team Information Packet* provides an overview of factors important in decisions about deer populations in Minnesota, starting with the mission of the Minnesota Department of Natural Resources. Sections on the history of deer hunting and management in Minnesota, deer population biology, social considerations, health concerns, Minnesota's deer management framework, deer population and harvest trends, and public perceptions are discussed.

Minnesota's deer population has fluctuated, at least since European settlement, primarily in response to land conversion, habitat changes, winter severity, and hunting. Minnesota's current deer population management framework evolved after the last closure of the deer season in 1971. The firearms season, which begins each year on the Saturday closest to November 6th, is the primary contributor to hunting-related mortality. As of 2014, a hunter may purchase up to three seasonal licenses (archery, firearm, and muzzleloader) and harvest up to five deer annually throughout the state, depending upon DPA management strategies.

In addition to providing opportunities for outdoor recreation and the commercial use of natural resources, the MN DNR is directed by mission to work with citizens to conserve and manage the state's natural resources. Natural resource management decisions, including those related to deer, must consider the various and often competing values and objectives that are central to this mission. The MN DNR strives to manage deer populations in a manner that will provide quality recreational hunting opportunities, protect ecosystems, and minimize damage caused by deer.

Deer are important to the economy of Minnesota, particularly in rural regions where hunters typically travel to hunt deer during the firearms deer season. Deer hunting is highly valued in Minnesota, and revenues generated from deer hunting support many wildlife programs. There are more than 500,000 deer hunters in Minnesota; about 1 out of every 10 Minnesotans hunt deer each year. There are many more Minnesotans who also enjoy observing deer. While arguably Minnesota's most popular game species, deer population management also requires consideration of potential conflicts, such as browsing impacts (on agriculture, natural habitats, and landscaping), public safety (e.g., deer vehicle collisions), and the risk of disease (for deer, people, and other species).

In Minnesota, deer population management occurs at various levels – from local habitat management to statewide laws, rules, and regulations. Minnesota's deer population goals have been focused on the desired direction (increase, remain the same, or decrease) and magnitude (e.g., moderate) of population change for each DPA; hunting is the primary method used to manage deer populations. To manage deer densities within target levels, staff members consult on an annual basis to determine the hunting season management designation for each DPA. Information considered in this process includes annual harvest statistics including hunter success rates, population trend data, and recommendations from the deer population goal-setting process as well as public comments.

Deer population increases in from the 1970s through the 1990s were influenced by a management strategy designed to build the deer population and a trend toward milder winter weather. After the severe winters of 1996 and 1997, deer population numbers increased to record levels during the early 2000s; again due to relatively mild winters and low antlerless harvests. Following deer population goal setting during 2005-2007, deer densities in almost half of the DPAs were intentionally reduced through harvest management. In general, after population goals were last established, deer numbers decreased in the forested part of the state but remained fairly stable in the farmland.

As a consequence of purposeful population reduction, Minnesota deer hunters harvested numbers of deer during the period 2003 – 2006 that are not sustainable over the long-term. High antlerless harvest rates, along with liberal bag limits contributed to high harvest numbers and the decline in the statewide deer population. Recent severe winters have also reduced deer numbers, resulting in the implementation of a significantly more restrictive deer season in 2014 by the MN DNR. The reduced 2014 harvest is anticipated to boost the deer population in 2015.

During 2014, the MN DNR collected information, through surveys, on hunter and landowner perceptions about the current deer population and desires regarding future management. Survey recipients were selected randomly and provide a statistically representative sample of stakeholder opinions in the goal blocks under consideration. Thus, these surveys differ from public input opportunities which may include some bias according to self-selection of interested parties. When asked about the current deer population in the East Central Uplands goal block, the most common response from hunters and landowners was that the population was 'too low'; however, 52% of non-hunting landowners believed the population 'about right'.

Over the course of the next few months, deer population goals will be considered for the East Central Uplands goal block. The process will include a review of applicable data, public input (online and meetings) during February and advisory team meetings during March. After final public comment, population goals will be finalized by the MN DNR. Harvest management strategies to move populations toward goals will be implemented for the 2015 hunting season.

Minnesota DNR Mission Statement

The mission of the Minnesota Department of Natural Resources (MN DNR) is to work with citizens to conserve and manage the state's natural resources, to provide outdoor recreation opportunities, and to provide for commercial uses of natural resources in a way that creates a sustainable quality of life.

About the mission statement and deer management

The MN DNR works to integrate and sustain the interdependent values of a healthy environment, a sustainable economy, and livable communities. The DNR's integrated resource management strategy shares stewardship responsibility with citizens and partners to manage for multiple interests. Natural resource management decisions, including those related to deer, must consider the various and often competing values and objectives that are central to this mission. The MN DNR:

- protects the state's natural heritage by conserving the diversity of natural lands, waters, and fish and wildlife;
- manages natural lands such as forests, wetlands, and native prairies;
- maintains healthy populations of fish and wildlife;
- protects rare plant and animal communities throughout the state;
- manages the state's water resources, sustaining healthy waterways and ground water resources;
- provides access to enrich public outdoor recreational opportunities through a state outdoor recreation system; and
- supports natural resource-based economies in a manner consistent with sound natural resource conservation and management principles.

Public engagement

Public engagement is an important part of the Division of Fish & Wildlife's mission. Though all final decisions made by DNR are statutorily required to rest with the Commissioner, DNR is committed to incorporating public values into decision making.

The Division of Fish & Wildlife uses a range of public engagement activities, each customized for the scope and nature of the decision or issue at hand. These activities may include soliciting public comment, holding public meetings, convening citizen advisory teams or workgroups, hosting roundtable events, holding focus groups, or other methods.

The deer population goal setting process emphasizes collecting broad public input through public comment periods and public meetings, and by convening citizen advisory teams that make recommendations to DNR on deer population goals. During this process, DNR seeks to engage a wide range of public interests in deer management, including hunting, recreation, farming, forestry, public health and safety. By bringing in such diverse interests, the DNR is better poised to identify deer population goals that are both ecologically sustainable and socially acceptable.

History of Minnesota Deer Hunting and Management

Historically, white-tailed deer in Minnesota existed throughout the wooded river valleys and woodlands of central and southern Minnesota (Figure 1). Hardwood forests comprised of maple, basswood, and oak were abundant in southeastern and central regions of Minnesota and white-tailed deer were likely common in these areas. In northern Minnesota, deer were absent or rare; moose and caribou were the most abundant members of the deer family. The predominant forest landscape was comprised of extensive tracts of jack pine, and red and white pine, mixed with spruce-balsam and aspen-birch on the uplands and spruce, tamarack and white cedar on the lowlands.

European settlement of southern and central Minnesota during the mid- to late-1800s cleared forests for lumber and agriculture, which improved habitat quality for deer by creating new openings. However, as agricultural land conversion expanded, habitat quantity declined and so did deer numbers. Market and subsistence hunting accelerated the population decline in deer numbers; by the 1880s deer were rare in many parts of Minnesota (Figure 2).

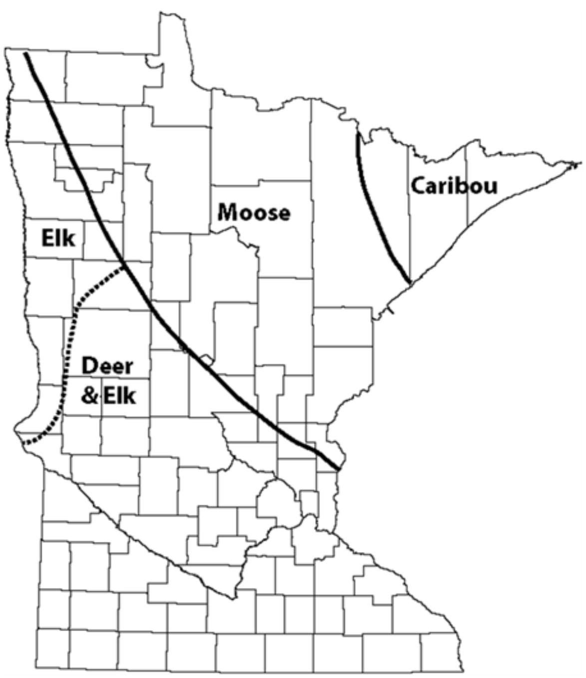


Figure 1. Range map of cervids (deer, elk, moose, and caribou) in Minnesota prior to European settlement.

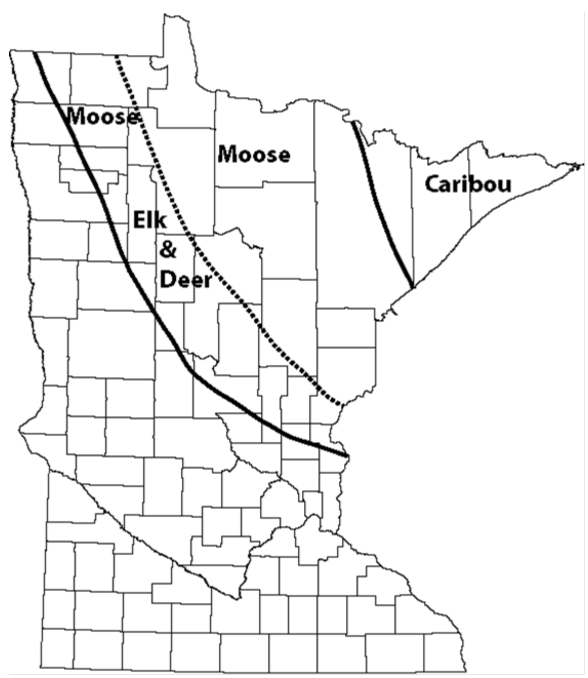


Figure 2. Range map of deer family members in Minnesota around 1880.

During the late 1800s, logging of the red and white pine forests and burning logging slash, as well as clearing land for farming, created new habitats for white-tailed deer in northern Minnesota. By 1920, white-tailed deer were common in northern forests but were rare in much of their former range (Figure 3).

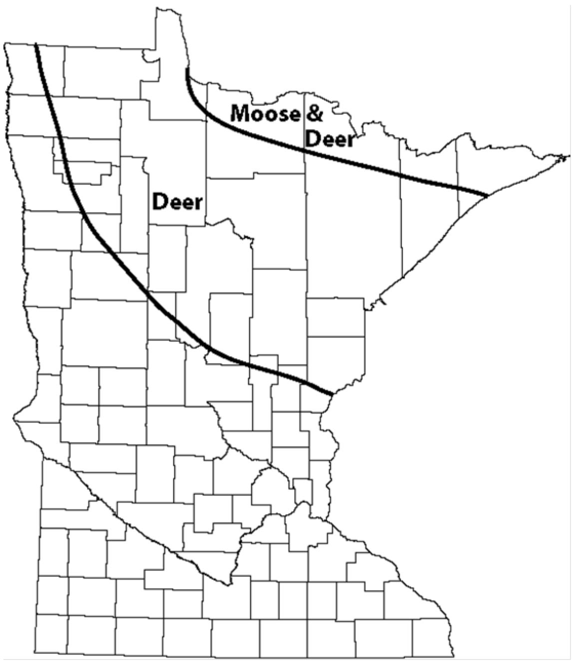


Figure 3. Range map of deer family members in Minnesota around 1920.

The State of Minnesota attempted to manage deer numbers through regulated hunting as early as 1858 (Table 1). Deer hunting seasons were closed in Minnesota's farmland area in 1923 and remained closed until 1945. The first statewide, any-deer season occurred in 1946. Deer were more abundant in the north and a deer hunting focus and traditions developed in the northern forest, including the far northeastern counties. Over the past century, deer populations have fluctuated throughout the state in response to changing habitat, patterns of winter severity, and hunting harvest. These factors, especially the latter two, forced season closures in the early 1940s and in 1951. A statewide deer population crash occurred in the late 1960s, which prompted the last season closure in 1971.

An improved management framework evolved during the 1970s that permitted annual hunting, while allowing the statewide population to grow. While the hunting zones, season lengths, and opening dates have changed slightly over the years, today's seasonal framework generally reflects the system developed in the 1970s which centers on an opening firearm season on the Saturday closest to November 6th. A hunter may purchase a season license to take a buck,

Table 1. General frameworks for Minnesota's firearms deer seasons, 1858-Present

Years	Length	Opening Dates	Limit
1858-63	5 Mo.	Sept. 1	None
1865-73	5 Mo.	Aug. 1	None
1874-86	2.5 Mo.	Oct. 1	None
1887-92	1 Mo.	Nov. 1	None
1893-94	19 Days	Nov. 1	None
1895-96	20 Days	Nov. 1	5/License
1897-98	22 Days	Oct. 25	5/License
1899-1900	21 Days	Nov. 1	5/License
1901-04	21 Days	Nov. 10	3/License
1905-14	21 Days	Nov. 10	2/License
1915-18	21 Days	Nov. 10	1/License
1919-20	22 Days	Nov. 15	1/License
1921-44[a]	5-11 Days	Nov. 10-21	1/License
1945-58[b]	1-9 Days	Nov. 8-20	1/License
1959-69	9 days	Nov. 7-13	1/License
1970	2 days	Nov. 14	1/License
1971	Closed		
1972-1976	5-17 days	Nov. 1	1/License
1977-1984	16 days	Nov. 3-10	1/License
1985-1992	16 days	Nov. 3-9	Up to 2 deer with bonus permit
1993-2014	16 days	Nov. 3-9	Up to 5 deer with bonus permit

[a] Season closed every other year from 1923 to 1931, closed again 1935, 1939, 1941
[b] Season closed 1950

or to take an antlerless deer with an either-sex permit, in a 'lottery' DPA. The either-sex permit quota depends on where the deer population is relative to the population goal, hunter success rates, and other factors. Because demand for either-sex permits typically exceeded supply in most permit areas, a lottery preference system has been utilized since the early 1980s in order to equally distribute antlerless permits among hunters through time. Beginning in the 1990s, the MN DNR allowed for issuance of additional either-sex permits (i.e., bonus permits) to help reduce deer populations in permit areas that exceed established goals. Beginning in 2003, permit areas were annually designated by wildlife managers as lottery, managed, and intensive. The latter two designations allowed the issuance of an either-sex license and purchase of one or up to four additional bonus permits, respectively. Hunter choice, a management strategy intermediate to lottery and managed harvest, was instituted in 2011 to allow hunters to take one deer of either sex in a permit area without making a lottery application. A bucks-only management strategy has been implemented on rare occasion (e.g., after the severe winters of 1995-96, 1996-1997 and again after the severe 2013-2014 winter). As of 2014, a hunter may purchase up to three seasonal licenses (archery, firearm, and muzzleloader) and harvest up to five deer annually throughout the state, depending upon DPA management strategies.

Minnesota's deer program has been largely successful based on hunter numbers and deer harvests. Minnesota firearms deer hunter numbers (Figure 4) and firearms deer harvests (Figure 5) have grown tremendously over the past 95 years. More recently, the MN DNR developed a public goal-setting process to better involve citizens in deer population decisions. The current framework has, for the last 40 years, brought stability to deer population management in Minnesota relative to previous decades, when liberal seasons were often followed by season closures. Population management through season structure and regulation, along with winter weather patterns, has been the most significant factor in both farmland and forest deer populations in the state during the past forty years.

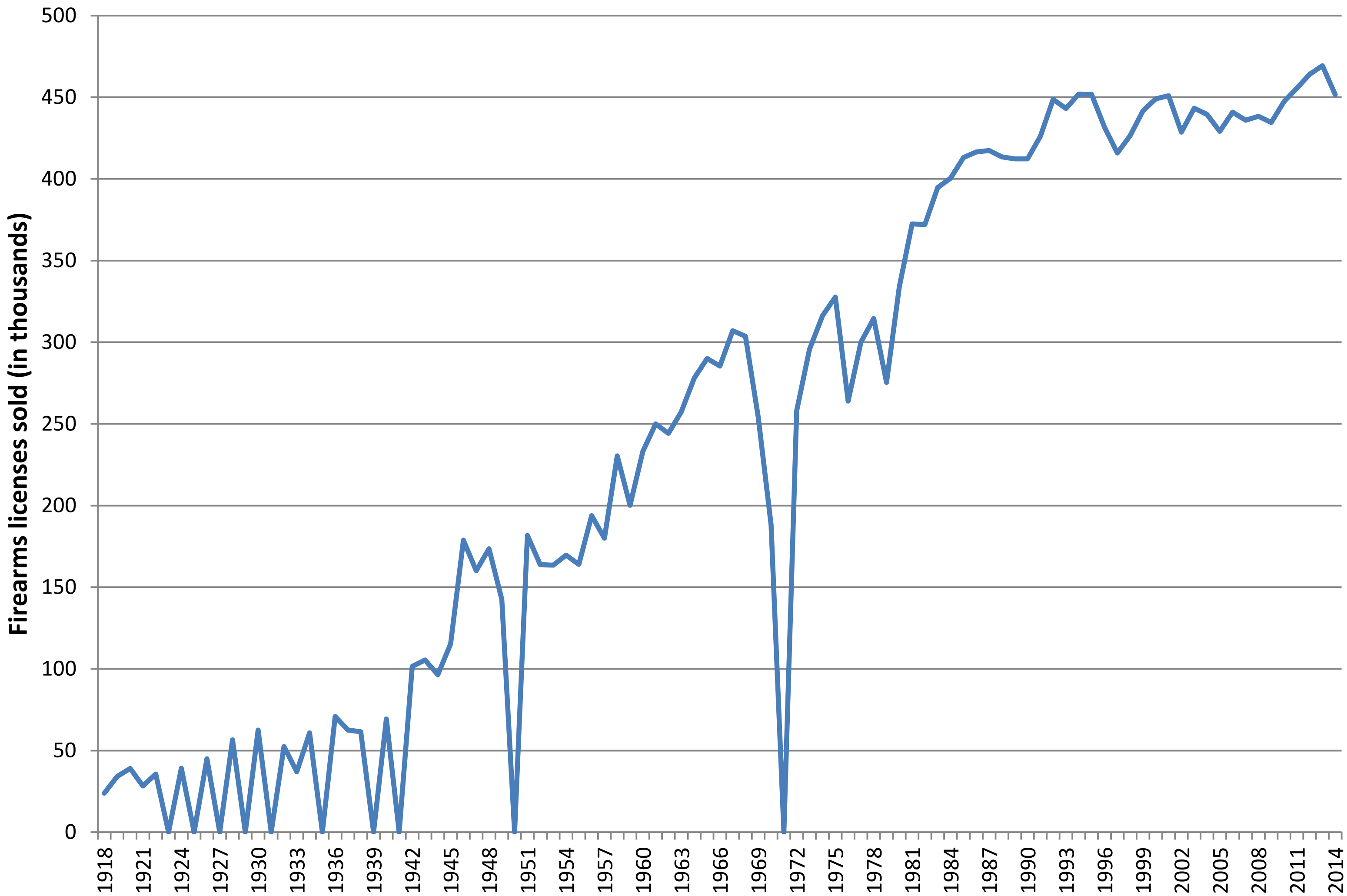


Figure 4. Minnesota firearm license sales between 1918 and 2014.

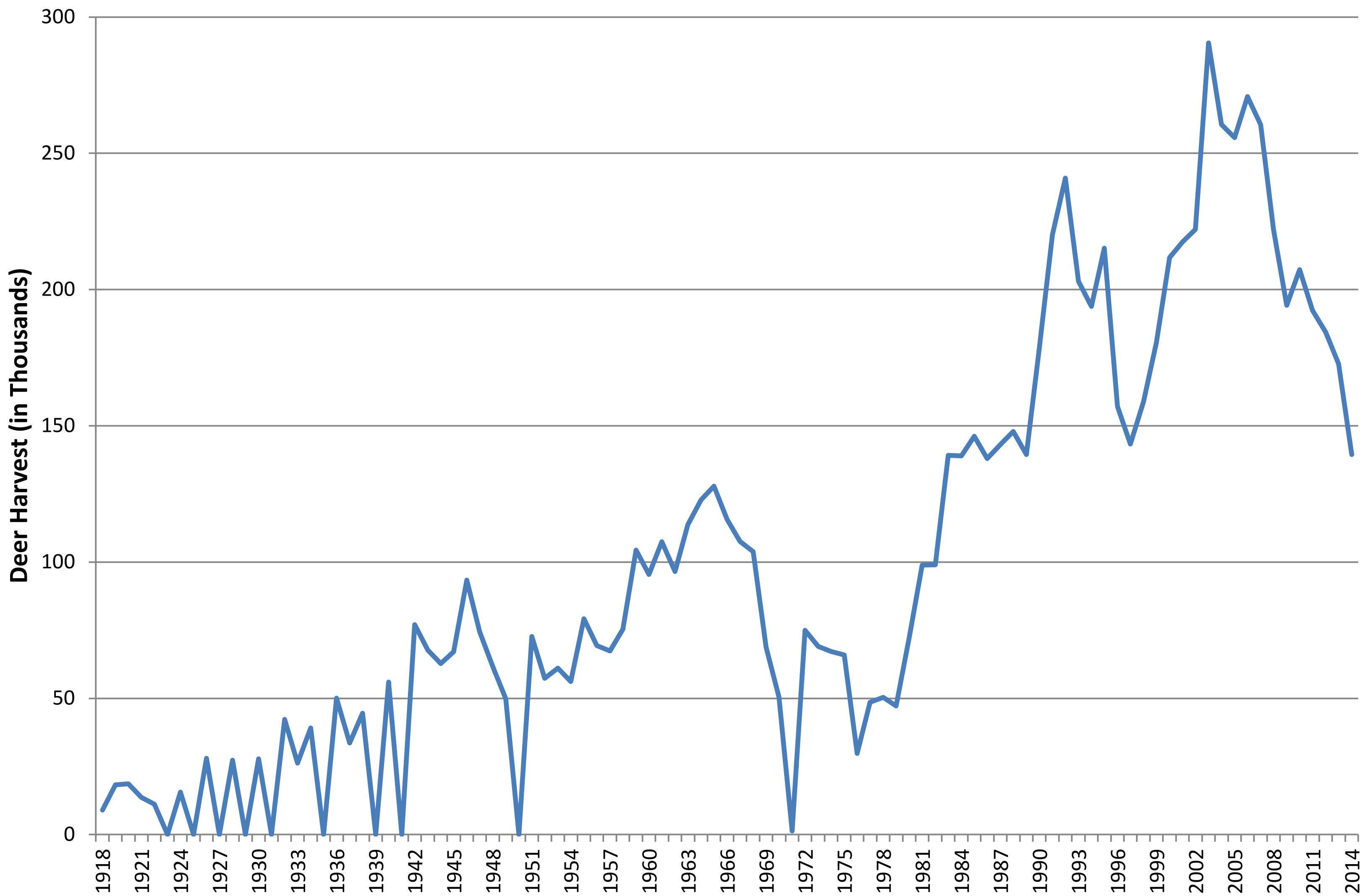


Figure 5. Minnesota deer harvest between 1918 and 2014.

Deer Population Management

Nationally, deer populations are managed using harvest regulations designed to stabilize populations or influence population direction (increase, decrease). In Minnesota, that is accomplished at the level of a deer permit area using season length (9 – 23 days) and management designations.

Population growth

Deer herds increase annually through recruitment of young deer into the population. *Recruitment* is the number of fawns born in spring that survive into fall. Reproduction is a high priority for female deer and regardless of influences such as food resources, deer densities, or the numbers of bucks in the population, most adult does are bred every year. Although winters may be stressful, does rarely abort their fetuses even when they are severely malnourished. However, fawns born to mothers that were severely malnourished in winter have lower body weights and are more prone to mortality. All does that give birth to fawns produce milk of the same quality with the proper composition of nutrients. However, when does are in poor condition or cannot find adequate food to support lactation, they produce a lower volume of milk for their fawns. Malnourished fawns are more prone to be killed by predators or die of abandonment or disease, and recruitment is negatively impacted.

Density-dependent factors, such as food resources and cover, affect recruitment rates in white-tailed deer populations. Density dependence relates to the concept of biological carrying capacity (BCC); in essence, there is only so much food and cover available to a deer population. The amount of food and cover available for each deer will decrease as deer numbers increase toward BCC and, as a result, the number of fawns recruited per doe will decrease. When food resources are limited, physical condition and adult deer survival also declines. Deer in poor physical condition will have lower body weights and bucks (particularly yearling males) will possess antlers with fewer points and smaller beam diameters. When food and cover resources are sufficient, deer densities have less of an effect on survival and reproduction, and recruitment is high. Harvest levels are maximized when deer densities are well below the BCC because fawn recruitment is maximized and mortality is minimized. When a population is at BCC there is no harvestable surplus and any additional mortality (harvest), by definition, reduces the population.

Understanding how deer herds respond to different levels of harvest is one of the most complex parts of managing deer populations. As indicated above, when the population is at BCC, deer densities will be high but recruitment of fawns will be low and overwinter survival will be affected (deer will be in poor condition). To maintain population growth, mortality through hunting and other causes cannot exceed the number of deer recruited into the population. The population will decrease if the number of deer dying exceeds the number of deer recruited into the population. A more comprehensive explanation of carrying capacity is described on page 13.

Predators, Winter Weather and Deer Survival

Predation is the leading cause of death for deer in their first few months of life. Fawns younger than one month old are especially vulnerable. They spend most of their time away from their mothers during this time, hiding and waiting for the doe to return. Predators search for fawns or happen upon them and fawns are easily killed. After a few weeks, fawns are mobile with their mothers and are capable of eluding capture by predators.

A study conducted by the MN DNR in the northern forest found that about half of fawns born died by 3 months of age and predation accounted for about 85% of mortality. Black bears and bobcats were responsible for most fawn deaths and wolves accounted for only about 5% of mortality. In the farmland region of Minnesota, more than 75% of fawns survive their first summer. Studies have shown that almost all fawn deaths that do occur in the farmland can be attributed to predation by coyotes.

Once a deer survives to their first fall, they are more likely to be harvested by hunters than killed by predators. One exception is when winter conditions are extreme. Each year, the MN DNR calculates a winter severity index (WSI) throughout the state. Among other factors, the WSI is used to help estimate the effect of winter weather on deer survival. From November 1 through May 31, one point is added to the WSI for each day with snow depths more than 15 inches. One point is also added to the WSI for each day when temperatures fall below zero degrees Fahrenheit. Snow depth, in particular, has a significant effect on deer survival. Winters are considered mild when the WSI is below 100. Severe winters have a WSI more than 180. Since 1968, only a few winters were classified as severe over significant portions of the state (i.e. 1995-1996, 1996-1997 and 2013-2014). Still, each year conditions in some localized areas, like within the moose range, can prove difficult for deer.

Many research studies have shown that severe winters can impact deer populations. The ability of deer to accumulate fat reserves in the summer and fall is important to their survival in winter. In quality habitats and in years when acorns and other mast crops (e.g., nuts) are plentiful, deer accumulate fat in the bone marrow, around the internal organs, and under the skin. Throughout winter as snow deepens and food resources are depleted, deer rely primarily on body fat to survive.

In north-central Minnesota, a 15-year MN DNR research study on adult female deer found that, over the long term, adult female deer have a strong winter survival capacity and mortality is relatively low. Female deer were the focus of the study because they represent the reproductive component of the population and have the greatest impact annually on population dynamics. In most years, less than 10% of does died during the winter; however, over 30% of radio-collared deer in the study died during the severe winter of 1995-1996. The study found that fawns and does older than 5 years old were most likely to die during winter.

Where there are established populations of wolves, predation by wolves during winter is typically the leading cause of death rather than death solely due to starvation. Deep snow, and snow crusted to allow easy travel by wolves versus deer, can give wolves an advantage with their wide, padded paws. Deer in poor body condition, with limited fat reserves and high parasite loads, are especially vulnerable to predation.

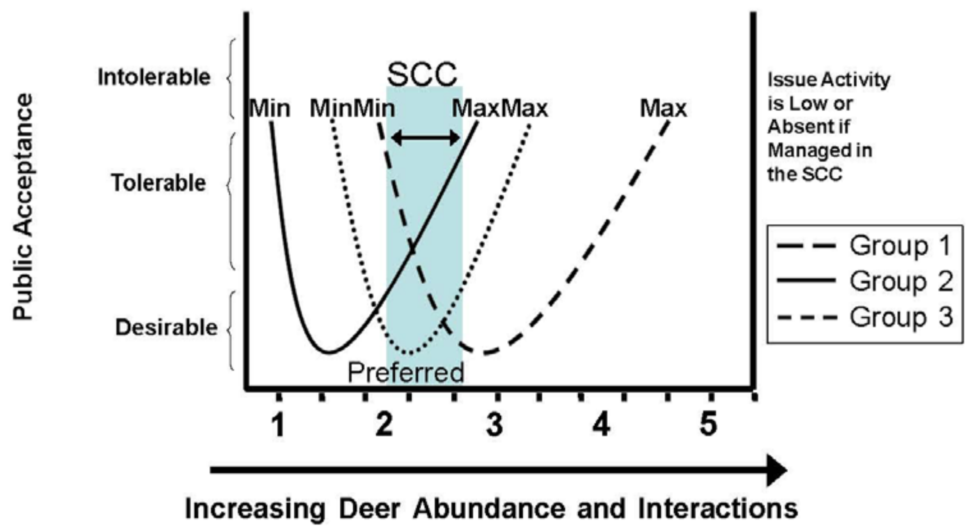
Carrying Capacity

The term carrying capacity is often used when speaking about deer numbers and goals, but it must be defined to be useful as there are a range of common uses. Ecologists use the term *carrying capacity* to define the maximum population of a particular species that a given area of habitat can support over a given period of time. The ecological principles that govern a habitat's carrying capacity are the same for all species. A sustainable supply of resources – including nutrients, energy, and living space – defines the carrying capacity for a particular population in a particular environmental system. This population level is generally referred to as the "biological carrying capacity" (BCC).

It is important to note that as a deer population increases, so does competition for quality forage and other habitat components, and the quality of habitat degrades over time. This increased competition leads to lower reproductive output (productivity) and fawn survival. The fawn recruitment rate eventually reaches a point where it equals the mortality rate and the population stops growing. This is also a definition of BCC. At this point the physical condition of the herd is usually poor, body and antler size is diminished, disease problems may be chronic, and winter survival is reduced. This is one reason why populations are not managed at the BCC. However, BCC is a useful theoretical benchmark in deer herd management, and deer densities relative to the BCC can be discussed.

The terms "social carrying capacity" (SCC) or "cultural carrying capacity" (CCC) are also commonly used when discussing deer populations. The SCC focuses on the impacts deer may have on people and the things people value; essentially, it is the maximum number of deer that humans will tolerate. That number is always lower than the BCC because social tolerance is always lower than the biological maximum. Negative impacts of deer that contribute to SCC include degraded natural ecosystems and associated negative impacts on other wildlife species, loss of biodiversity, deer-vehicle collisions, agricultural damage, and damage to residential landscaping. One problem with SCC is that people's tolerance varies greatly depending upon their social context. If your livelihood depends upon growing a crop, your tolerance is very different from an avid deer hunter. Thus, stakeholder groups will have varying levels of acceptance of deer populations. For each stakeholder group, the minimum and maximum number of deer that are supported is described as the 'latitude of acceptance.' Ideally, if we overlay min/max densities for each stakeholder group, we can create a range of densities (SCC) that can be supported by all groups. Figure 6, from the Michigan DNR[1], illustrates how 3 hypothetical stakeholder groups accept deer on a scale ranging from 1 to 5, yet a range of acceptance can still be achieved within that scale.

Figure 6. Hypothetical deer population acceptance curves and the resulting range of acceptable deer densities (social carrying capacity). Adopted from Michigan DNR.



Minnesota's Biological Carrying Capacities

Minnesota is a very large and diverse state with nearly 400 miles separating the northern and southern borders. Within the state, four different ecosystems are present (prairie grassland, deciduous forest, coniferous forest, aspen parklands). Each of these ecosystems provides differing quality and quantity of deer forage. Measuring BCC is very difficult (and complicated by habitat and climate differences); and long-term BCC in Minnesota is a function of both habitat quality (primarily food resources) and climate. In general, BCCs decrease on a gradient from south to north because climate and latitude in the Midwest are strongly related. Simply, southern Minnesota climate is significantly milder than northern Minnesota (much like the

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[1] http://www.michigan.gov/documents/dnre/WLD_Deer_Mgmt_Plan_Appendix_D-A_Review_of_Deer_Management_in_Michigan_310657_7.pdf

climate in southern Wisconsin is milder than that of central Minnesota). Also, the habitat gradient changes from south (hardwood) to north (conifer) thus leading to a corresponding decrease in habitat quality. Functionally, BCC for deer in Minnesota declines northward because of climatic differences, the energy demands that climate places on deer, and the resources available to support those energy demands.

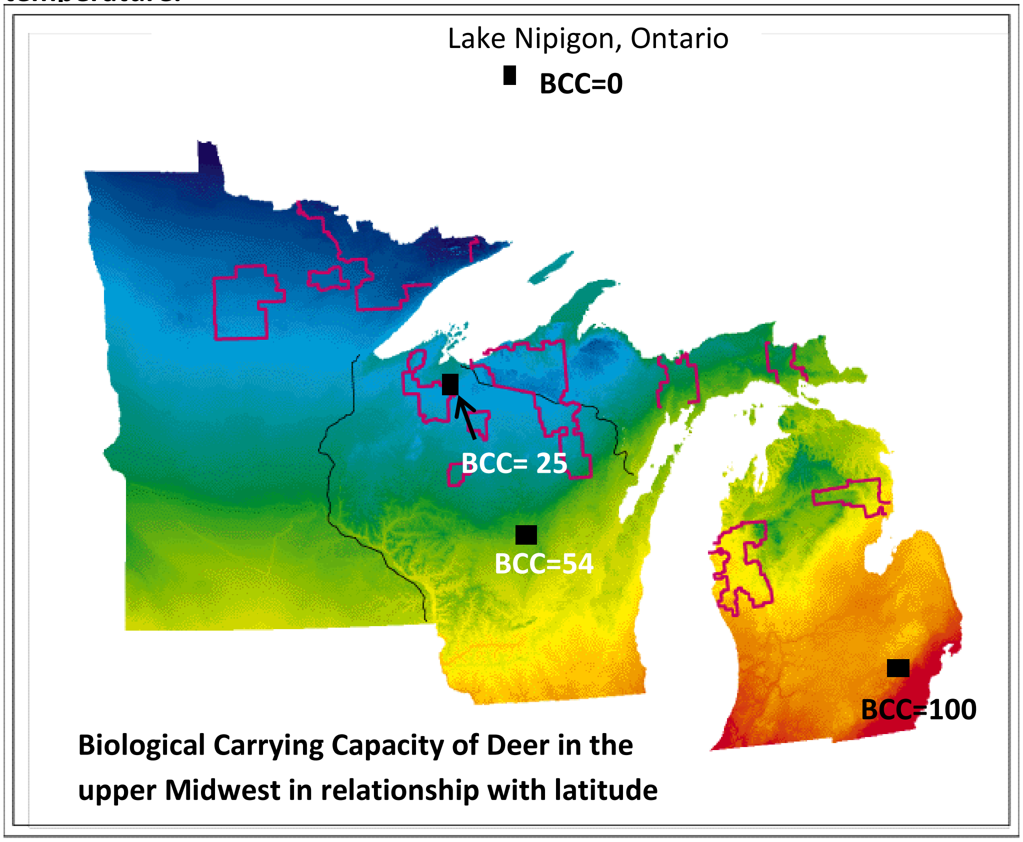
Through scientific research, BCCs have been estimated (and in some cases measured) at some locations in the Midwest and the relationship with latitude is evident. Keith McCaffery, now retired from the Wisconsin DNR, uses the following simple example[2]. The George Reserve in southern Michigan has a documented BCC of 100 deer per square mile of deer habitat. At the other end of the spectrum, the deer BCC just north of Lake Nipigon Ontario is zero. Winters are too long and its energy demands are too great for white-tailed deer to persist long-term. In between those points, other BCCs have been either measured or estimated. This is illustrated in Table 2 and Figure 7 below. The graphical representation of potential BCC in Figure 7 is depicted in relation to temperature gradients; differences in habitat quantity and quality (e.g., loss of natural habitat due to development or agricultural practices) reduce BCC in many areas and are not incorporated in this figure.

Table 2. Range of measured or estimated biological carrying capacity for Midwestern white-tailed deer populations.

Location	Latitude	BCC_K	Measured	Estimated	Source
George Reserve- s. Michigan	42 27 30	100	x		McCullough 1979
Sandhill WMA, central WI	44 18 27	54	x		WI DNR
Mercer, WI	46 09 57	25		x	WI DNR
Northshore Lake Nipigon, Ontario	50 17 10	0	x	x	OMNR

[2] http://buffalo.uwex.edu/files/2011/01/Lay-person%E2%80%99s-discussion-of-Deer-Carrying-Capacity.pdf

Figure 7. Graphical representation of biological carrying capacity for Midwestern white-tailed deer populations. Colors represent mean February temperature.



What is a Reasonable Carrying Capacity (RCC)?

A deer population could be managed anywhere at or below BCC. However, the MN DNR's approach to resource management strives for the maintenance of ecological systems and their associated biological diversity. The MN DNR strives to manage deer populations within a range that could simply be considered a Reasonable Carrying Capacity (RCC). Management for RCC attempts to maintain reasonable deer populations (densities) that are low enough to ensure productive deer herds and to minimize damage to habitats and other human interests, yet are still high enough to produce enough deer to satisfy hunters. This approach does not preclude management specifically for deer as long as it does not threaten the long-term well-being of other species, their habitat, or the functioning of the overall biological system.

Clearly, managing at BCC would not be reasonable as, on average, there would be no net annual population increase to provide an annual harvest. Deer would be in poor condition, forests would be severely impacted, and social tolerance would be very low. Thus, an RCC is one that is well below BCC; however, how much below is the real question. Research indicates that many deer hunters would advocate for a population that is about 50% of BCC as this is where the highest sustainable annual harvest could be taken. This point is often referred to as the Maximum Sustained Yield (MSY) in the scientific literature. In contrast, quality deer management proponents who advocate for more balanced sex ratios and age structures would typically support deer populations that are lower than MSY (in order to provide opportunity for older age classes). Foresters may also argue for a lower density relative to BCC in order to sustain timber productivity. Similarly, persons interested in maintaining areas of high biodiversity advocate for even smaller relative deer densities. It is the responsibility of the MN DNR to ensure that stakeholders reach consensus on a deer density that is reasonable. Within those bounds, the stakeholder teams, if supported by the public, can determine what is reasonable.

Scientists studying the relationship between deer and forest productivity have provided some guidance on this issue (Table 3). Based upon this and other research from Minnesota to Massachusetts, the MN DNR believes a RCC falls somewhere within the range of 20% to 50% of BCC.

Table 3. Interactions of deer with plant communities as a function of relative deer densities (RDD) expressed as a percentage of Biological Carrying Capacity (BCC). [3]

RDD	$\%BCC_K$	Effects on flora and fauna	Effects on deer dynamics	Implications for hunting
Low	<20%	Some browsing of preferred plants, productivity controlled by ecosystem.	Reproduction and recruitment at biological potential. Deer seldom seen.	Hunting yields low but sustainable, Trophy deer available.
Low-moderate	20-39%	Moderate change in relative abundance in plants. Production of standing crop declines visibly for preferred species, but total crop unchanged. Wildlife species susceptible to changes may decline.	Rate of reproduction declines but recruitment is still high.	Harvest yield high, trophy deer Abundant.
Moderate-high	40-59%	Impacts are obvious, species and structure composition change. Total stand crop productivity are decreased. Susceptible plants eliminated locally. Habitat structure much reduced.	Reproduction and recruitment declines at upper end of this range. Deer are frequently seen.	Maximum sustained yield of deer for harvest. Few trophy animals without specific buck management strategies (antler point restrictions, limited licenses).
High	$\geq$60%	Great impacts: changes in structure and species composition; reduced productivity, standing crop; reduced species richness of flora and fauna.	Recruitment nears zero as BCC is approached. Large numbers of deer seen.	Animal condition is poor, neither quality nor quantity of harvest is maximized.

[3] deCalesta and Stout. 1997.

Social Issues and Deer Management

As mentioned earlier, it is the responsibility of the MN DNR to ensure that stakeholders reach consensus on a deer density that is reasonable. Deer management must balance social considerations, including conflicts with other land uses and human tolerance. The desires of farmers, foresters, ecologists or others who experience conflicts with deer and favor lower deer densities must be considered along with those of hunters, wildlife watchers, and others who may support higher deer densities. While by no means a comprehensive list, some of the social concerns are discussed below.

Importance of deer to society

Deer are important to the economy of Minnesota, particularly in rural regions where hunters typically travel to hunt deer during the firearms deer season. Based on the 2011 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation, the total annual economic impact of hunting in Minnesota exceeded $725 million and more than 85% of hunters in Minnesota hunt deer.

Deer hunting is highly valued in Minnesota, and revenues generated from deer hunting support many wildlife programs. Passage of the 1937 Federal Aid in Wildlife Restoration Act, which created the Pittman-Robertson Program, marked the beginning of wildlife management as we know it today. Pittman-Robertson dollars are a result of a federal excise tax on firearms and ammunition. These funds, along with revenues generated directly from deer hunting license sales, are used to support a wide variety of wildlife-related activities including acquisition of conservation lands, management and research activities to benefit wildlife, natural resources education programs and law enforcement.

There are more than 500,000 deer hunters in Minnesota, which means that about 1 out of every 10 Minnesotans hunt deer each year. There are many more Minnesotans who also enjoy observing deer. The 2011 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation estimated that more than 1.5 million people spent $621 million to observe, feed, or photograph wildlife in Minnesota during 2011. While it is difficult to quantify the popularity of deer, they are a valued native species and it is probably safe to assume that a good portion of those people spent time and money enjoying and observing deer.

Agriculture

In 2012, over 50% of Minnesota’s land area was used for farming, 83% of which was used for cropland (USDA 2014). Minnesota’s agricultural industry accounts for approximately 20% of the state’s income and employment.[4] Many agricultural plants are preferred forage for deer;

[4] http://www.mda.state.mn.us/food/business/

limiting damage caused by deer is an important consideration in managing deer populations in Minnesota. The MN DNR has an animal damage program with staff committed to minimizing human-wildlife conflicts. Complaints of deer damage from agricultural producers do occur in localized areas and may occur at any deer density. Complaints of depredation by deer in Minnesota include consumption of forage stored for livestock and damage to specialty crops such as produce, row crops including corn and soybeans, and commercial forest stands.

Minnesota does not compensate farmers financially for crop damage caused by deer. Wildlife managers are available to work cooperatively with agricultural producers to develop strategies to reduce deer damage and improve deer population management. By excluding deer from stored forage, the damage can be effectively eliminated. Farmers who enter into a Cooperative Damage Management Agreement with the MN DNR are eligible to receive material assistance from the State, including installation of exclusion fencing. Sound and visual deterrents and taste and smell repellents have proven ineffective for reducing deer damage in most agricultural settings. Typically, agricultural fields are too large in area to deploy these strategies effectively. Therefore, to minimize damage to standing crops in Minnesota, localized population management techniques (including hunting and shooting permits) are used to decrease deer numbers where they are causing damage. If sport-hunting is utilized to the fullest extent and damage is still excessive, the agency may issue shooting permits to agricultural producers to harvest deer outside of hunting seasons. In addition, a pilot program was instituted in 2012 in southeastern Minnesota that allows the use of depredation permits allocated to specific properties where deer damage is occurring. Depredation permits allow increased limits for private sport-hunters to harvest additional antlerless deer during regular hunting seasons on ownerships where cooperative damage management is occurring. The MN DNR is committed to working with agricultural producers, and strategies to reduce deer damage will continue to be adapted to be effective with changing agricultural practices.

Habitats

Deer can have a major impact on the natural habitats they use. Deer feeding habits and their preferences for certain plants change the structure and composition of plant communities over time. Because they are large herbivores, white-tailed deer are highly effective at altering habitat due to their energy requirements and high reproductive potential. For example, high deer densities can cause drastic declines in the number of species of forest plants, the abundance of those species, and overall forest structure. Deer browsing may also reduce food sources, cover, and nesting sites for a variety of other wildlife species. Such alterations influence the number of species of birds, mammals, reptiles, and amphibians that can use habitats degraded by deer.

As the number of deer increase, plants that are preferentially consumed (e.g., orchids or white cedar) become less abundant and may disappear altogether. Other plants have developed a tolerance to high levels of deer browsing and those plants may out-compete more desirable plants for resources. For example, Pennsylvania sedge, which is not eaten by deer, may form dense mats on the forest floor inhibiting the growth of other plants. Likewise, garlic mustard, which is a non-native species introduced to Minnesota, is not preferred by deer. In this example, selective herbivory can contribute to garlic mustard prevalence at the expense of the native plant community.

Many of the tree species that have commercial value are also preferred forage for deer, which can result in revenue losses due to over-browsing. Deer browsing can kill trees or hinder their growth; both scenarios may result in significant economic losses. According to a 2011 MN DNR analysis, the state's forest products manufacturing and related sectors directly contributed $3 billion value-added to the Minnesota economy. As of 2012, over eight million acres (roughly half) of forests in Minnesota were certified for sustainable forest management through a voluntary third-party process. In 2005, a forest certification audit noted that deer browse in certain areas of the state was contributing to regeneration failures as well as possible loss of other plant species. Continued certification of the State's forest lands required demonstration by the MN DNR that deer population targets were consistent with ecosystem health goals.

While there is a natural assumption that deer damage to natural vegetation is related to high deer densities, in some situations damage can occur even where deer population size is not considered high. Foresters and land managers also have a variety of non-lethal techniques available to reduce deer damage such as adjusting forest management techniques to reduce damage (e.g., natural versus artificial regeneration), protecting seedlings (e.g. by retaining coarse woody debris, bud-capping or using tree shelters), and incorporating browsing risk into landscape-level planning.

Landscaping

In urban and suburban areas, deer damage landscape plants, ornamental trees, and gardens. There is a wide range of monetary estimates of deer damage to landscaping. This can be attributed to variations in the costs of landscaping in different residential neighborhoods and personal preferences of homeowners. In some neighborhoods, individual homeowners have reported deer damage to ornamental plants exceeding $10,000 annually. Homeowners can employ a variety of non-lethal techniques to reduce deer damage to landscaping including use of alternative plants less palatable to deer, taste and smell repellents, harassment, and fencing. At higher densities, only fencing secured to the ground and 10 feet in height will be effective at reducing deer damage. However, fencing can be expensive and unsightly. Management of deer in urban areas through harvest or permitted removal is critical to minimize risks to the public and to keep deer numbers in balance with remaining natural habitats.

Deer-vehicle collisions

Deer-vehicle collisions (DVCs) are a major concern throughout much of the United States, accounting for human injury and death, damage to vehicles, and waste of deer as a wildlife resource. Of the 2,096 collisions reported to the Minnesota Department of Public Safety (DPS), DVCs resulted in 8 fatalities and 302 reported injuries in Minnesota during 2013. It is challenging to get accurate estimates of DVCs; DPS notes that reported collisions have decreased in the past decade but “only due to the fact that many are not reported” (MN DPS 2014a). For the year ending June 2014, State Farm Insurance projected the occurrence of over 37,500 DVCs in Minnesota, ranking the state 8th in the country for likelihood of a DVC. State Farm Insurance reports that the average cost of damage of these incidents, nationwide, was $3,888.

Most states have attempted to minimize DVCs through a variety of techniques, including deer-crossing signs, modified speed limits, highway lighting, roadside fencing, over- or underpasses, habitat alteration, deer hazing, driver awareness programs, and reflective devices. However, most methods designed to reduce deer-vehicle collisions have been proven ineffective, including deer crossing signs. Proper deer management, improving visibility along roadways, managing the speed of vehicles, and educating residents about the seasonal risks of deer-vehicle collisions are all important. During May and early June when fawns are born, female deer are more mobile and are susceptible to deer-vehicle collisions. Likewise, in late October through November, bucks are actively chasing does for breeding purposes, and motorists should be especially alert.

Diseases and Health Concerns

Monitoring and management of deer diseases

The risks of deer-related disease for deer, people, other wildlife, and domestic animals are an important consideration in deer management. Since 2002, DNR has spent approximately $6 million on surveillance and management of CWD and over $4 million on the eradication of Bovine Tuberculosis (TB) in Minnesota’s deer.

Despite their close association with humans, white-tailed deer pose few direct disease risks to humans or livestock. Most diseases known to be found in deer occur naturally and are endemic to the U.S. Because of the significance of CWD and TB, and the human health implications of Lyme disease to deer management in Minnesota, summaries about these diseases are provided below. Some other diseases are a management concern for the MN DNR or are commonly mentioned diseases of interest to stakeholders. Detailed case histories of CWD and TB in Minnesota and descriptions of other diseases of concern are provided in Appendix 1.

Chronic Wasting Disease

Chronic Wasting Disease (CWD) is a fatal transmissible spongiform encephalopathy (TSE) caused by abnormal proteins and is known to infect members of the deer family including mule deer, white-tailed deer, elk, red deer, and moose. TSEs are diseases which are capable of being spread animal-to-animal (transmissible) and result in holes in brain tissue (spongiform) that lead to a progressive neurological condition resulting in death.

CWD is spread in free-ranging deer through contact with bodily secretions including saliva, feces, and urine and infected soils and plants in the environment. No treatment exists, and population management strategies for controlling CWD involve drastic deer population reductions in localized areas to reduce transmission of the disease. There is no evidence to date that CWD is a zoonotic disease, which may be transmitted to humans, but this possibility cannot be ruled out.

In 2002, the MN DNR began surveillance for CWD in free-ranging white-tailed deer after CWD was found in free-ranging white-tailed deer in Wisconsin in February 2002. Subsequently, CWD was found in a Minnesota domestic elk in August 2002. In November 2010, an archery hunter harvested a CWD-positive, free-ranging, adult female white-tailed deer near Pine Island two miles from an Olmsted County elk farm where CWD was found in 2009. Given this first discovery of CWD in Minnesota's wild deer herd, the agency implemented its CWD response plan in January 2011, which included establishment of a 306-square mile CWD Management Zone, designated DPA 602. Deer harvest was intensified in DPA 602 to reduce the risk of CWD transmission and testing of all adult deer harvested in the zone was mandatory. To date, the MN DNR has tested more than 40,000 deer, including more than 4,000 deer in the CWD management zone, and the single case near Pine Island was the only wild deer found to be CWD positive as of December 31, 2013. Because no CWD-positive deer were found during the 2013 deer season, the borders of the CWD Management Zone, DPA 602, were dissolved in 2014 and CWD-related restrictions were lifted.

The 2014 discovery of CWD in a wild deer earlier this year in Allamakee County, Iowa, triggered a surveillance effort in far southeastern Minnesota. The Iowa county borders Houston County in southeastern Minnesota. During the Minnesota firearms deer season, hunters voluntarily brought deer to be sampled for CWD at eight registration stations throughout deer permit areas 348 and 349. In total, the DNR sampled 411 deer within the two permit areas. No chronic wasting disease (CWD) was detected.

The MN DNR will continue to be proactive in surveillance for CWD in wild deer. If CWD-positive deer are detected in the future, the CWD Response Plan will be implemented in localized areas as necessary to minimize the risk of disease transmission and spread. The CWD response plan is on the DNR website and can be found at the following address, http://files.dnr.state.mn.us/fish_wildlife/wildlife/disease/cwd/cwdresponseplan.pdf.

Bovine Tuberculosis

Bovine Tuberculosis (TB) is caused by bacteria of the species *Mycobacterium bovis*. While domestic in origin, many animal species can harbor TB including non-cattle domestic animals, wildlife, and humans. TB was once common in cattle and swine in the U.S. until a cooperative effort started in 1917 by federal and state governments and the livestock industry made significant progress toward eradicating the disease. TB is still sporadically detected in U.S. cattle herds, and its discovery imposes costly trade restrictions, testing, and culling of suspect herds. Prior to the discovery of widespread infection of TB in wild white-tailed deer in northern Michigan, cases of TB-infected white-tailed deer were rare. TB is spread through nasal or oral discharges, and there is evidence that the disease may be transmitted through consumption of contaminated feeds by cattle and deer. Once established in a wildlife population, TB can be difficult to control and eradicate. TB progressively causes animals to become emaciated, debilitated, and severe respiratory infection causes labored breathing.

TB was detected on a northwest Minnesota cattle farm in 2005. The disease was subsequently found in a total of 12 cattle operations and 27 individual free-ranging white-tailed deer. Testing showed that both deer and cattle had the same strain of TB, which was consistent with a strain of TB found in cattle in the southwestern U.S. and Mexico. The Minnesota Board of Animal Health led efforts to eradicate the disease in Minnesota's cattle and the MN DNR initiated a response plan that included intensified deer harvest and testing in the area. From 2005 – 2012, the agency tested a total of 10,667 white-tailed deer for TB. No new infections have been detected in either cattle or deer since 2009. Minnesota cattle producers regained TB-free accreditation in 2011. While the MN DNR is unable to declare the local deer herd entirely disease-free, the surveillance efforts were aimed at TB detection of prevalence more than 0.5% with 99% confidence. These efforts provided solid evidence that TB is no longer within these detectable levels in the deer population. Consequently, efforts to monitor for TB in the state have been suspended.

Lyme disease and tick-borne illnesses

Lyme disease is the most commonly reported vector-borne illness of humans in the U.S. According to the Minnesota Department of Health, the number of Lyme disease cases has increased dramatically since the 1990s. The disease is caused by spirochete bacteria and is transmitted to people via the black-legged tick, which is also known as the deer tick. In

Minnesota, black-legged ticks also transmit other tick-related illnesses including babesiosis, human anaplasmosis, human ehrlichiosis, and a strain of Powassan virus.

Lyme disease is most commonly transmitted to humans when the infected ticks are nymphs during the spring, which are carried by a variety of small mammals and ground-dwelling birds. White-tailed deer are the primary reservoir hosts of the adult black-legged tick and the exact relationship between deer densities and Lyme disease infection rates is not clearly understood. To date, reducing deer numbers has been largely ineffective in preventing Lyme disease because deer are not the only reservoir for the disease and do not transmit the disease directly to humans or other deer. However, recent work in Groton, Connecticut, identified a relationship between reduced deer densities and reduced incidence of Lyme disease in the residential community.

Managing Deer Populations in Minnesota

Scales of deer management

Deer population management in Minnesota occurs at various scales. Most harvest-related laws, rules, and regulations are applied statewide. The MN DNR also reports annual harvests and population estimates at the statewide level. However, few management decisions are made at this broad level due to differences in land use, climate, topography, human population and hunter densities, and habitat differences throughout the state.

Differences in deer populations and management can also be interpreted and understood according to ecological landscape features. The State of Minnesota uses an Ecological Classification System (ECS) that separates the state into progressively smaller and similar landscape units based upon biotic and environmental factors (e.g., climate, soils, and vegetation). For example, Minnesota's forest deer population model closely reflects the Laurentian Mixed Forest at the ECS province level (Fig. 8). Habitat management activities, which influence deer densities, are implemented on a smaller scale based on subsection plans and more local landscape features.

Finally, deer population management decisions and strategies are implemented at regional and local scales that reflect both ecological and administrative boundaries. For example, the length of Minnesota's firearm deer hunting season varies statewide by zone (Figure 9) as a result of factors including differences in deer vulnerability and habitat, hunting pressure, and land ownership. The finest scale of deer population management occurs at the DPA level. In general, DPAs are the finest scale at which populations can be estimated and monitored (Figure 10). At the DPA level, the agency primarily uses harvest data and population models to estimate and track changes in white-tailed deer abundance with a focus on estimating whether populations are increasing, stable, or decreasing. Subsequently, the MN DNR develops harvest recommendations given management goals, regulatory options, and the likely deer population response over the next few years. Consequently, either-sex permit quotas are allocated by DPA.

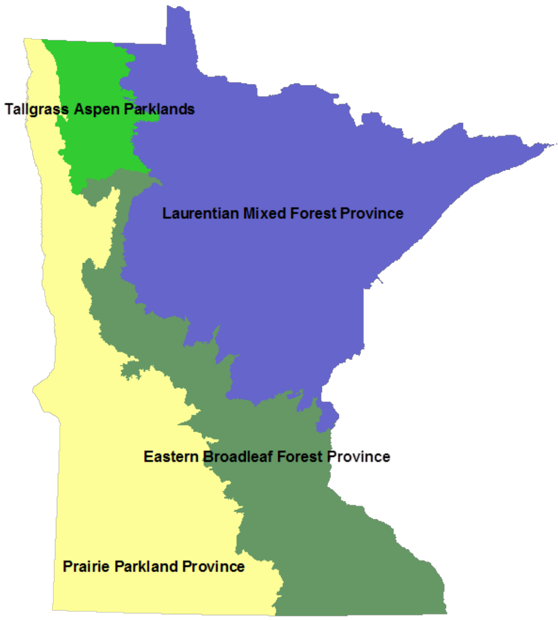


Figure 8. Ecological provinces in Minnesota

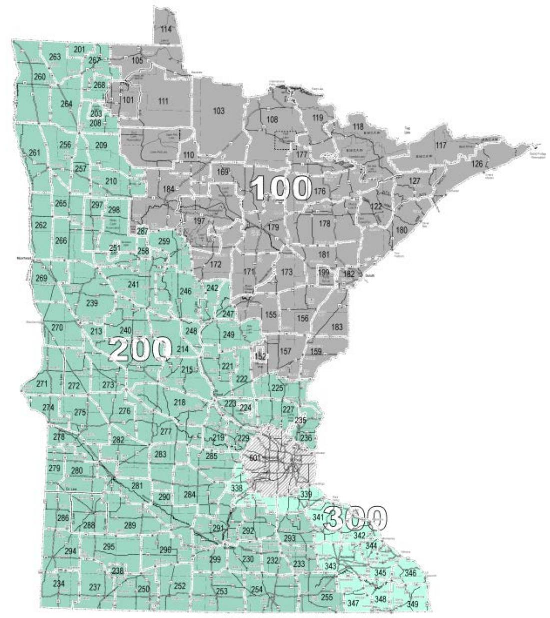


Figure 9. Deer Season Zone Map, 2014. Dates for the firearm season differ by deer management zone. In 2014, the season was held November 8-23 (100-series) and Nov. 8-16 (200- and 300-series). The 300-series also has a late (3B) season which ran from Nov. 22-30.

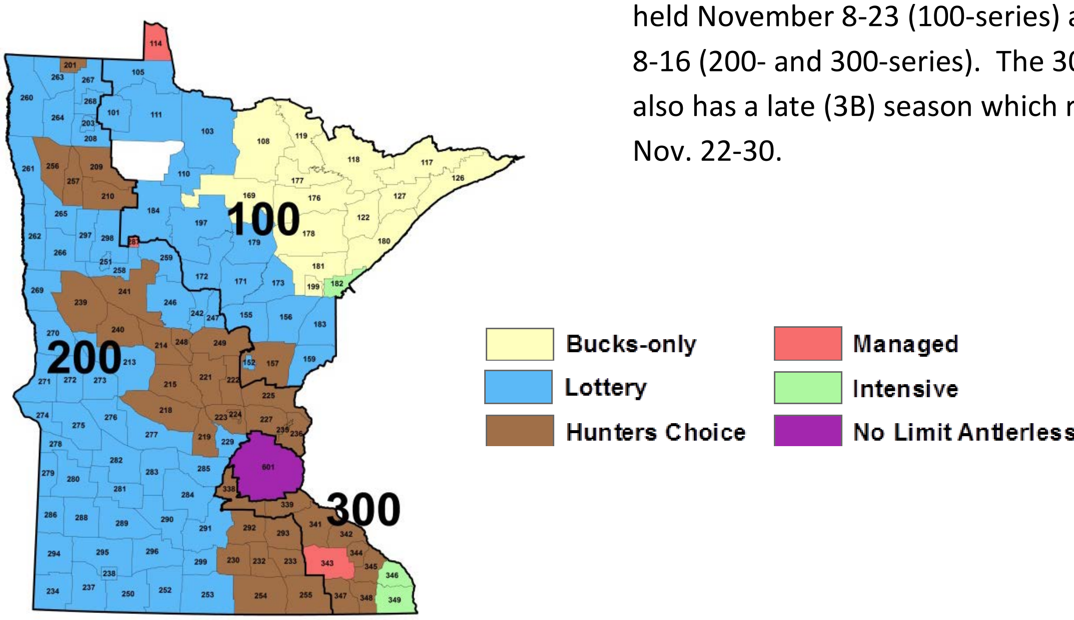


Figure 10. Minnesota deer management zones, permit areas and harvest management Strategies, 2014

Managing deer harvest

Hunting is the primary method used to manage deer populations in Minnesota. Population goals for each DPA were developed through a stakeholder-based process administered by the MN DNR between 2005 – 2007, 2012 and 2014. To manage deer densities within target levels, area wildlife managers, the big game program leader, and wildlife researchers consult on an annual basis to determine the management designation and the number of either-sex permits offered for each DPA. The information considered in this process includes annual harvest statistics including hunter success rates, population trend data, and recommendations from the deer population goal-setting process as well as hunter comments and deer damage complaints. When deer population goals are revised for DPAs, management strategies are adapted to move the population toward new goal levels.

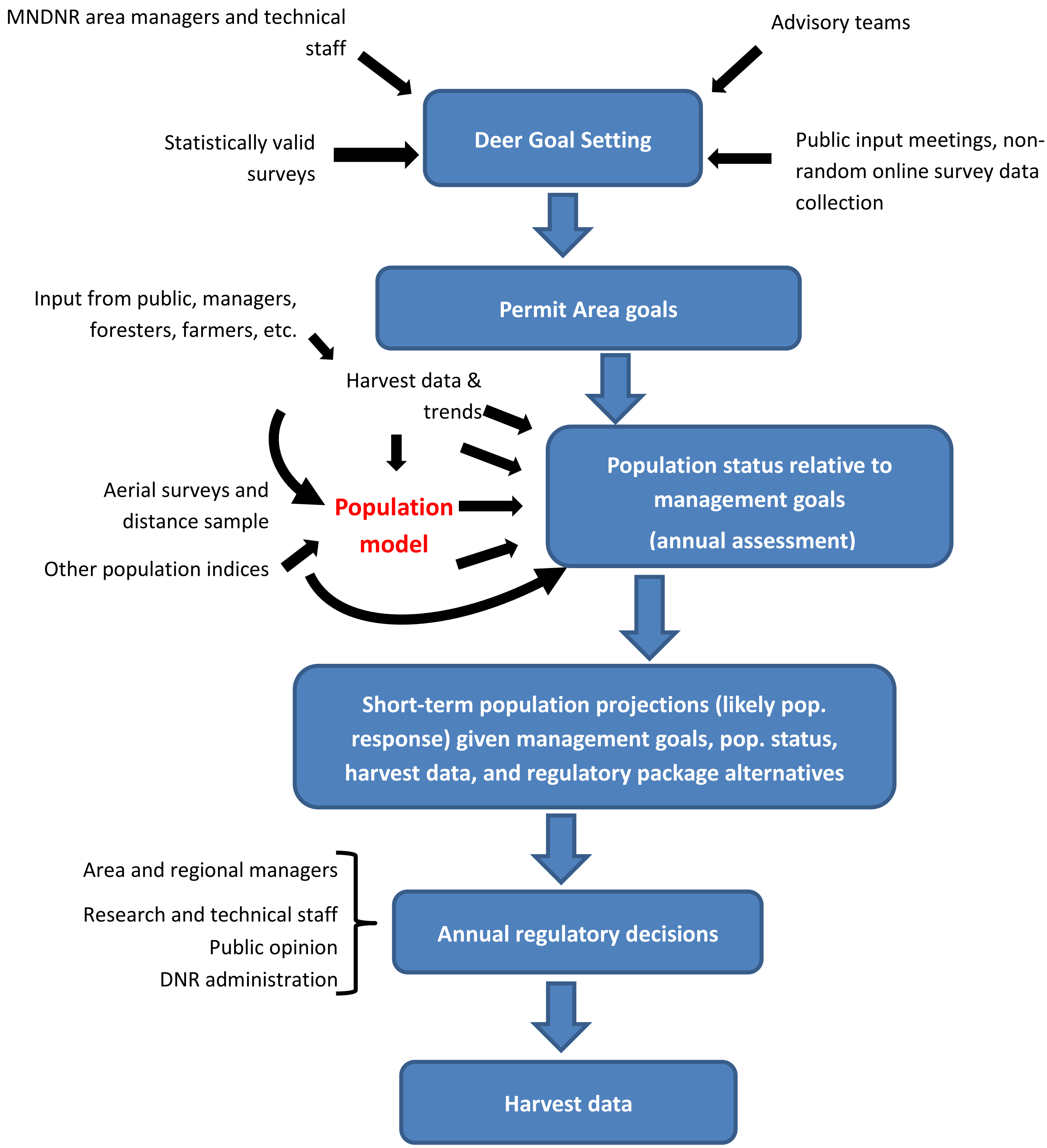
Monitoring Population Trends

The MN DNR primarily uses harvest data and a population model to estimate and track trends in white-tailed deer abundance. Research staff members conduct population modeling to understand how deer populations change over time, to predict population sizes, and to explore the impacts of various hunting regulations on deer populations. Modeling is just one of several tools the MN DNR uses to help make decisions about deer seasons and regulatory packages (Figure 11). The deer population model uses harvest data and estimates of other vital statistics (e.g., deer reproductive rates and non-hunting mortality rates) to tell us if a population is likely to be increasing, decreasing, or staying the same in a deer permit area.

No population model can estimate or predict with 100% certainty the exact number of deer on the landscape at any given point in time. It is not possible due to uncertainty associated with vital rates (e.g., annual productivity and survival). Vital rates vary naturally across space and time, and there is always some sampling uncertainty associated with estimates collected in a particular location and time period. While there are countless examples – winter mortality of deer is a good one. We cannot know exactly how many deer die in a particular area during a severe winter, but we have reasonably good estimates of how, on average, mortality rates vary as a function of winter severity.

Two accounting-type models (called a deterministic model) were developed 25 years ago for monitoring deer populations in Minnesota. Accounting-type models simply keep track of additions (births) and deletions (mortality sources) that occur during the annual population cycle. Harvest is an important source of mortality in deer in many areas of MN; thus, reported deer harvest is a very important piece of information in our population models. One model was tailored for the forested region where accounting for winter mortality is particularly important. The other model was developed for the farmland region where high hunting mortality and high productivity occurs.

Figure 11. Flowchart of the MN DNR deer management decision-making process showing where the population model fits within the larger context of management and regulatory decisions.



In 2014, the MN DNR modified the accounting models to provide estimates of a biologically reasonable range of deer density values (e.g., 10-14 deer per square mile) in addition to population trends. Again, no model can say with 100% certainty exactly how many deer are out there, but the model can help describe the range of values supported by the harvest data and what we know about vital rates and how they are likely to vary over space and time. The 'new' model we developed is called a stochastic model. Simply, *stochastic* means there is some element of uncertainty incorporated into the model. For this model, we apply research results to define the lower and upper bounds of uncertainty for each input value of the model (e.g., winter survival of adults). We then run multiple cycles of the model to create a range of potential deer densities (and population trends) that are reasonable for an area given the reported deer harvest history.

Vital statistics used in the models, including rates of reproduction and non-hunting mortality, are obtained through research studies (e.g., the 15-year adult doe survival study) or from the primary scientific literature. Harvest data are obtained through mandatory hunter-registered deer, which are reported as an adult male, adult female, fawn male, or fawn female; these data are tallied for each DPA in Minnesota. The population models estimate average deer density within DPAs annually.

The MN DNR also evaluates the model output based on periodic, independent deer population estimates and population reconstruction using harvest data. Where habitat and snow conditions allow, aerial surveys by helicopter are used in the forest-transition zone to estimate deer numbers for comparison with model output; distance sampling is conducted in the farmland zone. Harvest data, available annually, are used to statistically recalibrate models statewide. With periodic recalibration, simulation modeling has been demonstrated to perform as well as annual surveys and is much more cost-effective. Additional information on deer population monitoring methods is available on the deer management webpage (http://www.dnr.state.mn.us/mammals/deer/mgmt.html).

Goals and goal setting process

Current Population Goals

Deer population goals were established formally for the first time over a 3-year period (2005 – 2007) throughout Minnesota. Previous to that effort, deer population goals were established at the local level by area wildlife managers; similar information was considered and public input, while informal, was incorporated into decisions. Beginning in 2005, the goal-setting process was specifically designed to enable public participation from a broad spectrum of interested stakeholders in a consistent manner, statewide.

DPAs were consolidated into 15 blocks loosely aligned along the ecological classification system. A round-table, goal-setting process was advertised by the MN DNR; stakeholder teams for each block were formed using self-nominations submitted by interested individuals or organizations as well as input from local wildlife staff. For each block, a group of up to 20 individuals was selected based on their ability to best represent the local constituency and issues related to deer in their area. Teams met twice over a one-month period and provided guidance to DNR on deer population direction. DNR then solicited public input via an online presentation and survey. Final population recommendations were adjusted somewhat to reflect public comment, when necessary, and approved by the MN DNR Commissioner's office at the end of each process. The final goals for each permit area were articulated as a desired population trend (i.e., increase, decrease, remain the same) and the associated percent change in deer densities.

In total, nearly one-half of the permit areas were slated for a population reduction (Table 4). The DPAs where population reductions were recommended were in northern, central, and southeast Minnesota. Conversely, recommendations were made to increase populations in 40% of permit areas, which were mostly associated with the farmland regions of western, southern, and southwest Minnesota.

Table 4. Recommendations for deer population direction from the goal setting process, 2005-2007.

Recommendation	N	Percent	Percent of area with goals in this direction
Inc 50%	8	6%	
Inc 25%	36	29%	40%
Inc 10%	7	6%	
Stabilize	15	12%	12%
Dec 10%	14	11%	
Dec 25%	40	32%	48%
Dec 33%	4	3%	
Dec 50%	2	2%	
Total	126		

Current Status

Several significant changes to deer management have occurred since the completion of the first public goal setting effort. Specifically,

- The 4A (2 day) and 4B (4 day) seasons were eliminated and the permit areas were placed into a 9-day continuous 2A season structure.
- Bovine TB was discovered in northwest Minnesota and a new permit area was created (DPA 101) for disease management. At the same time, northwest permit areas were also realigned along habitat lines.
- Numerous forest permit areas in Zone 1 and Zone 2 were realigned along public/private land boundaries and to separate the moose range.
- A moose management plan established a maximum deer density (10 deer mi^2) for deer permit areas in the primary moose range (NE Minnesota).
- CWD was discovered in a wild deer near Pine Island, Minnesota, and a new permit area was created (DPA 602) for disease management in the Southeast. After 3 years of disease testing and disease response management, DPA 602 was dissolved in 2014.
- Population goals were revisited in 2012 and 2014 for southwestern and southeastern Minnesota, respectively.

Prior to the severe winter of 2013-2014, nearly 80% of permit areas were estimated to be within target density range, indicating that the population goal (i.e. desired population trend to increase, decrease, or remain the same) had been achieved. Based on 2014 pre-fawn density estimates, slightly over 60% of deer areas were estimated last spring to be within the range indicated by the goal (33% below, 7% above). The majority of areas below previously established goals are in northeastern Minnesota.

The current goal-setting public process (2014 – 2016) aims to improve upon methods used in 2005 – 2007. The process emphasizes collecting survey data from stakeholders (designed to provide results statistically representative of stakeholder groups) as well as public input (mail surveys, online questionnaires, public meetings, written comment) prior to convening stakeholder advisory teams selected to represent the diversity of perspectives related to deer management. Similar to the last time, stakeholder teams will provide DNR direction regarding deer population goals in each deer permit area.

Deer Population and Harvest Trends[5]

Statewide population trends

Deer population increases from the 1970s through the 1990s were influenced by a management strategy designed to build the deer population and a trend toward milder winter weather. After the severe winters of 1996 and 1997, deer population numbers increased to record levels during the early 2000s; again due to relatively mild winters and low antlerless harvests. Following deer population goal setting during 2005-2007, deer densities in most DPAs were intentionally reduced through liberal harvest management strategies.

The impact winter weather has on deer population numbers is most apparent in Minnesota's northern forested region. About half of Minnesota's deer population is in the forested region so the statewide population, and associated harvest opportunity, declines noticeably when the forested region's population declines.

Deer populations are relatively more stable in Minnesota's farmland region. Winter weather has less impact on farmland deer because these deer are in better physical condition when winter begins due to a virtually unlimited food bank. Further, most of Minnesota's farmland is located in southern Minnesota where winter weather is comparatively mild. Management of deer populations in the farmland region is primarily limited by winter habitat availability and conflicts with agricultural producers.

Some of the highest deer densities in the state can be found In Minnesota's transition zone, where farmland shifts to forest. In many of these habitats, abundant food and cover, combined with relatively mild weather, allow deer to be managed at greater numbers compared to other regions in the state.

In general, after population goals were last established, the deer population decreased in the forested portion of the state (where most permit areas were slated for reductions) but remained fairly stable in the farmland (where most permit areas were slated for increases).

Recognizing the heightened public interest in deer population estimates, versus trends, the MN DNR developed a stochastic population model in 2014 to better communicate the uncertainty associated with model estimates. Data on population trends within the goal block will be presented in the packet addendum. Historic population trends, based on the deterministic model, may be reviewed within the DNR population model reports. The most recent population report is available online or by request (Grund 2014).

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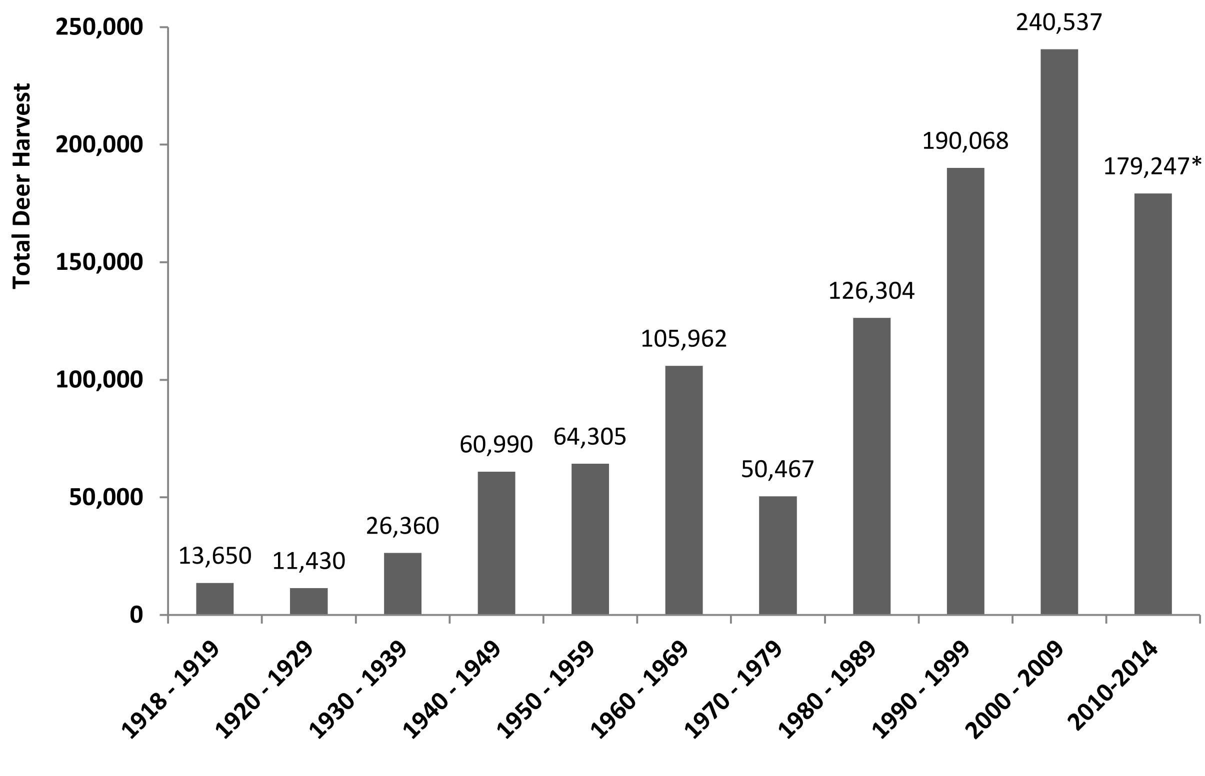
[5] Final 2014 harvest data and 2015 population estimates were not available at the time of this report. Harvest and population data for goal block permit areas will be provided to teams in an addendum to this informational packet.

Statewide harvest trends

Prior to the last goal setting effort, the statewide deer harvest was on a generally increasing trend (Figure 5, page 12; Figure 12). Beginning in the 2003 deer season, DNR staff recognized that populations were at historic size and that, although goal setting had not formally begun, management changes needed to be made to lower the densities across much of Minnesota. Consequently, several deer management changes were instituted that provided for increased recreational opportunity and more liberal bag limits. As a consequence of this purposeful population reduction, Minnesota deer hunters harvested numbers of deer during the period 2003 – 2006 that would not be sustainable over the long-term (Figure 12). High antlerless harvest rates, along with liberal bag limits contributed to high harvest numbers and a decline in the statewide deer population (Figure 13). While antlerless harvest levels have changed considerably over the past 15 years, buck harvest has been relatively more stable.

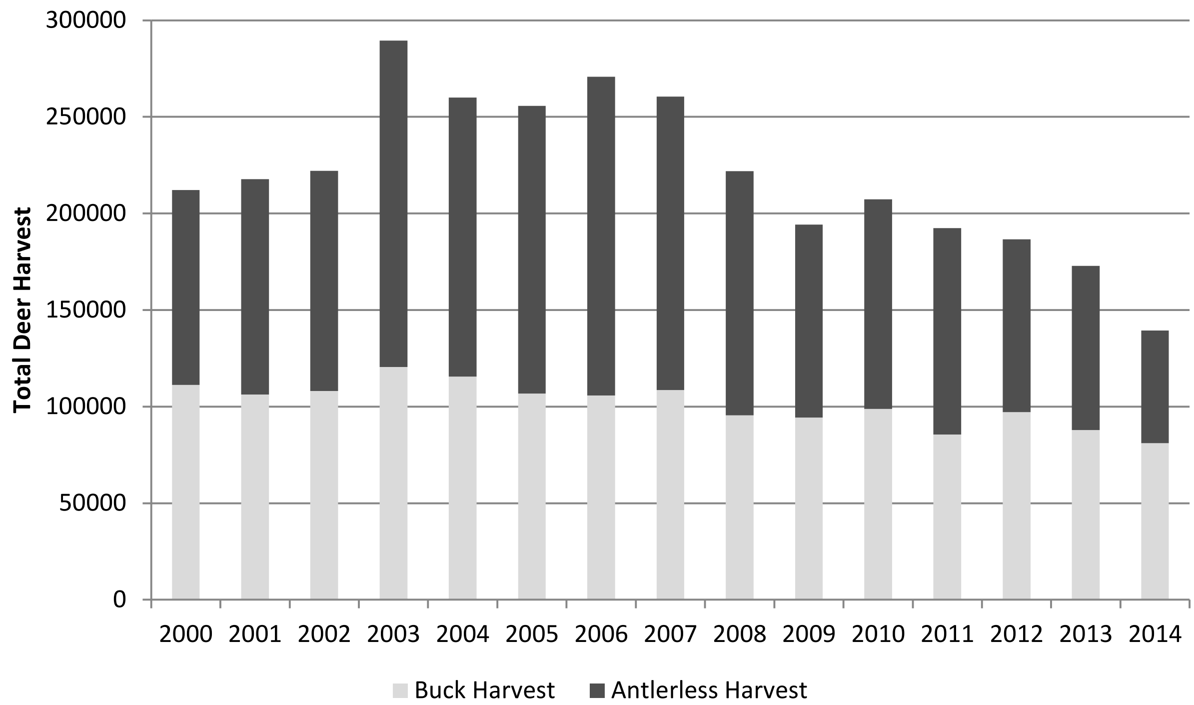
Even with the low 2014 harvest, at just under 140,000 deer, the average harvest this decade is still higher than any pre-1990s. The last time harvest was close to this level was 1997 when roughly 144,000 deer were harvested; three years later the statewide harvest was over 210,000 deer.

Figure 12. Minnesota Average Annual Deer Harvest, by decade.



** Note: Harvest data for 2014 are preliminary.*

Figure 13. Statewide Deer Harvest, 2000-2014.



East Central Uplands population and harvest trends

Population and harvest trends specific to this goal block will be provided in the packet addendum.

Hunter and Landowner Surveys

The MN DNR periodically conducts stakeholder surveys to collect information about public desires and opinions regarding specific natural resource management issues. Survey recipients are selected randomly and provide a statistically representative sample of stakeholder opinions. Thus, these surveys differ from annual public input opportunities which may include some bias according to self-selection of interested parties. In 2014, both hunters and landowners in this goal setting block were surveyed; the resulting information provides a basis for the 2015 deer population goal setting process. Hunters and private landowners were surveyed using a mixed mode design that included two waves of letters requesting survey completion online; the third wave was mailed using a self-administered mail back questionnaire. Full results of the surveys are reported in a separate document and will be posted to the deer management webpage (www.mndnr.gov/deer).

Demographics

Hunters

Nearly all respondents (98%) indicated they hunted during the 2013 firearm deer season. Overall 25% indicated they hunted deer during the archery season and 11% hunted muzzleloader. Overall, 89% of respondents were male and the average age was 48.7.

Landowners

In total, 65% of respondents indicated they hunted deer in Minnesota during the 2013 deer season. By stratum, a lower proportion of respondents who owned 2 – 20 acres indicated they hunted (40%), as compared to other landowners (20-79.9: 65%; 80-319.9: 69%; 320+: 72%). In total, 87% of respondents were male and the average age was 60.5.

Perceptions about deer populations

Table 5 provides a brief summary regarding general hunter and landowner perceptions about deer numbers as well as desires for deer population management. Considerably more detail is available in the full report, including information on individual permit areas, priority issues to consider when establishing deer population goals, hunter satisfaction, and perceived damage from deer browse impacts.

Table 5. Landowner and hunter deer population perceptions and desires, East Central Uplands goal setting block 2014.

Perception of deer population around property (or area hunted) and surrounding areas			
	Too high	**About right**	**Too low**
Hunters	2%	28%	68%
Landowners	9%	42%	50%
Hunting Landowners	5%	36%	58%
Non-hunting Landowners	15%	52%	33%

Desired direction for deer population management							
	Decrease 50%	**Decrease 25%**	**Decrease 10%**	**No change**	**Increase 10%**	**Increase 25%**	**Increase 50%**
Hunters	1%	2%	3%	17%	23%	32%	22%
Landowners	3%	5%	5%	29%	21%	23%	14%
Hunting Landowners	1%	3%	5%	22%	22%	27%	19%
Non-hunting Landowners	6%	8%	5%	40%	20%	15%	6%

Select Bibliography

Alverson, W. S., D. M. Waller, and S. L. Solheim. 1988. Forests too edge: edge effects in northern Wisconsin. *Conservation Biology.* 2:348-358.

Augustine, D. J. and P. A. Jordan. 1998. Predictors of white-tailed deer grazing intensity in fragmented deciduous forests. *Journal of Wildlife Management.* 62:1076-1085.

Behrend, D. F., G. F. Mattfeld, W. C. Tierson and J. E. Wiley III. 1970. Deer density control for comprehensive forest management. *Journal of Forestry.* 68:695-700.

Berner. A. H., & D. E. Simon (Compilers). 1993. The white-tailed deer in Minnesota's farmland: The 1960's. *Minnesota Wildlife Report*, 9.

Brown, S.E. and G. R. Parker. 1997. Impact of white-tailed deer on forest communities within Brown County State Park, Indiana. *Proceedings of the Indiana Academy of Sciences*. 106:39-51.

Carstensen, M., G. D. DelGiudice, B. A. Sampson, and D. W. Kuehn. 2009. Survival, birth characteristics, and cause-specific mortality of white-tailed deer neonates. *Journal of Wildlife Management*. 73:175-183.

Chronic Wasting Disease Alliance. 2013. Chronic Wasting Disease Alliance homepage. <http://www.cwd-info.org/>. Accessed 2 December 2013.

D'Angelo, G. J., R. J. Warren, K. V. Miller, and G. R. Gallagher. 2004. *Evaluation of strategies designed to reduce deer-vehicle collisions: an annotated bibliography.* <http://www.dot.ga.gov/doingbusiness/research/Documents/reports/Deer_Review.pdf>. Accessed 2 December 2013.

Davidson, W. R., and V. F. Nettles. 1997. *Field manual of wildlife diseases in the southeastern United States.* Southeastern Cooperative Wildlife Disease Study, Athens, Georgia. 417 pp.

deCalesta, D. S. 1994. Effects of white-tailed deer on songbirds within managed forests in Pennsylvania. *Journal of Wildlife Management.* 58:711-718.

deCalesta, D. S. and S. L. Stout. 1997. Relative deer density and sustainability: a conceptual framework for integrating deer management with ecosystem management. *Wildlife Society Bull.* 25: 252-258.

Deckard, D. and Skurla, J. 2011. *Economic contribution of Minnesota's Forest Products Industry.* Minnesota Department of Natural Resources. 18 pages.

Fisichelli, N. A., L. E. Frelich, P. B. Reich, and N. Eisenhauer. 2013. Linking direct and indirect pathways mediating earthworms, deer, and understory composition in Great Lakes forests. *Biological Invasions.* 15:1057-1066.

Grovenburg, T. W., C. C. Swanson, R. W. Klaver, T. J. Brinkman, B. M. Burris, C. S. DePerno, and J. A. Jenks. 2011. Survival of white-tailed deer neonates in Minnesota and South Dakota. *Journal of Wildlife Management*. 75:213-220.

Grund, M. 2014. Monitoring Population Trends of White-tailed Deer in Minnesota. Pages 18-21 *in: Farmland Wildlife Populations. A Minnesota DNR research report*. Minnesota DNR, Madelia, Minnesota. http://files.dnr.state.mn.us/publications/wildlife/population2014/1-farmland-wildlife.pdf Accessed 13 January 2015.

Grund, M. D., and A. Woolf. 2004. Development and evaluation of an accounting model for estimating deer population sizes. *Ecological Modeling.* 180:345-357.

Hewitt, D. G., editor. 2011. *Biology and management of white-tailed deer.* CRC Press, Boca Raton, Florida, USA.

Jordan, R. A., T. L. Schulze, and M. B. Jahn. 2007. Effects of reduced deer density on the abundance of Ixodes scapularis (Acari:Ixodidae) and Lyme Disease in a northern New Jersey endemic area. *Journal of Medical Entomology*. 44:752–757.

Kilpatrick, H. J., A. M. Labonte and K. C. Stafford III. 2014. The relationship between deer density, tick abundance, and human cases of Lyme disease in a residential community. *Journal of Medical Entomology*, 51:777-784.

McCullough, D. R. 1997. Irruptive behavior in ungulates. Pages 69-93 *in* W.J. McShea, H.B. Underwood, and J. H. Rappole, eds., *The Science of Overabundance: Deer Ecology and Population Management.* Smithsonian Institution Press, Washington, D.C.

McDonald, J. E., D. E. Clark, and W. A. Woytek. 2006. Reduction and maintenance of a white–tailed deer herd in central Massachusetts. *Journal of Wildlife Management.* 71:1585–1593.

Minnesota Department of Health. 2013. *Lyme disease.* <http://www.health.state.mn.us/divs/idepc/diseases/lyme/index.html>. Accessed 2 December 2013.

Minnesota Department of Natural Resources. 2013. Section of Wildlife - deer hunting homepage. http://www.dnr.state.mn.us/hunting/deer/index.html. Accessed 2 December 2013.

Minnesota Department of Public Safety. 2014a. Deer Facts/Background and Talking Points. https://dps.mn.gov/divisions/ots/law-enforcement/Documents/talking-points-2011-2013-deer.docx Accessed 3 January 2015.

Minnesota Department of Public Safety. 2014b. Minnesota Motor Vehicle Crash Facts 2013. A report by the Office of Traffic Safety. 123 pages. St. Paul, MN. https://dps.mn.gov/divisions/ots/reports-statistics/Documents/2013-crash-facts.pdf. Accessed 3 January 2015.

Pradhanga, A., Davenport, M. & Cornicelli, L. 2013. *2013 survey of deer management on private lands in southeast Minnesota.* University of Minnesota, Minnesota Cooperative Fish and Wildlife Research Unit, Department of Fisheries, Wildlife, and Conservation Biology and Department of Forest Resources.

Porter, W. F., N. E. Mathews, H. B. Underwood, R. W. Sage, and D. F. Behrend. 1991. Social organization in deer: implications for localized management. *Environmental Management.* 15:809-814.

Rand, P. W., C. Lubelczyk, G. R. Lavigne, S. Elias, M. S. Holman, E. H. Lacombe, and R. P. Smith. 2003. Deer density and the abundance of Ixodes scapularis (Acari:Ixodidae). *Journal of Medical Entomology.* 40:179–184.

Rand, P. W., C. Lubelczyk, M. S. Holman, E. H. Lacombe, and R. P. Smith. 2004. Abundance of Ixodes scapularis (Acari:Ixodidae) after the complete removal of deer from an isolated offshore island endemic for Lyme Disease. *Journal of Medical Entomology*. 41:779–784.

Romin, L. A., and J. A. Bissonette. 1996. Deer-vehicle collisions: status of state monitoring activities and mitigation efforts. *Wildlife Society Bulletin.* 24:276-283.

Russell, F. L. and N. L. Fowler. 1999. Rarity of oak saplings in savannas and woodlands of the eastern Edwards Plateau, TX. *Southwestern Naturalist.* 44:31-41.

Schroeder, S. & Cornicelli, L. 2013. *Surveys of Hunters Participating in the 2012 3A and 3B Deer Seasons.* University of Minnesota, Minnesota Cooperative Fish and Wildlife Research Unit, Department of Fisheries, Wildlife, and Conservation Biology.

State Farm Insurance. 2013. State Farm homepage, news. <https://www.statefarm.com/retirees/news/top-states-for-deer-collisions>. Accessed 2 December 2013.

Tilghman, N. G. 1989. Impacts of white-tailed deer on forest regeneration in northwestern Pennsylvania. *Journal of Wildlife Management.* 53:524-532.

University of Minnesota Extension. 2013. University of Minnesota Extension homepage. <http://www1.extension.umn.edu/>. Accessed 2 December 2013.

Urbanek, R. E., C. K. Nielsen, M. A. Davenport, and B. D. Woodson. 2013. Determinants of public perceptions of suburban deer density. *Human Dimensions of Wildlife.* 18:82-96.

U.S. Department of Agriculture. 2014. National Agricultural Statistics Service, Census of Agriculture, Washington, D.C., Table 8.

U.S. Fish and Wildlife Service. 2013. *2011 survey of fishing, hunting, and wildlife-associated recreation.* U.S. Department of the Interior, U.S. Fish and Wildlife Service, U.S. Department of Commerce, and U.S. Census Bureau, Washington, D.C., USA.

Warren, R. J. 1997. Deer overabundance-special issue. *Wildlife Society Bulletin.* 25.

White, M.A. 2012. Long-term effects of deer browsing: composition, structure, and productivity in a northeastern Minnesota old-growth forest. *Forest Ecology and Management.* 269:222-228.

Woolf, A., and J. D. Harder. 1979. Population dynamics of a captive white-tailed deer herd with emphasis on reproduction and mortality. *Wildlife Monographs.* 67.

Appendix A: Diseases and Health Concerns

Chronic Wasting Disease

Chronic Wasting Disease (CWD) is a fatal transmissible spongiform encephalopathy (TSE) known to infect members of the deer family including mule deer, white-tailed deer, elk, red deer, and moose. TSEs are diseases which are capable of being spread animal-to-animal (transmissible) and result in holes in brain tissue (spongiform) that lead to a progressive neurological condition resulting in death. CWD-infected animals are most commonly adults, but yearling deer may also be infected. As the disease progresses, CWD-infected animals lose weight as they eat less food over time and their body condition worsens. The behavior of infected deer changes, they interact less with other animals, become lethargic, have a tendency to keep their head lowered, have blank facial expressions, and may repetitively walk in patterns. They may drink, urinate and salivate excessively. Deer with other illnesses that occur more commonly (e.g., bacterial infections, hemorrhagic disease) may have similar symptoms.

CWD is the only TSE known to persist in free-ranging wildlife populations and the cause of the disease is believed to be abnormal proteins, called prions, which accumulate in brain tissue. CWD is spread in free-ranging deer through contact with bodily secretions including saliva, feces, and urine and infected soils and plants in the environment. The disease was first found in 1967 in a captive mule deer in the Colorado Division of Wildlife's Foothills Wildlife Research Facility in Fort Collins, Colorado. CWD is known to be endemic to parts of Colorado and Wyoming, where it has persisted more than 30 years in free-ranging deer. No treatment exists, and population management strategies for controlling CWD involve drastic deer population reductions in localized areas to reduce transmission of the disease. There is no evidence to date that CWD is a zoonotic disease, which may be transmitted to humans, but this possibility cannot be ruled out.

In 2002, the MN DNR began surveillance for CWD in free-ranging white-tailed deer after CWD was found in free-ranging white-tailed deer in Wisconsin in 2001. CWD was first detected in Minnesota in 2002 in a captive elk farm near Aitkin. The entire herd was subsequently depopulated to reduce the risk of the disease spreading to free-ranging deer and no additional CWD-positive animals were found. A second farmed elk, which was part of a herd exposed to the CWD-positive Aitkin elk, tested positive after it was quarantined and killed for testing on a Stearns County farm in January 2003.

In 2006, a captive white-tailed deer in Lac qui Parle County was diagnosed as CWD positive. The deer and elk in that facility were depopulated and no additional CWD-positive animals were found. In 2009, a herd of more than 600 captive elk in Olmsted County was found to be infected with CWD, all animals in the herd were euthanized, and four elk tested positive for CWD.

In November 2010, an archery hunter harvested a CWD-positive, free-ranging, adult female white-tailed deer 2 miles from the aforementioned Olmsted County elk farm near Pine Island. Given this first discovery of CWD in Minnesota's wild deer herd, the MN DNR implemented its CWD response plan in January 2011, which included: 1) establishment of a 306-square mile CWD Management Zone, DPA 602; 2) monitoring of deer densities via aerial surveys in DPA 602; 3) reduction of deer densities within the zone through maximized hunting opportunities and government culling to reduce the risk of CWD transmission and to provide samples for additional disease surveillance; 4) a ban on deer feeding and mineral attractants in the 4-county area surrounding the harvest location of the CWD-positive deer; 5) mandatory registration of all deer harvested in the zone at an official CWD registration station; 6) submission of a sample for CWD testing from all adult deer harvested in the zone; and 6) the requirement that all deer that are tested for CWD must remain in the zone until a negative test result is reported.

To date, the MN DNR has tested more than 40,000 deer, including more than 4,000 deer in the CWD management zone, and the single case near Pine Island was the only wild deer found to be CWD positive as of December 31, 2013. Because no CWD-positive deer were found during the 2013 deer season, the borders of the CWD Management Zone, DPA 602, were dissolved and CWD-related restrictions were lifted.

Due to the discovery of CWD near Shell Lake, Wisconsin in 2011, the MN DNR conducted CWD surveillance during the fall 2012 firearm deer season in several DPAs along the border with Wisconsin. Of nearly 1,100 samples taken, no deer were positive for CWD and testing efforts were suspended in the area.

In 2012, a captive European red deer was found to be infected with CWD in a herd of approximately 400 animals in Ramsey County. This marked the first time CWD was discovered in this species. Also in 2012, USDA discontinued funding which was previously available to depopulate CWD-infected captive herds. Thus the Ramsey County herd was quarantined with no future plan in place to deal with the infection. Herd owners voluntarily slaughtered approximately half the herd through 2013 and the entire herd was depopulated in 2014. In 2012, CWD testing of wild white-tailed deer in the north metro area was initiated by the MN DNR as a precautionary measure in response to the discovery of the infected captive red deer. Of the 347 samples collected, no deer were positive for CWD.

The 2014 discovery of CWD in a wild deer in Allamakee County, Iowa, triggered a surveillance effort in far southeastern Minnesota. The Iowa county borders Houston County in southeastern Minnesota. During the Minnesota firearms deer season, hunters voluntarily brought deer to be sampled for CWD at eight registration stations throughout deer permit areas 348 and 349. In total, the DNR sampled 411 deer within the two permit areas. No chronic wasting disease (CWD) was detected.

The MN DNR will continue to be proactive in surveillance for CWD in wild deer. If CWD-positive deer are detected in the future, the CWD Response Plan will be implemented in localized areas as necessary to minimize the risk of disease transmission and spread.

Bovine Tuberculosis

Bovine tuberculosis (TB) is caused by bacteria of the species *Mycobacterium bovis*. Many animal species may harbor TB including domestic animals, wildlife, and humans. TB was once common in cattle and swine in the U.S. until a cooperative effort started in 1917 by federal and state governments, and the livestock industry made significant progress toward eradicating the disease. TB is still detected in U.S. cattle herds, and its discovery imposes costly trade restrictions, testing, and culling of suspect herds.

Prior to the discovery of widespread infection of TB in wild white-tailed deer in northern Michigan, only eight cases of TB-infected deer were documented in North America. TB is spread through nasal or oral discharges, and there is evidence that the disease may be transmitted through consumption of contaminated feeds by cattle and deer. Cattle found to be infected with TB are typically culled rather than treated, and TB-suspect carcasses do not enter the food chain. Once established in a wildlife population, TB can be difficult to control and eradicate without significant population reductions. TB-infected animals may appear normal and healthy. TB is a chronic disease, which progressively causes animals to become emaciated, debilitated, and severe respiratory infection causes labored breathing.

TB was detected in a northwest Minnesota cattle farm in 2005. The disease was subsequently found in a total of 12 cattle operations and 27 individual free-ranging white-tailed deer. Testing showed that both deer and cattle had the same strain of TB, which was consistent with a strain of TB found in cattle in the southwestern United States and Mexico. The Minnesota Board of Animal Health led efforts to eradicate the disease in Minnesota's cattle, which included the depopulation of all infected herds, a buy-out program that removed 6,200 cattle from the infected area, and mandatory fencing of stored feeds on remaining farms. In an effort to reduce deer densities within the infected area and increase sampling for the disease, the MN DNR initiated a response plan that included intensified deer harvest by hunters, landowners, and government sharpshooters. The MN DNR tested a total of 10,667 white-tailed deer for TB in northwest Minnesota from 2005 to 2012. No new infections have been detected in either cattle or deer since 2009. Minnesota cattle producers regained TB-free accreditation in October 2011. However, some testing requirements remained on cattle herds within the endemic area until the infection in deer could be determined as nonexistent. While the MN

DNR is unable to declare the local deer herd entirely disease-free, the cumulative years of intensive surveillance efforts were aimed at TB detection of prevalence more than 0.5% with 99% confidence. These efforts provided solid evidence that TB is no longer within these detectable levels in the deer population. The MN DNR has now suspended any future efforts to monitor for TB in the state.

Epizootic hemorrhagic disease

Epizootic hemorrhagic disease (EHD) is a naturally occurring virus in North America and is caused by one of ten types of the hemorrhagic or bluetongue viruses. EHD infects white-tailed deer, mule deer, elk, pronghorn, and domestic animals including sheep, cattle, and alpacas. White-tailed deer are most susceptible to EHD and it is considered the most infectious disease in white-tailed deer throughout the United States. In other species, such as elk, the animals are susceptible to infection but typically only develop mild clinical signs of the disease. EHD cannot be transmitted to humans. Most deer mortality from the disease occurs before archery season, but deer that are chronically afflicted may develop secondary infections and may not be suitable for consumption if they are harvested by hunters.

EHD is transmitted by the bite of the *Culicoides* midge, a small gnat, which is most abundant in late-summer and early fall. The virus begins to replicate in the deer after being infected, and the deer will get a significant fever within a week after being infected. The viral replication results in holes in the blood vessels and hemorrhaging. Hemorrhaging can happen throughout the body; it is especially apparent throughout the gastro-intestinal tract. The ears, eyelids, and tongue swell and eventually bleed. The hooves of the deer are sensitive to the disease and will often times slough off partially or entirely. Behaviorally, the deer may lose its fear of humans, lose its appetite, have labored breathing, become lethargic, and may have droopy ears. Often times, deer will stand in water or stay near water due to the fever associated with the disease. Some animals recover from EHD while others die within days or weeks.

Widespread outbreaks of EHD have been known since 1900. It occurs annually throughout the white-tail's range, but the impact varies geographically. EHD does not impact deer populations at the state level, but localized deer densities can be reduced substantially during outbreaks. Since mortality from EHD rarely exceeds 25%, deer populations can recover in as little as one year after an outbreak. Although common throughout the Midwest, no documented cases of EHD have occurred in Minnesota's wild deer[6]. In recent years, the range of EHD has been expanding northward, and all states bordering Minnesota have had widespread reports of EHD. In 2012, the Minnesota Board of Animal health reported that a cow in Brown County was infected with EHD; this was the first clinical case of the disease identified in any species in

[6] One report has been recorded nationally for Cook County, Minnesota. Documentation is not available.

Minnesota. A second case was reported in a cow from Murray County in 2013. Therefore, it is likely that EHD will occur in Minnesota's deer population in the future.

Options for managing the disease are very limited. Vaccination of wild deer is not practical, and eliminating gnats from large geographic areas is not possible. Because the disease is not spread from animal to animal, EHD is considered "density-independent" and attempts to manage deer numbers at lower population levels would not have any impact on the prevalence of the disease. If an outbreak of EHD occurred in Minnesota, management would be similar to actions taken in response to severe over-winter mortality in northern Minnesota. Staff would attempt to estimate the spatial extent of the disease and the impact it had on local deer numbers. Hunting regulations would be adjusted accordingly to prevent overharvest of deer from occurring in DPAs that were impacted by EHD.

Anaplasmosis

Anaplasmosis is an important disease of domestic cattle in North America caused by rickettsia bacteria. Infected cattle develop severe anemia, high fever, and jaundice followed by death or severe debilitation. Although white-tailed deer may carry the disease, deer are not clinically impacted by anaplasmosis. The disease is spread by the transfer of fresh blood by biting insects or other mechanical means such as needles or de-horning shears. The bacteria replicate in certain species of ticks. With the exception of areas of the western U.S. where deer are hosts to those species of ticks, deer are not considered to be reservoirs of the disease and are not important in its transmission.

Giant liver flukes

Giant liver flukes are a type of parasitic flatworm naturally found in white-tailed deer. White-tailed deer are considered the normal host for giant liver flukes, and usually tolerate fluke infestations without serious clinical illness. Other wild deer, including moose and elk, and domestic cattle and sheep may also be infected by giant liver flukes. The life cycle of giant liver flukes is rather complex, and requires aquatic snails as intermediate hosts. Eventually, animals ingest larval cysts of the flukes, the cysts break open in the host, and the larvae migrate to the liver where they develop into adult flukes. In white-tailed deer, adult flukes reside in the liver and shed eggs to continue the life cycle. Moose are not normal hosts for giant liver flukes and adult flukes eventually die in the moose liver; however, infestations may contribute to reduced condition and secondary infections in nutritionally stressed moose. In sheep, flukes migrate through the liver and typically kill the sheep before the life cycle of the fluke can be continued. In cattle, reactions in the liver prohibit eggs from leaving the animal and the life cycle of the flukes does not continue. Although giant liver fluke infestations in cattle are generally not serious, damage by flukes causes livers to be condemned at slaughter. Domestic cattle and sheep may also be infected by the common liver fluke, which is not found in deer. Livestock producers concerned about the role of wild deer in fluke infestations should work with their veterinarian to identify the species of flukes infecting their animals. If giant liver flukes are found to be the cause of infestation, livestock producers should take measures to keep deer separated from livestock and their feed. Control of snails may interrupt the life cycle and reduce the local abundance of flukes.

Johne's disease

Johne's disease is caused by slow-growing bacteria, which cause a progressive loss of body condition in cattle, sheep, goats, and deer. Johne's is transmitted through infected feces, and animals with Johne's often have chronic diarrhea. Johne's causes considerable economic losses to the cattle industry. However, reports of Johne's infection in wild deer are rare. Therefore, free-ranging wild deer are not believed to be important hosts for the disease.

Leptospirosis

Leptospirosis is a disease caused by spirochete bacteria. There are over 180 known varieties of this organism. The disease can infect a wide variety of mammals including domestic livestock, pets, humans, and wildlife. Although each variety may infect many different species, there are specific animals that are hosts thought to maintain and spread particular varieties of the disease. Some domestic species are primary reservoirs for certain varieties including cattle, dogs, pigs, and horses. Several wild mammals have been found to be primary reservoirs for individual varieties of Leptospirosis including raccoons, opossums, rats, and mice. Carrier animals have persistent infections of the urinary tract and contaminate the environment with bacteria in their urine. Most animals contract the disease by contact with urine-contaminated food, water, and other materials. Numerous studies have shown that white-tailed deer have a lower rate of Leptospirosis infection than domestic livestock, and naturally occurring clinical infection of the disease is rare in white-tailed deer. Therefore, deer are not considered to be important in maintaining and spreading leptospirosis to domestic livestock.

Lyme disease

Lyme disease is caused by spirochete bacteria and is transmitted to people via the black-legged tick, which is also known as the deer tick. Lyme disease is the most common vector-borne illness of humans in the U.S. If Lyme disease is left untreated during its early stages, it could lead to serious health problems including arthritis and various neurologic diseases. In Minnesota, black-legged ticks also transmit other tick-related illnesses including babesiosis, human anaplasmosis, human ehrlichiosis, and a strain of Powassan virus.

White-tailed deer are the primary reservoir hosts of the adult black-legged tick. Lyme disease is transmitted among ticks when uninfected ticks take blood from infected deer or other already-infected animals. The disease is most commonly transmitted to humans when the infected ticks are nymphs during the spring. The exact relationship between deer densities and Lyme disease infection rates is not clearly understood. Reducing deer numbers has been largely ineffective in preventing Lyme disease because deer are not the only reservoir for the disease and do not transmit the disease directly to humans or other deer. However, recent work in Groton, Connecticut, identified a relationship between reduced deer densities and reduced incidence of Lyme disease in the residential community

The Minnesota Department of Health reported that during the years 1996 through 2012 more than 17,000 tick-borne illnesses were reported in people, with Lyme disease confirmed in 12,935 of those cases. The reported rate of Lyme disease infection in Minnesota during 2012 was approximately 17.2 cases per 100,000 people. According to the Minnesota Department of Health, the number of Lyme disease cases has increased dramatically since the 1990s. A variety of factors, including increasing physician awareness, increasing infection rates in ticks, and expanding tick distribution may have led to this trend. People are encouraged to take preventive measures to avoid Lyme disease infection. Using approved repellents, avoiding brushy and grassy areas when possible, and conducting regular checks for ticks is recommended.

Meningeal worm ("Brain worm")

The meningeal worm, which is commonly referred to as "brain worm", is a nematode of the species *Parelaphostrongylus tenuis*. Meningeal worms may infect all members of the deer family as well as domestic sheep and goats. The meningeal worm is naturally occurring throughout the range of white-tailed deer. White-tailed deer are the definitive host for meningeal worms, and normally harbor the worms with few signs of disease. Occasionally, white-tailed deer will accumulate massive infections of meningeal worms and these deer will display neurological symptoms including incoordination and paralysis. The life cycle of meningeal worms is complex, involving snails and slugs as intermediate hosts, which harbor larvae, and white-tailed deer as the final host for adult worms. Animals become infected with the larvae when they inadvertently eat snails and slugs. When white-tailed deer ingest infective larvae, the larvae develop in the spinal cord and migrate to the brain as adult worms where they produce eggs that deer shed into the environment. Deer species other than white-tailed deer, including moose and elk, that consume larvae can suffer severe clinical illness and death. Where white-tailed deer populations overlap with moose in Minnesota, deer densities are managed at less than 10 deer per square mile to reduce the potential risk of meningeal worm infestations in moose. Meningeal worms are not a health risk to humans.

Appendix B: Programs that support deer management in Minnesota

In addition to local and regional wildlife managers, several programs and supporting staff are involved with deer management in Minnesota.

Populations and regulations program: Responsible for management of hunting seasons to maintain deer populations within established goals. Management tools associated with the populations and regulations program include establishment of deer seasons, bag limits, and seasonal hunting regulations.

Animal damage program: Works with landowners to reduce wildlife damage. Management tools associated with the depredation program include technical assistance, damage management abatement materials and animal removal. Animal removal via shooting or depredation permits is used to address local damage concerns.

Wildlife research program: Supports DNR operations with science-based information and recommendations. Deer management tools associated with the research program include population monitoring, evaluation of management techniques, surveys, and associated ecological research.

Wildlife health program: Monitors and protects the health of Minnesota's wildlife populations, with a focus on game species. The extent of work ranges from large-scale surveillance efforts to individual case investigations. Structured within the DNR's Wildlife Research Unit, the Wildlife Health Program also conducts research into current wildlife health issues.