MICHIGAN

WOLF MANAGEMENT PLAN

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Approved:

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Keith Creagh, Director

Michigan Department of Natural Resources

Lansing, Michigan

Date: _____

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ACKNOWLEDGMENTS

The Michigan Department of Natural Resources (DNR) appreciates the valuable contributions offered by many individuals, agencies and organizations during the development of this plan from 2006 – 2008 and the update to this plan in 2014-2015

We thank the thousands of Michigan residents who helped shape the content of this plan through their participation in public wolf meetings held throughout the State, through the input and opinions they shared during public-comment periods, through their involvement in focus-group discussions, and through their participation in public-attitude surveys.

We express our appreciation to the members of the Michigan Wolf Management Roundtable for their dedication and hard work as they developed a set of principles to help guide wolf management in Michigan. Those principles are directly reflected in the management strategies outlined throughout this document.

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Finally, we thank members of the Wolf Management Forum for their continued involvement in wolf management in the State through implementation of the 2008 plan and contributing their comments on how to improve the 2015 updated plan.

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LIST OF ABBREVIATIONS

DNR	Michigan Department of Natural Resources
LP	Lower Peninsula
MSU	Michigan State University
UP	Upper Peninsula
USDA	United States Department of Agriculture
USFWS	United States Fish and Wildlife Service
NRC	Michigan Natural Resources Commission

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1. INTRODUCTION

1.1 Purpose of Plan

This plan provides strategic guidance for the management of wolves in Michigan. It was developed to help: 1) maintain a viable Michigan wolf population above a level that would warrant its classification as threatened or endangered; 2) facilitate wolf-related benefits; 3) minimize wolf-related conflicts; and 4) conduct science-based wolf management with socially acceptable methods.

The DNR has a public trust responsibility for the management of all wildlife species and populations. Primary legal authority for wildlife management and regulation comes from the Natural Resources and Environmental Protection Act, Public Act 451 of 1994 (www.legislature.mi.gov). Part 401 of Public Act 451 gives specific authorities to the Natural Resources Commission (NRC) and the DNR Director to issue orders regulating wildlife management and hunting. Accordingly, this plan was developed primarily to guide the DNR's management of wolves and any subsequent recommendations to the NRC. This plan also may inform Federal, State and Tribal agencies and private organizations as they develop strategies pertinent to wolves. We hope this plan encourages cooperation and consistent approaches among partners in their efforts to manage wolves in Michigan.

This plan does not outline operational details of wolf management in Michigan. Operational details will be specified within an adaptive-management framework, in which specific management methods are routinely adjusted and updated as local conditions, technology, regulations, and other aspects of management context change.

1.2 Context of Plan

In 1997, the DNR finalized the Michigan Gray Wolf Recovery and Management Plan (Michigan DNR 1997). That plan was developed when the gray wolf (*Canis lupus*) in Michigan was classified as a federally endangered species and the number of wolves in the State was relatively small. The plan focused on the biological needs of a small population and was a valuable tool for the recovery of wolves in Michigan. It also contributed to the regional recovery of wolves in the western Great Lakes region: in 2007, the U.S. Fish and Wildlife Service (USFWS) removed the gray wolf in the Western Great Lakes Distinct Population Segment, which includes all of Michigan, from the Federal List of Threatened and Endangered Species (USFWS 2007).

To address these changes and to continue to manage the wolf population based on the best available scientific information, the DNR revised its original wolf plan and created the 2008 Michigan Wolf Management Plan. The 2008 plan addressed the challenges associated with the biological, social and regulatory context of wolf management in Michigan at that time. From 1997 to 2015, the context of wolf management in Michigan has changed in a variety of ways.

- Wolf population size and distribution have expanded, presenting a different set of biological and social issues that need to be addressed; including the complex and divisive issue of public hunting of wolves.

- Understanding of wolf biology has improved significantly, enabling managers to better predict the consequences of their management decisions.

- Since 2000, USDA Wildlife Services personnel have played a key role in population monitoring, research, training of field staff, and program planning. The DNR and USDA Wildlife Services have formalized their cooperative relationship in a memorandum of understanding.

The legal status of wolves at both the Federal and State level has changed multiple times, which impacts the ability of all agencies to manage wolves. In April of 2009, wolves were removed from the State Threatened and Endangered Species List (Part 365 of Public Act 451 of 1994) and given Protected Animal status under the State's Wildlife Conservation Order. In January 2012, wolves in Michigan were removed from the Federal List of Threatened and Endangered Species (USFWS 2011). On two separate occasions, once in 2012 and again in 2013, wolves were classified as game animals in Michigan. The latter statute provided the NRC with the ability to designate species as game, and as such, expanded their authority beyond the method and manner of take of game species. The laws that allowed these classifications were repealed by public referendum in November of 2014. However, in August of 2014, citizen initiated legislation then again classified wolves as game animals. Furthermore, this legislation added the authority to classify species as game animals to the NRC's already existing authority to decide if a game species will be hunted, and the parameters around a regulated harvest. The effective date of the citizen initiated legislation is March 31, 2015.

In the fall of 2014, the DNR initiated an update to the 2008 Michigan Wolf Management Plan and shortly after, in December 2014, a Federal court decision returned wolves in the western Great Lakes Distinct Population Segment to the Federal List of Threatened and Endangered Species. This action marked the 5th time, due to lawsuits or threat of lawsuits against USFWS delisting efforts, the Federal legal status of wolves changed in Michigan since 2008.

Regardless of changes in legal status, this updated management plan acknowledges that wolves in Michigan have surpassed State and Federal population recovery goals for 15 years. Further, and regardless of the Federal listing status, the State has and will continue to have management responsibility for wolves in the State. It is the regulatory authority over lethal take of wolves that varies with the changing State and Federal status of wolves. Therefore, the ability of, or the methods used by, the State to implement some parts of this plan will vary depending on the Federal and State legal status of wolves.

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2. PLANNING PROCESS

The DNR developed the 2008 plan through a process that included review of the best available scientific information and substantial involvement of affected stakeholder groups and the general public. The process included the following eight phases:

- Intra- and inter-agency scoping
- Public meetings and comment period
- Focus-group meetings
- Public-attitude surveys
- Review of science relevant to wolf management in Michigan
- Michigan Wolf Management Roundtable
- Plan writing
- Public review and comment

The information compiled and evaluated during all of these phases was used to produce a plan that is based on sound science and careful and respectful consideration of the diverse perspectives held by Michigan society. These phases are described under the following headings.

2.1 Intra- and Inter-agency Scoping

In August 2004, the DNR met with Federal and State agency partners to identify issues regarding wolves and their management in Michigan. Each agency shared its vision and concerns regarding wolf management. Agencies also identified future wolf management needs and opportunities for continuing partnerships. After this initial meeting, the DNR Wolf Management Work Group conducted a situational analysis to identify the strengths, weaknesses, opportunities, threats and issues surrounding future wolf management in Michigan. During the ensuing months, the group continued to explore the issues and formulated a plan and timeline for revising the Michigan wolf management plan.

2.2 Public Meetings and Comment Period

In May 2005, the DNR hosted ten public meetings to discuss wolf management in Michigan. Six meetings took place in the Upper Peninsula (Watersmeet, Houghton, Escanaba, Newberry, Sault Ste. Marie and Marquette) and four meetings took place in the Lower Peninsula (Clare, Grand Rapids, Ann Arbor and Gaylord). The purpose of the meetings was to provide the public with an opportunity to identify important issues and express opinions regarding wolves and wolf management in the State. A professional facilitator not affiliated with the DNR moderated each meeting. Meeting participants were given the opportunity to provide verbal comments, and they were also asked to complete a survey regarding their views on wolves and wolf management.

Based on information obtained from sign-in sheets, at least 560 people attended the public meetings. Four hundred twenty-two of those individuals attended the Upper Peninsula (UP) meetings, and the remaining 138 individuals attended the Lower Peninsula (LP) meetings. Four

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hundred thirty-three people who attended the meetings submitted a completed survey. Results of the survey are summarized in Beyer et al. 2006.

The DNR press release that announced the public meetings also announced the opening of a public-comment period during which people were encouraged to mail or email their wolf-related comments. From April 12 through August 31, 2005, the DNR received 133 emails and 36 letters that specifically dealt with wolves.

2.3 Focus-group Meetings

During the summer of 2005, the Michigan State University (MSU) Department of Fisheries and Wildlife coordinated nine focus-group meetings to discuss wolves and wolf-related issues. The main purpose of the meetings was to refine understanding of issues identified as important by members of different stakeholder groups and to test and improve questions being considered for a statewide public-attitude survey.

The nine focus-groups included: 1) eastern UP livestock producers; 2) western UP livestock producers; 3) UP hunters who hunt with dogs; 4) northern LP hunters who hunt with dogs; 5) UP deer hunters; 6) northern LP deer hunters; 7) wolf conservationists (i.e., individuals focused on wolves at a population or ecosystem level); 8) wolf protectionists (i.e., individuals focused on the welfare and rights of individual wolves); and 9) trappers. A total of 78 individuals participated in the focus-group meetings.

Topics of discussion differed somewhat among the focus-groups. However, all focus-groups discussed the following six subjects: 1) benefits of having wolves in Michigan; 2) costs of having wolves in Michigan; 3) compensation and losses associated with wolf depredation; 4) preferences regarding quantification of wolf numbers in Michigan; 5) topics that should be addressed by the Michigan Wolf Management Roundtable (see 2.6); and 6) the role of the Michigan Wolf Management Roundtable in the development of the wolf management plan. Overviews of the discussions are provided in Bull and Peyton 2005 (included as Appendix IX in Beyer et al. 2006).

2.4 Public-attitude Surveys

Studies conducted prior to 2005 had assessed the attitudes held by Michigan residents regarding wolves (e.g., Kellert 1990, Mertig 2004). However, those studies may not reflect current public opinions given the substantial changes in wolf abundance and distribution in the UP and limitations of sample size. To ensure current social data were available during development of this plan, the MSU Department of Fisheries and Wildlife undertook a new study that explored the attitudes of Michigan residents.

Data for this new study were obtained from public-attitude surveys designed to address specific management questions relevant to the planning process. The questions focused on respondents' preferences and opinions regarding: 1) reasons for having wolves in Michigan; 2) the number of wolves and frequency of wolf-related interactions in different regions of the State; 3) options to address depredation of livestock, hunting dogs and other pets; 4) options to address public

concerns regarding human safety; 5) options to address impacts to deer; and 6) a public harvest of wolves.

After survey questions were refined through focus-group discussions and tested through a pilot survey mailing, the final versions of the surveys were mailed repeatedly from November 2005 through January 2006. A general-public survey was mailed to 8,500 Michigan driver's license holders statewide. Slightly modified versions of the survey were mailed to 1,000 licensed furtakers and 1,000 livestock producers. These modified versions were designed to obtain sufficient input from two groups of stakeholders that comprise a relatively small proportion of the general population but experience disproportionately high levels of conflicts with wolves.

Repeated mailings resulted in an overall response rate of 53% for the general-public survey, 69% for the furtaker survey, and 69% for the livestock-producer survey. Data from the different versions of the survey were compiled and analyzed separately. The methods and results of the study are provided in Beyer et al. 2006. Survey responses regarding specific management issues (e.g., human-safety concerns, depredation of livestock, impacts on deer) are summarized under the relevant headings within section 6 (Wolf Management Strategies) of this plan.

2.5 Review of Science Relevant to Wolf Management in Michigan

Concurrent with the phases described above, the DNR and MSU Department of Fisheries and Wildlife developed a document entitled: *Review of Social and Biological Science Relevant to Wolf Management in Michigan* (Beyer et al. 2006). The document summarized the best available biological and social science relevant to wolves, wolf-related issues, and wolf management options in Michigan, and it described the remaining scientific uncertainty on those topics. The information presented was obtained from published scientific literature, agency and university reports, unpublished agency data, and personal communication with wolf experts. Results of public-attitude surveys and focus-group discussions conducted by MSU in 2005 and 2006 are presented throughout the document.

Science allows managers to predict the outcomes of particular management actions. However, science alone does not establish wildlife management goals. Those goals are often determined within a social context where stakeholder values and priorities must be addressed. Accordingly, the *Review of Social and Biological Science Relevant to Wolf Management in Michigan* does not provide answers to questions of how wolves should be managed in Michigan. Rather, it facilitates understanding of the potential consequences of particular management approaches, and it thus helps managers make decisions based on the best available science.

The *Review of Social and Biological Science Relevant to Wolf Management in Michigan* is a companion document to this plan, and much of the information it contains is incorporated by reference. The document is available on the DNR website (www.michigan.gov/dnr).

2.6 Michigan Wolf Management Roundtable

To help it develop a plan that is acceptable to a wide range of stakeholder interests, the DNR convened an advisory committee called the Michigan Wolf Management Roundtable

(Roundtable). Membership included 20 agencies and organizations (see Appendix) that represented the diversity of Michigan interests in wolves. These interests included environmental and ecological interests, hunting and trapping interests, livestock-producer interests, public-safety interests, tourism and resource-development interests, tribes, and wolf-protection interests. Each organization on the Roundtable was selected to ensure the views of all Michigan residents would be represented in a fair and effective manner. Membership included UP and LP residents in roughly the same numbers to ensure adequate representation of the different regions of the State. The charge of the Roundtable, as given by the DNR, was to develop principles to guide management of Michigan wolves and wolf-related issues following Federal de-listing.

From June through September 2006, Roundtable members met for a total of 10 days to deliberate on wolf management. They identified and prioritized important wolf-related issues, reviewed relevant social and biological science, and engaged in intense negotiations to reach consensus on a set of guiding principles for wolf management in Michigan.

The Roundtable submitted its final report to the DNR in November 2006. That report, entitled *Recommended Guiding Principles for Wolf Management in Michigan* (Michigan Wolf Management Roundtable 2006; included as the Appendix to this plan; also available on the DNR website at www.michigan.gov/dnr), outlines guiding principles pertaining to wolf distribution and abundance, benefits of wolves, management of wolf-related conflicts, information and education, funding, research, hybrid and captive wolves, and future plan revisions.

2.7 Plan Writing

Between November 2006 and August 2007, the DNR evaluated the information and recommendations obtained during the previous phases to develop a draft of this plan. DNR staff and the Michigan Wolf Management Roundtable reviewed the draft prior to its public release.

2.8 Public Review and Comment

In August 2007, the DNR released a draft of this plan for public review and comment. During the 90-day comment period, agencies, organizations and individuals submitted approximately 1,480 emails and 15 hard-copy letters that offered comments on the draft plan. Based on those comments, the DNR modified the plan, as appropriate, prior to its final approval.

2.9 2015 Plan Update Process

In November of 2014, the DNR announced their intent to update the 2008 Michigan Wolf Management plan. As an update to the 2008 plan, the four principal goals of the 2008 plan would remain the same in the updated plan. The DNR announced that the update process would include a scientific literature review and inclusion of new information that may influence strategic management direction, an evaluation of plan implementation based on the strategic action items in the plan, updating the strategic action items as necessary, and addressing outdated information or clarifications that are needed.

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The DNR asked all 12 federally-recognized tribes in Michigan to provide comments on implementation of the 2008 plan and to provide suggestions for changes to be incorporated into this plan update. In addition, the 2007 Inland Consent Decree Wildlife Technical Committee was briefed on the process used to update the plan and asked to express desires regarding how the five 1836 ceded territory tribes would like to engage in government to government consultation on this update. The DNR continues to reach out to tribal governments on mutually important aspects of wolf management in Michigan.

The DNR provided an online and paper opinion survey for the public to rank performance and comment on the DNR's implementation of the 12 Strategic goals in the 2008 plan. During the 30-day comment period commencing on November 13th, 2014, the DNR received 3010 responses online and 21 responses in paper form. The results of the survey were used to help the DNR evaluate implementation of strategic actions and identify those actions that would remain, be modified, removed, or added to the updated plan. The DNR produced a summary of management accomplishments since the inception of The Michigan 2008 Wolf Management Plan as part of this planning effort.

On March 3rd 2015, the DNR released a draft of the updated plan for public review and comment. The DNR met on March 9th with the members Michigan Wolf Management Forum to review the plan update process and to answer any questions on the draft updated plan. During the 30-day comment period agencies, organizations and individuals submitted 1464 emails and 17 hard-copy letters that offered comments on the draft updated plan. Based on those comments, the DNR modified the plan, as appropriate, prior to its final approval.

3. WOLF BIOLOGY AND ECOLOGY

3.1 Wolf Taxonomy

Scientists have long debated the taxonomy of wolves. At the time the United State Fish and Wildlife Service (USFWS) listed eastern timber wolves (*Canis lupus lycaon*) as an endangered species under the 1973 Endangered Species Act, this scientific debate was focused on the number of subspecies of wolves that existed in North America (USFWS 1992). However, advancements in the analysis and interpretation of genetic information has raised new questions about whether one or two species of wolves currently occupy the western Great Lakes region and whether those species have hybridized. This debate can be broken into two interpretations (1) the western Great Lakes wolves are gray wolves (*Canis lupus*) and hybrids between gray wolves and coyotes (*Canis latrans*); or (2) they are gray wolves, eastern wolves, (*Canis lycaon*) and their hybrids (Chambers et al. 2012).

Given the scientific uncertainty, for purpose of this management plan we will continue to refer to wolves in Michigan as gray wolves, *Canis lupus.* Regardless of the final outcome of the taxonomic debate, wolves in Michigan today represent the same animals the USFWS listed as an endangered species in 1974. Perhaps most importantly, wolves in Michigan appear to function as a single population (Wheeldon et al. 2010) and are fulfilling their ecological role as an apex predator.

3.2 Physical Description

Wolves are the largest members of the Canidae (dog family) in Michigan. Other native Michigan canids are the coyote (*Canis latrans*), red fox (*Vulpes vulpes*) and gray fox (*Urocyon cinereoargenteus*). Wolves are larger than coyotes, with body dimensions exceeding those of a fully grown German shepherd or Alaskan malamute. In Michigan, weights of adult wolves range from 58 to 112 pounds (26–51 kg), with males (average: 87 lbs; 39 kg) weighing slightly more than females (average: 76 lbs; 34 kg). Wolves are approximately 6 feet (1.8 m) long from the nose to the end of the tail. Adults stand 30–34 inches (75–85 cm) tall at the shoulder. The feet of wolves are large, with tracks measuring 3.5–4 inches (9–10 cm) wide and 4.5–5 inches (11–13 cm) long.

Wolves are well-adapted to cold and temperate climates. The dense underfur in their winter coats is protected by guard hairs that may be up to 6 inches (15 cm) long over the shoulder. Their skeletal and muscular structures make them well-adapted to travel. They have tremendous stamina and often spend 8–10 hours per day on the move, primarily during early morning and evening.

3.3 Social Structure and Behavior

The life of a typical individual wolf is centered on a distinct family unit or pack (Baker 1983). The basic functional unit of a pack is the dominant breeding pair, often called the 'alpha' pair (Mech and Boitani 2003*a*). A pack is typically comprised of these two dominant animals, their pups from the current year, offspring from previous litters, and occasionally other wolves that may or may not be related to the alpha pair (Young and Goldman 1944, Stenlund 1955, Mech 1966). A dominance hierarchy occurs within the pack, where each member occupies a rank or position (Mech 1970). The alpha male and female are normally the only animals that breed, but there are exceptions (Ballard et al. 1987).

Based on ten studies, the average pack size of wolves that prey primarily on deer (*Odocoileus* spp.) is 5.7 animals (Fuller et al. 2003). This size is slightly greater than recent estimates of average pack size in Minnesota (mean=4.4; Erb et al. 2014) and Wisconsin (mean≤4.5; Wydeven et al. 2012). From 2009 through 2014, average winter pack size in Michigan ranged from 5.0 to 5.3 animals (B. Roell, Michigan DNR, unpublished data).

Wolves establish and maintain territories (Ballard et al. 1987, Fuller 1989, Mech and Boitani 2003*a*). Howling between packs and scent-marking along territory edges are the principal means of spacing in wild wolf populations. Territory size can vary greatly and depends upon the density of wolves and on the density and distribution of prey.

Estimated sizes of wolf territories in the UP have ranged from 5 mi^2 to 291 mi^2 (14–753 km^2); in 2011-12, average territory size (95% minimum convex polygon method) in the UP was 45 mi^2 (117 km^2; D. Beyer, Michigan DNR, unpublished data). Average territory size has decreased as the UP wolf population increased.

3.4 Reproduction

Some wolves that were held in captivity were capable of breeding at 9–10 months of age (Medjo and Mech 1976), but wild wolves typically reach sexual maturity at 22 months of age (Mech 1970, Fuller 1989). Mating takes place in February, dens are dug in March, and pups are born in middle to late April (Peterson 1977, Fuller 1989).

Litter sizes can vary, but usually include 4–6 pups (Mech 1970). Pups are born with their eyes and ears closed and lack the ability to properly regulate their body temperature (Mech 1970). Their eyes open when they are between 11 and 15 days old (Rutter and Pimlott 1968, Mech 1970). Pups emerge from their dens when they are approximately 3 weeks old (Young and Goldman 1944). At approximately 9 weeks of age, they are weaned and moved to a rendezvous site, an above-ground area where pups develop until they are able to travel with the pack. By the time pups are 4–6 months old, they are nearly as large as an adult wolf (Carbyn 1987).

3.5 Causes and Rates of Mortality

No animal habitually preys on wolves, but pups may occasionally be taken by bears (*Ursus* spp.) or other predators. Both moose (*Alces alces*) and deer have injured or killed wolves (Nelson and Mech 1985, Mech and Nelson 1989). Other natural mortality factors include accidents, malnutrition, starvation, parasites, diseases, and fatal encounters during territorial disputes between packs. Human-induced mortality can involve vehicle strikes and intentional killing. Causes of wolf mortality are often compensatory (Mech 2001, Fuller et al. 2003). For example, human-induced mortality can sometimes replace mortality that would otherwise occur due to natural factors, such as starvation, disease or intraspecific aggression (Fuller et al. 2003).

Annual mortality of wolves can fluctuate widely from year to year. Up to 60% of pups may die from disease and malnutrition during their first 6 months of life. Mortality rates approximate 45% from 6 months to 1 year, and 20% between years 1 and 2 (Pimlott et al. 1969, Mech 1970, Mech and Frenzel 1971, Van Ballenberghe et al. 1975, Fritts and Mech 1981). Annual adult wolf mortality in Wisconsin averaged 39% during a period of population decline, and 19% during a period of population increase (Wydeven et al. 1995). Adults may live past 11 years, but most die much sooner (Mech 1988, B. Roell, Michigan DNR, unpublished data).

Using two methods of data analysis, Huntzinger et al. (2005) estimated annual mortality rates of radio-collared wolves in the UP from 1999 to 2005. Estimates of annual mortality rates varied between 15% and 46% and depended on the method of analysis. Although the confidence limits were large and the estimates varied annually, there was no trend in annual mortality. In other words, annual mortality of wolves did not increase or decrease with time.

In Michigan, illegal killing accounted for 41% of radio-collared wolf mortality from 1999 through 2014 (B. Roell, Michigan DNR, unpublished data). Compared to uncollared wolves, radio-collared wolves could be more or less likely to be killed illegally because radio-collars can be visible when wolves are sighted. When vehicle strikes, depredation-control activities, harvest and other human-caused trauma are included, 66% of the radio-collared wolf mortality was directly attributable to humans (B. Roell, Michigan DNR, unpublished data). Causes of wolf

mortality may have been biased toward human actions during 1999–2004 because biologists vaccinated captured wolves for a variety of diseases and treated for mange prior to 2004; that is, the vaccination procedures may have reduced the amount of natural mortality that would have otherwise occurred in the Michigan sample.

3.6 Immigration and Emigration

Most wolves disperse because animals rarely assume a breeding position within their natal packs (Mech and Boitani 2003*a*). Dispersal rates vary geographically and temporally with no clear differences between sexes (Mech and Boitani 2003*a*). Wolves are capable of traveling long distances and movements greater than 500 miles (800 km) have been reported (Ballard et al. 1983, Fritts 1983, Boyd et al. 1995). Long-distance movements and gene flow help preserve or enhance genetic diversity within populations and help mitigate the effects of detrimental demographic fluctuations due to environmental catastrophes (Simberloff and Cox 1987, Boitani 2000).

Movements of wolves among Michigan, Minnesota, Wisconsin and other States have been confirmed through the recovery or observation of marked animals (ear-tagged and/or radio-collared) (Mech et al. 1995, A. P. Wydeven, Wisconsin DNR, unpublished data, D. E. Beyer, Michigan DNR, unpublished data). There is also evidence of wolf movements between the eastern UP and Ontario across Whitefish Bay and the St. Mary's River (Jensen et al. 1986, Thiel and Hammill 1988).

With regard to the documented movements of 28 wolves that traveled from the UP to other States and Canada, the average distance between the points of origin (capture location) and the points of subsequent location (death location) was 155 miles (249 km; B. Roell, Michigan DNR, unpublished data). The farthest documented dispersal by a Michigan wolf was made by a male that was captured, tagged and released in Gogebic County in 1999 and killed near Trenton, Missouri in 2001. The straight-line distance between the two points is 457 miles (756 km).

3.7 Wolf Food Habits

Wolves prey on a variety of wildlife species, and predation on those species often changes seasonally and geographically (Voigt et al. 1976, Fritts and Mech 1981, Potvin et al. 1988, Fuller 1989, Mech and Peterson 2003). In general, prey abundance, distribution, vulnerability and behavior influence a prey species' importance to wolves as a food source. In multiple-prey systems, the more-vulnerable species commonly predominates as the main food source for wolves (Van Ballenberghe et al. 1975, Fritts and Mech 1981).

Mandernack (1983) analyzed scats of Wisconsin wolves to determine the relative abundance of prey species in their diet. White-tailed deer (*Odocoileus virginianus*) comprised 55%, beaver (*Castor canadensis*) comprised 16%, snowshoe hare (*Lepus americanus*) comprised 10%, and other small mammals and miscellaneous items comprised 20% of wolf diet in that area. Beaver provided as much as 30% of a Wisconsin wolf's spring diet. In Minnesota, white-tailed deer, moose and beaver comprised the majority (>75%) of annual wolf diet (Van Ballenberghe et al.

1975). The predominance of deer remains in wolf scat indicates deer were the principal prey throughout the year despite relatively high densities of moose.

In the UP, white-tailed deer and moose constitute the ungulate prey available for wolves. However, during an intensive study of the western UP moose herd from 1999-2005, wolves rarely preyed on moose, probably due to the lack of overlap in distribution with wolf-pack territories, the low abundance of moose in comparison to deer, and differences in vulnerability (D. E. Beyer, Michigan DNR, personal communication). It is uncertain if this pattern of low predation on moose has remained, or will remain, the same as the number of deer, moose, and wolves fluctuate over time. The most current research in Michigan indicates deer are the primary prey item for wolves during winter; smaller animals such as beaver, snowshoe hare and ruffed grouse (*Bonasa umbellus*) comprise relatively small percentages of winter wolf diet (Huntzinger et al. 2004). Other food items known to have been eaten by wolves in the UP include domestic livestock, shrews, squirrels, mice, crayfish, insects, berries and grass (Stebler 1944, 1951, B. Roell, Michigan DNR, personal communication).

3.8 Ecological Function

Wolves are top predators and can have a major influence on the ecological systems in which they live (Mech and Boitani 2003*b*). Primary effects of wolves can include the removal of weak, sick or otherwise vulnerable individual prey, local influences on prey numbers, and increased availability of food for scavengers (Mech 1970). Wolves may also limit populations of competitors such as coyotes (Crabtree and Sheldon 1999). These primary effects can also cause changes (indirect effects) in other elements of the ecosystem. These indirect effects have been termed 'trophic cascades' (Paine 1966) because changes at one trophic level (e.g., carnivores such as wolves) cause changes at another trophic level (e.g., herbivores such as deer).

Trophic cascades can be either 'bottom-up,' wherein changes at lower trophic levels affect higher levels, or 'top-down,' such as when predators cause changes at lower levels. The relative importance of bottom-up versus top-down processes can vary depending on local circumstances. The mechanism that starts a trophic cascade may be direct (e.g., wolves limit prey numbers; McLaren and Peterson 1994), or indirect (e.g., the risk of wolf predation causes a change in ungulate behavior and browsing patterns; Ripple and Beschta 2004). On Isle Royale, McLaren and Peterson (1994) documented a top-down trophic cascade among wolves, moose and balsam fir (*Abies balsamea*). In this system, wolves controlled moose numbers and moose controlled growth of balsam fir. A similar relationship may be occurring in Yellowstone National Park as a result of the reintroduction of wolves. Some researchers have reported that wolf predation on elk (*Cervus elaphus*) is allowing several tree species, which were formerly limited by elk browsing, to recover (Ripple and Larsen 2000, Ripple et al. 2001, Ripple and Beschta 2003). However, more recently some scientists have questioned whether wolves are the most important factor causing trophic cascades and whether adequate evaluation of these hypotheses has occurred (see review by Mech 2012, Peterson et al. 2014).

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3.9 Wolf Habitat

Wolves are habitat generalists and have the potential to occupy areas with an adequate abundance of hoofed prey (Fuller 1995). Given sufficient prey, the chance of an area being occupied and the number of wolves that could be supported is related to the proximity of source populations and the extent of human-caused mortality (Fuller 1995).

Road density has been used as an index of wolf–human contact and appears to be related to illegal and accidental killing of wolves (Mladenoff et al. 1995). Mladenoff et al. (1995) developed a spatial habitat model based on road density that predicted wolves would be unlikely to occupy areas with greater than 0.72 miles of roads per square mile (0.45 km/km^2). Although the model successfully predicted wolf occupancy in northern Wisconsin (Mladenoff et al. 1999), its predictions for the UP were questionable because areas of low deer density (Doepker et al. 1995) that were unlikely to be occupied by wolves were identified as suitable habitat.

Potvin et al. (2005) developed a spatial habitat model for the UP that incorporated measures of both road density and deer density. This model identified a road-density threshold of 1.1 mi/mi^2 (0.7 km/km^2) and a deer-density threshold of 6–15 deer/mi^2 (2.3–5.8 deer/km^2). The deer-density threshold is near the point where wolves become nutritionally stressed (Messier 1987).

The two models produced similar estimates of habitable area (Mladenoff et al. 1999: 11,331 mi^2 or 29,348 km^2; Potvin et al. 2005: 10,695 mi^2 or 27,700 km^2) but differed in how the suitable habitat was distributed. The Mladenoff et al. model predicted many areas in the northern portion of the UP would be occupied, whereas the Potvin et al. model predicted that most habitat occupied by wolves would occur in the southern portion of the UP, where deer densities tend to be higher.

Using an earlier version of the Potvin et al. (2005) model, Potvin (2003) estimated the northern LP contained approximately 3,089 mi^2 (8,000 km^2) of suitable wolf habitat. Gehring and Potter (2005) applied the Mladenoff et al. (1995) model to the northern LP and estimated 1,634 mi^2 (4,231 km^2) of suitable habitat was available. Both modeling efforts indicated wolf habitat is more fragmented in the northern LP than in the UP.

4. WOLVES IN MICHIGAN

4.1 History

Wolves have been part of the Great Lakes fauna since the melting of the last glacier and as such are native to the land area known as Michigan. Stebler (1951) indicated that pioneer documents and museum specimens show wolves were once present in the areas of all present-day Michigan counties.

Throughout the history of aboriginal peoples of present-day Michigan, wolves figured prominently in Tribal culture and beliefs. For example, the wolf is a sacred clan animal among the Anishinaabe (Odawa, Ojibwe and Potawatomi) people. In the Anishinaabe creation story,

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Maahiingun (the wolf) is a brother to Nanaboozhoo (half man/half spirit); Gzhemnidoo (the Creator) instructed Maahiingun and Nanaboozhoo to travel together to name and visit all the plants, animals and places on earth; later, Gzhemnidoo instructed them to walk their separate paths, but indicated each of their fates would be always tied to that of the other; they would be feared, respected and misunderstood by the people that would later join them on earth (see 6.8 for a more-detailed account of the story of Maahiingun and Nanaboozhoo).

Settlers brought their wolf prejudices with them (Lopez 1978). European werewolf mythology, fairy tales, and religious beliefs, along with views that wolves were incompatible with human civilization, resulted in the persecution of wolves in Michigan as well as the rest of the United States. This practice led to the near-extermination of wolves in the contiguous United States.

The United States Congress passed a wolf bounty in 1817 in the Northwest Territories, which included what is now Michigan. A wolf bounty was the ninth law passed by the first Michigan Legislature in 1838. A wolf bounty continued until 1922, when it was replaced by a State-paid trapper system. The bounty was reinstated in 1935 and repealed in 1960, only after wolves were nearly eliminated from the State. Michigan wolves were given legal protection in 1965 (Beyer et al. 2009).

By the time bounties were imposed in the 1800s, wolves were nearly extirpated from the southern LP. They were absent from the entire LP by 1935, if not sooner (Stebler 1944). In the more sparsely settled UP, the decline was less precipitous. In 1956, the population was estimated at 100 individuals in seven major areas in the UP (Arnold and Schofield 1956). The Michigan wolf population was estimated at only six animals in the UP in 1973. Sporadic breeding and occasional immigration of wolves from more-secure populations in Ontario and Minnesota were postulated as the factors that maintained the small number of wolves in the UP (Hendrickson et al. 1975). It is likely that a few animals persisted in remote areas of the UP and that wolves were never completely extirpated from the State.

In the early 1970s, the wolf population in Minnesota began to expand southward from its northern range. In 1975, a pack of wolves occupied a territory that spanned the Minnesota–Wisconsin border (Thiel 1993), signifying the beginning of re-colonization of former wolf range in Wisconsin. After 1975, the wolf population in Wisconsin expanded into suitable habitat across the northern Wisconsin counties (Wydeven and Wiedenhoeft 2005). In the 1980s, wolves from Minnesota and Wisconsin began to re-colonize the western and central portions of the UP (Thiel 1988, Mech et al. 1995, (Beyer et al. 2009)). In addition, wolves from Ontario may have crossed into the UP over ice at Whitefish Bay, along the St. Mary's River, and near northern Lake Huron islands (Jensen et al. 1986, Thiel and Hammill 1988). The beginning of wolf recovery in Michigan was first documented in 1989 when a pair established a territory in the central UP (Beyer et al. 2009).

Only one wolf reintroduction was attempted in Michigan. Four wolves from Minnesota were released in Marquette County in March 1974 and all died as a result of direct human activities between July and November 1974. These wolves did not reproduce and did not contribute to the current wolf population (Weise et al. 1975). The wild wolves that currently occur in the UP are the result of natural immigration and reproduction.

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4.2 Recent Population Size and Distribution

The wolf population in the UP (excluding Isle Royale) showed mostly steady growth from 1989 to 2009 (Figure 4.1). From 1994 to 2007, the population grew at an average annual rate of 19%. From 2003 to 2007, the average annual growth rate was 12%. The growth rate is expected to decline as the population moves toward the maximum level the UP can sustain (Huntzinger et al. 2005). Population estimates have not significantly changed since 2011. An estimated 636 wolves occurred on the UP mainland during the winter of 2014.

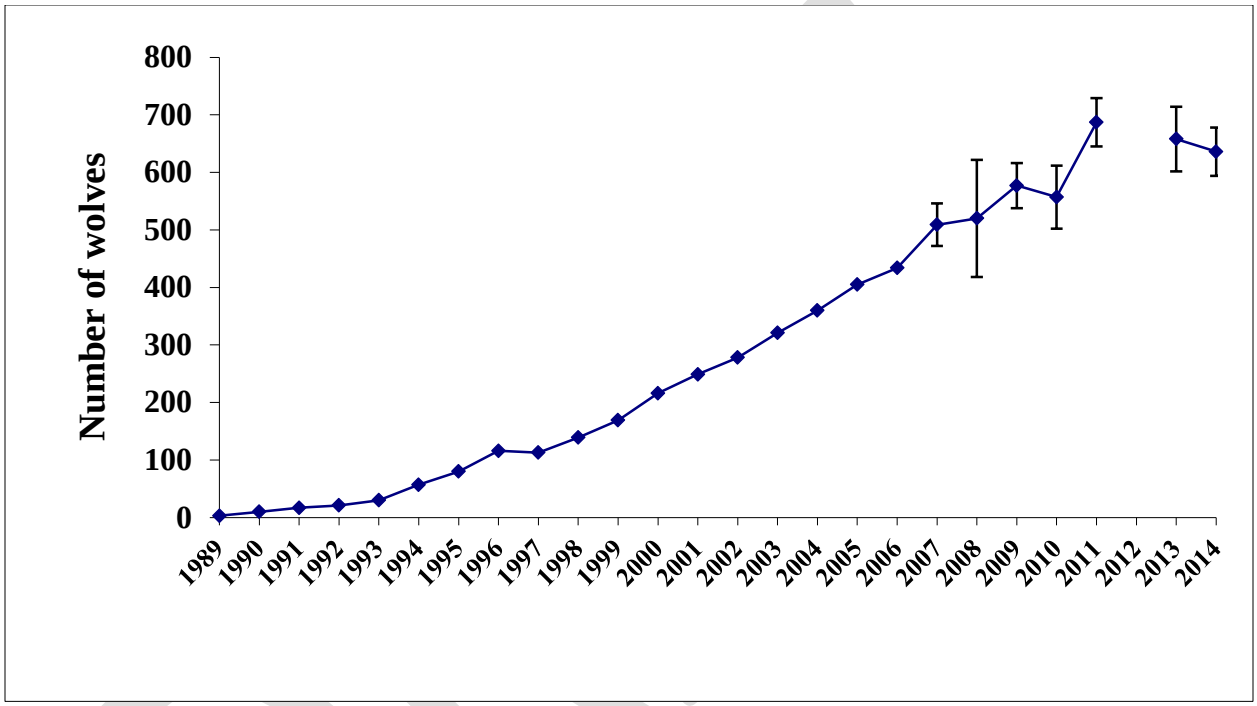

Figure 4.1. Minimum winter estimates of the number of wolves in Michigan's Upper Peninsula (excluding Isle Royale), 1989–2014. Prior to 2007, the entire Upper Peninsula was searched; starting in 2007, a stratified sampling plan was used. Error bars represent the 95% confidence limits on survey estimates from 2007-2014. No survey was conducted in 2012.

Wolves have been found in every county of the UP, but some years they have been absent from Keweenaw County (excluding Isle Royale) during the population surveys. Wolf density has been higher in the western UP (approximately 13-15 wolves/1000 km^2 in 2014) than in the eastern UP (approximately 10-11 wolves/1000 km^2 in 2014). Wolves may not be able to establish year-round territories in the deep-snow areas of the northern UP because of low deer densities during the winter (Potvin et al. 2005).

In October 2004, a wolf that had been captured and radio-collared in the eastern UP was captured and killed by a coyote trapper in Presque Isle County of the LP. This event represented the first verification of a wild wolf in the LP in at least 69 years. However, winter track surveys during 2005-2010 failed to indicate the presence of any wolves in the LP.

In 2010, 3 young of-the-year canids were captured in Cheboygan County of the northern LP and initially identified as wolf pups based on dentition, size (especially length of legs and size of the feet and toes) and weight (Wheeldon et al. 2012). Genetic analyses indicated, however, the pups were coyotes rather than wolves. In addition, the analyses found evidence of maternal introgression from a Great Lakes wolf (hybrid heritage from gray wolves and eastern wolves) in their pedigree. The disagreement between the physical appearance of these animals and the genetic assignment indicates the Department should use genetic testing to validate classifications based on appearance or tracks until wolves have re-established themselves in the LP in significant numbers (Wheeldon et al. 2012).

During the 2011 winter track survey, and shortly after the 2015 survey period, tracks consistent with a wolf-like animal were observed in Cheboygan and Emmet Counties, respectively; while track surveys in 2013 failed to produce any evidence of wolves. Although it is possible that wolves occur in the LP, as of April 2015, no genetic verification exists.

4.3 Isle Royale

Wolves first appeared on Isle Royale in the late 1940s, when a wolf pair or two lone wolves crossed the ice from either Minnesota or Ontario (Mech 1966, Peterson 1995). There is no physical evidence that wolves occurred on the island prior to this period, but research on that topic has been limited. Wolves arrived on the island to find a substantial moose population, which became their primary food source. Formal monitoring of the moose and wolf populations began in 1958.

The wolf and moose populations on the island followed a pattern of dynamic fluctuations, wherein high moose numbers (particularly older moose) were followed by high wolf numbers. Wolves influenced moose numbers predominantly through the direct killing of calves and have remained the only consistent source of moose mortality on the island. The moose–wolf population patterns held until a dramatic crash occurred in the wolf population in the early 1980s, during which wolf numbers dropped from 50 to 14. Circumstantial evidence suggests the decline in wolf numbers was related to the introduction of canine parvovirus (Peterson 1995*a*, Kreeger 2003). Wolf reproduction progressively declined during 1985–1992 and numbers dropped to their lowest level (12 animals). During the next decade, the wolf population increased slowly. It reached 30 animals in 2005, and included the same number in 2006 (Peterson and Vucetich 2006). In 2007, the wolf population declined to 21 animals, most likely due to lack of food. (Vucetich and Peterson 2007). The wolf population remained above 20 animals until 2010 when the population began declining reaching the lowest level ever recorded at 8 animals in 2013. Scientists studying the population believe the decline in wolf abundance is related to the effects of inbreeding and have recommended introducing new wolves as a form of genetic rescue (Vucetich and Peterson 2014).

Isle Royale was established as a national park in 1940, and protection of the native flora and fauna is the primary management goal for the area. Management of the Isle Royale wolf population is guided by National Park Service (NPS) policy and ongoing research. Currently, there is not agreement among scientists representing NPS management, wolf ecologists, disease and genetics

experts, and conservation-biology specialists on what, if any, management actions the NPS should take in response to the low wolf abundance.

5. WOLF MANAGEMENT GOALS

The principal goals of this plan are fourfold: 1) maintain a viable Michigan wolf population above a level that would warrant its classification as threatened or endangered; 2) facilitate wolf-related benefits; 3) minimize wolf-related conflicts; and 4) conduct science-based wolf management with socially acceptable methods.

To achieve those goals, the DNR must consider the complex interactions of many biological factors and implement measures that assure adequate protection and conservation of the species. At the same time, it must also address the many complex and often controversial social issues that accompany wolf management.

The public is highly polarized on wolf management, as evidenced by the tremendous amount of public input and litigation that has been associated with management decisions in the United States during the past 35 years. Stakeholder groups often have disparate or opposing views and needs regarding wolf management, and this plan reflects efforts to identify an appropriate balance among the biological needs of the species, the benefits wolves provide to some segments of society, the costs they impose on others, and the acceptability and feasibility of particular management methods. These elements reflected in the principal goals of this plan are discussed under the following headings.

5.1 Maintain a Viable Population

5.1.1 Definition of 'Viable Population'

The DNR is committed to maintaining a viable Michigan wolf population above a level that would warrant its classification as threatened or endangered at either the State or Federal level. Therefore, the Michigan wolf population must exceed criteria used to define a viable population in the *Recovery Plan for the Eastern Timber Wolf* (USFWS 1992) and the *Michigan Gray Wolf Recovery and Management Plan* (Michigan DNR 1997).

The *Recovery Plan for the Eastern Timber Wolf* indicated: "A population of at least 200 wolves . . . is believed to be large enough to be viable, as well as to have sufficient genetic diversity, to exist indefinitely in total isolation from any other wolf population" (USFWS 1992:25).
The 1997 *Michigan Wolf Recovery and Management Plan* adopted this definition of a viable isolated population as a criterion for wolf recovery in Michigan (Michigan DNR 1997). When the winter population maintained a minimum level of 200 animals for 5 consecutive years and the species was federally de-listed, wolves could be removed from the State list of threatened and endangered species.

The Michigan wolf population does not exist in isolation. Wolf movements among Minnesota, Wisconsin and Michigan are not uncommon (Mech et al. 1995, A. P. Wydeven, Wisconsin DNR,

unpublished data, B. Roell, Michigan DNR, unpublished data), and those movements enhance intra-population genetic diversity and mitigate any adverse effects of demographic and environmental fluctuations. Therefore, a Michigan wolf population connected to other populations through occasional dispersal may require fewer than 200 animals to remain viable (USFWS 1992). However, the recovery criterion of 200 wolves was adopted in the *Michigan Gray Wolf Recovery and Management Plan* to ensure the viability of the Michigan wolf population regardless of the biological status of wolves in other neighboring States and Provinces.

The minimum criterion of 200 wolves does not reflect the maximum number of wolves the available habitat in Michigan can support. Indeed, the winter population exceeded 200 wolves in 2000, and it grew each year between 2000 and 2009, at an annual rate of 11% (see Figure 4.1). During the winter of 2014, an estimated 636 +/- 42 wolves lived in the UP. Estimates of biological carrying capacity for the Upper Peninsula are imprecise and range from 600 to 1350 (Mladenoff et al. 1997, Miller et al. 2002, Potvin 2003, Van Deelen 2009).

The winter Michigan wolf population must exceed 200 animals to achieve the first stated goal of this plan. However, this minimum requirement is not necessarily sufficient to provide all of the ecological and social benefits valued by the public (see 5.2). Accordingly, 200 wolves is not a target population size. Management will be conducted to maintain the wolf population above the minimum size requirement and facilitate those wolf-related benefits while minimizing and resolving conflicts where they occur (see 5.3). This plan does not identify a target population size, nor does it establish an upper limit for the number of wolves in the State. As a result, public preferences regarding levels of positive and negative wolf–human interactions will strongly influence the extent to which wolf abundance and distribution exceed the minimum requirements for a viable population.

5.1.2 Need to Maintain a Viable Population

The DNR is committed to the conservation, protection, management, use and enjoyment of the State's natural resources for current and future generations. Since wolves have become re-established in Michigan, they have once again become an integral part of the natural resources of the State and are a component of naturally functioning Michigan ecosystems. In the context of the DNR's mission and its implicit public trust responsibilities for the State's wildlife, natural communities and ecosystems, the maintenance of a viable wolf population is an appropriate and necessary goal.

Long-term maintenance of a viable wolf population removes the need for Federal or State classification of the species as threatened or endangered. Anything that warrants subsequent reclassification would be detrimental to not only the wolf population; it would also have negative consequences for the people of Michigan. A decline in the wolf population below a viable level would reduce opportunities for positive wolf-related interactions and other benefits derived by many residents. Moreover, regulatory restrictions associated with Federal reclassification would complicate and impede some efforts to address the needs of people who experience wolf-related conflicts. Therefore, maintenance of a viable population serves the best interest of wolves and the human residents of Michigan.

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The most-recent public-attitude research shows most Michigan residents support the presence of a wolf population in the State. The format of the general-public survey coordinated by MSU in 2005 and 2006 allowed respondents to identify themselves as either interested or not interested in wolf-related issues. When 'disinterested' respondents were removed from the analysis, the percentage of respondents who approved of having wolves in the State was 73% (52% in the UP, 71% in the northern LP, and 74% in the southern LP; Beyer et al. 2006). These results indicate that maintenance of a viable wolf population is supported by the vast majority of residents who feel they have an interest and stake in the management of wolves.

5.2 Facilitate Wolf-related Benefits

5.2.1 Benefits Valued by Michigan Residents

Many Michigan residents value the diverse benefits derived from the presence of wolves (Beyer et al. 2006, Lute et al. 2012). Many of those benefits fall within five general categories.

Ecology

As top predators, wolves fill an important ecological niche (Mech and Boitani 2003*b*) and are positive indicators of environmental health. Wolves can improve natural ecosystem function by controlling prey numbers, improving the overall health of prey populations, and increasing food available to scavengers (Mech 1970). In addition, they can help control populations of secondary predators and thus have indirect effects on many trophic levels (Paine 1966, Crabtree and Sheldon 1999; see 3.8 for additional information). A study conducted in the Upper Peninsula concluded that wolves likely altered deer behavior which benefited maple growth and species richness of rare forbs (Flagel 2014). Seventy-two percent of interested Michigan residents who responded to the most-recent public-attitude survey believed ecological benefits were a 'very' or 'somewhat' important reason to have wolves in Michigan.

Cultural and religious values

Wolves are a species of great significance to many Native Americans. Today, many Native American communities in Michigan value the return of Maahiingun (the wolf) as an intrinsic spiritual component in the reaffirmation and continued viability of their own cultural well-being. Many other people value wolves for reasons that are based on personal or religious convictions. Sixty-seven percent of interested survey respondents indicated at least moderate agreement with the statement: "Regardless of our laws, wolves have a right to exist in Michigan."

Interaction with nature

The presence of wolves in Michigan provides a unique opportunity for people to interact with and experience a particular component of the natural world. The opportunity to personally observe, photograph or study wolves in the wild may be restricted to a relatively small proportion of residents, but the option for those residents to have those experiences is highly valued by society. "People want to view, hear, photograph or study wild wolves in Michigan"

was ranked by 60% of interested survey respondents as a 'very' or 'somewhat' important reason to have wolves in the State.

Personal appreciation

Independent of cultural or religious convictions, many people feel wolves have an 'existence value' and they value the knowledge that they exist as a healthy, thriving, wild population in the State. This benefit can be realized whether or not people are able to see or hear those animals. "There are people who appreciate wolves and want to know that wolves exist in Michigan" was ranked by 54% of interested survey respondents as a 'very' or 'somewhat' important reason to have wolves in Michigan.

Tourism and recreation

Forty-two percent of interested survey respondents felt the economic benefits of wolf-based tourism were a 'very' or 'somewhat' important reason to have wolves in Michigan. However, additional survey results suggested the full potential economic benefits were not being realized: the presence of wolves in an area would attract some respondents while deterring others, but more than half of respondents indicated the presence of wolves would not be a consideration when choosing a vacation area.

Fifty-five percent of interested survey respondents supported a controlled hunting season "in those areas of Michigan where wolf population could be hunted without endangering the population" and 33% of interested respondents opposed such a hunt. Forty-eight percent and 41% of interested respondents respectively supported and opposed a controlled trapping season "in those areas of Michigan where wolf population could be hunted without endangering the population." Consumptive use of wolves for hunting, trapping and fur harvest may bring additional tourism to local communities within wolf range. See Section 6.12.2 for additional details regarding implementation of a policy for a public wolf harvest for reasons other than managing wolf-related conflicts. Any promotion of tourism and recreational opportunities associated with wolves might attract a greater number of people to local communities within wolf range and thus increase the economic benefits derived from the species.

5.2.2 Providing Benefits through Management

Public support is critical for the long-term viability of a wolf population (USFWS 1992, Wisconsin DNR 1999, Bangs et al. 1995, Minnesota DNR 2001, Boitani 2003, Fritts et al. 2003). The depth and extent of that support is partially influenced by the physical, spiritual, psychological, and economic benefits provided by the population (Slovic 1987). Thus, management that enhances opportunities for positive wolf-related experiences fosters public support for the population and thus serves the best interests of both wolves and the human residents of Michigan.

This plan identifies and supports measures to promote positive wolf-related interactions. Many benefits will be provided through the maintenance of a viable wolf population. Other benefits

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may be achieved through efforts to develop and promote opportunities for people to experience and appreciate wolves.

5.3 Minimize Wolf-related Conflicts

5.3.1 Need to Minimize Conflicts

Although the wolf population offers benefits as described above, it also poses significant costs and concerns for some Michigan residents (Beyer et al. 2006). These costs include losses of domestic animals, anxieties over the presence of wolves near residential or recreational areas, and concerns over the impact wolves may be having on populations of game species. Given the unequal distribution of wolves in the State and the nature of certain types of conflicts, all segments of society do not bear these costs equally; the presence of wolves represents a greater challenge for some groups of Michigan residents than others.

Left unaddressed, sources of conflict can foster the development of negative public attitudes toward wolves, and those negative attitudes can lead to adverse impacts on wolf distribution and abundance. Indeed, negative public perception of wolves was the primary reason they were historically threatened with extinction in many areas (Mech 1970, Beaufort 1987, Thiel 1993). Negative perceptions, manifesting themselves in the form of widespread killing, nearly eliminated the species from the contiguous United States.

As stated previously, public support is critical for the long-term viability of a wolf population (USFWS 1992, Wisconsin DNR 1999, Bangs et al. 1995, Minnesota DNR 2001, Boitani 2003, Fritts et al. 2003). The risk and frequency of conflicts still influences human views and tolerance of wolves (e.g., Huber et al. 1992, Mishra 1997), and public support for a population of any large predator depends, in part, on confidence that conflicts will be resolved in a timely and effective manner (Frost 1985, Wolstenholme 1996, Beyer et al. 2006). Many researchers have suggested resolution of conflicts would allow people to tolerate greater abundance and distribution of wolves on the landscape (Bangs et al. 1995, Mech 1995, Boitani 2003, Fritts et al. 2003, Mech and Boitani 2003*a*). By contrast, a failure to address conflicts could foster negative attitudes that lead to adverse impacts on wolf distribution and abundance. Thus, effective management of wolf-related conflicts assists affected stakeholders and the wolf population as a whole.

Most Michigan residents recognize the importance of addressing wolf-related conflicts (Beyer et al. 2006). The most-recent public-attitude survey showed at least 76% of interested respondents would support some type of active wolf management to address strong public concerns regarding human-safety risks posed by wolves. At least 75% percent of interested respondents would support active management in areas experiencing high levels of wolf depredation of livestock, hunting dogs and other pets. At least 65% of interested respondents would support active management if evidence showed wolves significantly lowered the number of deer available for hunting in a particular region.

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5.3.2 Effective Conflict Management

Setting numeric goals for wolf abundance at large geographic scales (e.g., the entire State, the entire UP) may not be necessary or effective for addressing most wolf-related conflicts. Broadly based abundance goals may not reflect the unequal distribution of wolf habitat, human activity and the potential for positive and negative interactions in local areas. Moreover, wolf numbers alone do not necessarily predict the frequency of certain types of interactions. In an area of abundant natural prey and few human residences, for example, a large number of wolves could cause a relatively low level of negative interactions. Conversely, a small number of wolves could create an unacceptably high level of negative interactions in local areas where natural prey is scarce or where human population density is high. Management driven by broad numeric abundance goals would not necessarily reduce negative interactions, could unacceptably restrict positive interactions desired by the public, and could promote an inaccurate public perception regarding the relationship between wolf numbers and the risk of conflict.

Previous management experience indicates most wolf-related conflicts can be best handled on an individual basis. Conflicts in local areas are often caused by the behavior of a few individual wolves, and management at small scales can often address problems effectively. Therefore, this plan does not set broad numeric abundance goals for the purpose of managing most conflicts. To the extent it is expected to be effective and logistically feasible, management under this plan will be conducted to prevent and minimize conflicts on a local rather than landscape level.

5.4 Conduct Science-based and Socially Acceptable Management

Science allows managers to predict consequences of particular management actions. It is a tool of primary importance for identifying those actions that could effectively achieve particular wildlife management goals. The importance of using sound science when making wildlife management decisions is formalized in the Michigan Natural Resources and Environmental Protection Act (Part 401 of Public Act 451 of 1994).

Science can identify probable outcomes of particular management approaches, but as an objective process, it does not prescribe subjective values to those outcomes. Rather, the desirability or acceptability of any outcome depends on the values of affected stakeholders. Moreover, when disagreements originate from differences in values rather than questions of fact, consideration of the available science alone will not be sufficient to resolve conflict. Consequently, a process of social deliberation is often necessary to determine which science-based management approaches are acceptable to individual stakeholder groups and society at large.

This plan outlines approaches for managing many wolf-related issues. These approaches were chosen, in part, based on scientific evaluation of their potential impacts to the wolf population, their feasibility, and their probability of success. In addition, they were chosen because they appear to be acceptable to most Michigan residents. They are not expected to satisfy everybody; indeed, satisfying everybody with any single wolf management approach is not possible. However, the approaches outlined in this plan were supported by a majority (often a strong majority) of interested respondents to the most-recent public-attitude survey (Beyer et al. 2006),

and they directly reflect the guidance collectively offered by the diverse interests represented on the Michigan Wolf Management Roundtable.

6. WOLF MANAGEMENT STRATEGIES

The following wolf management strategies will be implemented to achieve the principal goals of this plan. They provide guidance for the management of several wolf-related issues at the strategic level; they do not outline operational details of wolf management in Michigan. Operational details will be specified within an adaptive-management framework, in which specific management methods are routinely adjusted and updated as local conditions, technology, and feasibility of individual management techniques change.

The ensuing headings indicate strategic goals (in bold; e.g., **6.1**), objectives (underlined; e.g., 6.1.1) and actions. They partition broad needs into manageable segments, and thus provide a structure for addressing individual management issues.

6.1 Increase Public Awareness and Understanding of Wolves and Wolf-related Issues.

Researchers, managers and stakeholder groups generally agree an informed public is important for successful wolf conservation and management (Fritts et al. 2003). State and Federal wolf plans (e.g., USFWS 1992, Michigan DNR 1997, Wisconsin DNR 1999) frequently identify education and outreach as a high priority. At the series of wolf-focused public meetings hosted by the DNR in May 2005, a large proportion of public comments underscored the need for an effective information and education program focused on wolves.

Although the need for an effective wolf-based education program is widely recognized, development of such a program is not a simple task. Strong public opinions, the controversial nature of many issues, and other barriers present agencies and other education partners with several challenges.

Wolves, perhaps more than any other wildlife species, tend to elicit strong emotions among stakeholder groups and the general public (Meadow et al. 2005), and personal views of wolves are often based on core beliefs, which are resistant to change (Fulton et al. 1996). Therefore, the presentation of information alone is not always effective at influencing personal perceptions and opinions (Meadow et al. 2005). Moreover, individuals tend to selectively accept and recall information that is consistent with their existing attitudes (Olson and Zanna 1993, Petty et al. 1997). Similarly, people may interpret new information in ways that support their existing attitudes (Petty et al. 1997).

Another challenge of a wolf-based education program is to present information that is not biased toward a particular point of view. Fritts et al. (2003: 297) cautioned that "there are important and critical differences between objective wolf education and wolf advocacy or activism." Different groups may find difficulty agreeing on the focus of an education program, or even on the facts to be presented, because ethical and subjective values are often involved. However, the

presentation of accurate, unbiased information is especially important when education is used as a tool to help resolve wolf-related conflicts among stakeholders.

A third challenge involves popular presentations of wolf-related issues. Controversy tends to receive attention, and the public may receive inaccurate or exaggerated impressions of the extent of wolf-related conflicts (Mech 1995, Bangs and Fritts 1996). In addition, misinformation can spread quickly through a variety of media.

The following objectives have been identified to help overcome many of the challenges identified above. To the extent the objectives are achieved, public awareness and understanding of wolves and wolf-related issues are expected to increase.

6.1.1 Coordinate with management partners to develop and implement a wolf-based information and education program.

Coordinating an education program in cooperation with management partners (e.g., other agencies, tribes and private organizations) is the most-effective way to overcome many challenges and barriers. Coordination can help identify target audiences, information needs, and the educational approaches that may be most effective. Partnership with multiple organizations and stakeholder groups can also lend credibility to educational materials and help ensure those materials present unbiased, accurate information. A coordinated program that involves the media can foster the presentation of accurate information to broad audiences.

Coordination also facilitates the involvement of partners who possess the expertise and resources necessary to develop and implement an effective program. Therefore, it can accelerate the development and distribution of educational materials that address the specific needs and interests of particular target audiences. It can also facilitate the organization of wolf-based events and programs, and thus expand opportunities for people to personally experience and appreciate wolves. In these ways, a coordinated education program can maximize the available tools and opportunities for increasing public awareness and understanding.

Actions:

1. Work with management partners to identify target audiences and information and educational needs.
2. Work with management partners to develop and distribute materials that address the needs and interests of target audiences.
3. Work with management partners to develop and deliver presentations that address the needs and interests of target audiences.
4. Work with management partners to coordinate wolf-based programs and events.
5. Work with media to present accurate information to broad audiences.
6. Invite public and media participation in wolf-related projects.

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7. Support efforts of management partners to provide positive wolf-related experiences.

6.1.2 Provide timely and professional responses to information requests.

Providing prompt and professional responses to information requests is one way to increase individual understanding, dispel misconceptions, and generate support for wolf management efforts. A clear process for responding to information requests will facilitate efforts to achieve this objective.

Actions:

1. Increase public awareness regarding where to find and request information regarding wolves.
2. Refine procedures for responding to a broad range of information requests.
3. Train staff on response procedures.

6.1.3 Support training opportunities for staff and management partners involved in the wolf-based information and education program.

Agencies and other management partners can provide the public with accurate information only to the extent they understand wolf-related issues themselves. Therefore, opportunities for personnel to attend regional wolf management meetings, to participate in training, and to review relevant scientific publications are important for an effective education program.

Actions:

1. Provide staff with the training and information resources necessary for effective participation in the information and education program.
2. Share information with management partners to facilitate understanding of current wolf-related issues.

6.1.4 Evaluate the effectiveness of the wolf-based information and education program.

During recent decades, much attention has been given to wolves through a variety of media. Publication of wolf-related research in scientific literature has become increasingly common (Fritts et al. 2003). Conservation organizations and centers have focused on educating the public about wolves. In addition, numerous websites, books, documentaries, magazines and other media reports have provided the public with information on wolves. The DNR has engaged and continues to engage in several wolf education and outreach activities (Beyer et al. 2006).

Despite the great availability of information, the general public still holds many misconceptions about wolves. Mertig (2004) found that Michigan survey respondents generally had poor

knowledge of wolves, noting that public understanding had not improved significantly during the 12-year period following re-establishment of the wolf population in the UP. The persistence of misconceptions and lack of knowledge in the face of abundant information underscores the need to evaluate the effectiveness of any education program.

Action:

1. Work with partners to develop and implement methods to evaluate the information and education program.

6.2 Maintain Active Research and Monitoring Programs to Support Science-based Wolf Management.

As wide-ranging and often controversial components of a large and complex Great Lakes ecosystem, wolves present many complicated management challenges. As a result, the role of science is especially important in the management of the species. Management decisions can have serious biological and social consequences and are often scrutinized by affected stakeholders. To conduct responsible management and earn credibility among the public, agencies must make decisions that are scientifically defensible.

Wolf management in Michigan has regularly benefited from research and management experience from other parts of the world. However, wildlife managers in Michigan cannot always rely on work conducted elsewhere due to differences among local biological and social environments. For example, the experiences of managing wolves in Alaska, Canada or Italy are not always readily applicable to Michigan on account of differences in human density, infrastructure, habitat, wildlife communities, regulations, and public attitudes. In addition, the management environment changes constantly, and scientific information must be regularly updated to reflect current conditions.

In many instances, the Michigan Wolf Management Roundtable felt the available science was inadequate to guide its recommendations for wolf management. For example, the Roundtable identified needs for more research regarding the interactions between wolves and humans, the dynamics of wolf–ungulate systems, management options to address wolf-related conflicts, and the relationship between wolf population size and wolf-related conflicts. As a result, the Roundtable recommended that the DNR place a high priority on wolf-related research. These research topics have been and continue to be priority research topics since the 2006 Wolf roundtable recommendations.

The following objectives and actions address the need to maintain active wolf research and monitoring programs in Michigan. These programs will investigate and integrate the biological and social questions associated with wolf management and thus improve the ability of wolf managers to make decisions that are based on sound science.

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6.2.1 Monitor the abundance of wolves in Michigan.

To determine whether the population remains viable and above the Federal recovery goal, the USFWS will use data collected by State agencies and other partners to closely evaluate the status of wolves in Michigan. Annual estimates of wolf abundance occurred from 1990 through 2011. In 2011, the DNR determined that bi-annual abundance estimates were adequate to meet monitoring needs and, in addition, would result in staff time and monetary savings. After Federal delisting, estimates of wolf abundance will facilitate the Fish and Wildlife Service's evaluations of wolves during at least a 5-year period. After that period, the frequency and/or necessary precision of wolf abundance estimates may change depending on the type of management actions implemented and the relative size of the wolf population.

Actions:

1. Estimate wolf abundance bi-annually for at least 5 years after Federal de-listing.
2. After wolves in Michigan have been federally de-listed for 5 years, assess the frequency and intensity of wolf abundance monitoring necessary to support the wolf management program.
3. Conduct monitoring to assess wolf presence in the northern LP using genetic testing.

6.2.2 Monitor the health of wolves in Michigan.

In Michigan, wolves have been or could be affected by several diseases and parasites (see 6.6 for additional information). Exposure to some diseases and parasites is continuous, and the wolf population has had the opportunity to develop individual or collective immunity to some of the more-common agents over time (Gillespie and Timoney 1981). Other diseases and parasites can be significant sources of mortality for wolves, but they are generally not considered to be limiting at the population level. Although a study in Minnesota provided circumstantial evidence that canine parvovirus may effect rates of wolf population growth and colonization via increased pup mortality (Mech et al. 2008). In general, diseases and parasites are not expected to threaten the long-term viability of the wolf population (Kreeger 2003). However, the DNR will continue to monitor their prevalence and their impacts on Michigan wolves. Approaches for monitoring wolf health are outlined under 6.6.1.

6.2.3 Investigate biological and social factors relevant to wolf management.

Recent wolf research often focused on factors associated with the biological recovery of the species. As a result, many important biological and social questions regarding wolf management after recovery remain unanswered. An active wolf research program in Michigan could help answer these questions by focusing on two broad areas: 1) wolf ecology and the biological impacts of particular management approaches; and 2) attitudes of Michigan residents toward wolves and their management.

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Actions:

1. Determine wolf population responses to selected management options.
2. Investigate the relationships between wolf and prey populations.
3. Periodically monitor public attitudes on wolves and investigate factors that influence public tolerance for wolves.
4. Assess public responses to selected wolf management practices (e.g., information and education activities, depredation-control measures).

6.2.4 Coordinate with partners to support a wolf research program.

In Michigan, an established network of research partners works in a coordinated manner to investigate questions regarding wolves and their management. Although these partners effectively conduct many types of research, the expertise required to investigate particular questions may sometimes be found in agencies, organizations and institutions outside the established network. Accordingly, the network will continue to expand to ensure the best possible expertise is applied to particular research questions.

In addition to allowing application of the best available expertise, coordination with research partners increases the funding and staff that are potentially available to support wolf research. Funding and staff available to the DNR alone are not sufficient to study all the important questions related to wolves. Thus, collaboration with a greater number of partners could accelerate the rate at which those questions are answered.

Actions:

1. Expand and maintain cooperative relationships with agencies, organizations and institutions interested in investigating biological, ecological and social questions regarding wolves and their management.
2. Seek funding from additional sources to complement agency contributions.

6.3 Enact and Enforce Regulations Necessary to Maintain a Viable Wolf Population.

Legal protection under Federal and State regulations was a key component in the biological recovery of wolves in Michigan and other areas of the Midwest. Although protection of Michigan wolves under the Federal Endangered Species Act is no longer warranted (USFWS 2007, 2011), legal protection remains necessary to help ensure the long-term persistence of a viable population. The following objectives focus on providing adequate legal protection, informing the public on regulations, and investigating and penalizing wolf-related violations.

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6.3.1 Ensure adequate legal protection for wolves.

Options for general protection under State regulations involve designation of wolves as endangered, threatened, game, or protected animals. Any of those four designations would prohibit a person from taking (which includes killing or otherwise harming), selling or purchasing wolves, except under permit, license, or certain specified conditions. The Michigan Natural Resources Environmental Protection Act (Public Act 451 of 1994) defines each of those designations as follows.

'Endangered species means any species of fish, plant life, or wildlife that is in danger of extinction throughout all or a significant part of its range, other than a species of insecta determined by the [Michigan DNR] or the secretary of the United States [D]epartment of the [I]nterior to constitute a pest whose protection . . . would present an overwhelming and overriding risk to humans.'

'Threatened species means any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.'

'Game' is defined as a list of species that currently hold that designation. The definition does not reference permissible and restricted activities associated with such a designation. Game-animal status allows but does not require the establishment of a regulated harvest season.

'Protected animal means an animal or kind of animal designated by the [Michigan DNR] as an animal that shall not be taken.'

Wolves in Michigan have surpassed State and Federal population recovery goals for 15 years, and no longer warrant Threatened or Endangered Status in Michigan. In April 2009, wolves were removed from the State Threatened and Endangered Species list and given protected animal status. On two separate occasions, once in 2012 and once again in 2013, wolves were classified as game animals in Michigan. The laws that allowed these classifications were repealed by public referendum in November of 2014. However, in August of 2014, citizen initiated legislation then again classified wolves as game animals. Furthermore, this legislation added the authority to classify species as game animals to the NRC's already existing authority to decide if a game species will be hunted, and the parameters around a regulated harvest. The effective date of the citizen initiated legislation is March 31, 2015.

Taking into account the current Federal and State legal status, regulations will be reviewed, modified or enacted as necessary to provide the wolf population with appropriate levels of protection.

Actions:

1. Re-classify wolves as endangered or threatened under State regulations if population size declines to 200 or fewer wolves.
2. Review, modify, recommend, and/or enact regulations, as necessary, to ensure appropriate levels of protection for the wolf population.

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3. If necessary to avoid a lapse in legal protection, amend the Wildlife Conservation Order to designate wolves as a protected animal.

6.3.2 Inform the public on regulations pertaining to wolves.

The Federal and State legal classifications of wolves has changed several times during the last decade. Wolf legal status may continue to change beyond the finalization of this plan. Frequent regulation changes can create public confusion regarding permissible and prohibited activities. Public education on prevailing regulations could help reduce such confusion and prevent inadvertent violations.

Actions:

1. Provide the public with information on wolf regulations as part of a wolf-based information and education program (see 6.1.1).

6.3.3 Investigate and penalize violations of wolf regulations.

To help deter wolf-related crimes, the DNR will make its best efforts to investigate violations and to pursue the appropriate penalties based on available evidence. Achieving this objective will require an efficient system for receiving and directing reports of violations, clear investigation procedures, and adequate training of staff.

Actions:

1. Increase public awareness regarding where to report suspected violations of wolf regulations.
2. As necessary, update and refine procedures for investigating violations of wolf regulations.
3. Train field staff on investigation procedures.
4. As appropriate, issue and pursue penalties for violations of wolf regulations.
5. Recommend modification of law, at the State level, to make penalties for illegally killing a wolf commensurate with other highly valued species with similar legal status (endangered, threatened, game, or protected animals).

6.4 Maintain Sustainable Populations of Wolf Prey.

Wolves prey on a variety of wildlife species (see 3.7 for additional information), and the importance of particular species as wolf food sources often varies seasonally and geographically (Voigt et al. 1976, Fritts and Mech 1981, Potvin et al. 1988, Fuller 1989, Mech and Peterson 2003). In Michigan, the primary prey for wolves during winter is white-tailed deer (Huntzinger et al. 2004, Vucetich et al. 2012), and adequate deer densities are necessary for the long-term

persistence of a viable wolf population. Other prey, such as beaver, snowshoe hare and other small animals, are an important complement to deer in the diet of Michigan wolves (Huntzinger et al. 2004).

Many Michigan residents view the natural dynamics of wolf–prey relationships in a positive way (Beyer et al. 2006). Seventy-two percent of interested Michigan residents who responded to the most-recent public-attitude survey believed a 'very' or 'somewhat' important reason to have wolves in Michigan was reflected by the following statement: "As predators, wolves could benefit Michigan's ecosystem by helping to control some other wildlife populations."

Despite general appreciation for the ecological role of wolves, some Michigan residents are concerned about the impacts of wolves on populations of deer and other wildlife (Beyer et al. 2006). They are concerned wolf predation may have adverse ecological consequences by reducing wildlife populations below sustainable levels. Some residents are also concerned wolf predation will reduce opportunities for hunting, trapping and other wildlife-based benefits.

The following objective addresses the need to ensure the persistence of healthy wildlife populations, especially white-tailed deer, in order to simultaneously provide for abundant hunting opportunities, and the associated economic activity with hunting-based tourism, and adequate prey for wolves.

6.4.1 Maintain prey populations required to provide for sustainable human uses and a viable wolf population.

Several studies have estimated the average number of deer killed per year by individual wolves. Some research indicates an individual wolf may kill roughly 15–19 deer per year (Mech 1971, Keith 1983, Fuller 1989), whereas other research indicates a single wolf may kill as many as 37–50 deer per year (Pimlott 1967, Huntzinger et al. 2004). Some amount of scientific uncertainty accompanies each of these estimates. This uncertainty derives from limitations of particular estimation techniques as well as geographic and temporal variability in kill rates (Vucetich et al. 2012). Additional research is necessary to refine estimates of the numbers of deer killed by wolves in Michigan.

Wolf–prey interactions are dynamic and complex. They are influenced by many factors, including the relative densities of wolves and prey, the responses of both wolves and prey to fluctuations in prey densities, and the effects of environmental conditions on wolves and prey (Mech and Peterson 2003). Each of these factors varies geographically and temporally, and the impacts of wolves on prey populations depend on local conditions. In some situations, wolves may significantly reduce local prey populations, whereas in others, the impact may be negligible (Mech and Peterson 2003). Thus, there is no general answer to the question of how wolves affect prey densities.

Prey and predators coevolved. As a result, prey possesses physical and behavioral adaptations for avoiding predation (Mech and Peterson 2003). Adaptive behavioral shifts that cause deer to become more elusive to predators also may reduce deer sightability by humans and contribute to a public perception that deer populations have been heavily impacted by wolf predation. Despite

these common perceptions, however, the efficacy of such adaptations generally allows prey populations to be sustained, even in areas with robust predator populations.

Moreover, wolf predation may be compensatory to those other sources of mortality. In other words, mortality caused by predation may replace mortality that would have otherwise occurred. Evidence that wolves tend to kill weak, sick or otherwise vulnerable individuals supports the notion that wolf predation is at least partially compensatory (Mech and Frenzel 1971**,** Fritts and Mech 1981, Huntzinger et al. 2004), but the extent of such compensation in wolf–deer systems is unknown. Additional research is necessary to assess the compensatory nature of predator-induced deer mortality in Michigan.

Deer populations in Michigan are managed for a variety of social values including providing an adequate number of deer to meet the demand for recreational hunting. Regardless of whether the average deer kill rate by wolves occurs at or even somewhat above the high end of the existing estimates, the number of deer required on the landscape to meet these societal values means the number of deer has not been, and is not predicted to be, a limiting factor in maintaining a viable wolf population in Michigan. Nor is wolf predation alone expected to significantly reduce the number of deer and other prey available for public harvest or other human uses across the landscape. Furthermore, deer populations in Michigan, and especially the UP, are heavily influenced by the severity of winter weather. Given this reality, there will be times that the number of deer will fluctuate significantly and wolf numbers are also expected to fluctuate.

Management activities that maintain deer and other prey at numbers similar to those that occurred in the UP during the past decade would continue to sustain opportunities for recreational hunting, and the associated economic activity it provides, while ensuring a prey base that is more than adequate to maintain a viable wolf population. These management activities will be planned and implemented at several geographic scales (e.g., statewide, management unit, and deer management unit). In addition, the DNR will work with partners to educate the public about the ecological role of wolves and to further research the dynamics of wolf–prey interactions.

Action:

1. Ensure management of deer and other prey populations at multiple geographic scales addresses the need to provide sufficient food for wolves.
2. Manage white-tailed deer in a sustainable manner to yield healthy fawns, does and bucks without negatively impacting habitat, other wildlife species, or creating undue hardship to private interests.
3. Conduct management activities to provide for public harvest of deer and other prey species.
4. Understand distribution and abundance of beaver in the UP and the role they play as prey for wolves.

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5. Provide the public with information on wolf–prey interactions and the impacts of wolves on prey populations as part of a wolf-based information and education program (see 6.1.1).
6. Support research to investigate wolf–prey interactions and the impacts of wolves on prey populations (see 6.2.3).

6.5 Maintain Habitat Necessary to Sustain a Viable Wolf Population.

Wolves occupy a broad range of habitat types and do not require wilderness areas, as previously believed (Mech 1995). The suitability of any particular habitat is generally related to the availability of ungulate prey and the extent to which human-caused mortality can be avoided (Fuller 1995; see 3.8 for additional information).

Road density has been used as an index of wolf–human contact and appears to be related to illegal and accidental killing of wolves (Mladenoff et al. 1995). Using models that incorporated measures of deer density and/or road density, researchers recently estimated that approximately 11,000 square miles of suitable wolf habitat occurred in the UP (Mladenoff et al. 1995, Potvin et al. 2005) and approximately 1600–3,000 square miles of suitable habitat occurred in the LP (Gehring and Potter 2005, Potvin 2003).

The current amount of available wolf habitat is expected to be sufficient to allow the long-term persistence of a viable wolf population. Moreover, the amount of suitable habitat is expected to remain adequate into the foreseeable future. Based on an assessment of several factors, including land ownership and stability of protection, rates of land-use conversion, and changes in human and road density, Hearne et al. (2003) predicted the suitable habitat expected to be available in Michigan and northern Wisconsin in 2020 would be sufficient to maintain a viable population.

To ensure the continued availability of sufficient habitat, management will focus on three areas: 1) maintaining habitat necessary to sustain adequate levels of wolf prey; 2) maintaining wolf habitat linkages; and 3) minimizing disturbance at known active wolf den sites.

6.5.1 Maintain habitat necessary to sustain adequate levels of wolf prey.

As stated previously, prey availability strongly influences the suitability of an area for wolves. Therefore, many wolf habitat needs will be met through the maintenance of habitat for sufficient levels of wolf prey, primarily white-tailed deer. Approaches for managing prey populations are outlined under 6.4 (Maintain Sustainable Populations of Wolf Prey).

6.5.2 Maintain habitat linkages to allow wolf dispersal.

Wolf recovery in the UP began with immigration of wolves from Minnesota, Wisconsin and Ontario (Thiel 1988, Mech et al. 1995). Migration and gene flow among these areas help to preserve or enhance genetic diversity within populations and to mitigate the detrimental effects of random demographic fluctuations and environmental catastrophes (Simberloff and Cox 1987,

Boitani 2000). Thus, continued movement of wolves within and among jurisdictions will help ensure the long-term viability of the wolf population.

Wolves are effective dispersers (Forbes and Boyd 1997, Treves et al. 2009), and existing habitat linkages among the UP, Wisconsin and Minnesota appear to be adequate to allow long-distance movements. Between 2000 and 2014, researchers documented the movements of at least 38 marked wolves between the UP and either Minnesota or Wisconsin (B. Roell, Michigan DNR, unpublished data). In addition, there is evidence that wolves have moved between the eastern UP and Canada (Jensen et al. 1986, Thiel and Hammill 1988, B. Roell, Michigan DNR, unpublished data).

The types of landscape features that represent barriers to wolf movements are poorly understood. Long-distance movements of wolves through human-dominated landscapes in Minnesota and Wisconsin suggest highways and roads are not barriers (Mech et al. 1995, Merrill and Mech 2000, Kohn et al. 2009). Wolves are capable of traveling through crop and range land (Licht and Fritts 1994, Wydeven et al. 1998). They can also cross ice-covered lakes and rivers (Mech 1966) as well as unfrozen rivers during the summer (Van Camp and Gluckie 1979). However, a series of linear obstacles, such as a river flanked by roads, railways and disturbed habitat, may act synergistically and be more of a barrier to wolf movements (Blanco et al. 2005). Jensen et al. (1986) suggested areas of human settlement along the St. Mary's River were barriers to dispersing wolves, but some wolves have been able to pass through or around those areas (Mech et al. 1995).

Although few natural or artificial landscape features may absolutely prevent wolf dispersal, maintenance of habitat linkages across the landscape may facilitate regular exchange of individuals and genetic material among areas. The amount and distribution of public wild lands in Minnesota, Wisconsin, Michigan and Ontario may facilitate efforts to conserve habitat linkages within the region.

Action:

1. Cooperate with Federal, State and Tribal agencies and private landowners to identify and protect wolf habitat linkage zones.

6.5.3 Minimize disturbance at known active wolf den sites.

Wolves dig or otherwise establish sheltered dens to provide early protection for young pups. Early studies (Joslin 1967, Stephenson 1974, Allen 1979) suggested human disturbance can cause den abandonment or movements to new dens. Wydeven and Schultz (1993) documented possible abandonment of dens in Wisconsin as a result of nearby road construction and logging activity. However, some wolves have been tolerant of human disturbances, even denning near logging sites, open-pit mines, garbage dumps, moss harvesters and military firing ranges (Thiel et al. 1998).

The 1997 *Michigan Gray Wolf Recovery and Management* Plan recommended the seasonal protection of den sites. However, den sites are dynamic, often changing from year to year and even during the same year (Mech and Boitani 2003*b*). As a result, the detection of these areas is difficult,

and only a small percentage of den sites have been identified in any given year. Although identified den sites have been protected during active use, most sites were not identified and did not receive active protection. The general lack of protection at most sites did not appear to hinder the recovery of the wolf population, and disturbance at den sites is not considered to be a significant threat.

The DNR does not plan to conduct systematic searches for wolf den sites. However, it will minimize management-related disturbance near the active den sites (i.e., sites currently used by wolf pups) that are identified on the land it manages. The agency will also work with management partners to help minimize disturbance near sites on other properties.

Actions:

1. Consider known active den sites during compartment reviews and other DNR management efforts.
2. Minimize management-related disturbance near known active den sites on land managed by the DNR.
3. Work with management partners to help minimize disturbance near known active den sites on other properties.

6.6 Monitor and Manage Adverse Effects of Diseases and Parasites on the Viability of the Wolf Population.

Michigan wolves have been or could be affected by a variety of diseases, including those caused by viruses (e.g., canine distemper, canine parvovirus, rabies), bacteria (e.g., Lyme disease, leptospirosis, tularemia) and fungi (e.g., blastomycosis), as well as both internal (e.g., canine heartworm and intestinal worms of various species, echinococcosis) and external (e.g., sarcoptic mange, lice, ticks) parasites.

On account of their taxonomic and physiologic similarities, wolves and domestic dogs are susceptible to many of the same diseases. Moreover, in all but the most-remote areas of Michigan, wolves face virtually continuous exposure to some of these diseases (e.g., distemper, parvovirus) which cycle through the dog population. Others are enzootic in the wolf population itself (e.g., sarcoptic mange, echinococcosis), in prey (e.g., tularemia), or in the environment (e.g., *Blastomyces*). Consequently, the wolf population has had the opportunity to develop individual and collective immunity to some of the more-common agents over time, which in some cases can be lifelong and conferred to offspring through maternal antibodies (Gillespie and Timoney 1981). Although these established diseases can be significant sources of mortality for wolves, they are generally not considered to be limiting at the population level. Despite evidence of ubiquitous exposure, affected wolf populations demonstrate good recruitment, suggesting long-term stability of a robust Michigan population is likely to remain unaltered by these diseases (Kreeger 2003).

The following objectives and actions focus on monitoring the prevalence and effects of wolf diseases and parasites and on assessing the most-appropriate approach for managing their impacts.

6.6.1 Monitor the health of wolves in Michigan.

Wolf health will be monitored through necropsies of dead wolves and analysis of biological samples from captured live wolves. Necropsies provide information on condition, age, reproductive status, food habits, and cause of death, as well as the geographic distribution and prevalence of diseases and parasites. Analysis of biological samples such as blood, feces, and skin scrapings provide similar information on diseases and parasites. The DNR will continue to conduct these analyses at its Wildlife Disease Laboratory. In addition, the DNR will collaborate with researchers interested in studying wolf diseases and parasites.

Actions:

1. As necessary, update and refine procedures for collecting, submitting, and storing information on carcasses and biological samples.
2. Train field staff on collection and submission procedures.
3. Conduct necropsies and analyses of dead wolves and biological samples, respectively.
4. Work with management partners to develop and conduct studies of wolf diseases and parasites.

6.6.2 Assess the need to manage diseases and parasites in the wolf population.

In most cases, treatment of diseases and parasites in free-ranging wolves is not practical. Prior to 2004, wolves captured in Michigan for research purposes were administered vaccinations for canine distemper and parvovirus and were treated for sarcoptic mange. These procedures may have reduced the amount of natural mortality that would have otherwise occurred in the Michigan sample (although objective assessment of any such effect was essentially impossible). Discontinuing vaccination and treatment as part of handling procedures has eliminated this source of bias and has recently allowed more-accurate estimations of natural mortality.

At present, diseases and parasites do not pose a significant threat to the Michigan wolf population. With the exception of euthanizing wolves observed to be suffering from serious detrimental effects of infection, active management of diseases and parasites in the wolf population is not currently warranted or recommended. Thus, vaccinations are not expected to resume. However, if wolf-health monitoring indicates that diseases and parasites someday pose a significant threat to the wolf population, managers will evaluate options for more-active management.

6.7 Achieve Compatibility between Wolf Distribution and Abundance and Social Carrying Capacity.

A principal goal of this plan is to maintain a viable Michigan wolf population above a level that would warrant its classification as threatened or endangered. Therefore, the Michigan wolf

population must exceed criteria that have been used to define biological recovery (USFWS 1992, DNR 1997). However, the minimum requirement to preclude listing is not necessarily sufficient to provide all of the ecological and social benefits valued by the public. Accordingly, management will be conducted to maintain the wolf population above the minimum size requirement and facilitate those wolf-related benefits while minimizing and resolving conflicts where they occur. This plan does not identify a target population size, nor does it establish an upper limit for the number of wolves in the State. As a result, public preferences regarding levels of positive and negative wolf–human interactions will strongly influence the extent to which wolf abundance and distribution exceed the minimum requirements for a viable population.

The attitudes and actions of society historically influenced the abundance and distribution of wolves on the landscape (Mech 1970, Beaufort 1987, Thiel 1993). Indeed, public intolerance of wolves led to the virtual extirpation of the species from the State. During recent decades, policies that reflected significant increases in public support for wolves facilitated the recovery of the Michigan population. Public attitudes still have the power to influence wolf population levels. People can take measures to either sustain or threaten the population. These measures can be direct (e.g., maintenance of adequate prey, illegal killing) or indirect (e.g., litigation, legislation).

'Social carrying capacity' refers to the range bounded by the minimum and maximum levels of wolves society will tolerate. Inclusion of both a lower and an upper limit is critical to the definition, because society may not be willing to accept a decline in the wolf population below a certain level, nor may it be willing to accept the challenges and costs associated with wolves above a certain population level. Social carrying capacity is strongly influenced by the actual and perceived benefits and costs associated with particular levels of wolf abundance and distribution.

All segments of society do not value the benefits or bear the costs of wolf presence equally. Therefore, the minimum and maximum tolerable levels of wolves can vary regionally or by stakeholder group. Defining social carrying capacity becomes complicated when different segments of society hold different tolerances, because a social carrying capacity exists only when the ranges of tolerance held by different groups overlap. If the ranges of tolerance do not overlap, then a social carrying capacity cannot be identified, and any goal for wolf abundance and distribution would be expected to encounter social resistance and conflict.

In such a situation, a social carrying capacity can be created only through a shift in tolerances at one or both ends of the range. Such a shift could be caused through: 1) management of the interactions between wolves and humans to reduce costs and/or increase benefits to affected stakeholders or 2) information and education programs aimed at factors that influence tolerances for wolves and wolf-related interactions.

The most-recent public-attitude study found that a social carrying capacity for wolves in different regions of Michigan did not exist (Beyer et al. 2006). That is, the minimum levels of wolves and wolf-related interactions some segments of society would tolerate were higher than

the maximum levels others would tolerate. No particular level was acceptable to a majority of interested survey respondents.

Survey-respondent preferences regarding the levels of wolves within each region varied according to region of residence and stakeholder group (Beyer et al. 2006). For example, the preferred level of wolves in both the UP and northern LP was highest among residents of the southern LP and lowest among UP residents. Compared to non-hunters, hunters tended to be less tolerant of wolves. However, even among these two groups, hunters and non-hunters in the UP were less tolerant of wolves than were their counterparts in southern Michigan. As a group, livestock producers were much less tolerant of wolves than was the general public.

Given the disagreement in preferences and tolerances among different segments of the public, a shift in public attitudes is necessary to create a social carrying capacity for wolves in Michigan. Until management or education causes an adequate shift, any particular level of wolves will not be acceptable to society at large. The following objectives were designed to help achieve compatibility between wolf abundance and distribution and public tolerance.

6.7.1 Promote consistent public understanding and appreciation of the benefits and costs associated with particular wolf levels.

People can hold preferences and tolerances regarding wolf abundance and distribution without a complete understanding of all the relevant issues. For example, a person who is not willing to tolerate any wolves on the landscape may not be aware of or appreciate the benefits wolves provide to many residents. Intolerance can also be caused by an inaccurate, exaggerated perception of the problems wolves cause. Conversely, a person who demands the highest number of wolves the available habitat can support may be unaware of or may not appreciate the costs and risks such a level would impose on certain members of society.

Public education could help foster a realistic understanding of the positive and negative consequences associated with particular wolf levels. This education could allow some Michigan residents to place a higher value on wolves, alleviate concerns held by some Michigan residents, and thus increase general tolerance for the wolf population. It could also help other residents understand the real costs and risks associated with wolves and help them appreciate the potential adverse consequences of particular wolf levels for affected residents.

To some extent, personal preferences and tolerances will continue to reflect personal values, which are resistant to change (Fulton et al. 1996). However, education efforts may encourage attitude shifts that are based on consistent, accurate information and thus facilitate the creation of a social carrying capacity for wolves in Michigan.

Actions:

1. Increase public awareness regarding where to obtain information on the consequences of particular levels of wolf abundance.

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2. Provide the public with accurate information on the benefits and costs associated with particular wolf levels as part of a wolf-based information and education program (see 6.1.1).

6.7.2 Manage wolf-related interactions to increase public tolerance for wolves.

Social tolerance for a population of any large predator depends on the benefits attributed to the population and on confidence that conflicts will be resolved effectively (Slovic 1987, Frost 1985, Wolstenholme 1996, Beyer et al. 2006). Therefore, facilitation of wolf-related benefits and effective conflict resolution could do more than serve the interests of Michigan residents. Those actions could also reduce levels of intolerance among some stakeholders and cause a shift in attitudes that leads to the development of a social carrying capacity for wolves in the State.

Section 5.2 describes the many types of benefits people can derive from the presence of wolves. In brief, these benefits can be: 1) ecological, as wolves fill an important ecological niche and improve ecosystem function; 2) cultural or religious, as people derive spiritual satisfaction or fulfillment from the presence of wolves; 3) personal, as the presence of wolves provides unique opportunities to interact with, study, and appreciate a particular component of the natural world; and 4) economic, as wolf-based tourism and recreation could draw a greater number of people to local communities. The approaches that will be used to foster these types of wolf-related benefits are outlined under 6.8 and 6.12.

Conflicts associated with wolves can involve human-safety concerns regarding the presence of wolves near residential or recreational areas, depredation of domestic animals, and concerns regarding the impact wolves may be having on populations of other wildlife species. The approaches that will be used to manage specific types of wolf-related conflicts are outlined under 6.9, 6.10, 6.11 and 6.12.

6.7.3 Manage wolf distribution and abundance as necessary to maintain positive and negative wolf-related interactions at socially acceptable levels.

As stated previously (see 5.3.2), broadly based abundance and distribution goals may not be necessary or effective for managing most negative wolf-related interactions. Wolf-related conflicts in local areas are often caused by the behavior of a few individual wolves, and management at small scales can often address problems effectively. Accordingly, management of wolf–human conflicts under this plan will be conducted at the level of individual wolves or packs to the extent that it is expected to be effective and logistically feasible.

Some situations may warrant consideration of reducing wolf numbers in localized areas as a means to reduce the risk of negative interactions. Such consideration could be necessary if a high density of wolves in an area, rather than the behavior of individual wolves, was determined to be responsible for problems that could not otherwise be addressed through non-lethal or individually directed lethal methods.

Many Michigan residents would support local reduction of wolf numbers if it would reduce problems caused by wolves (Beyer et al. 2006). The extent of public support appears to depend

on the nature of the problem to be addressed. The percentage of interested survey respondents that supported reducing wolf numbers through lethal means was highest with regard to human-safety concerns (59%), intermediate with regard to depredation problems (54%), and lowest with regard to impacts on the number of deer available for hunting (49%).

The severity, immediacy and frequency of conflicts will determine whether active management of wolf abundance or distribution in local areas is necessary. More-conservative management methods will be applied when the risk of problems is considered to be relatively small and non-immediate, whereas increasingly aggressive methods may be applied as the severity, immediacy and frequency of problems increase.

According to the results of the most-recent public-attitude survey, the public generally desires some presence of wolves in the northern LP (Beyer et al. 2006). Indeed, 79% of interested survey respondents indicated they would be unwilling to accept the complete absence of wolves in that area. However, respondents would be willing to tolerate lower minimum and maximum levels of wolves in the northern LP than in the UP. Even the respondents who were most tolerant of wolves preferred a lower level of wolf abundance and interactions in the northern LP than in the UP.

Wolves will not be prevented from colonizing the LP. However, their presence in that area is not necessary to maintain a viable population in Michigan. Additionally, if a wolf population becomes established in the LP, the higher density of human residences and livestock operations in that area relative to the UP (see 6.10 for additional information) would create a higher potential for wolf-related conflicts. The severity, immediacy and frequency of conflicts would guide management responses in the LP, but given the preceding considerations, relatively aggressive responses may be warranted in many cases.

The presence of wolves in the LP would be unlikely to: 1) exacerbate the prevalence of tuberculosis in the deer herd, 2) spread the disease geographically, or 3) increase the risk of tuberculosis transmission to cattle. Indeed, the presence of a natural predator might be expected to reduce tuberculosis prevalence in the deer herd; by preying upon individuals weakened by tuberculosis, a predator would remove the deer most likely to spread the disease. Although all mammals, including wolves and other canids, can be infected with bovine tuberculosis in certain circumstances, canids are generally resistant to infection. Moreover, there is no evidence that wolves or other wild canids transmit the disease to each other or to other species. In Canada, where tuberculosis is present in free-ranging bison (*Bos bison*) in Wood Buffalo National Park and in free-ranging elk in Riding Mountain National Park, there is no evidence that the wolf populations in those areas have contributed to the spread of the disease (Carbyn 1982, Tessaro 1986).

Actions:

1. Effectively manage wolf-related conflicts at the smallest possible scale.
2. Allow wolves to colonize and remain in the LP to the extent that the accompanying negative interactions can be managed within socially acceptable levels.

3. Evaluate the outcomes of active management on wolf abundance and distribution.

6.8 Facilitate Positive Wolf–Human Interactions and Other Wolf-Related Benefits.

A principal goal of this plan states the need to facilitate wolf-related benefits. Those benefits serve the interests of affected stakeholders and they foster the public support that is necessary for the long-term viability of the wolf population (USFWS 1992, Wisconsin DNR 1999, Bangs et al. 1995, Minnesota DNR 2001, Boitani 2003, Fritts et al. 2003). They can be ecological, personal, economic, and cultural or religious (see 5.2 for more information).

People hold diverse cultural values and religious beliefs regarding wolves. Wolves can play major or minor roles or be viewed positively or negatively within particular cultures and religions. As only one example among many different perspectives, the cultural and religious values regarding wolves are particularly important to many Native Americans. To help illustrate those values held by many Native Americans in Michigan, the representatives of the Chippewa Ottawa Resource Authority and the Great Lakes Indian Fish and Wildlife Commission on the Michigan Wolf Management Roundtable provided the following account of the story of Maahiingun and Nanaboozhoo:

> *"Nanaboozhoo, (half man/half spirit) was placed on the Earth at the beginning of time and given instructions by Gzhemnidoo (The Creator) and told to walk the Earth to name the plants, animals, insects and the entirety of everything that comprised the world of his time.*
>
> *"Throughout his travels, Nanaboozhoo began to notice that the animals he was tasked to name came in pairs and also had the ability to repopulate their species. Seeing the various animal families throughout all of creation, Nanaboozhoo became lonely and so he spoke of his feelings to Gzhemnidoo and asked "Why is there no other like me?" Gzhemnidoo answered, "I will bring you someone to walk, talk and play with" and in his infinite wisdom, Gzhemnidoo sent Maahiingun (the wolf) to be with Nanaboozhoo and together they set out to complete the task that Gzhemnidoo had asked.*
>
> *"In their journey, they became very close to each other, like brothers. It was through this closeness that they soon came to realize that they were also brothers to all of Creation.*
>
> *"Once they had finally completed the task that Gzhemnidoo asked of them, they talked with the Creator once again. Gzhemnidoo was pleased with what he heard but this time Creator curiously replied, "From this day on, you are to separate and go different ways. What happens to one of you will also happen to the other. You will be feared by some, respected by others, but misunderstood by all of the people who will come to inhabit these lands."*
>
> *"Reluctantly, Maahiingun and Nanaboozhoo set off on their different journeys. Their shared sadness is evident by Maahiingun's cry that can still be heard wherever the wolf still roams the Earth on his separate journey.*

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"The teachings of Nanaboozhoo and Maahiingun serve as an important reminder for Indian People to this day. All of what Gzhemnidoo said to Nanaboozhoo and Maahiingun has come true. Indian and Maahiingun have come to experience the same things, both good and bad, that life has to offer. Both take a mate for life, have a Clan System, and also are part of a Tribe. Both have been stripped of their land and hunted for their skin. Both have been pushed to the brink of extinction yet somehow miraculously survive to this day.

"It is our belief as Indian people that our ability to foretell our future is evident by looking at the wolf, who remains one of the most significant cultural indicators to our continued existence."

The following objectives focus on increasing public awareness regarding the benefits provided by wolves, ensuring an adequate distribution and abundance of wolves, and providing specific opportunities for people to experience and appreciate wolves.

6.8.1 Inform the public on benefits derived from the presence of wolves.

The benefits of wolves may not be apparent to many Michigan residents. Public education and outreach could help residents understand and appreciate those benefits.

Action:

1. Provide the public with information on the benefits of wolves as part of a wolf-based information and education program (see 6.1.1).

6.8.2 Maintain a distribution and abundance of wolves adequate to maintain benefits at levels acceptable to the public.

The size of some benefits depends on the abundance and distribution of wolves on the landscape. For example, an informed individual can derive personal satisfaction from the presence of a healthy wolf population only if such a population actually exists.

Maintenance of a viable wolf population will allow the level of positive wolf-related interactions desired and appreciated by many Michigan residents (Beyer et al. 2006). However, some people prefer higher levels of interactions than others, and some people prefer the level of interactions associated with the largest number of wolves the available habitat can sustain (Beyer et al. 2006). Both positive and negative interactions can increase as wolf abundance or distribution expands. Although some individuals may prefer the level of benefits associated with a maximum level of wolves, the corresponding level of negative interactions may not be acceptable to other segments of society. Therefore, wolf-related benefits will be maximized to the extent that the accompanying levels of negative interactions can be managed effectively.

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Actions:

1. Facilitate the ecological, cultural, economic and personal benefits derived from the presence of wolves by maintaining a viable wolf population.
2. Facilitate the maximum level of positive wolf-related interactions that is possible while maintaining negative interactions at publicly acceptable levels.

6.8.3 Promote opportunities for people to experience and appreciate wolves.

Wolf-based programs and events can increase opportunities for people to appreciate the benefits of wolves. Such programs and events can provide participants with positive, unique experiences, increase public knowledge of the positive values of wolves, and generate support for the wolf population.

Actions:

1. Work with management partners to coordinate wolf-based programs and events.
2. When prudent, invite public and media participation in wolf-related projects.
3. Support efforts of management partners to provide positive wolf-related experiences.

6.9 Manage Actual and Perceived Threats to Human Safety Posed by Wolves.

Most Michigan residents place a high priority on wolf management that addresses public concerns for human safety (Beyer et al. 2006). Eighty-seven percent of interested respondents to the most-recent public-attitude survey indicated human-safety issues should be an important factor when considering whether to reduce the number of wolves in a particular area. At least 76% of interested respondents would support some type of active wolf management to address strong public concerns regarding human-safety risks posed by wolves.

The following objectives for the management of human-safety issues fall into three general categories. The first category focuses on educating the public on the actual safety risks posed by wolves and ways to reduce those risks. The second category focuses on managing the factors that influence the probability of wolf-related problems, including rabies and habituation of wolves to humans. The third category focuses on eliminating actual safety threats.

6.9.1 Promote accurate public perceptions of the human-safety risks posed by wolves.

Most wildlife has the potential to be dangerous to humans in certain situations. In most cases, people can take simple, sensible measures to avoid those situations and protect themselves against harm. Other cases may warrant higher levels of concern and professional assistance. Accurate perceptions of the human-safety risks posed by wildlife can facilitate appropriate levels of concern and responses to particular situations.

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Segments of the public can overestimate or underestimate the actual human-safety risks posed by wolves. Some people may feel the mere presence of a wolf population poses a serious safety threat, whereas others may not recognize that wolves could be dangerous to people in certain situations. Perceptions and attitudes regarding safety risks can vary by geographic region and stakeholder group (Beyer et al. 2006). For example, the most-recent public-attitude study showed that urban residents placed a lower priority on wolf-related safety concerns than did rural residents. Compared to the general public, livestock producers as a group were more concerned about wolf-related safety risks.

In Michigan, wolves are not likely to attack any person who does not deliberately invite aggression (i.e., by provoking or feeding wolves). As of this writing, a wolf attack on a human has never been documented in Michigan. However, wolves have attacked people in other areas of North America (McNay. 2002*a, b*), and concerns for public safety are warranted in some situations. Regardless of the extent to which wolves pose a threat to human safety, anxieties over a perceived threat can impact the quality of life of affected residents as well as public tolerance for the wolf population.

Public education could help foster a realistic understanding of the human-safety risks associated with Michigan wolves. This education could help alleviate concerns held by some Michigan residents, and thus increase general tolerance, if not support, for the wolf population. It could also help other residents understand that some wolf-related human-safety concerns are legitimate, and thus help them appreciate the consequences of those concerns for affected residents.

Actions:

1. Increase public awareness regarding where to obtain information on wolf-related threats to human safety.
2. Provide the public with accurate information on the human-safety risks posed by wolves as part of a wolf-based information and education program (see 6.1.1).
3. Provide prompt responses to requests for information regarding wolves and human safety.

6.9.2 Provide timely and professional responses to reports of human-safety risks posed by wolves.

The protection of human safety is a top priority, and the DNR, USDA Wildlife Services, and other management partners will make their best efforts to respond to reports of habituated, sick or injured wolves in a timely and professional manner. Achieving this objective will require an efficient system for receiving and directing reports, clear investigation procedures, and adequate training of staff.

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Actions:

1. Increase public awareness regarding where to report wolf-related threats to human safety.
2. As necessary, update and refine procedures for the investigation of reported threats to human safety.
3. Train field staff on investigation procedures.

6.9.3 Minimize the incidence of rabies in wild and domestic populations.

Worldwide, most documented wolf attacks on humans during the past century involved rabid wolves. For example, from 1900 through 2002, rabid wolves were involved in more than 80% of documented attacks in Europe and 70% of documented attacks in areas of Asia (Linnell et al. 2002, U.S. National Park Service 2003).

The role of rabies in wolf attacks has been smaller in North America than in other parts of the world. In a summary of wolf attacks in Canada and Alaska since 1900, McNay (2002*a, b*) reported that only 12 of 80 (15%) reviewed attacks involved rabid wolves. This comparatively low incidence may reflect the implementation of programs designed to minimize the incidence of rabies in domestic and wild animals (Centers for Disease Control and Prevention 1999, USDA Wildlife Services 2002). Rabies has not been documented in Michigan wolves, and the potential for the disease to affect wolves in the State is small.

Actions:

1. Support programs to assess and minimize the incidence of rabies in wild and domestic animal populations.
2. Euthanize wolves and other animals suspected to be infected with rabies.

6.9.4 Promote accurate public perceptions of the human-safety risks posed by echinococcosis

Echinococcus spp. is a tapeworm which parasitizes wild carnivores, particularly members of the canid family, in its adult form. However, its life cycle has intermediate hosts such as livestock, wildlife species and on rare occasion, humans. In Michigan there are two species of *Echinococcus* (*E. granulosus* and *E. multilocularis*) which can be found in coyotes, fox and wolves (Storandt and Kazacos 1995, Eckert et al. 2000, T. Cooley Michigan DNR, unpublished data).

This parasite can cause a life threating disease in humans known as cystic or alveolar echinococcosis (Pawłowski et al. 2001). People at a higher risk include trappers, biologists, veterinarians, or others who have contact with wild canids and are exposed to *Echinococcus* spp. eggs by "hand-to-mouth" transfer. Fortunately, in North America the transmission of wild strains of *Echinococcus* spp. to humans has been very low (Rausch 2003, Foreyt 2009).

Actions:

1. Work with management partners and the media to provide accurate information on the risks of echinococcosis to humans.
2. Monitoring the prevalence of *Echinococcus* spp. in Michigan's wild canids.

6.9.5 Prevent or minimize the habituation of wolves.

The most-important factor contributing to wolf attacks in Canada and Alaska appears to be habituation to humans. Of the 80 wolf attacks reviewed by McNay (2002 *a*, *b*), 29 cases (36%) involved habituated wolves. Wolves can become habituated and lose their fear of humans by having frequent and increasingly closer contact with humans, and by receiving food rewards for their boldness.

Several human behaviors can attract wolves and contribute to habituation. Directly feeding wolves is the most obvious way to cause habituation. Drawing deer into residential areas by feeding them also can attract wolves and other predators. Feeding pets outside and leaving pets outside unattended also may attract wolves. Avoiding these behaviors can reduce the chance a wolf will become habituated and lose its fear of humans.

In addition to avoiding the behaviors listed above, people can take other, active measures to prevent wolf habituation. Wolves can be deterred by strange odors, sights or sounds (USDA 2002), and devices designed to scare wolves may help prevent problems. Some examples of scare devices include lighting systems, sirens and other noisemaking devices, flagging (fladry), and movement-activated guard devices (Beyer et al. 2006).

Public education on ways to avoid attracting wolves and technical assistance on the appropriate use of scare devices could help prevent the habituation of wolves and help reduce associated risks to human safety.

Actions:

1. Provide the public with information on ways to help prevent wolf habituation as part of a wolf-based information and education program (see 6.1.1).
2. Provide property owners and residents with technical assistance on methods to help prevent wolf habituation.
3. As warranted, recommend modifications in law, policy or enforcement that could more-effectively discourage human activities that lead to the habituation of wolves.

6.9.6 Eliminate actual human-safety threats where they occur.

A habituated, sick or injured wolf in or near areas of human activity can represent an actual threat to human safety. Where actual threats are identified, the DNR, USDA Wildlife Services and other management partners will take the steps necessary to eliminate those threats.

The severity, immediacy and frequency of safety threats will guide management responses. More-conservative management methods will be applied when the risk of physical harm to humans is considered to be relatively small and non-immediate, whereas increasingly aggressive methods may be applied as the severity, immediacy or frequency of threats increase.

This strategy places a high priority on developing, evaluating and applying non-lethal management methods to reduce human-safety threats. Non-lethal methods will be applied wherever they are expected to be effective and where the severity and immediacy of a threat do not warrant more-aggressive action. Non-lethal methods can include elimination of wolf attractants (see 6.9.5), use of scare devices (see 6.9.5), and aversive conditioning. Aversive conditioning involves a stimulus (e.g., rubber bullets) that causes discomfort, pain or an otherwise negative experience without permanently injuring or killing a wolf.

To the extent non-lethal methods are effective at eliminating actual threats to human safety, lethal control of wolves will not be necessary. However, when such practices prove to be ineffective, are not expected to be effective, or are infeasible, lethal control may be necessary to prevent problems. Reserving lethal control as a management option allows the potential use of all the tools that might be required to help ensure the protection of human safety. Results of the most-recent public-attitude survey showed that at least 76% of interested respondents supported some form of lethal control to address strong public concerns regarding human-safety risks posed by wolves. The DNR and its management partners will apply lethal control methods as necessary to eliminate demonstrable threats to human safety.

Additionally, current regulations (Federally endangered) allow a person to remove, capture or kill a wolf when it poses an immediate threat to human life, and they require reporting of any such action to the USFWS within five days. A situation of this type has not occurred in Michigan, nor is one expected. However, the Department would like to maintain the 24 hour reporting provision, that was required when the wolf was State listed as endangered, regardless of the future legal classification of wolves. A 24 hour reporting requirement would allow the DNR and its management partners to investigate and document such an incident in a timely manner.

Relocation of wolves is often proposed by the public as a method to reduce wolf-related conflicts. However, eliminating a threat to human safety through wolf relocation is not reasonably possible. Data from radio-collared wolves indicate relocated wolves rarely settle in the areas where they are released, and relocated wolves may return to their original territories (D. E. Beyer, Michigan DNR, unpublished data). Even if habituated wolves were relocated and did not return to the areas of capture, they would still be fearless of humans and would probably continue to cause human-safety threats elsewhere. Relocating wolves is problematic for additional reasons. Given the current widespread distribution of wolves across the UP, unoccupied, suitable release areas are no longer available, and any relocated wolves may be killed by resident packs. Also, residents have expressed opposition to the release of wolves near their communities.

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Actions:

1. Remove habituated wolves that present a threat to human safety.
2. Support the development, evaluation and appropriate use of non-lethal and lethal management methods to reduce human-safety threats.
3. As necessary, update and refine management responses according to the severity, immediacy and frequency of human-safety threats.
4. Train field staff on response procedures.
5. Develop regulations to require individuals who capture, remove or kill a wolf in response to a human-safety threat, to report the incident to the DNR within 24 hours, regardless of legal status.

6.10 Manage Wolf Depredation of Domestic Animals.

A depredation event occurs when a predator kills or injures one or more animals at a given time. Wolves normally kill or injure wild prey and competitors, but they may sometimes attack domestic animals. Although its frequency is currently lower in Michigan than in Minnesota or Wisconsin, wolf depredation of domestic animals in Michigan has become an important management issue.

In the United States, farmers and ranchers as an overall group still hold strong negative views of wolves (Fuller et al. 2003, Nie 2003). Indeed, the most-recent Michigan public-attitude study indicated that livestock producers were far less supportive of having wolves in the State than was the general public. Whereas 73% of all interested respondents to the general-public survey indicated approval for having wolves in the State, only 24% of interested livestock producer survey respondents indicated such approval. Sixty-four percent of interested livestock producers disapproved of having wolves in the State. These results indicate a strong need to address livestock-producer concerns and thus foster greater tolerance for wolves. Without relief from depredation problems, intolerant stakeholders may adopt indiscriminate anti-wolf behaviors that could have adverse impacts on the population (Fuller et al. 2003). For example, a recent study in Wisconsin found that illegal killing of radio-collared wolves increased during periods when the state did not have authority to use lethal control (Olson et al. 2014). This study suggests that a depredation management program may reduce illegal killing.

More than 900 livestock farms occur in the UP (USDA 2004). From 1998 through 2014, the DNR and USDA Wildlife Services verified 249 wolf–livestock depredation events on 84 (9%) of those farms. However, the most-recent public-attitude study found that 31% of interested livestock producers in the UP suspected wolves had been responsible for recent livestock losses on their farms in at least 1 out of 5 years (Beyer et al. 2006). In the UP there is an association between verified wolf livestock depredation events and wolf abundance (Edge et al. 2011). However, the distribution of farms and associated livestock depredations are not uniform across the UP and are likely influenced more by the behavior of a small number of individual wolves or packs than by wolf population size.

More than 2,100 livestock farms occur in the northernmost 21 counties of the LP (USDA 2004). There is an average of one farm per 5.1 square miles in this area versus an average of one farm per 18.1 square miles in the UP. To date, no wolf depredation events have been verified in the LP. However, if a wolf population becomes established in the northern LP, the higher density of livestock farms in this region suggests the number of wolf depredations could be higher than what has been experienced in the UP.

In addition to livestock, wolves sometimes attack domestic dogs. These attacks may be caused by inter-specific aggression or by perception of dogs as potential prey (Fritts and Paul 1989). Between 1996 and 2014, the DNR and USDA Wildlife Services verified 72 wolf depredation events on domestic dogs in Michigan. Fifty-seven percent of those attacks involved hunting hounds (bear and hare) in the field. However, some dogs were attacked in close proximity to their owners' residences.

Many Michigan residents place a high priority on wolf management that addresses depredation of domestic animals (Beyer et al. 2006). Eighty-four percent of interested respondents to the most-recent general-public attitude survey indicated that "the number of farm animals actually lost to wolves" should be an important factor when considering whether to reduce the number of wolves in a particular area. Sixty-one percent and 85% of interested survey respondents respectively indicated that "the number of hunting dogs lost to wolves in the field" and "the number of pets actually attacked by wolves near the pets' homes" should be 'somewhat' or 'very' important factors in a decision to reduce wolf numbers in a particular area. At least 75% of interested respondents would support some type of active wolf management to address wolf depredation of domestic animals.

The following objectives for the management of depredation of domestic animals fall into three general categories. The first category focuses on educating the public and providing technical assistance on ways to reduce the risk of wolf depredation. The second category focuses on managing ongoing depredation problems. The third category focuses on compensation for losses of livestock caused by wolves.

As a document that offers guidance at the strategic level, this plan does not describe the operational methods of preventing and eliminating wolf depredation problems. A description of those methods is available on the DNR website (www.michigan.gov/dnr) and will be updated as regulations, technology, and other aspects of management context change.

<u>6.10.1 Provide timely and professional responses to reports of suspected wolf depredation of domestic animals.</u>

The causes of depredation are not always apparent and other causes of death or injury can often be mistaken for wolf depredation. For example, at least 27% of the wolf-depredation complaints submitted by Michigan residents in 2004 were prompted by depredations that were actually caused by dogs or coyotes. Another 23% of the alleged wolf-depredation events reported in 2004 could not be attributed to a specific cause because the available physical evidence was insufficient.

Given multiple potential causes and the need to assess the available evidence, professional investigation of a depredation event is necessary to determine whether it was caused by a wolf. On-site investigations also provide responding agencies with opportunities to provide affected stakeholders with information and technical assistance that may help them reduce future depredations.

To the extent possible, the DNR, USDA Wildlife Services, and other management partners will respond to reports of suspected wolf depredation in a timely and professional manner. Achieving this objective will require an efficient system for receiving and directing reports, clear investigation procedures, and adequate training of staff.

Actions:

1. Increase public awareness regarding where to report wolf depredation of domestic animals, the need to report depredation events rapidly, and how to preserve evidence at depredation sites.
2. As necessary, update and refine procedures for the investigation of suspected wolf depredation of domestic animals.
3. Train field staff on investigation procedures.

6.10.2 Minimize the risk of wolf depredation of domestic animals.

Certain human behaviors and practices can attract wolves and thus increase the risk of depredation of domestic animals. Directly feeding wolves is the most obvious way to invite depredation problems. Baiting and feeding other wildlife can attract and concentrate natural prey and thus attract wolves and other predators. Feeding pets outside and leaving pets outside unattended also may attract wolves. Avoiding these behaviors and practices can help reduce the risk of depredation.

In addition to avoiding the behaviors and practices describe above, livestock producers can help prevent depredation of livestock through certain animal husbandry practices. For example, prompt and proper disposal of livestock carcasses may eliminate attractants that could draw wolves to particular farms. Barrier fencing, monitoring and pasturing of livestock based on their vulnerability, lighting systems, sirens and other noisemaking devices, flagging (fladry), movement-activated guard devices, and livestock-guarding animals are a few of the other tools and techniques that may help reduce the risk of depredation of livestock (Beyer et al. 2006).

There is an inherent risk to dogs allowed to range in areas frequented by wolves, but individuals who hunt with dogs can also take measures to reduce the risk of an attack on their animals (Wisconsin DNR et al. 2004). Avoiding specific areas that are currently being used by wolves or where problems have occurred previously may be the most-effective way to reduce the risk of a wolf–dog conflict. The DNR will provide information on its website (www.michigan.gov/dnr) and at local DNR offices to help hunters identify and avoid areas of probable or previous conflicts. Staying close to dogs, using collars with bells or beepers, and avoiding bait sites

recently visited by wolves are other techniques that may reduce the chance of a wolf attack on a hunting dog.

The DNR cannot compel residents to adopt any of the practices or techniques described above. However, public education, information-sharing, and technical assistance could provide valuable information, encourage the use of beneficial practices and techniques, and thus help reduce the risk of depredation of domestic animals.

Actions:

1. Provide the public with information on ways to help reduce the risks of wolf depredation as part of a wolf-based information and education program (see 6.1.1).
2. Provide livestock producers, individuals who hunt with dogs, property owners and other residents with technical assistance on methods to help prevent or minimize wolf depredation.
3. Share information on areas of probable or previous conflicts between wolves and dogs and advise avoidance of those areas.
4. As warranted, recommend modifications in law, policy or enforcement that could more-effectively discourage human activities that increase the risk of wolf depredation.
5. As warranted, recommend modifications in law, policy, enforcement or practice that could reduce wolf visitation to bear-bait sites.

<u>6.10.3 Eliminate or minimize ongoing wolf depredation of domestic animals.</u>

Many techniques can effectively prevent or deter depredation. However, the effectiveness of some techniques may be temporary, and some techniques may fail to work altogether in certain situations. Where depredation occurs despite reasonable efforts to prevent it, the DNR, USDA Wildlife Services and other management partners will take appropriate steps to eliminate or minimize ongoing problems.

The severity, immediacy and frequency of depredation problems will guide management responses. More-conservative management methods will be applied when the risk of depredation is considered to be relatively small and non-immediate, whereas increasingly aggressive methods may be applied as the severity, immediacy and frequency of problems increase.

This strategy places a high priority on developing, evaluating and applying non-lethal management methods to reduce depredation problems. Non-lethal methods will be applied wherever they are expected to be effective and where the severity and immediacy of a problem do not warrant more-aggressive action. Non-lethal methods can include the elimination of wolf attractants, the use of improved husbandry practices and scare devices (see 6.10.2), as well as aversive conditioning. Aversive conditioning involves a stimulus (e.g., rubber bullets) that

causes discomfort, pain or an otherwise negative experience without permanently injuring or killing a wolf.

To the extent non-lethal methods are effective at eliminating or minimizing depredation problems, lethal control of wolves will not be necessary. However, when such practices prove to be ineffective, are not expected to be effective, or are infeasible, lethal control may be necessary to prevent problems. Reserving lethal control as a management option allows the potential use of all the tools that might be required to help prevent depredation problems. Results of the most-recent public-attitude survey showed that at least 75% of interested respondents supported some form of lethal control to address wolf depredation of domestic animals.

Lethal control will be a management option in situations where loss of livestock has been documented or where a wolf is in the act of depredating livestock; it will not be used as a preventative measure in areas where livestock depredation has not yet occurred. Similarly, lethal control will be a management option in specific areas where wolf attacks on free-ranging hunting dogs have been documented, but it will not be used as a preventative measure where attacks have not yet occurred. In addition, lethal control will be a management option in specific areas where wolf attacks on dogs and other pets have occurred near human residences.

Relocation of wolves is often proposed by the public as a method to reduce wolf-related conflicts. However, reducing depredation problems through relocation has become increasingly problematic and is no longer recommended as a management tool in Michigan. Data from radio-collared wolves indicate relocated wolves rarely settle in the areas where they are released, and relocated wolves may return to their original territories (D. E. Beyer, Michigan DNR, unpublished data). Even if depredating wolves were relocated and did not return to the areas of capture, they may cause depredation problems elsewhere. Relocating wolves is problematic for additional reasons, which are outlined under Objective 6.9.5.

Actions:

1. Provide for the selective lethal removal of wolves that are a threat to livestock or other private property.
2. Support the development, evaluation and appropriate use of non-lethal and lethal management methods to prevent or minimize wolf depredation of domestic animals.
3. As necessary, update and refine management responses according to the severity, immediacy and frequency of depredation problems.
4. Train field staff on response procedures.

<u>6.10.4 Develop a program to allow livestock producers to control depredating wolves on their property.</u>

The level of personal control with regard to depredation problems appears to be the most-important factor that influences livestock-producer tolerance for wolves (Beyer et al. 2006).

Eighty-five percent of interested livestock producers recently surveyed indicated that being prevented from controlling or removing wolves that posed a threat to their livestock had 'greatly decreased' their willingness to have wolves in their farming area. Seventy-eight percent of surveyed livestock producers indicated they would be 'very' or 'somewhat' satisfied with a management program that, among other things, empowered them to remove problem wolves from their own property. By contrast, only 20% of respondents indicated they would be 'very' or 'somewhat' satisfied with a management program that lacked such a provision. Seventy-five percent of interested respondents to the general-public attitude survey approved of empowering livestock growers to handle their own depredation problems.

Given this information, a carefully regulated program that allowed livestock producers to control depredating wolves would be generally acceptable to the public and it would address a major concern of livestock producers. At the same time, it could assist efforts to maintain a viable wolf population. Although such a program could cause the deaths of a small number of wolves, it could help prevent an increase in the prevalence and intensity of the negative attitudes that led historically to widespread indiscriminate killing by intolerant stakeholders. Indeed, a program that allowed responsible and effective personal control could allow livestock producers to tolerate a greater abundance and distribution of wolves on the landscape.

Personal control of depredating wolves by livestock producers could involve non-lethal (see 6.10.3) and lethal methods. Lethal control would not be authorized when problems could be addressed through other, non-lethal methods. However, a livestock producer could be authorized to kill problem wolves when reasonable efforts to deter depredation have failed or when other feasible options are unavailable. Only the minimum level of lethal control necessary to resolve an ongoing depredation problem would be authorized.

Any program allowing personal control of depredating wolves by livestock producers would be administered to ensure it does not have adverse consequences for the long-term viability of the wolf population. Monitoring, reporting and enforcement would be conducted to help ensure compliance with program requirements.

Actions:

1. Develop a permitting process to allow livestock producers to control wolves on their property, as necessary, following a verified wolf depredation event.
2. Develop a system to allow livestock owners to kill wolves in the act of livestock depredation.
3. Monitor and enforce compliance with program requirements.

<u>6.10.5 Facilitate financial compensation for livestock losses caused by wolves.</u>

In the United States and other countries, compensation programs have been designed to assist livestock producers by reimbursing them for losses attributable to wolves, with the intention of increasing overall public acceptance for wolf populations (Fritts et al. 2003). An expectation that compensation will increase tolerance for wolves is often based on an assumption that livestock

producers primarily perceive wolf depredation as an economic problem. Recent research has shown that other, non-economic factors more strongly influence livestock-producer attitudes toward wolves, and that compensation programs have not substantially improved tolerance among this group (Naughton-Treves et al. 2003, R. B. Peyton, MSU, personal communication).

Current Michigan law requires the State to compensate livestock owners for livestock killed by wolves, regardless of the extent to which efforts have been made to reduce depredation risks. The Michigan Animal Industry Act (Public Act 466 of 1988) defines livestock as "those species of animals used for human food and fiber or those species of animals used for service to humans. Livestock includes, but is not limited to, cattle, sheep, new world camelids, goats, bison, privately owned cervids, ratites, swine, equine, poultry, aquaculture, and rabbits. Livestock does not include dogs and cats." The Michigan Wildlife Depredations Indemnification Act (Public Act 487 of 2012) provides payment to livestock owners, but it may do so only if the DNR or its designated agent (USDA Wildlife Services) verifies the depredation was caused by wolves, coyotes, or cougars or is a missing animal claim.

Currently, compensation payments shall be made for each animal included in the claim at 100% of the fair market value not to exceed $4,000.00 for each animal. Funding for this program shall be from the MDARD budget, unless otherwise determined by statute or the appropriations process. If DNR funds are appropriated or otherwise authorized for reimbursement, the DNR funds shall not be used for reimbursement for missing animals. Funding for depredation payments and more recently missing animal claims has changed over time however currently it is covered under a general fund appropriation. Through the end of 2014, the State paid $115,591 and Defenders of Wildlife paid $10,053 to compensate for wolf-related livestock losses in Michigan. Funding for the supplemental payments from Defenders of Wildlife ended in 2010. Livestock producers in Michigan strongly desire financial compensation as part of a depredation-management program, and they overwhelmingly support the use of tax dollars for this purpose (Beyer et al. 2006). A majority (58%) of interested respondents to the most-recent general-public attitude survey strongly or somewhat supported the use of tax dollars as compensation for lost livestock (excluding privately owned cervids).

Current Michigan law does not require or allow the State to compensate owners for dogs killed by wolves. The lack of State compensation for wolf depredation of dogs is consistent with the public preference on this issue (Beyer et al. 2006). Opposition (45% opposed) was greater than support (35% supported) for the use of tax dollars to compensate for hunting dogs lost to wolves. Support and opposition for the use of tax dollars to compensate for other pets were virtually identical, but support was indicated by less than a majority (40%) of interested survey respondents.

Actions:

1. Investigate the causes of depredation to facilitate compensation to livestock producers for livestock losses caused by wolves.

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6.10.6 Work with partners to reduce the likelihood of privately owned cervids lost to wolves.

Cervids (i.e., deer, elk and other members of the Cervidae family) are the natural prey of wolves. Enclosures that contain privately owned cervids, often at unnaturally high densities, are expected to attract wolves. A wolf that gains entry to such an enclosure would be expected to exhibit natural predatory behavior.

The public generally does not support compensation for privately owned cervids lost to wolf depredation (Beyer et al. 2006). Thirty-three percent and 45% of interested respondents to the most-recent public-attitude survey respectively supported and opposed the use of tax dollars for that purpose. However, privately owned cervids are defined as livestock under the Michigan Animal Industry Act (Public Act 466 of 1988) and current Michigan law requires the State to provide compensation for livestock lost to wolves.

Actions:

1. Work with partners and the privately owned cervid industry to develop voluntary standards to reduce the likelihood of wolves getting into enclosures.

6.11 Minimize the Negative Impacts of Captive Wolves and Wolf–Dog Hybrids.

Captive wolves and wolf–dog hybrids that are released or escape pose a threat to both people and the wild wolf population. These animals could pose risks to human safety, they could cause adverse biological impacts, and they could reduce social acceptance for the wild population because the public is unlikely to distinguish between problems caused by released captive or hybrid wolves and those caused by wild wolves. The following objectives focus on reducing the risks posed by these animals.

6.11.1 Minimize and deter the possession of captive wolves in Michigan.

Well-designed wolf exhibits at zoos open to the public may serve an educational function, but possession of captive wolves by private individuals will not help save the species in the wild, regardless of intentions. Conservation of the species is better achieved through management of the wild population rather than efforts to save or breed individual animals. Given the risks posed by captive wolves, minimizing their possession in Michigan will help protect human safety and the wild wolf population.

The capture of wild wolves for possession in captivity is illegal in Michigan. However, regulations in place as of this writing do not prohibit the importation and possession of wolves that were legally obtained in other States and countries. Designation of wolves as a game animal or a protected animal or other amendment of the Michigan Wildlife Conservation Order could allow the DNR to regulate the possession of such animals. In addition, amendment of the Michigan Large Carnivore Act (Public Act 274 of 2000) to include wolves would provide another tool for limiting the possession of wolves in captivity.

When a severely injured wolf (e.g., hit by a vehicle) is encountered, euthanizing the animal is often more humane and prudent than subjecting it to long-term captive treatment and rehabilitation. Severe injuries often result in permanent damage to an animal, making it unfit for release into the wild. Captivity is a traumatic experience for any wild animal, and whether a wolf would be readily accepted into a pack after extended confinement is unknown. The DNR does not advocate rehabilitation of sick or injured wolves.

Actions:

1. Amend the Wildlife Conservation Order as necessary to prohibit the possession of wolves in captivity, except under permit.
2. Support inclusion of wolves as animals covered by the Michigan Large Carnivore Act (Public Act 274 of 2000).

6.11.2 Minimize and deter the possession of wolf–dog hybrids in Michigan.

Wolf–dog hybrids are produced when a wolf interbreeds with a dog or another wolf–dog hybrid. Ownership and proliferation of these animals in Michigan could threaten public safety. Most wolf–dog hybrids are poorly adapted as pets and are difficult to train (Jenkins 1991, Warrick 1991, Sikarskie 1993). Hybrids are frequently destructive of their owners' property, attack people and domestic animals, and are generally too wary of people to be effective guard animals. In one instance in the UP, wolf–dog hybrids killed the pet dog of the owner and bit another person. Those animals were subsequently killed for rabies testing, but other hybrids have either escaped or been released by their owners into the wild (B. Roell, Michigan DNR, personal communication).

Ownership and proliferation of wolf–dog hybrids could also threaten the viability of the Michigan wolf population in multiple ways. First, escaped or released hybrids may breed with wild wolves and thereby introduce dog genes into the wolf population. The DNR has documented the assimilation of at least one hybrid wolf into a pack of wild wolves in the UP (B. Roell, Michigan DNR, personal communication). This behavior can jeopardize the genetic integrity of the population and cause population-wide changes in morphological and behavioral characteristics. Second, a desire to breed and raise wolf hybrids may prompt some people to capture wild Michigan wolves illegally. Third, problems caused by released hybrids are often incorrectly attributed to wolves and thus reduce social acceptance for a wolf population.

The Michigan Wolf–Dog Cross Act (Public Act 246 of 2000) currently prohibits the ownership and possession of wolf–dog hybrids, except under permit. Maintaining the prohibitions and penalties under that law would help deter possession of hybrids and thus reduce the risks associated with them.

In many cases, wolf–dog hybrids can be difficult to identify. Although the DNR does not have regulatory authority for the management of such animals, it can offer expertise to other agencies, law-enforcement officials, and local animal-control agents for the purpose of identifying and managing hybrids.

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Actions:

1. Support prohibitions and penalties associated with the possession of wolf–dog hybrids, as outlined under the Michigan Wolf–Dog Cross Act (Public Act 246 of 2000).
2. Train staff on the identification of wolf–dog hybrids.
3. Assist other agencies, law-enforcement officials, and local animal-control agents in efforts to identify and manage wolf–dog hybrids.

6.12 Develop Socially and Biologically Responsible Management Recommendations Regarding Public Harvest of Wolves.

Harvest (i.e., hunting and trapping) of wolves by the public is both: a potentially important tool to reduce conflict from, and realize benefits of, a healthy wolf population; and a controversial issue that often polarizes stakeholder groups. Indeed, "the issue of hunting and trapping wolves—a public take—is only possible after they become Federally delisted and is perhaps the most divisive and potentially explosive issue in the entire wolf debate" (Nie 2003: 59). Public harvest of wolves is also biologically complex. The effects of harvest on a wolf population are determined by a suite of factors, including population size, age and sex structure, immigration and emigration rates, birth rates, and natural and human-induced mortality rates (Beyer et al. 2006).

In certain situations, members of the public could be authorized to take wolves in the absence of a designated harvest season (e.g., with a permit issued by the DNR), regardless of the State legal classification of wolves. However, a public harvest during a regulated season requires that wolves be Federally delisted and classified as game animals in Michigan. Citizen initiated legislation, passed by the Michigan Legislature in 2014, classified wolves as game animals and provided the NRC with the authority to classify species as game animals, with an effective date of March 31, 2015. In addition, the State Legislature or the NRC can authorize the first harvest season. With wolves classified as game animals, the Michigan NRC has the exclusive authority to enact regulations pertaining to the methods and manner of public harvest. Although the decisions regarding establishment of a harvest season will be made by the NRC, this strategy offers some relevant recommendations, to the DNR, in order to make socially and biologically responsible recommendations to the NRC, regarding public harvest of wolves.

The following objectives separate the issue of a public wolf harvest into two categories. The first category deals with harvest that addresses a need to reduce wolf-related conflicts. The second category deals with harvest as a recreational or utilitarian benefit, independent of any need to reduce wolf-related conflicts through management. Public support for a public harvest appears to differ according to the primary purposes reflected in those two categories.

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6.12.1 Develop recommendations regarding public wolf harvest for the purpose of reducing wolf-related conflicts.

Wolf-related conflicts are often caused by the behavior of a few individual wolves, and management at small scales can often address problems effectively. To the extent that it is expected to be effective and logistically feasible, conflict management under this plan will be conducted at the level of individual wolves or packs.

Some situations may warrant consideration of reducing wolf numbers in localized areas as a means to reduce the risk of negative interactions. Such consideration could be necessary if a high density of wolves in an area, rather than the behavior of individual wolves, was determined to be responsible for problems that could not otherwise be addressed through non-lethal or individually directed lethal methods.

Many Michigan residents would support reduction of wolf numbers in localized areas if it would reduce problems caused by wolves (Beyer et al. 2006). The extent of public support appears to depend on the nature of the problem to be addressed. The percentage of interested survey respondents that supported reducing wolf numbers through lethal means was highest with regard to human-safety concerns (59%), intermediate with regard to depredation problems (54%), and lowest with regard to impacts on the number of deer available for hunting (49%).

Current public attitudes also vary according to management methods. Public support for the use of trained, paid professionals to reduce wolf numbers is generally weak. Thirty-eight percent and 26% of interested survey respondents supported the use of professionals to either shoot or trap wolves, respectively. Opposition to the use of paid professionals to either shoot or trap wolves was expressed by 49% and 59% of respondents, respectively. By contrast, the public indicated moderate or strong support for the use of licensed hunters and trappers during a controlled public harvest season. Sixty-seven percent and 60% of respondents supported the use of licensed hunters and licensed trappers, respectively. Opposition to the use of licensed hunters and licensed trappers was expressed by 26% and 31% of respondents, respectively.

Surveys of registered Michigan voters by an independent marketing firm just prior (October 2013) and after (March 2014) the 2013 wolf hunt found 67-68% support for a limited hunt to address citizen claims of depredation and safety issues (http://mrgmi.com/2013/10/michigan-poll-wolves-not-as-popular-as-doves/; http://mrgmi.com/2014/04/michigan-poll-michigan-residents-favor-a-limited-hunting-season-on-wolves/). In contrast, on 4 November 2014 (Proposal 1, 2014) Michigan voters repealed Public Act 520 of 2012, legislation that designated wolves as game species and was a necessary step before the NRC could consider whether to establish a wolf harvest season.

The efficacy of using licensed hunters and trappers to reduce local wolf numbers would depend on the behavioral and reproductive responses of wolves and the method and manner of take. Wolves are prolific and can quickly re-colonize areas through immigration (Fuller et al. 2003). As a result, wolf populations can remain stable or increase despite relatively high mortality rates (Fuller 1989, Mech 2001). Recent public wolf harvests in Alaska, Canada and other parts of the world did not cause long-term reductions in wolf populations (Boitani 2003); however,

population reduction was not necessarily a goal of those harvests. Where efforts to reduce wolf population sizes have been successful, the methods that were used (e.g., poisoning, aerial shooting) are generally considered to be politically and socially unacceptable (National Research Council 1997, Boitani 2003). Public harvest with those methods should not be authorized in Michigan. Any legal public harvest in Michigan should be conducted with socially and biologically responsible methods.

This strategy provides the option to evaluate and apply, as appropriate, the use of hunters and trappers as a management tool for addressing conflicts that cannot otherwise be resolved. This strategy does not recommend or oppose establishing a regulated harvest season on wolves. Rather, it recommends evaluating local situations on a case-by-case basis, and then applying the assistance of hunters and trappers, as prudent, to reduce wolf-related risks to acceptable levels. If such action is deemed necessary, it will be planned based on the best available research and its effects will be evaluated to ensure it does not threaten the long-term viability of the Michigan wolf population.

Actions:

1. Evaluate conflict situations to determine whether localized reduction of wolf numbers is necessary to reduce wolf-related conflicts.
2. Evaluate the potential impacts of licensed hunters and trappers on local levels of wolf-related conflicts and the local and regional wolf population.
3. If prudent, develop recommendations to the NRC to recruit and use licensed hunters and trappers to reduce levels of wolf-related conflicts in localized areas.

6.12.2 Develop recommendations regarding public wolf harvest for reasons other than managing wolf-related conflicts.

Although the public generally supports the use of licensed hunters and trappers to reduce wolf-related conflicts, it is more ambivalent on the issue of a public wolf harvest specifically for recreational or utilitarian purposes (Beyer et al. 2006). A slight majority, Fifty-five percent of interested survey respondents, supported a controlled hunting season "in those areas of Michigan where wolf population could be hunted without endangering the population" and 33% of interested respondents opposed such a hunt. Forty-eight percent and 41% of interested respondents respectively supported and opposed a controlled trapping season "in those areas of Michigan where wolf population could be hunted without endangering the population."

In November of 2014, only 45% of statewide voters voted yes on the public referendum (Proposal 1, 2014) to approve the law that made wolves a Game animal. When Proposal 1, 2014 results are analyzed at the county level, strong regional and urban/rural variation are evident in the desire for game animal status for wolves. All 15 counties in the UP had a majority of voters voting yes on proposal 1, while almost all of the most populated counties of southern Michigan had a majority of voters voting no (Figure 6.1).

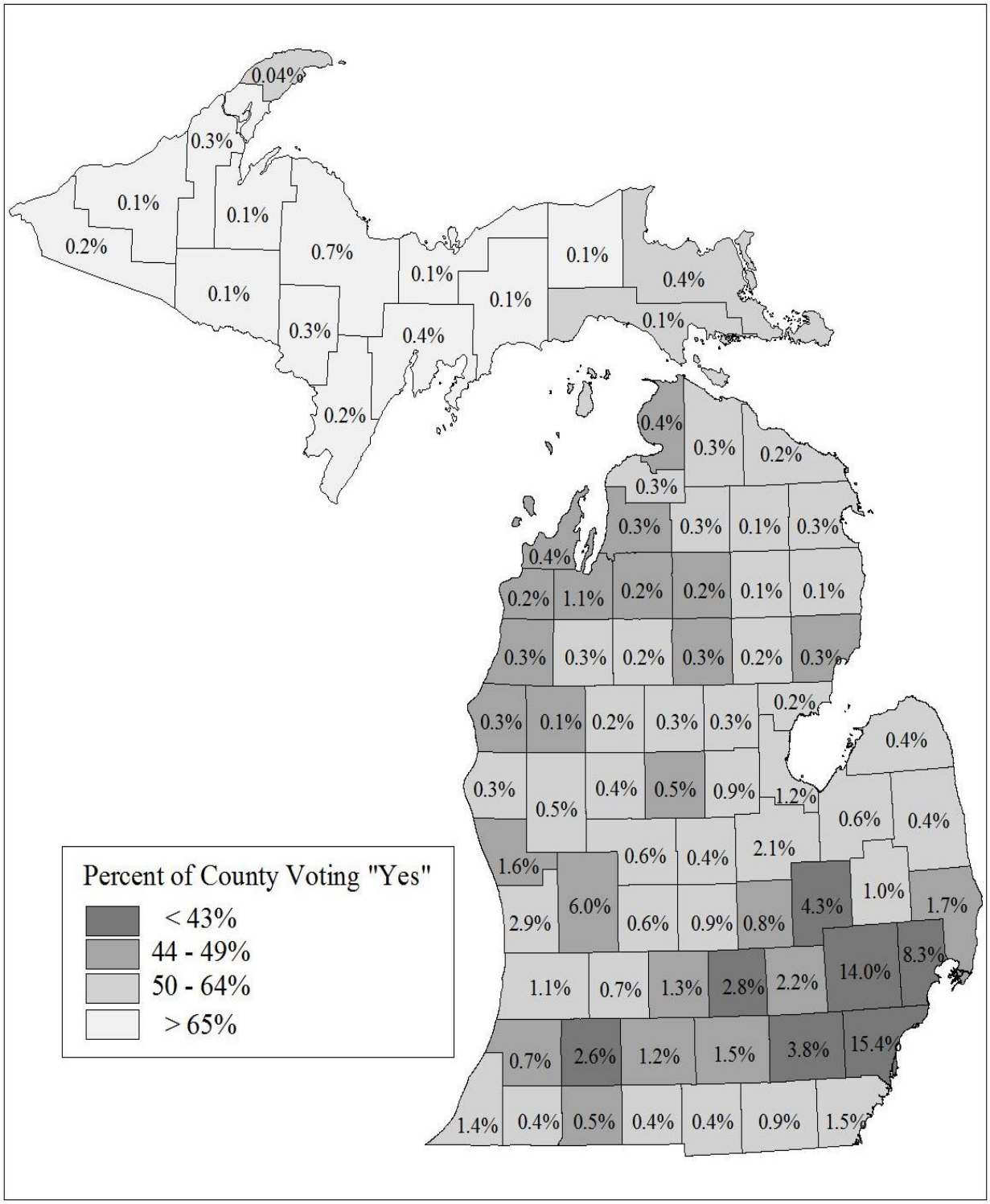

Figure 6.1. County level results on Proposal 1, 2014 showing strong regional and urban/rural differences in the results of voting. A yes vote would have approved the law that made wolves a game animal in 2012. A no vote repealed the law. The numeric value in each county is the proportion (%) of total votes cast statewide on proposal 1.

Although members of the Michigan Wolf Management Roundtable reached consensus on every other issue, they did not reach agreement on whether a regulated wolf hunting/trapping season should be provided in the absence of any need to reduce wolf-related conflicts. Some Roundtable members supported such a hunting/trapping season because many Michigan residents would place an important value on and derive benefits from the opportunity to harvest wolves. Other members opposed a hunting/trapping season in the absence of a specific need to reduce local wolf abundance because it would conflict with the cultural and personal values of many other Michigan residents. After substantial deliberation, the group concluded consensus on any guiding principles regarding the issue was not possible because the disagreement focused primarily on important differences in fundamental values.

A meta-analysis of wolf population growth rates in North America suggested that rates of human-caused mortality (including harvest) less than 29% did not importantly influence growth rates (Adams et al. 2008). In the event a public wolf harvest is authorized in Michigan, the effects of particular levels of take on the wolf population would depend on a variety of factors, including local conditions and population characteristics. Analyses of those factors would be important for the regulation of a sustainable harvest that does not threaten population viability.

Given the absence of a strong public preference, and given the lack of specific guidance from the Roundtable, and the need to assess the biological effects of different levels of take, the following actions focus on the need to gather and evaluate biological and social information regarding a general wolf harvest.

Actions:

1. Evaluate the potential biological effects of a public wolf harvest specifically for recreational or utilitarian purposes.
2. Evaluate the demand for and public acceptability of a public wolf harvest specifically for recreational or utilitarian purposes.
3. If biologically sustainable, legally feasible, and socially responsible, develop recommendations to the NRC to offer opportunities for the public to harvest wolves for recreational or utilitarian purposes.

7. PLAN MONITORING AND REVIEW

Regular communication among agencies, stakeholder groups and the general public allows interested parties to monitor progress made toward implementation of this plan. It also provides opportunities for management agencies to receive input on specific management issues. One of the ways to facilitate these benefits is through the establishment a wolf management stakeholder group. The group will convene on an annual basis, or as otherwise needed, to discuss management goals, educational opportunities, conflict resolutions, plan implementation, and other topics. Membership of this group will represent the diversity of wolf-related interests and management responsibilities in Michigan. The role of the stakeholder group will differ from that

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of the Michigan Wolf Management Roundtable, which fulfilled its charge and was disbanded following its review of the 2008 version of this plan.

Wolf abundance and distribution, attitudes of Michigan residents, and wolf legal status may continue to change through time. To address ecological, social and regulatory shifts in a timely manner, the DNR will review and update this plan at 5-year intervals. The plan-revision process will include review of the best available scientific information and substantial involvement by affected stakeholder groups and the general public.

8. FUNDING

Costs of wolf management are associated with salaries, wages, contracts, travel, equipment, facilities, livestock compensation, and information and education materials. These costs have been significant for many of the agencies and partners involved in wolf management. Given persistent management needs, they are expected to remain significant into the foreseeable future.

At all ten wolf-focused public meetings hosted by the DNR in May 2005, the public expressed diverse concerns pertaining to funding for wolf management. Some people were concerned about the large expense of population monitoring and other management activities. Others desired assurance that sufficient funds would be available to maintain adequate staffing levels and allow timely agency responses to depredation complaints and other concerns. Others objected to a funding approach that has traditionally caused some stakeholder groups (i.e., hunters and trappers) to disproportionately bear the financial costs of wolf management.

Most funding for wildlife management has traditionally been derived from revenues generated by sportspersons. For example, the Michigan Game & Fish Fund is generated by State hunting and fishing license revenues, and the Federal Aid in Wildlife Restoration Act (a.k.a. Pittman–Robertson Fund) provides funds derived from an excise tax on purchases of firearms and sporting goods. In the absence of many other funding alternatives, the DNR wolf management program has been supported primarily by these two funding sources. As a result, sportspersons have played a critical role in the recovery, conservation and management of Michigan wolves.

Other agencies, tribes and private organizations also have played an important role by addressing education, conservation and research needs. The financial and staff resources applied by these groups have complemented traditional funding sources in ways that have broadened the wolf management program.

Sportspersons and other management partners have provided most of the funding for wolf management, but they currently represent only a small proportion of all Michigan residents. Regardless of the inequities that may be associated with such a system, a funding approach that relies on the disproportionate contributions of these groups may become inadequate, especially if the prevalence of sportspersons within the general population continues to decline.

Successful efforts to obtain funding from alternative sources could spread the financial support for wolf management among a greater variety of stakeholder groups than traditional funding

sources currently allow. Such an approach could help sustain the required levels of funding, and it could provide the general public with a greater stake and interest in wolf management.

The DNR will work with management partners to explore opportunities to identify new funding sources and to distribute the financial support for wolf management more-evenly among a greater diversity of stakeholders. It will also assist its management partners in their efforts to maintain the funding required for their wolf management activities. Finally, the DNR will take other prudent steps to ensure sufficient funding will be available to address management needs and to ensure funding is used in a responsible, efficient manner.

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10. APPENDIX:

MICHIGAN WOLF MANAGEMENT ROUNDTABLE REPORT

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