WISCONSIN WOLF MANAGEMENT PLAN 2023

A Plan For Stewardship, Conservation And Management Of The Gray Wolf In Wisconsin

Wisconsin Department of Natural Resources

Bureau of Wildlife Management

WISCONSIN
DEPT. OF NATURAL RESOURCES

PUB WM-687-23

Department Mission Statement

To protect and enhance our natural resources: our air, land and water;

our wildlife, fish and forests and the ecosystems that sustain all life.

To provide a healthy, sustainable environment and a full range of outdoor opportunities.

To ensure the right of all people to use and enjoy these resources in their work and leisure.

To work with people to understand each other's views and to carry out the public will.

And in this partnership consider the future and generations to follow.

Plan approved by the Wisconsin Natural Resources Board on October 25, 2023, in Madison, Wisconsin.

- Bill H. Smith, Chair, Wisconsin Natural Resources Board
- Adam N. Payne, Secretary, Wisconsin Department of Natural Resources

This document should be cited as:

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Disclaimer: the Wisconsin Department of Natural Resources recognizes that this document contains some language and terms which are accepted scientific terminology but may be objectionable or offensive to some readers when used in reference to wolves. The use of such certain terms in this document is strictly intended to be consistent with the prevailing scientific terminology and usage.

Acknowledgments

The Wisconsin Department of Natural Resources recognizes and appreciates the many individuals, agencies, tribes and organizations who have provided countless valuable contributions during the development of this plan and over the course of wolf recovery and management in Wisconsin.

Wolf Management Plan Committee (2021)

Bad River Band of Lake Superior Ojibwe

Forest County Potawatomi

Great Lakes Indian Fish and Wildlife Commission

Great Lakes Wildlife Alliance

Humane Society of the United States

Ho-Chunk Nation

Lac Courte Oreilles Band of Lake Superior Ojibwe

Menominee Tribe of Wisconsin

Red Cliff Band of Lake Superior Ojibwe

Safari Club International Wisconsin Chapter

Sierra Club Wisconsin Chapter

Stockbridge-Munsee Community

Timber Wolf Alliance

US Fish and Wildlife Service

US Forest Service

USDA Wildlife Services

Wisconsin Bear Hunter's Association

Wisconsin Bowhunter's Association

Wisconsin Cattleman's Association

Wisconsin Chapter of Backcountry Hunters & Anglers

Wisconsin County Forests Association

Wisconsin Conservation Congress

Wisconsin Conservation Voices

Wisconsin Farm Bureau Federation

Wisconsin Farmer's Union

Wisconsin's Green Fire

Wisconsin Trapper's Association

Wisconsin Wildlife Federation

Wisconsin Wolf Facts

The Wisconsin Department of Natural Resources would also like to recognize that while many of Wisconsin's Tribal Nations participated in the development of this plan, they have continued to express firm opposition to any wolf harvest seasons. The department acknowledges these concerns and will continue to respectfully engage with Wisconsin's Tribal Nations regarding wolf management and harvest.

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Executive Summary

In about six decades, the Wisconsin landscape has gone from being devoid of wolves to supporting one of the most robust wolf populations in the Lower 48 states. Today, wolf packs are established in about half of all Wisconsin counties, primarily in the forested northern and central parts of the state. Statewide winter population estimates suggest approximately 1,000 wolves have occupied the state in recent years.

The Wisconsin wolf population is part of a larger and well-connected wolf population that extends east into the Upper Peninsula of Michigan and west into Minnesota. Today, these states collectively support a northern Great Lakes regional wolf population of over 4,000 wolves, with thousands more connected to the north across the Canadian border. In the last decade, population growth and range expansion have generally slowed and stabilized in all three states, suggesting wolves have fully recolonized most available habitat in the region.

Wolves are an important part of the state's natural and cultural heritage and are deeply significant to Wisconsin's Tribal Nations. As apex predators, wolves play an important role on the landscape and provide numerous ecological benefits. Their presence contributes to healthier, more biologically diverse ecosystems, ultimately providing benefits for all. The recovery of this native species in Wisconsin stands as a wildlife success story and a testament to righting the conservation wrongs of the past.

The return of wolves also generates challenges related to living alongside a population of large carnivores. Wolves occasionally kill livestock, hunting dogs and pets and these events can carry significant financial and emotional costs to those involved. The presence of wolves also causes some people to become concerned for the safety of their pets, themselves or others. This can translate to opportunity loss, such as changes in how people use their property or recreate on public lands, in an effort to avoid potential conflicts. These costs are typically felt most by those who live, work and recreate among wolves, which can lead to reduced societal acceptance for wolves at the local scale. This dynamic is fundamental to gaining a fuller appreciation of the diverse perspectives surrounding wolf management.

Plan Purpose And Organization

The Wisconsin Wolf Management Plan provides a comprehensive summary of wolf ecology and management in Wisconsin and provides a pragmatic vision to wolf management and stewardship in the years ahead. The actions outlined in this plan provide a focused and meaningful path forward toward maintaining a healthy wolf population while being responsive in addressing conflicts and assisting those negatively affected by interactions with wolves.

The plan is organized into four primary sections. The first three sections provide a foundation of information related to wolves to enhance understanding of the species and the complexities surrounding wolf management. The fourth section provides the plan's detailed wolf management policies.

- **Section One** includes a scientific overview of the species and discussions of biology, ecology and population dynamics of wolves.
- **Section Two** focuses entirely on the human element, providing insights into the human dimensions of wolf management.

- **Section Three** reviews historical and contemporary information on management of wolves in Wisconsin.
- **Section Four** defines the plan's overall wolf management goal, identifies a detailed suite of objectives, strategies and products to guide wolf management decisions and it provides metrics for evaluating whether the objectives are being realized.

Plan Development

The department began developing this wolf management plan in early 2021. Along the way, extensive public input and discourse on the future of wolf management was encouraged, received and considered. Key elements of this process included:

- Establishing a Wolf Management Plan Committee, consisting of representatives of 29 various stakeholder groups, agencies and tribes, to provide diverse and inclusive input toward the new plan.
- Completing a scientific assessment of Wisconsin residents' opinions and preferences related to wolves.
- Engaging Wisconsin's Tribal Nations through invited government-to-government consultations and technical meetings with their respective natural resources staff.
- Holding a 110-day public review and comment period on the draft version of this plan. During this period, we received around 3,500 public comments and well over 10,000 views of the draft plan on the DNR website.
- Considering all public feedback received during the review period and preparing the revised draft of the plan.

The plan and policy recommendations contained within it were developed by the department in accordance with current state and federal laws and informed by principles of wildlife management, the scientific literature, the items listed above and other sources of public input. Writing of the plan was led by department staff in the Bureau of Wildlife Management with collaboration from department staff in the Office of Applied Science, Bureau of Environmental Analysis and Sustainability, Bureau of Legal Services and the Secretary's Office.

Effect Of Listing Status On Wolf Management

The legal status of wolves in Wisconsin has varied greatly over the years and this has had direct effects on the state's management authority with respect to wolves. Depending on if wolves in the state are included on the federal or state endangered species list and whether they are classified as endangered or threatened status directly affects which management options are available in the state. The two most profound implications are the availability of lethal control (such as landowner removal permits or agency removal efforts) as an abatement option in response to wolf-related conflict and whether a public wolf harvest season can occur in Wisconsin. Because these two items are critical components of a responsive approach to management and necessary to fully realize the goals of this plan, it is crucial that any actions outlined in the plan demonstrate the state's long-term commitment to sustainably and responsibly managing the wolf population once delisted.

The legal statuses and their implications on wolf conflict and harvest are summarized in the following table.

Federal Or State Endangered Species Status	Available Responses To Wolf-Related Conflicts	Public Wolf Hunting And Trapping Season In Wisconsin
Endangered	Non-lethal only*	No
Threatened	Non-lethal and lethal	No
None	Non-lethal and lethal	Yes

*Except in verified cases of human health and safety conflicts.

This plan recognizes the value and biologically recovered status of gray wolves in Wisconsin. Accordingly, the plan supports long-term, collaborative and science-based wolf management in Wisconsin to allow full realization of the goal, objectives, strategies and products identified in the plan and within the scope of the law. This management plan describes the principles intended to guide the department's management of wolves when wolves are not listed on the federal and/or state list of endangered and threatened species. During times when wolves in Wisconsin are listed on the federal and/or state list of endangered and threatened species or there is a change in the listed status of wolves, the department will evaluate whether and to what extent the various components of this plan may be applied to ensure consistency with the listed status, the department's authority and applicable laws.

WISCONSIN DNR

Wolf Management Plan Goal And Objectives

This plan recognizes the biologically recovered status of gray wolves in Wisconsin and turns attention from wolf recovery to long-term stewardship and sustainable management of wolves in the state. It demonstrates the state's dual commitments of maintaining a sustainable and ecologically functional wolf population while also being responsive in addressing wolf-related conflicts and concerns. The stated goal of the Wisconsin Wolf Management Plan is to:

Ensure a healthy and sustainable wolf population

that fulfills the numerous ecological, cultural and recreational benefits of wolves,

while being responsive in addressing and preventing wolf-related conflicts

and recognizing the diverse values and perspectives of all residents in Wisconsin.

Six specific objectives have been developed to focus efforts toward achieving this goal. Within each objective, the plan identifies a series of strategies and actionable products to link the objectives to on-the-ground implementation. Each objective also includes a set of metrics to be used in helping measure and evaluate progress toward the objective. The objectives, strategies, products and associated metrics are summarized below (see Section 4 of the plan for full details).

Objective A: Ensure A Healthy And Sustainable Wolf Population To Fulfill Its Ecological Role

A wolf population that is healthy and ecologically functional will continue to provide various ecosystem benefits and services across the species' range in Wisconsin.

Importantly, this objective acknowledges that both wolf population increases and/or decreases may occur over time, whether naturally or via management actions, while maintaining a population that is deemed healthy and sustainable.

To meet this objective, the plan recommends the following strategies:

- Manage the wolf population at sustainable and ecologically functional levels that reflect public preferences regarding wolf-related benefits and wolf-related conflicts.
- Continue rigorous annual wolf population monitoring.
- Use science-based and data-driven methods to estimate the wolf population.
- Support law enforcement in enforcing existing laws and ensure effective and appropriate legal protection for wolves.
- Protect and monitor wolf population health.
- Maintain sustainable populations of wolf primary prey.
- Consider wolves in habitat management planning and decisions.

Metrics identified to help evaluate whether this objective is being met include assessments of wolf population abundance and distribution trends, genetic connectivity and potential threats to the wolf population such as illegal killing and disease.

Objective B: Address And Reduce Wolf-Related Conflict

A critical component of wolf conservation in human-dominated landscapes is the effective management of wolf-related conflicts to ensure long-term support and compatibility

within those areas. As expected with any large carnivore, some level of wolf-related conflict is inevitable, so this objective focuses instead on mitigating conflicts through effective conflict response and prevention.

To meet this objective, the plan recommends the following strategies:

- Maintain an integrated and responsive wolf conflict program including both lethal and non-lethal conflict mitigation strategies.
- Administer a wolf damage compensation program.
- Maintain a cooperative services agreement with USDA Wildlife Services to provide timely and effective wolf conflict assistance.
- Ensure adequate funding for the wolf conflict program.
- Continue to research conflict mitigation and prevention measures while developing new techniques for addressing conflicts.
- Increase public awareness of wolf conflict program and abatement techniques.

Metrics identified to help evaluate whether this objective is being met include evaluations of conflict trends (livestock, hunting dog, pet and human health and safety), effective administration and implementation of the conflict program and public support for the program.

Objective C: Provide Multiple Benefits Associated With The Wolf Population

This objective strives to provide opportunities to appreciate and draw multiple benefits from the wolf population, including a regulated harvest of wolves consistent with state and federal law, while also safeguarding the resource for current and future generations.

Current Wisconsin state law requires the department to implement a wolf harvest season whenever wolves are not listed as a state or federal threatened or endangered species. Results from the department's 2022 scientific public opinion survey indicated that support (46%) for a regulated hunting and trapping of wolves was higher than opposition (29%); one-quarter of Wisconsinites were undecided. The survey also found support was higher among wolf-range residents (57%) than it was for residents outside wolf-range (43%; Bradshaw et al. 2022). In addition, the preponderance of current scientific evidence demonstrates that the Wisconsin wolf population is capable of sustainably supporting some level of public harvest. Nevertheless, public harvest of wolves remains perhaps the most highly controversial aspect of this plan, so it is critical that this legislative directive is carried out in a highly regulated manner consistent with management plan objectives, while also considering the public's diverse preferences and values.

To meet this objective, the plan recommends the following strategies:

- Provide an effectively regulated wolf harvest season consistent with public preferences and management plan objectives.
- Evaluate wolf harvest season structure and implementation.
- Encourage and recognize other forms of recreation and positive interactions with the wolf population.

Metrics identified to help evaluate whether this objective is being met include wolf harvest opportunities, non-harvest recreational opportunities and effective wolf harvest season implementation.

Objective D: Increase Public Understanding Of Wolves In Wisconsin

Public educational efforts have long been a cornerstone of wolf conservation in the state and such efforts remain an important and publicly supported aspect of the state's management plan. This objective aims to provide science-based information to the public to ultimately improve awareness and understanding of the various ways that wolves influence Wisconsin's landscapes and people.

To meet this objective, the plan recommends the following strategies:

- Provide public education and understanding of wolves by ensuring information is accurate and readily available to the public.
- Ensure educational materials are reflective of the latest science and accumulated management experience.
- Encourage the use of creative and forward-thinking outreach tools to reach new and broader audiences.

Metrics identified to help evaluate whether this objective is being met include active and passive outreach efforts to share accurate information on wolves and measures of public knowledge of how to responsibly live, work or recreate in wolf range.

Objective E: Conduct Scientific Research To Inform Wolf Stewardship

For the purposes of this plan, stewardship is defined as the careful and responsible management of resources. To be effective stewards, a scientific foundational understanding of a species' ecology and population dynamics is essential. This objective outlines a non-exhaustive list of research projects, existing information gaps and program efforts related to contemporary wolf management issues. These items are intended to build upon the existing knowledge base and support continued science-based wolf stewardship in Wisconsin.

To meet this objective, the plan recommends the following strategies:

- Continue to evaluate and improve methods used to monitor the wolf population.
- Evaluate social and economic implications related to wolves in Wisconsin.
- Continue to research conflict mitigation, prevention measures and develop new techniques for addressing conflicts.
- Continue to assess effects of regulated wolf harvest on Wisconsin's wolf population.
- Carry out research on the population dynamics and ecological influences of wolves in Wisconsin.
- Communicate scientific findings from research conducted in Wisconsin and elsewhere.

Metrics identified to help evaluate whether this objective is being met include completion of wolf-related scientific research, publishing and sharing of findings and addressing information gaps to inform management.

Objective F: Provide Leadership In Collaborative And Science-Based Wolf Management In Wisconsin

The recovery of gray wolves in Wisconsin is a conservation success story which could not have occurred without the combined and sustained efforts of numerous local, state and federal governmental entities, Tribal Nations, non-government organizations and the residents of the state. As the focus

now moves from wolf recovery to ongoing sustainable management, it will be crucial for the department to provide leadership, maintain and build trust through high levels of collaboration and relationship building, apply innovative thinking to address ongoing and emerging issues and rely upon science to inform sound decision-making.

To meet this objective, the plan recommends the following strategies:

- Provide leadership for science-based wolf management in Wisconsin.
- Utilize the department's Wolf Advisory Committee to advise on implementation of the Wisconsin Wolf Management Plan.
- Support science-based wildlife management and increase capacity through collaboration with other government agencies, tribes, conservation organizations, universities and residents.

Metrics identified to help evaluate whether this objective is being met include regular meetings of the department's Wolf Advisory Committee, collaboration with Tribal Nations, government agencies, conservation organizations and universities and public input opportunities on wolf management.

Implementation Of The Management Plan

Notably, the plan does not include a targeted statewide population size or goal by which to guide management actions. While such numeric goals may be appropriate for a recovering species, static abundance goals often become ineffective and even unnecessary when considering the social, biological and legal complexities of a recovered wolf population. Instead, the plan recommends adjusting management actions and methods, such as conflict abatement and public harvest, in response to conditions observed in the field. This style of adaptive management ultimately strives to balance public preferences regarding population sizes and related benefits with potential and realized negative interactions with wolves. It is more scientifically defensible than a static numeric population goal in the face of future uncertainties and, therefore, also more likely to support the long-term maintenance of full management authority upon future wolf delisting.

Utilizing the adaptive management approach identified in this management plan, changes in wolf population abundance and distribution would be the result of natural wolf population dynamics as well as varying levels of regulated public harvest of wolves (when legally allowed). Based on state statutes, an annual regulated wolf harvest season would occur when wolves are not listed on the federal or state endangered species list, with management and harvest actions informed by this plan and designed to help balance the objectives identified in the plan.

This is expected to generally maintain statewide wolf abundance and distribution at levels comparable to recent years (overwinter estimates of approximately 800 to 1,200 wolves), while explicitly allowing for fluctuations in local wolf densities, including population reductions as warranted. This expected range of population sizes is informed by the best current estimate of maximum biologically sustainable carrying capacity in the state (~1,242 wolves; Stenglein et al. 2015b) and reflects the social science findings that most Wisconsinites would like *about the same number* of wolves or more in the state (approximately 1,000 wolves at the time of the survey; Bradshaw et al. 2022).

Specifically, the department's scientific survey of Wisconsinites found one-third (33%) of residents would like *about the same number*, 27% would like *more* wolves and 6% would like *many more* wolves in the state, whereas 15% of Wisconsinites would like *fewer* (9%) or *many fewer* (6%) wolves and 4% would like to have *zero* wolves in the state. Sixteen percent were unsure about how many wolves they would like to have in the state. Although there were clear differences in opinions between those living in wolf range and those living outside of wolf range, the most common response remained a preference for about the same number of wolves as today (Figure 1, Bradshaw et al. 2022).

To provide additional transparency and accountability, a table with observed statewide population sizes and likely statewide population management outcomes is also included in the plan (Table 1 below; see Objective A in Section 4 for full details).

Any future wolf harvest recommendations should consider not only these guidelines, but also the objectives and metrics of this management plan, wolf population estimates and trends, wolf-related conflict levels and trends, annual estimates of observed and expected wolf mortality, population modeling projections, outcomes of previous years' harvests, legal requirements including off-reservation treaty rights and on-reservation jurisdiction of Native American tribes, relevant scientific developments and other relevant biological and social factors. The department's wolf advisory committee should play a key role in this process to ensure inclusion of all perspectives during these discussions.

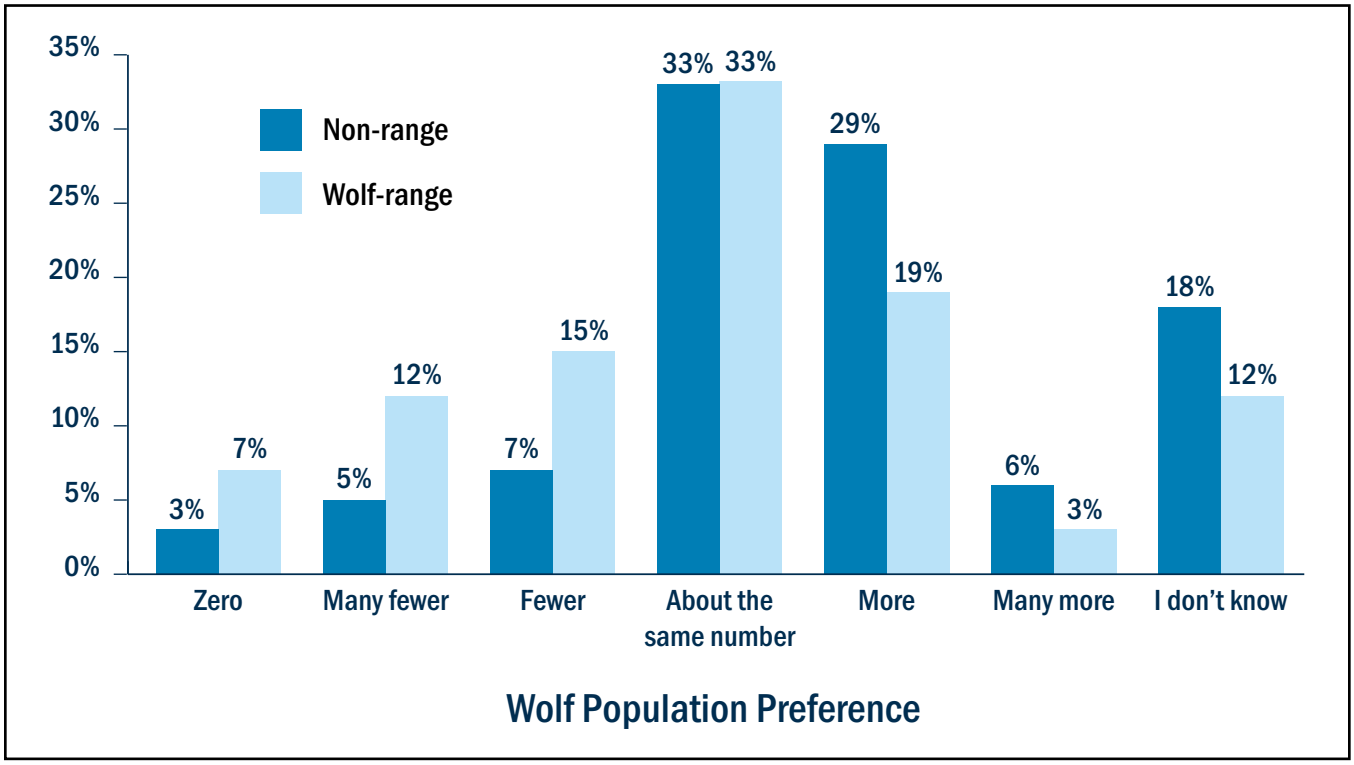

Figure 1. Distribution of preferred statewide wolf population sizes relative to the population at the time of study (~1,000 wolves) among residents of wolf-range and non-range in Wisconsin (Bradshaw et al. 2022).

Table 1. This table provides guidance only and does not establish any population size as a management goal. The information in this table was developed based upon the prevailing wildlife science and a full suite of biological and social factors, including recognition that the Wisconsin wolf population has biologically recovered. The expected range of future population sizes was informed by the body of contemporary wildlife science. This includes the best estimate of maximum biologically sustainable carrying capacity in the state of approximately 1,242 wolves (Stenglein et al. 2015b) and the population dynamics best practice of maintaining wildlife populations above 50% carrying capacity to ensure population viability. It also reflects the department's social science findings that most Wisconsinites would like *about the same number* of wolves or more in the state (approximately 1,000 wolves at the time of the survey). It has been developed in response to public input and feedback received during the development of this management plan centered on wolf harvest and desired population sizes. This table is intended to provide more transparency and accountability in these areas. Any future wolf harvest recommendations should consider not only these guidelines, but also the objectives and metrics of this management plan, wolf population estimates and trends, wolf-related conflict levels and trends, annual estimates of observed and expected wolf mortality, population modeling projections, outcomes of previous years' harvests, legal requirements including off-reservation treaty rights and on-reservation jurisdiction of Native American tribes, relevant scientific developments and other relevant biological and social factors. The department's wolf advisory committee should play a key role in this process to ensure inclusion of all perspectives during these discussions.

General guidance in anticipated future population sizes and likely statewide management outcomes for the Wisconsin wolf population.	
Statewide Off-Reservation Wolf Population Abundance Estimate	**Likely Statewide Population Management Outcome**
<650	Growth
650 – 799	Growth
800 – 999	Growth/Stable
1,000 – 1,199	Stable/Decline
1,200+	Decline

Together, the objectives and actions in this plan provide a pragmatic vision to wolf management and stewardship in the years ahead. If fully implemented, this plan will support the perpetuation of a healthy wolf population in Wisconsin to fulfill its numerous roles and benefits, while also being responsive in addressing wolf-related conflicts and recognizing the numerous values and perspectives of all residents in Wisconsin.

Please read the full Wisconsin Wolf Management Plan for more details and content.

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Introduction

Plan Development

This plan replaces the previous version of the Wisconsin Wolf Management Plan which was approved in 1999 and reaffirmed with an addendum in 2007. Multiple subsequent efforts to update the state's wolf management plan occurred in the years that followed, none of which resulted in a new management plan. Most notable among these efforts was a nearly complete draft management plan resulting from significant work between 2013 and early 2015. That draft ultimately remained unfinished due to a change in federal wolf legal status in late 2014 and the department's decision at that time not to further expend resources on a species while the state lacked full management authority. In recognition of both the value of the work completed during that time, as well as the seven years which has elapsed since, the department utilized the 2015 draft plan as a non-binding reference point throughout the development of this updated wolf plan.

The department began the process of updating the state wolf management plan shortly after Jan. 4, 2021, when gray wolves in Wisconsin were removed from the federal list of endangered species. This action returned full management authority of gray wolves in Wisconsin to the state and tribes. On Feb. 10, 2022, federal protections for gray wolves were reinstated as a result of an order by the U.S. District Court. Despite this change in legal status, the department decided to continue with the development of this updated plan.

This plan was developed in accordance with current state and federal laws and further informed by several inputs including the best available wildlife and social science, broad and inclusive public input, government-to-government consultations between the department and Wisconsin's Tribal Nations and the department's policies (Figure 2). Throughout these efforts, the department has remained committed to providing a transparent, deliberative and inclusive plan update process which recognizes the diversity of interest areas regarding wolf management. This multi-step process included:

- Launching a dedicated webpage to transparently provide information and updates on the wolf management plan update (early 2021).
- Collecting broad public input on wolf management through an open access questionnaire (spring 2021).
- Establishing an inclusive 29-member Wolf Management Plan Committee (WMPC) to provide diverse perspectives and input toward the development of the new plan (spring 2021). Committee membership included representatives from various government agencies, Tribal Nations and stakeholder groups representing hunting/trapping, agriculture/ranching and wolf advocacy/education interests. See acknowledgments for a list of WMPC members.
- Conducting a series of four professionally facilitated meetings of the WMPC, resulting in a comprehensive report detailing the WMPC's input on wolf management and used to guide development of the plan (summer-fall 2021).
- Providing an update on plan development and progress to the Natural Resources Board (winter 2021/22).

- Inviting and participating in government-to-government consultations with Tribal Nations in Wisconsin, including the department attending a meeting of the Voigt Intertribal Task Force, several technical meetings with staff from the Great Lakes Indian Fish and Wildlife Commission and individual meetings with natural resources staff and representatives from the Menominee and Stockbridge-Munsee tribes (spring and summer 2022).
- Conducting a scientific survey to measure statewide public opinions about and attitudes toward wolves as well as changes in those opinions and attitudes since the last statewide study in 2014 (summer and fall 2022).
- Holding a 110-day public review and comment period on the draft version of the plan, generating well over 10,000 views of the document online and submission of 3,500 public comments (fall 2022 to winter 2022).
- Reviewing all comments and feedback received on the draft plan and developing a revised draft of the plan based upon consideration of all public feedback (spring/summer 2023).
- Sharing the revised draft of the wolf management plan with the public, WMPC and Wisconsin's Tribal Nations (summer 2023).
- Offering additional meetings with Wisconsin's Tribal Nations to discuss the revised plan (summer 2023).
- Exploring additional opportunities to meet with stakeholder groups and the public to discuss the revised plan (summer 2023).
- Presenting the final plan to the Natural Resources Board for approval (fall 2023).

The development and writing of the plan was led by department staff in the Bureau of Wildlife Management with collaboration and assistance from department staff in the Office of Applied Science, Bureau of Environmental Analysis and Sustainability, Bureau of Legal Services and the Secretary's Office.

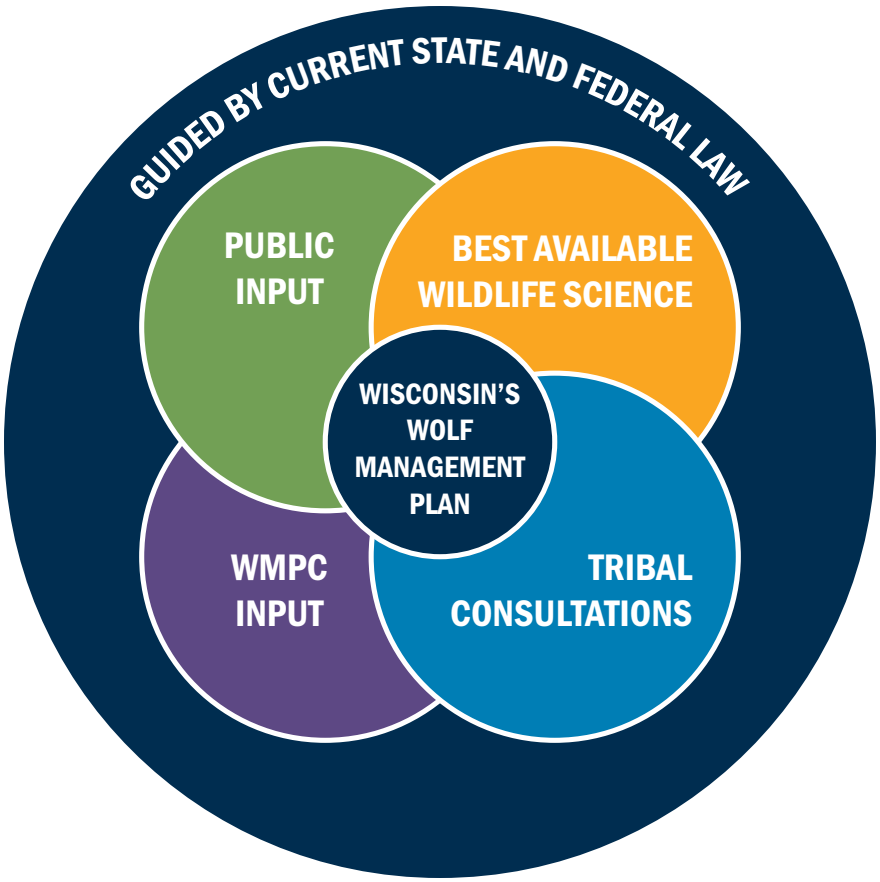

Figure 2. The Wisconsin Wolf Management Plan was developed in accordance with current state and federal laws and further informed by several inputs including the best available wildlife and social science, broad and inclusive public input, and consultations with Wisconsin's Tribal Nations.

Definitions

Species Definition

The taxonomical and evolutionary history of wolves in North America is complex, controversial and remains scientifically unresolved (USFWS 2020a). For the purposes of this plan, the department will continue to refer to Wisconsin wolves as gray wolves (*Canis lupus*) and manage them as a single species. Use of the word "wolf" and "gray wolf" in this document similarly refers to *Canis lupus* and may be used interchangeably. For a more in-depth discussion of the taxonomy of wolves in Wisconsin, please see the "Taxonomy and Genetics" topic in Section 1 of this plan.

Management Planning Period

Species management should be adaptive to changing ecological and social conditions to ensure management efforts accurately reflect the ecological and social landscapes in which they are applied. During the plan's implementation, new scientific findings, changes in the wolf population or public preferences or changes in legal status may call for a review of the contents of this plan. The complexities of assessing and responding to biological and social issues means that the timing of responses to changing conditions is not amenable to strict timetables. This plan includes an expected implementation timeline of approximately 10 years but should be considered valid until it is replaced. The plan is recommended to be reviewed by the department every 5 years after approval to ensure it continues to address contemporary wolf management issues.

Effect Of Listing Status On Wolf Management

The legal status of wolves in Wisconsin has varied greatly over the years and this has had direct effects on the state's management authority with respect to wolves. Depending on if wolves in the state are included on the federal or state endangered species list and whether they are classified as endangered or threatened status directly affects which management options are available in the state. The two most profound implications are the availability of lethal control (such as landowner removal permits or agency removal efforts) as an abatement option in response to wolf-related conflict and whether a public wolf harvest season can occur in Wisconsin. Because these two items are critical components of a responsive approach to management and necessary to fully realize the goals of this plan, it is crucial that any actions outlined in the plan demonstrate the state's long-term commitment to sustainably and responsibly managing the wolf population once delisted.

The wolf management goal and full set of objectives, strategies and products contained in this management plan describe the principles intended to guide the department's management of wolves when wolves are not listed on the federal and/or state list of endangered and threatened species. During times when wolves in Wisconsin are listed on the federal and/or state list of endangered and threatened species or there is a change in the listed status of wolves, the department will evaluate whether and to what extent the various components of this plan may be applied to ensure consistency with the listed status, the department's authority and applicable laws. The legal statuses and their implications on wolf conflict and harvest are summarized below.

Federal Or State Endangered Species Status	Available Responses To Wolf-Related Conflicts	Public Wolf Hunting And Trapping Season In Wisconsin
Endangered	Non-lethal only*	No
Threatened	Non-lethal and lethal	No
None	Non-lethal and lethal	Yes

*Except in verified cases of human health and safety conflicts.

Section 1: Gray Wolf Biology, Ecology And Population Dynamics

Gray Wolf Biology

Taxonomy And Genetics

The gray wolf (*Canis lupus*), also known as the timber wolf, is the largest member of the canid family (*Canidae*) which includes 35 currently recognized species of "dog-like mammals" across the globe (Padilla and Hilton 2015). In North America, the canids can be more generally organized into wolves, coyotes and foxes. Of these, the gray wolf, coyote (*Canis latrans*), red fox (*Vulpes vulpes*) and gray fox (*Urocyon cinereoargenteus*) are the four canid species native to Wisconsin and all species are present in the state today. The domestic dog (*Canis familiaris*) is also included in the canid family.

The gray wolf once occurred across much of North America, Europe and Asia (Nowak 1995). Wolves occupying portions of the eastern and southeastern United States were the smaller red wolf (*Canis rufus*) species (National Academies of Sciences, Engineering and Medicine 2019, Nowak 2003). As many as 24 subspecies of wolves have been recognized in North America (Hall 1981). Wisconsin's wolves were formerly classified as the Eastern timber wolf subspecies (*Canis lupus lycaon)* when placed on the Endangered Species List by the federal government in 1974 and in the 1989 Timber Wolf Recovery Plan (DNR 1989). Subsequent research reduced the number of subspecies of gray wolves from 24 to 5 (Nowak. 1995). This revised classification grouped wolves in the Great Lakes Region from the Upper Peninsula of Michigan westward within the Great Plains wolf subspecies (*Canis lupus nubilus*). Since then, there has been a proliferation of morphological, taxonomical and genetic studies conducted on wolves. Despite contributing greatly to the understanding of the evolutionary history of wolves, collectively these studies have failed to converge on a single, satisfactory understanding of wolf species' evolution or subspecies classifications. Further, none of the competing viewpoints is more widely supported or accepted (USFWS 2020b), resulting in ongoing disagreement within the scientific community. This is especially true regarding the taxonomic assignment of wolves in the Great Lakes region (including Wisconsin) and the eastern and northeastern portions of North America.

Wolf populations in the eastern portions of North America have been given various classifications including the original eastern wolf subspecies (*C. lupus lycaon)*, a separate eastern wolf species designation (*C. lycaon*), suggestion of being the same species as the red wolf (*C. rufus*) or the product of introgressive hybridization between gray wolves (*C. lupus*) and either red wolves (*C. rufus*) or coyotes (*C. latrans*) (Thiel and Wydeven 2011, USFWS 2020a). Similarly, wolves occupying Wisconsin and the Great Lakes Region, historically and presently, have been referred to with a variety of classifications ranging from the original eastern wolf subspecies (*C. lupus lycaon)* to the Plains wolf subspecies (*C. lupus nubilus*) to a distinction of "Great Lakes wolves" resulting from hybridizations among gray wolves from the west and either wolves living in the east or coyotes (Thiel and Wydeven 2011, USFWS 2020a).

Regardless of taxonomical or species designations, there is general agreement that wolves in the Great Lakes area are morphologically and to a lesser degree genetically, distinct from wolves living in western North America (Chambers et al. 2012, USFWS 2020a). Wolves in eastern North America are generally somewhat

smaller in size than those living in western North America, perhaps reflecting differences in forest types and prey species between the regions i.e., the smaller white-tailed deer (*Odocoileus virginianus*) in the east and the larger moose (*Alces alces*) and elk (*Cervus candadensis*) in the west (USFWS 2020a, Mech and Boitani 2003).

A growing body of work assessing wolf population genetics from an ecotype perspective also continues to provide insights. In this sense, ecotypes are populations which are considered genetically distinct reflecting differences in ecological factors such as prey and habitat types (Schweizer et al. 2016). This work has identified six ecotypes of wolves across Canada and Alaska (Schweizer et al. 2016), a coastal ecotype in the Pacific Northwest (Weckworth et al. 2010) and that wolves in the Great Lakes Region represent a unique ecotype (Koblmüller et al. 2009). These ecotypes appear driven primarily by climate and ecological factors, including prey specialization, allowing regional adaptation in phenotypic traits such as morphology, coat color and metabolism (Schweizer et al. 2016, USFWS 2020a).

For the purposes of this management plan, we will continue to refer to Wisconsin wolves as gray wolves (*Canis lupus*) and consider them a single species while recognizing the ongoing scientific efforts to better understand the origins, taxonomy and ecologically relevant subdivisions of North America's wolves.

For a more comprehensive review of the historical and scientific debate surrounding this issue, see the United States Fish and Wildlife Service's (USFWS) Gray Wolf Biological Report (USFWS 2020a).

Physical Characteristics

Gray wolves are the largest wild species in the Canidae family in the order Carnivora (USFWS 2020a). Species in this order are determined by their pointed canine teeth, their sheering premolars, sharp claws, simple digestive systems and intelligent, developed brains (USFWS 2020a, Mech 1970). The gray wolf is characterized by a large head and boxy muzzle, long legs and large feet, with ears smaller and more inconspicuous than that of a coyote (Nowak 2009, Banfield 1974). Wolf fur can vary significantly from white to sable gray to black. They have a double coat consisting of long, course guard hairs on top of a short, dense, soft undercoat (Paquet and Carbyn 2003). Some wolves may be mistaken for large domestic dogs, with a major difference often being the tail. A wolf's tail does not curl upward, instead, it remains straight out (Paquet and Carbyn 2003). Pups weigh about 1 pound at birth (early April) (Mech 1970) and grow quickly to 10 pounds by May and over 50 pounds by November (Table 2; Figure 3). Mature wolves are 4.5 to 6.5 feet long from tail tip to nose tip and stand 28-34 inches at the shoulder. Adult female wolves captured in Wisconsin for research purposes have on average weighed 68 pounds (range 48-86 pounds), while male wolves captured in Wisconsin for research have on average weighed 80 pounds (range 57–108 pounds; Table 3).

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Average Weights (lbs.) Of Gray Wolf Pups In Wisconsin				
Month	**Avg Pup Weight (lbs.)**	**Low**	**High**	**Number**
May	10	10	10	1
June	22.7	12	33	13
July	27.3	15	44	33
August	35.7	23	48	27
September	37.1	26	65	22
October	44.6	27	55	11
November	53.4	40	69	9
December	59.5	55	64	2

Table 2. Average weights (lbs.) of gray wolf pups in Wisconsin captured for research purposes from May through December 1980-2016 (Stewart 2007).

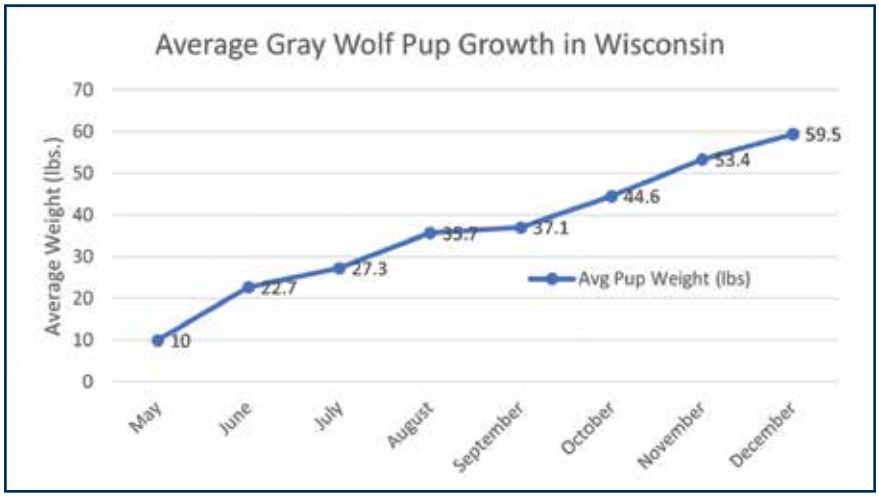

Figure 3. Average pup weight from May to December. Data taken from wolf pup captures from 1980-2016 (DNR unpublished data).

Average Weights (lbs.) Of Gray Wolves In Wisconsin				
	Yearling Female	**Yearling Male**	**Adult Female**	**Adult Male**
Avg. Weight	60.7	68.9	68.6	80.8
Lower Range	40	45	48	56.5
Upper Range	79	87	86	108
Number	109	52	162	191

Table 3. Average weights of yearling and adult gray wolves captured in Wisconsin for research purposes from 1980-2016 (Stewart 2007; DNR, unpublished data).

Historical And Current Distribution

The gray wolf has one of the most extensive ranges of any mammal (Nowak 1983). Historically, gray wolf range included almost all of North America and Eurasia (Paquet and Carbyn 2003). It is believed by some that a common canid ancestor inhabited North America 1-2 million years ago, with a subset of those animals traveling to Eurasia over the Bering land bridge, which would then evolve into the gray wolf (Wilson et al. 2000). The canid ancestor in North America would evolve into the coyote and other species of wolf, the taxonomic classification of which has yet to be agreed upon. The gray wolf in Eurasia eventually made its way back over the Bering land bridge into North America 300,000 years ago to populate the western United States and Canada (Paquet and Carbyn 2003). Once established in North and Central America, their range included all habitats north of 20°N Latitude (Figure 4).

During the 19th century, expansion and colonization of North America by Europeans caused conflict with wolves which resulted in an overall population reduction of all wolf species across the continent, including near extinction of gray wolves in the eastern US (Paquet and Carbyn 2003). In Wisconsin, wolves were completely extirpated from the state by 1960. When the Endangered Species Act of 1973 put protections on the gray wolf, their populations started to recover.

Today, in North America, gray wolves are mainly found in Alaska, parts of the western United States and Canada, as well as the Great Lakes Region and southeastern Canada. They are listed on the International Union for Conservation of Nature (IUCN) Red List as a species of least concern globally but threatened or endangered regionally. In the western Unites States, gray wolves are expanding their range into the Pacific Northwest after being reintroduced into Wyoming and Idaho and breeding with dispersing wolves from Canada (Jimenez 2017). In the Midwest, breeding wolf populations are currently found in Minnesota, Wisconsin and Upper Michigan (USFWS 2020a).

After wolves were given protection under the federal Endangered Species Act, existing wolf populations in northern Minnesota rebounded and naturally expanded their range into northern Wisconsin; wolves were never released into Wisconsin by humans (Wydeven et al. 2009). Today, Wisconsin's gray wolves are found primarily across the forested areas of the northern and central regions of the state.

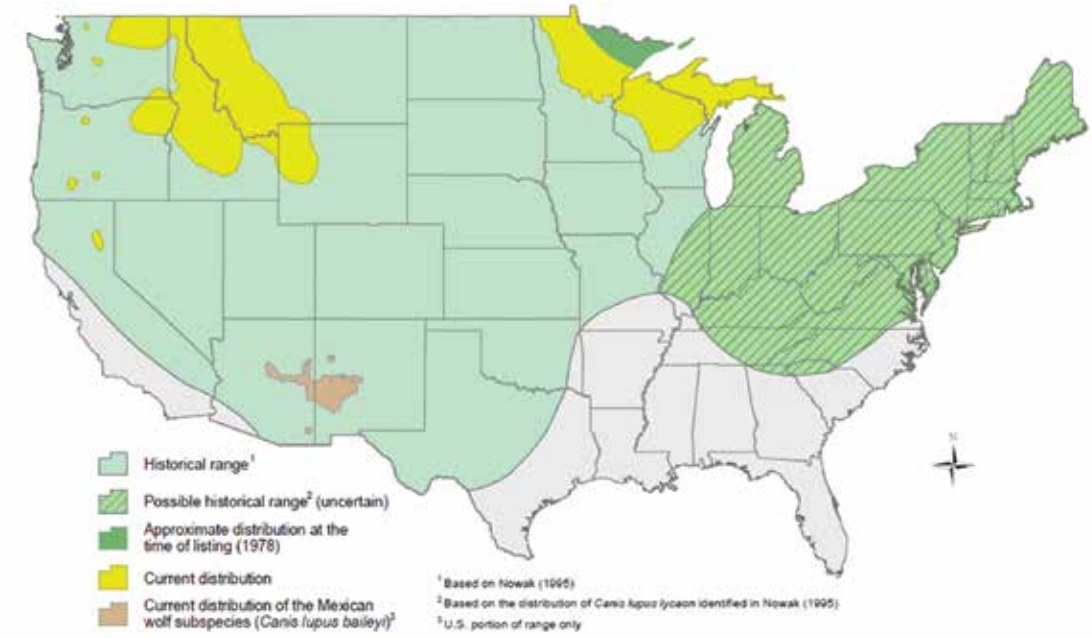

Figure 4. Historic and current range of gray wolves across the lower 48 states. Red wolves (Canis rufus) would have occupied the gray areas of the southeastern United States. Credit: USFWS 2020a.

Habitat Use And Requirements

Historically, wolves inhabited virtually every habitat type across the northern hemisphere north of 20° latitude to the polar ice regions, including deserts, prairies, forests, swamps and tundra (Mech and Boitani 2003). Wolves can persist on most any large landscape so long as prey populations are adequate and rates of human-caused mortality remain sufficiently low (Fuller 1995). Research continues to show how adaptable wolves are and the variety of factors which play into the habitats they are willing and able to use.

During early recolonization in Wisconsin, pack territories typically averaged 40-100 square miles and were in areas of low human densities, limited public accessibility and minimal livestock production (Thiel 1985, Mech 1986, Fuller 1995, Wydeven et al. 1995). In the 1990s, Mladenoff et al. (1995, 1997, 1999) estimated approximately 5,812 mi^2 of primary wolf habitat, 5,015 mi^2 of secondary habitat and 45,252 mi^2 of tertiary habitat in Wisconsin. The primary factor used to estimate likely habitat was road density, with wolves assumed to be unlikely to occupy areas with road densities greater than 0.72 mi/ mi^2. During wolf recolonization and range expansion, the most remote areas of the state were colonized first with wolves eventually occupying areas with higher road densities as the total population increased. In 2009, Mladenoff et al. updated their previous habitat assessment using data from existing Wisconsin packs in 2007 and estimated approximately 16,200 mi^2 of Wisconsin was likely wolf habitat (defined as having a greater than a 50% probability of being settled by wolf packs). Gray wolves continued to select areas of lower local road density, but the overall mean density of roads in pack territories had risen to 1.5 mi^2. Lack of agriculture was the best predictor of habitat selected by wolves, with wolf pack areas averaging 5% farmland compared to 27% for the whole study area. Gray wolves selected areas which consisted mainly of forestland and other wildland areas. Mladenoff et al. (2009) cautioned that the new model was more descriptive of habitats wolves were currently willing to use, while the original model was more predictive of core habitat areas that would continue to be important to the long-term viability of wolves in the state. In 2022, researchers assessed wolf locations from winter tracking surveys and found that wolf distribution on the landscape was most strongly correlated with increases in natural cover and distance to agricultural crops and used that relationship to produce a regional landscape suitability map (Figure 5; Gantchoff et al. 2022).

During the mid-winter of 2020-21, almost 50 years after wolves began to recolonize Wisconsin, there were an estimated 292 packs and occupied wolf range had grown to more than 28,493 square miles (73,796 km^2), with an average territory size of 63.4 square miles (164.3 km^2; Wisconsin DNR 2021).

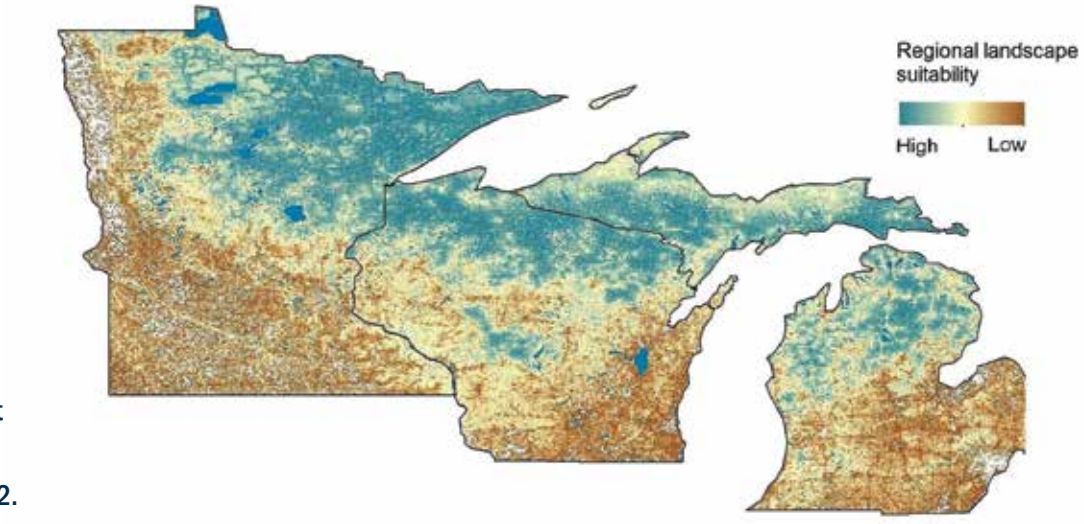

Figure 5. Landscape suitability for wolves in the Great Lakes region as estimated by Gantchoff et al. 2022. Figure adapted from Gantchoff et al. 2022.

Food Habits And Hunting Behavior

Gray wolves are considered generalist carnivores and their diet across North America consists primarily of medium to large ungulates (Mech and Peterson 2003). However, gray wolves are also highly opportunistic and their diet may include anything from bison (Bison bison) to mice and from trash to berries, often reflecting food resource availability in that time and location. When two ungulate species are present in the same ecosystem, gray wolves will generally target the smaller species (Mech 1970). Moose, elk, mule and white-tailed deer, caribou, muskoxen, mountain goats and sheep are all typical prey items for wolves in western and far northern North America. In the Great Lakes Region, white-tailed deer, moose, beaver, elk and snowshoe hare are the primary prey items for wolves, with white-tailed deer generally comprising about 70-90% of prey biomass consumed by wolves (DelGiudice et al. 2009). Wolves also consume various medium and small mammals, birds and may target fish (Lafferty et al. 2014, Gable et al. 2018). In Minnesota's Greater Voyageurs Ecosystem, where beaver abundance is high, beaver make up 42% of wolves' diet during the ice-free season (spring to fall; Gable et al. 2020). That study also demonstrated the ambushing techniques and olfactory concealment used by wolves as part of their strategy to hunt beaver successfully (Gable et al. 2021). Although primarily carnivorous, wolves in Minnesota in a recent study were documented regurgitating wild blueberries for their pups in mid-summer (Homkes et al. 2020), reinforcing the notion that wolves can be opportunistic omnivores and will utilize a wide variety of food items throughout the year.

The perception of wolves as highly efficient prey killing machines is a popular one and perhaps it is deserved given their tenacity and ability to capture and consume a wide variety of prey under equally broad circumstances. However, decades of scientific research and observation paint a more nuanced picture. In general, wolves are coursing predators, meaning they chase their prey until a conclusion is reached. If successful, they capture the prey, kill it and consume it. If unsuccessful, wolves waste valuable energy and also risk injury to themselves. Based on this risk-reward scenario, wolves have evolved to become highly effective at identifying weaknesses (disease, age, poor nutritional condition, injury, etc.) among their prey that may skew the odds of success more toward their favor. Despite this, most wolf hunts result in failure (Mech et al. 2015, Mech and Peterson 2003).

White-tailed deer and other prey have simultaneously evolved numerous effective anti-wolf strategies and characteristics such as keen vision, hearing and smell, communicating potential danger to each other (e.g., a white-tailed deer flagging its tail), high reproductive potential and changes in habitat use in response to wolf presence (Mech et al. 2015). This interplay between the vulnerabilities of wolf prey and the persistence of wolves in detecting those vulnerabilities, continually changing throughout the seasons, results in an endless series of wolf-prey interactions that ultimately allows both predator and prey to endure.

In the 1940s, evidence of deer occurred in 97% of 435 wolf scats found in Wisconsin, at a time when deer populations were very high and beaver numbers were low (Thompson 1952). Deer comprised 55% of scats collected and analyzed in Wisconsin between 1980 and 1982, while beaver and snowshoe hare comprised 16% and 10%, respectively (Mandernack 1983).

Wolves have been estimated to kill 15-19 adult deer per wolf per year (Mech and Peterson 2003). In Quebec, wolves were estimated to remove about 15% of the beaver population per year and over a period of 2-3 years could reduce the beaver population by 30% (Potvin et al. 1992b). Wolves may thus affect the abundance and distribution of these herbivores on the landscape.

Wolves also change prey behavior. Anderson et al. (2005) found that the presence of wolf packs affected elk habitat selection in Wisconsin, with elk establishing home ranges away from areas used by wolves. In the western U.S., female elk exhibit higher vigilance when wolves are present (Laundré et al. 2001). Deer and other prey may also respond to wolves by increasing vigilance, becoming less active during the day and changing movement patterns. From 2011-2013, Warbington et al. (2017) captured and collared fawns in portions of the northern forest and the eastern farmland of Wisconsin to determine white-tailed fawn mortality. Of the 89 collared fawns in the northern forest, there were 42 mortality events recorded with 83% due to predation, with the highest percentage of predation being attributed to unidentified predators (37%) and black bears (26%). Of the 139 fawns collared in the eastern farmland, there were 43 recorded mortalities. Of those 43 mortalities, 49% were due to natural causes. In addition, 35% of those mortalities were caused by predation, with the highest percentage of predation attributed to coyotes (60%). Wolves were not identified as a conclusive predator in any fawn mortality, although wolves likely contributed to the unidentified predator category given the lack of evidence that often accompanies wolf predation of a fawn.

Historically throughout the Midwest, elk were an important prey source for gray wolves. Elk were reintroduced into Wisconsin in 1995. After reintroduction, wolves did not kill any elk until 1999, however, from 1999 through 2015, they killed a total of 106 (43%) of the 244 elk found dead (Table 4). In 2009, wolves killed 13 elk when the elk population ranged from 131 (pre-calving) to 153 elk (post-calving; Stowell and McKay 2006). From 2015 to 2021, wolf predation on elk decreased from the predation rates of 2009-2015. From 2009-2015, the average number of elk known to be killed by wolves per year was about 11 elk. From 2016-2022, the average number of elk known to be killed by wolves dropped to about four elk. The reasons behind this decline are unknown. The highest rates of predation tend to occur in mid- to late-summer and mid- to late-winter. A noteworthy observation of wolves killing sick or injured elk occurred in 2015-2016 when two elk, known to have meningeal worm and a broken leg from a vehicle collision, respectively, were killed by wolves.

Other important elk mortality factors include bears, vehicle collisions and disease (Stowell and McKay 2006). There were higher levels of total elk mortality observed between 2018-2021 (Table 4). There were several factors that could not be measured which may have contributed to this. For example, in 2017 and again in 2019, elk from a source herd in Kentucky were reintroduced in Wisconsin and had to acclimate to Wisconsin's climate. Similarly, these elk were naïve to wolves and had to acclimate to living with them. Another factor for the higher mortality between 2018-2021 was the establishment of elk hunting in Wisconsin in the fall of 2018. In the first 4 years since a fall harvest season was established (2018-2021), Wisconsin and tribal hunters harvested 30 elk, adding to the overall increase in mortality. Finally, some mortality events had causes that were undetermined or unknown due to lack of staff to investigate during vacancies and restrictions during the COVID-19 pandemic.

Table 4. Observed wolf predation on elk in the northern and central herds 1995-2022.

Northern Elk Herd				Central Elk Herd		
Year	Total Observed Mortalities	Observed Wolf Predations	% Of Observed Mortality Due To Wolves	Total Observed Mortalities	Observed Wolf Predations	% Of Observed Mortality Due To Wolves
1995	3	0	0%			
1996	1	0	0%			
1997	1	0	0%			
1998	2	0	0%			
1999	8	3	38%			
2000	2	0	0%			
2001	8	0	0%			
2002	6	0	0%			
2003	2	1	50%			
2004	8	2	25%			
2005	22	7	32%			
2006	16	8	50%			
2007	12	2	17%			
2008	18	8	44%			
2009	27	13	48%			
2010	10	5	50%			
2011	26	15	58%			
2012	22	13	59%			
2013	22	14	64%			
2014	27	12	44%			
2015	8	3	38%	3	1	33%
2016	6	2	33%	17	8	47%
2017	9	3	33%	13	1	8%
2018	24	0	0%	12	0	0%
2019	41	10	24%	4	0	0%
2020	29	3	10%	9	0	0%
2021	21	6	29%	8	1	12%
2022	21	3	14%	14	1	7%
Total	402	133	33%	80	12	15%

ELK AND WOLVES IN WISCONSIN

Elk are a native species to Wisconsin but were extirpated by the 1880s due to unregulated and exploitative hunting and habitat loss. In 1995, a collaborative effort resulted in 25 elk from Michigan being collared and reintroduced to northwest Wisconsin's Chequamegon-Nicolet National Forest (Stowell and McKay 2006, Wisconsin DNR 2001). The northern herd has grown to over 250 individuals as of the post-calving period in 2022. However, growth rates of the northern herd have been lower than expected, due to loss of heterozygosity as well as predation. It was discovered that a population of 25 animals was too small to keep enough genetic differences for a healthy grown rate (Roepke 2012).

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To combat this, the department entered into an agreement with Kentucky to translocate additional elk to Wisconsin. In 2015-2016, another reintroduction effort began to add another group of elk in the Black River Falls area of Jackson County. Kentucky elk were chosen, in part, due to their genetic composition. The elk in Kentucky had never lost their genetic heterozygosity which made them ideal candidates to introduce new genes into the northern herd to hopefully boost calf survival. In 2017 and 2019, additional elk from Kentucky were translocated to the northern elk management zone to supplement the genetic composition of the northern herd. All originally translocated elk were fitted with radio collars to monitor the success of these efforts and the characteristics of the population into the future.

Wolves are the primary predator of elk in Wisconsin and occupy all suitable habitat where elk are found. Since elk were reintroduced, wolves have accounted for approximately 33% and 15% of known elk mortalities in the northern and central herds, respectively (Table 5 and Table 6). However, wolf predation events and their impact on the population are variable. The northern herd has grown at an average annual growth rate of 10% while the central herd has shown 16% average annual growth in its first 7 years (Figure 6).

Northern Elk Herd – Mortality Cause – 1995–2022	Number	Percent of Cumulative Observed Mortality
Wolf Predation	133	33%
Unknown Or Undetermined	62	15%
Vehicle Collision	48	12%
Poor Health (E. coli, pneumonia, bacterial infection, etc.)	42	11%
Legal Harvest	39	10%
Bear Predation	29	7%
Meningeal Worm/Other Parasites	12	3%
Drowning	12	3%
Illegal Harvest	8	2%
Euthanized	7	1%
Birthing Complications	4	1%
Other Or Unknown Predation	4	1%
Rut Fight/Trauma	2	1%
TOTAL	**402**	**100%**

Table 5. Observed causes of elk mortality detected within the northern elk herd from 1995-2022. Adapted from Wisconsin DNR Elk Management Plan.

Central Elk Herd – Mortality Cause – 2015–2022	Number	Percent of Cumulative Observed Mortality
Vehicle Collision	22	28%
Wolf Predation	12	15%
Unknown Or Undetermined	11	14%
Illegal Harvest	8	10%
Poor Health (E. coli, pneumonia, bacterial infection, etc.)	7	9%
Euthanized	6	8%
Meningeal Worm/Other Parasites	6	8%
Rut Fight/Trauma	3	4%
Other Or Unknown Predation	3	4%
Drowning	1	1%
Birthing Complications	1	1%
TOTAL	**80**	**100%**

Table 6. Observed causes of elk mortality detected within the central elk herd from 2015-2022. Adapted from Wisconsin DNR Elk Management Plan.

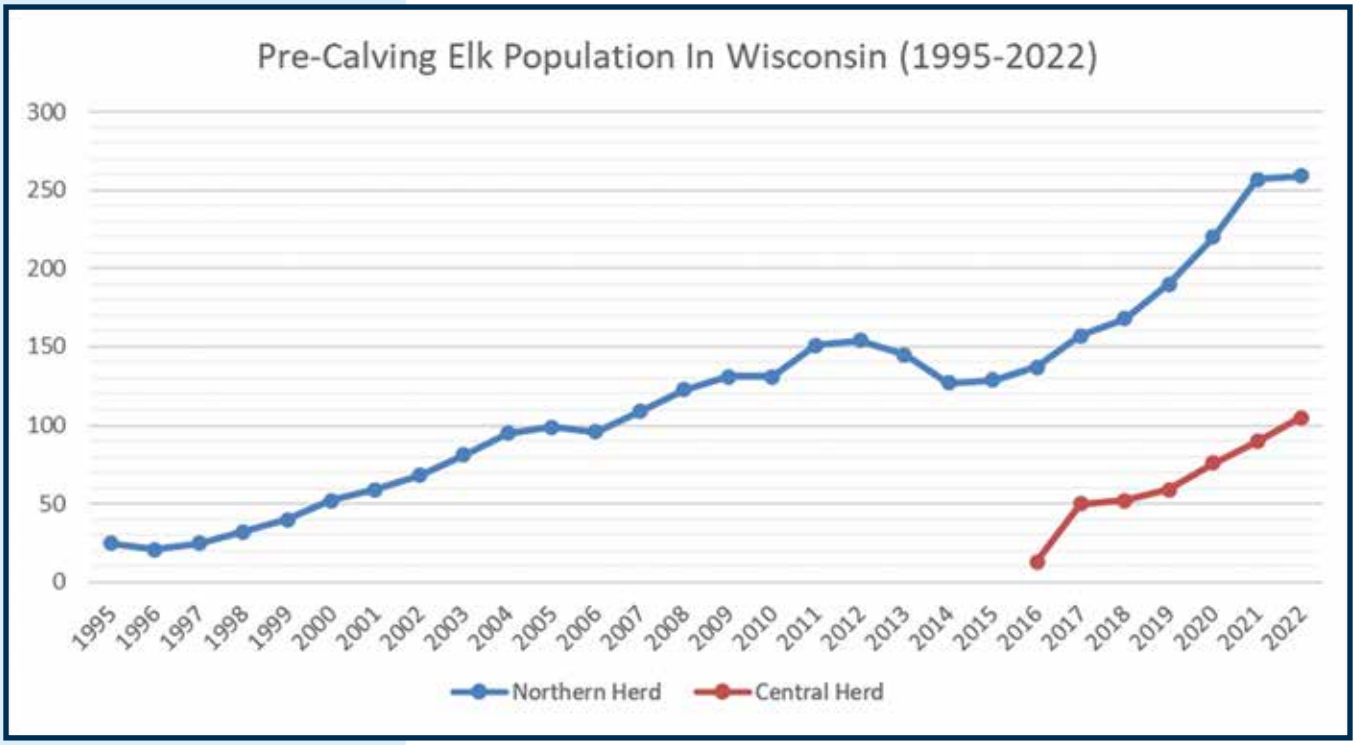

Figure 6. Annual pre-calving elk population for the northern and central elk herds from 1995-2022. Adapted from Wisconsin DNR Elk Management Plan.

Social System

Gray wolves have a highly developed and adaptable social structure. They are territorial animals that live and hunt in groups called packs. Packs consist of two or more animals, usually made up of the breeding pair and their offspring (Mech 1970; Mech and Boitani 2003). Occasionally, older offspring remain with the pack or an unrelated adult wolf may be a member. Packs are organized by a dominance hierarchy with each position reflecting that wolf's privilege and status in the pack (Paquet and Carbyn 2003). The top positions in a pack are the breeding male and female. The breeding pair not only lead the pack, but also take the lead on foraging for food, defending the territory and caring for and rearing of pups (Paquet and Carbyn 2003).

Lone wolves, often dispersing wolves, are considered on their own until they join another or find a mate and start their own pack. Packs usually consist of less than 7 wolves but can include 20 or more individuals (Mech and Boitani 2003). In Wisconsin, pack size ranges from 2-12 wolves, but typically averages around 4 wolves in the winter (Wydeven et al. 2009). Rapidly expanding populations often consist of smaller packs, while established populations have a slow growth rate with larger packs contingent on adequate food sources (Mitchell et al. 2008). Size of prey species has also shown to influence pack size (Smith and Ferguson 2012).

Packs occupy exclusive territories of 13 to 1,016 square miles (Fuller 2003). In Wisconsin, average winter territory sizes, while variable, have averaged approximately 60 square miles in recent years (Wisconsin Department of Natural Resources 2021). Territory size varies with several key factors including prey abundance and vulnerability, pack size and the availability of suitable habitats for rearing pups (Mech and Boitani 2003). Territories rarely overlap and are readily defended against other wolves (Peters and Mech 1975). Territory boundaries may be obvious topographical features but are often indiscernible to humans. They are maintained and defended via auditory and olfactory cues (Ballard et al. 1987, Fuller 1989, Mech and Boitani 2003). Advertisement of pack residency and defense of the territory tends to peak during the breeding season (Peters and Mech 1975; Harrington and Mech 1979). Pack boundaries, unless pack composition is substantially disturbed, are typically stable from year to year.

Communication

Gray wolves use several methods to communicate with each other. Vocalizations through howling and barking are long-distance and immediate forms of communication. These are thought to be used to coordinate pack activities, recall pack members after being separated and alert pack members to nearby kills, with the rate of howling increasing during the breeding season (Harrington and Mech 1978). Wolves are also known to let out howls and barks in response to human disturbances near their den or rendezvous sites (Chapman 1977). Pack rank can determine the rate of the howl response as well. Subordinate pack members are less likely to howl in response than the breeding male or female (Paquet and Carbyn 2003). On Isle Royale, Michigan, when the average pack size was quite large, wolves were most often heard at night using howls to coordinate pack movements while hunting (Peterson 1977). Howling can also be used as an expression of dominance and challenge during aggressive encounters in the form of low-frequency, harsh tonal howls (Paquet and Carbyn 2003).

Scent marking is another important way wolves communicate. A scent mark can tell the sex, reproductive state and dominance level of that wolf over a long period of time. Scent marking is also thought to be more important in maintaining and marking territory boundaries than howling (Rothman and Mech 1979). Breeding

female wolves are more likely to scent mark than breeding male wolves or other subordinate pack members (Ryon and Brown 1990).

Reproduction

Gray wolves are sexually mature 9-46 months after birth, but often do not successfully reproduce until age 2 or 3 due to the social structure of the pack. Generally, only the breeding male and female produce pups within a pack (Mech 1970, Paquet and Carbyn 2003). Wolves have a high reproductive potential, with packs typically producing a litter of pups each year, although multiple litters from additional breeders in the pack have been reported (Harrington et al. 1982, Mech and Boitani 2003). The breeding pair normally prevent sexual contact between other mature members of the pack (Packard et al. 1983). Breeding takes place between late January and early March with gestation lasting approximately 60-63 days. Pups are typically born in early to mid-April, with litters ranging from 1-11 pups, with the average litter size being 6 (Fuller 1989, 2003). In Wisconsin, reproductive output has been found to average 5.2 pups per breeding female (range 4-8 pups, average = 5.2 pups), with an estimated 29% of pups surviving to mid/late winter (Wydeven et al. 2009). With the birth pulse of pups in the spring, the wolf population may double during a short period of time, but declines through summer and fall as pup mortality, adult mortality and dispersal occurs.

Shannon McNamara

An example of a wolf den entrance, excavated in sandy soil under the roots of a tree.

Den And Rendezvous Sites

Wolf home-site selection for den and rendezvous sites varies somewhat in Wisconsin and eastern Minnesota (Unger et al. 2009). Den sites are commonly placed near the core of wolf territories and are generally one mile from the nearest road. Vegetation around the immediate vicinity of the den is commonly upland trees including sugar maple (*Acer saccharum*), aspen (*Populus sp.*) and balsam fir (*Abies balsamea*) but tends to be close to lowland shrubs as well. The den may be a dug-out burrow, a hollow log or an overturned tree. Female wolves can create one or several dens in preparation for the litter, often facing south to maximize sun exposure. The pups are kept at a den site for 6-8 weeks following birth. By mid-June, the pups are moved from the dens to rendezvous sites where they stay while adults search for food. Throughout summer, a wolf pack will utilize 1-10 rendezvous sites (Fuller 1989). The distribution of rendezvous sites is scattered through the territory, with initial sites within 2 km (1.2 mi) of the den site and later sites more distant. Rendezvous sites are often located in grassy areas, near open water or in wetlands with dense cover nearby. Unlike den sites, wolves seem less careful to avoid roadways when selecting rendezvous sites. Some rendezvous sites are also used because of kills nearby or presence of abundant berries (Fuller 1989). By September and October, the pups become large enough to travel with the adults and the pack vacates its rendezvous site and moves as a single unit throughout its territory.

Shannon McNamara

Recently born wolf pups in the den.

Dispersal

Yearlings and 2-year-old wolves of both sexes regularly disperse from their natal packs to seek mates and establish territories of their own. Adult dispersal (up to 5 years old) has also been noted (Fritts and Mech 1981, Thiel et al. 2009). Dispersal can occur at any time of the year, but typically peaks in the fall/early winter and again in the spring denning season (Mech and Boitani 2003). Dispersal is important for the creation of new packs and for gene flow between them (Treves et al. 2009). Dispersing individuals are often made up of younger and/or low-ranking pack members that would not have the ability to breed in their birth packs, as well as adult animals forced from their pack by stronger individuals. Dispersers may travel up to 500 miles in less than 10 months (Fritts 1983). In Montana, dispersing wolves in one study took an average of 66 days (range 2-202 days) to find other wolves (Boyd and Pletscher 1999). Wisconsin wolves have dispersed an average straight-line distance of 34 miles (52 km) from natal to final territory (Treves et al. 2009). Wisconsin wolves have been known to disperse into Illinois, Indiana, Minnesota, Michigan, Missouri and Ontario (Treves et al. 2009). In the Central Forest of Wisconsin, mean straight-line dispersal for males was 52 miles and 42 miles for females, with one yearling male dispersing 428 miles (689 km) into eastern Indiana (Thiel et al. 2009). Wolves' ability to disperse long distances allows for populations to readily expand and recolonize vacant habitats if human-caused mortality is sustainable (e.g., Mech 1995, Boyd and Pletcher 1999, Treves et al. 2009, Mech 2017, Hendricks et al. 2019). The degree of intervening unoccupied habitat between the source population and newly colonized area can affect the rate of recolonization, as Allee effects (reduced probability of finding a mate at low densities) are stronger at greater distances from the source populations (Hurford et al. 2006, Stenglein and Van Deelen 2015).

Mortality

Wolves are apex predators in their environment and are not hunted by other animals in the same way that they hunt their prey. There are, however, a variety of ways that a wolf can be killed. Humans and human activities are one of the biggest drivers of wolf mortality today, as well as in the past. Common sources of human-caused mortality include accidentally being struck by vehicles, illegal poaching, legal harvest, depredation removals and accidental take. Non-human causes of mortality include starvation, diseases, parasites and interspecific (conflict between different species such as a moose killing a wolf during a hunt) and intraspecific (conflict between the same species, such as a wolf killing another wolf) conflict. In areas where human sources of mortality were minimized such as national parks, most wolf deaths are due to starvation or wolves killing each other in intraspecific strife (Fuller et al. 2003). It has also been noted that intraspecific conflict is more common in instances of low prey availability (Van Ballenberghe and Erickson 1973). There are several diseases that are important factors in survivability of wolves, particularly pups. Rabies, canine distemper, parvovirus, heartworm and sarcoptic mange have all been documented in wolves and can potentially contribute to mortality in wolves (Beineke et al. 2015, Jara et al. 2016, Niedringhaus et al. 2019).

Regardless of mortality cause, wolf pack structure creates resiliency in the event of a pack member's death. Breeding members can be replaced by either an internal pack member or an outside member brought into the pack and pups can be brought up by remaining pack members (Mech and Boitani 2003). Gray wolves have high reproductive potential and populations in general are resilient in the face of severe disruptions or population declines, with the ability to rebound quickly if the disruption is reduced after an event (USFWS 2012, 2020a, Fuller 2003, Hayes and Harestad 2000b). Past research has found that in areas of high prey

abundance and exploitation of wolves (harvest), litter sizes increased on average 31% alongside an increase in ungulate biomass available per wolf (Van Ballenberghe et al. 1975, Boertje and Stephenson 1992).

Gray Wolf Ecology

Trophic Cascades

Ecosystems have many interacting parts and levels. Keystone species, such as wolves, are an important component of a healthy ecosystem. Keystone species are those species which have outsized impacts on their environments relative to their abundance; through various processes, they directly or indirectly affect all trophic levels in the system. Therefore, when a keystone species is either removed from or returned to an ecosystem, the change tends to set off a chain reaction throughout numerous biotic and abiotic processes within the landscape. This process is termed a trophic cascade.

Gray wolves are an example of a keystone species that is also an apex predator. Evidence of trophic cascades from wolves have been demonstrated in the western United States as well as the Great Lakes Region. For example, in the Great Lakes Region, researchers have documented greater understory plant diversity in areas of high wolf use as compared to areas of low wolf use, attributing the effects to reduced deer browsing pressure as a result of wolf presence (Callan et al. 2013). Another study found wolves were likely affecting deer browsing behavior enough to mitigate pressure on some sensitive plant species (Flagel et al. 2015). Further west, the Yellowstone National Park wolf reintroduction of the mid 1990's has often been cited as a textbook example of a trophic cascade involving an apex predator. There are many studies that point to vegetative regeneration (particularly aspen and willow) and increases in biodiversity as a result of wolf reintroduction to the park (Beschta and Ripple 2007, Beschta et al. 2016, Painter and Tercek 2020). Many such results became generalized and even romanticized in the popular media (Mech 2012). However, several subsequent studies have pointed out that the conclusions from some of these studies are likely exaggerated or misconstrued due to the use of biased or inappropriate sampling procedures (Brice et al. 2021, Fleming et al. 2019, Kauffman et al. 2013). Although these studies still indicate the likely existence of trophic cascade events, the resulting effects were likely not as extreme as previously reported. Further, because much of this work had been conducted in and around National Parks, questions remain on how

Licht et al. (2010) summarized some of the ecosystem services provided by wolves, which include:

- Limiting and possibly regulating the growth and abundance of prey populations.
- Removing weak, injured or otherwise less-fit prey and altering sex and age ratios.
- Influencing prey behavior, movement patterns, distribution and habitat use.
- Creating a trophic cascade affecting the composition, structure and function of plant communities, which in turn affect habitat availability for animals.
- Creating a trophic cascade affecting other biotic and abiotic resources, including water, soil and geomorphology, which in turn affect habitat availability for other species.
- Creating carcasses that provide food for other species and cycles nutrients; and
- Affecting the abundance, distribution and behavior of other animals (e.g., coyotes, fox and fisher) through interspecific interactions.

or if these relationships translate to a more anthropogenically influenced landscape (Kuijper et al. 2016, Mech 2012). Regardless, it remains clear that wolves can generate trophic cascades through numerous direct and indirect influences on their environments, though some of the generalized and extrapolated claims surrounding trophic cascades remain controversial due to the complexity of ecosystem processes and other unknown factors at play.

Ecological Influences Of Wolves

Gray wolves in North America are known to significantly affect the ecosystems in which they inhabit. In particular, wolves often influence both the abundance and behavior of the animals they prey upon, other predatory species and the vegetation of the ecosystem through a variety of direct and indirect mechanisms (Anderson et al. 2005, Callan et al. 2013, Licht et al. 2010, Mech 2012, Potvin et al. 1992a). The following sections provide a look at some of the key ways wolves shape their environment.

The "Landscape of Fear" And Ecosystem Effects

First described by Brown et al. (1999), the presence of predators can create a "landscape of fear" for the various prey species in a system. The theory states that the fear of being killed by predators drives prey species to be more vigilant (Laundré et al. 2001), utilize the landscape differently to avoid predator inhabited areas and causes other behavioral changes in response to predation risk. This landscape of fear can also manifest itself indirectly by increasing prey stress levels, affecting use of high-quality forage and generally reducing body condition, all potentially resulting in decreases to prey reproductive outputs (Preisser et al. 2005). These changes in herbivore prey behavior and distribution often result in tangible impacts on vegetative communities.

Such effects have been demonstrated in Wisconsin. Anderson et al. (2005) found that presence of wolf packs affected elk habitat selection in Wisconsin, with elk establishing home ranges away from areas used by wolves. Similarly, research on deer behavior and browse activity conducted in Land O' Lakes, WI found that in areas with high wolf use, deer spent 43% less time foraging, visitation was reduced by 82% and overall deer density was reduced by 62%. These behavioral changes allowed the vegetation an opportunity to rebound from heavy browsing, as evidenced by a sevenfold decrease in the proportion of saplings browsed and increases in both sampling height and forb species richness (Flagel et al. 2015). Another study (Bouchard et al. 2013), found that reproduction and plant size improved among 3 browse-sensitive herbaceous plant species during the 12+ years following colonization by wolves. Finally, Callan et al. (2013) found that wolves improved forest regeneration and vertical structure, while increasing plant species diversity at fine spatial scales.

Although this concept is largely accepted, work continues to better understand the nuances of how the landscape of fear theory plays out in real-world scenarios and the magnitude of those affects. For example, recent work demonstrated how elk adapted to the presence of wolves by shifting their space use in response to wolf activity cycles, effectively minimizing the indirect effects of wolf presence (Kohl et al. 2018). Another study attributed a 24% average reduction in county deer-vehicle collisions to changes in deer behavior associated with the areas being occupied by wolves (Raynor et al. 2021). These shifts may also be perceived as declines in local deer abundance and negatively impact recreational deer hunting satisfaction. Future research will continue to shed light on the myriad ways that wolves influence their surroundings.

Interactions With Other Wild Canids And Associated Effects

Wolves also affect other carnivore and predator species. Coyote abundance and distribution is thought to be generally limited by wolves through interference competition and direct predation (Berger and Gese 2007, Flagel et al. 2017, Levi and Wilmers 2012, Merkle et al. 2009). Although some recent work conducted in Wisconsin found only limited evidence of wolves suppressing coyote populations, they nonetheless noted coyote distribution was affected (Crimmins and Van Deelen 2019). Coyotes are important predators of deer fawns and in many locations, they are the leading cause of mortality to fawns (Rohm et al. 2007, Kilgo et al. 2010, Vreeland et al. 2004). Therefore, sufficient wolf numbers may cause decreases in coyote numbers, in turn reducing coyote predation rates on deer. In the western United States where wolves and coyotes co-occur, the survival rate of pronghorn antelope fawns was found to be higher at sites used by wolves (Berger and Conner 2008, Berger et al. 2008).

The reduction of coyotes due to wolves may lead to other ecological changes. In Minnesota, wolves' suppression of coyote populations led to increases in fox populations (Levi and Wilmers 2012). This study echoed another conducted in 2011-2013 near Land 0' Lakes, Wisconsin (Flagel et al. 2017), which found that foxes almost exclusively inhabited high wolf-use areas vs. high coyote-use areas. This had cascading effects into other species such as hares and mice, as well as increased vegetative browse by hares in high wolf-use areas. These illustrate how wolves can create trophic cascades by changing coyote distribution, as coyotes avoided high wolf-use areas, which then benefited hares and foxes, as they avoided areas of high coyote-use. A wolf and fox-dominated predator community is predicted to have greater impacts on small mammal communities than a coyote-dominated predator community, potentially resulting in a number of other ecological implications. For example, Chandler et al. (2020) found that in areas of high-wolf occupancy in Wisconsin, the abundance of mice and voles was reduced, resulting in large-scale changes in seed removal patterns, which may ultimately lead to differences in tree seedling recruitment and plant community composition inside wolf territories. Similarly, since small mammals are the dominant reservoir hosts for Lyme disease, sufficient wolf numbers could potentially reduce the incidence of Lyme disease in human populations (Flagel et al. 2017, Levi and Wilmers 2012, LoGiudice et al. 2003). Despite the variety of work and findings conducted to date, these interactions and associated ecosystem effects are complex and remain not fully understood.

Wolves And Black Bears

Wolf and black bear (Ursus americanus) overlap across much of their range in Wisconsin as well as other areas of North America where both species occur. However, detailed work on the direct interactions between black bears and wolves remains sparse. One study detailed a number of observations between wolves and black bears in northeastern Minnesota between 1969 and 1979, including 206 bear years of radio-tracking data (Rogers and Mech 1981). Of these, only one interaction included wolves killing bears. In this case, wolves roused a sow from her den and managed to kill and consume the sow and newborn cubs. The rest of the interactions typically involved bears chasing wolves off or showing indifference toward wolf presence. Of the 206 occupied bear dens examined multiple times each during the study, only 2 showed signs of being visited by wolves. Similarly, multiple wolf scat studies noted in the paper revealed very few cases of bear hair in wolf scat. They concluded that single wolves tended to flee from bears, but wolf packs are capable of killing bears as large as adult females.

This apparent lack of predation between wolves and bears in Minnesota was reaffirmed in bear research including over 700 radio-collared bears, conducted between 1981 and 2019. They found only two bears killed by wolves during that time, even though wolves were common throughout the study areas. Similarly, although they reported commonly finding wolf tracks around bear dens, only twice did they observe interactions between wolves and denned bears; one resulting in injuries to the bear, one resulting in no injuries (Garshelis et al. 2021).

Another review of past research by Ballard et al. (2003) summarized 26 documented interactions between black bears and wolves. In these interactions, wolves killed black bears in nine interactions, with two-thirds of those cases involving wolves killing bears in or near their dens. Only one case of a bear killing a wolf was documented, although wolves outnumbered bears in most of these reports (Ballard et al. 2003).

Given these findings, it appears direct predation by wolves on black bear (or vice versa) is not a significant mortality factor for either species although some level of interference competition may occur and more research is needed to better understand this dynamic. For example, wolves are known to be attracted to bear baits placed for bear hunting purposes (Bump et al. 2013). This could potentially increase interactions between bears and wolves in the summer and fall months, when both species may have young, but any implications of this are largely unknown.

Selective Predation And Chronic Wasting Disease

Large predators are known to target sick individuals in an event called selective predation (Wild et al. 2011). The rate at which these sick individuals are targeted can alter patterns of disease emergence and persistence (Packer et al. 2003 and Holt and Roy 2007). Packer et al. (2003) indicated that as infected individuals are predated, the rate of disease goes down. However, Holt and Roy (2007) indicated that in some cases, high predation rates could increase disease prevalence by ultimately predating recovered individuals with acquired immunity.

Much work has been done to evaluate the potential role carnivores may play in the disease dynamics of chronic wasting disease (CWD), yet questions remain. CWD is an infectious prion disease that has a 100% fatality rate in cervids and sustained by infected animals and contaminated environments (USGS 2015). Through selective predation, wolves tend to select more vulnerable prey through visual, scent and behavior cues (Hudson et al. 1992), which increases catch success and expends less effort than selecting a healthy individual. With this understanding, two theoretical computer modeling applications (Hobbs 2006, Wild et al. 2011) have demonstrated the potential for wolves to influence prevalence and distribution of CWD in a wild landscape. Under varying levels of selective predation pressure, these models suggested wolves could suppress or even eliminate CWD from wild elk or deer herds. Another more recent modeling study (Brandell et al. 2022) again found support for the predator cleansing hypothesis, but the net effect was highly dependent upon predators selecting the age/sex classes of prey most likely to be infected and the kill rates. Wolves tend to kill the young and old prey, whereas transmission of CWD is often driven more by prime age adults. Despite the promising inclinations to date, such results have yet to be empirically demonstrated in the wild, partly due to the lack of significant overlap between CWD infected herds and wolf range across North America.

Studies involving cougars and CWD may serve as the best indicators to date of the role of predators in altering CWD dynamics due to greater geographic overlap. Krumm et al. (2009) found that cougars in

Colorado were selectively preying on CWD-infected mule deer, based on the finding that cougars were killing more CWD-infected mule deer than hunter harvested deer in the same area. Interestingly, CWD-infected deer killed by cougars tended to be younger adult deer compared to uninfected cougar killed deer, suggesting that there were strong enough cues to indicate vulnerability in younger adult deer (Krumm et al. 2009). In addition to selecting for CWD-infected individuals, cougars may also be immune to contracting CWD from eating infected meat. Wolfe et al. (2022) studied three cougar siblings orphaned in the wild and raised in captivity at the Foothills Wildlife Research Facility of the Colorado Division of Parks and Wildlife for 18 years. From 2002-2020, 20% of their diet consisted of positively tested CWD-infected mule deer. Not only were no clinical signs observed outwardly, but after a necropsy, there were no spongiform changes typical of prion diseases found in the nervous system of any of the cougars. A secondary study was conducted using the same animals evaluating fecal matter and prion seeding in cougar feces (Baune et al. 2021). It was found that after a meal of CWD-infected meat with a known level of prions, only the first defecation after the meal had measurable prion levels. It was also discovered that the number of prions detected was more than 96% reduced from the original amount consumed (Baune et al. 2021). This suggests that cougars may not only be seemingly immune to CWD, but that they may also reduce the number of prions released into the environment after consuming a CWD-infected animal.

Other questions remain, including whether scavengers and wide-ranging carnivores could facilitate CWD spread to distant areas by translocating infectious prions from prey; this has been suggested for scats of coyotes, raccoons and crows (Escobar et al. 2020). Research has also shown that CWD-positive deer shed prions for months before visible symptoms develop and that these prions can persist for years in the soil and be taken up by plants, potentially meaning infections could occur long after the CWD-positive deer is removed (Plummer et al. 2017, Plummer et al. 2018, Pritzkow et al. 2015). Further, most of the work conducted to date has taken place in more controlled systems (e.g., national parks), leading to concerns about whether predation effects would be appreciable in more anthropogenically dominated landscapes (which include the movement of hunter harvested deer carcasses and live captive/farmed deer). In conclusion, there is a growing body of evidence which supports the potential of wolves and other predators to reduce the spread of CWD, although many questions remain. More research is needed to help determine whether predators can truly reduce CWD prevalence and spread, particularly in human-dominated landscapes like Wisconsin.

Predator-Prey Dynamics

The degree to which predators impact large herbivore populations is a controversial topic in wildlife management and continues to be an active area of research (Ballard et al. 2001, Clark and Hebblewhite 2021). Population dynamics of large herbivores are complex as population dynamics are potentially influenced by the abundance and quality of forage and cover, climate, inter- and intra-specific competition, predation, parasitism and human harvest, all of which may interact with one another to produce observed abundances and population trajectories (Coulson et al. 2001, Vucetich et al. 2005, Brodie et al. 2013). Some studies have detected negative impacts of predation on large herbivore populations (Wittmer et al. 2005, Nelson and Mech 2006, Brodie et al. 2013), while others concluded no population level effect (Bartmann et al. 1992, DelGiudice et al. 2012). Predation is thought to impact large herbivore populations when mortality from predation is additive, but not when it is compensatory (Ballard et al. 2001). A source of mortality is additive when its presence increases and its absence decreases the total mortality rate.

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Conversely, a mortality source is compensatory when its presence or absence has no effect on the total mortality rate. The proximity of a population's size to its biological carrying capacity (i.e., the maximum population size a given environment can sustain indefinitely) determines the degree to which mortality is additive or compensatory. When a deer population approaches carrying capacity, scarce resources result in deer with poor nutritional condition, which leads to reduced reproduction and survival (Pierce et al. 2012). In this scenario, predation would generally be compensatory, because those deer that were predated were likely to die from other factors anyway. Further, this predation alleviates competition, leading to higher survival for the remaining deer. Note that carrying capacity is often conceptualized as being stable over the long term, however, carrying capacity can exhibit long-term trends from changes in habitat quality (e.g., forest succession and harvest, chronic over-browsing). Also, stochastic events (e.g., drought, severe winters) can alter the capacity of the habitat to support deer in the short term. An additional factor in determining the dynamics and effects of predation and large herbivore populations is whether the predator relies on one primary species for prey (an obligate predator) or has multiple prey species (a facultative predator) (Ballard et al. 2001). Obligate predators, which rely primarily on one prey species, may be unable to drive prey populations to extreme scarcity because as their primary food source becomes scarce, predator survival and reproduction will decrease. Because facultative predators utilize multiple prey species, alternative prey can potentially maintain the predator population in the face of the decline of a single prey species.

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Aerial view of a wolf kill and feeding site, with numerous wolf tracks in the snow around the site. Also note two bald eagles perched in the tree nearby, likely scavenging from the carcass remains.

The following examples illustrate some of the principles outlined above and demonstrate the complexity of predator-prey relationships. Pierce et al. (2012) studied a mule deer population that experienced a dramatic decline followed by a slow recovery. They found that deer mortality and recruitment, and hence population growth, were not related to cougar abundance (the primary predator of mule deer in this area) but were related to deer exceeding the capacity of the habitat, which was reduced by extended drought, as evidenced by deer having poor nutritional condition and reduced body growth. Following the cessation of the drought and a period with low deer numbers, forage availability increased, leading to better nutritional condition, higher survival and reproduction. During this period of increase, cougar predation appeared to slow mule deer population growth; however, habitat availability, not cougar predation, was responsible for the initial decline. In a study of declining woodland caribou populations in British Columbia, Wittmer et al. (2005) reasoned that predation was responsible for the declines, based on predation being a principal cause of mortality and because malnutrition was infrequent and pregnancy rates

were high (indicating the population was below carrying capacity). They argued that moose were the primary prey species in that region and that elevated moose populations allowed predator populations to remain high in the face of declining caribou populations. Finally, a study in Delaware estimated white-tailed deer fawn survival rates in an area with few to no predators (black bear, coyote, bobcat, etc.). Despite the lack of predation, 90-day fawn survival rates of 44% were similar to many other studies which included predators as a source of mortality (Dion et al. 2020). This finding illustrates that predation of fawns may often be compensatory to natural causes of death for fawns (starvation, disease, birth defects, etc.).

Several research studies investigating wolves and white-tailed deer dynamics have been conducted in the Great Lakes region. In north-central Minnesota, wolf predation on white-tailed deer, in a moose-free area, was generally compensatory based on the positive correlation between mortality rates and winter severity and predated deer exhibiting poor nutritional condition (DelGuidice et al. 2012). In contrast, in northeast Minnesota where a robust moose population was able to sustain wolves and thus wolf predation on deer, wolf predation on white-tailed deer was observed to be additive, despite negligible deer populations (Nelson and Mech. 2006). Work done across the Upper Peninsula of Michigan found that in a system with four carnivores (black bears, coyotes, bobcats and wolves) predation accounted for most white-tailed deer fawn mortality (80% of all fawn death; Kautz et al. 2019). However, their observed fawn survival from birth to 6 months of age of 36% was not statistically different from the average estimated white-tailed deer fawn survival to 6 months of age of ~41%, estimated from 29 populations in forested landscapes across 16 states (Gingery et al. 2018). This finding lends support to the hypothesis that there may be an upper limit to predation rates on white-tailed deer fawns, above which additional predator species have little effect.

The department and University of Wisconsin-Madison conducted a 4-year study of white-tailed deer survival in Sawyer County, Wisconsin between 2011-2014 (Norton et al. 2021, Olson et al. 2021, Warbington et al. 2017). This study found that most non-harvest mortalities (including wolf predation) occurred from late winter through early spring and that most deer that died at this time were < 1 year of age and in poor nutritional condition. Additionally, the risk of winter/spring mortality was strongly correlated with winter severity. During the mild winter of 2011-2012, very few deer died during winter/spring, but mortality was high during the severe winter of 2013-2014. These patterns indicate that most wolf predation in the Sawyer County study area was compensatory and had little impact on deer populations. However, the effects of predation on deer populations can change over time and across space. Thus, there is a need for additional research to identify the circumstances under which wolf predation could impact white-tailed deer populations in Wisconsin.

Gray Wolf Population Dynamics

The factors driving wolf populations can be distilled down to two key items: the abundance and vulnerability of prey and cumulative wolf mortality. Due to an adaptable and redundant life-history strategy, research across the world and spanning decades has consistently shown wolf populations to be resilient and persistent, so long as these two factors remain adequate.

Regulation Of Wolf Populations

The ecological factors involved in whether a landscape can support wolves and how many, are complex and include the availability of prey, territoriality and social strife (Mech 1994). The ability to procure sufficient food

resources from a landscape ultimately affects wolf survival, reproduction and intrinsic behaviors such as dispersal and distribution of territories. In that way, factors which drive prey populations and particularly the proportion of prey which is more vulnerable to wolf predation (i.e., young, old or injured) such as weather and habitat quality, also play a significant role in limiting wolf populations.

Fuller et al. (2003) found that over 64% of the variation in wolf densities could be accounted for by variation in prey populations. In northeast Minnesota, Mech (1986) and Nelson and Mech (1986) reported a density of 1 wolf per 17 square miles in an area with deer densities of about 1 deer per square mile, but moose and beaver also occurred in this area. In north-central Minnesota, wolf densities of 1 wolf per 10-13 square miles were found in an area supporting 10-26 deer per square mile (Fuller 1989, Fuller 1990). Research in Minnesota (Erb and Sampson 2013) showed 27,250 square miles occupied at a density of one wolf per 12 square miles (31/1000 km2). The average deer density in deer management units comprising Wisconsin's Northern Forest was about 19 deer per square mile in 2011 and 20 deer per square mile in 2021. Deer density in the Central Forest averaged 28 deer per square mile in 2011 and 29 deer per square mile in 2021 (Wisconsin DNR 2021). To date, prey abundance does not appear to be a limiting factor for wolves in Wisconsin. When prey densities are not limiting factors, research indicates other social factors, such as territoriality and intraspecific strife, tend to negatively impact population growth (Cariappa et al. 2011, Stenglein et al. 2015a), which ultimately serve to internally regulate wolf populations.

See Section 3 of this plan for a more in-depth review of wolf recolonization, population growth and mortality patterns and discussion of carrying capacity for Wisconsin.

Impacts Of Human-Caused Mortality

Several researchers have explored how various levels of mortality impact wolf populations and have come to varying conclusions. Fuller et al. (2003) reviewed numerous studied wolf populations and found that wolves could generally withstand 29-35% human-caused mortality rates before population decline. Adams et al. (2008) updated research reviewed by Fuller et al. (2003) and determined that ≤29% human-caused mortality rates were sustainable in established wolf populations. Adams et al. (2008) suggested that "wolf populations compensate for human exploitation <29% primarily via adjustments in dispersal components (i.e., local dispersal, emigration and immigration), whereas responses in productivity or natural mortality have little or no role in offsetting harvests." In a re-examination of Fuller et al. (2003) by Creel and Rotella (2010), they estimated stable off-take by humans of most wolf populations averaged about 24.5%. They argued maximum stable off-take by humans for the Northern Rocky Mountain wolves was 22.4% and that human harvest can be super additive in that harvests of key individuals for wolf packs may disrupt the pack and reduce survival of remaining pack members or could cause packs to dissolve entirely. Brainerd et al. (2006) provide some support for the concept that loss of adults, especially breeders, may reduce survival of pups and cause packs to dissolve.

Gude et al. (2012) disagreed with portions of analysis by Creel and Rotella (2010) on maximum potential take for Rocky Mountain wolves. They point out that Creel and Rotella incorporated data on wolf population estimates during years when adequate surveys were not conducted and when these surveys were removed from analysis, allowable harvest was higher for Northern Rockies wolves. Gude et al. (2012) further argued that wolf recruitment needed to be considered in assessments of allowable take. The authors did not disagree with assessment of other wolf populations.

In summary, current research suggests some 24-29% of a wolf population can be removed annually via human-driven of mortality before populations begin to decline. However, some additional cautions need to be applied to this research when comparing it to Wisconsin. Many of the studies demonstrating allowable take at ≥29% only monitored populations for 2-10 years. Additionally, these studies were generally conducted in areas surrounded by high-quality wolf habitat with high wolf populations. These large population refugia can serve as a source of dispersing animals which may compensate for mortality in harvested areas. It is also important to note these studies were conducted in areas with fully established wolf populations. None of the Canadian provinces or Alaska approach the levels of allowable harvests depicted in these studies and wildlife biologists in these Canadian provinces generally indicate wolf populations are relatively stable. In northern Canada and much of Alaska, public harvest represents nearly all the human caused mortality, but wolves in the conterminous United States also absorb losses from illegal kills, vehicle collisions and depredation control activities (Smith et al. 2010, Stenglein et al. 2018).

Impacts Of Regulated Harvest On Wolf Dynamics

Public harvest of wolves may affect a wolf population in several ways. Wolves establish and maintain family units called packs (Ballard et al. 1987, Fuller 1989, Mech and Boitani 2003a) comprised of breeding pairs with their offspring and sometimes one or more unrelated wolves (Young and Goldman 1944, Stenlund 1955, Mech 1966). Maintenance of the social unit is essential for a packs' acquisition of food (Sand et al. 2006, Stahler et al. 2006) and increased pup survival (Brainerd et al. 2008). Wolves, along with other highly social mammals, have demonstrated that maintenance of kin relationships within social units have positive effects on fitness (Pope et al. 2000 and Gobush et al. 2008) and population stability (Adams et al. 2008, Murray et al. 2010). Excessive harvest mortality may disrupt the natural kin-based social structure of wolf packs and promote the adoption of unrelated animals into wolf packs (Rutledge et al. 2010). Harvest may also be an important factor for determining abundance and distribution of packs, particularly for colonizing populations, those along the edges of their range or with poor connectivity to a larger population (Fuller et al. 2003, Gehring et al. 2003, Brainerd et al. 2008).

Several studies have investigated how harvest may affect wolf packs. Harvest of wolves may have little effect on established packs if harvest generally targets dispersing wolves over residents (Peterson et al. 1984, Person and Russell 2008). Juvenile wolves and dispersers are often most susceptible to human harvest and if harvest rates are kept relatively low, these are the wolves most likely to be readily removed (Adams et al. 2008, Murray et al. 2010). Research on a harvested wolf population in southwestern Alberta found that environmental factors seemed to have a stronger effect on abundance and distribution of wolf packs than harvest; however, turnover of individuals within packs was driven by harvest (Bassing et al. 2019). The same researchers found that wolf immigration into packs did not offset harvest mortality in those packs (Bassing et al. 2020), whereas Adams et al. (2008) postulated that harvest losses may be offset via reduced emigration due to less food competition and opening of breeding opportunities within packs.

Mitchel et al. (2008) used monitoring data from the recovering wolf population in the northern Rocky Mountains to estimate the probability of packs at different sizes to contain successful breeding pairs and the extent to which demographic conditions and human caused mortality influenced successful breeding pair probabilities. Small packs were more influenced by human-caused mortality, with increased harvest reducing the probability of packs containing a successful breeding pair. A meta-analysis of the impact of breeder losses on wolves, especially pup survival and pack maintenance, observed pup survival was highest

in larger packs (especially with >6 wolves) and with the presence of other adults (Brainerd et al. 2008). Fifty-six percent of packs bred the next year if only one breeder was removed, while only 9% of packs bred the next year if both breeders were eliminated. When both breeders were eliminated, 85% of packs dissolved; however, only 26% of packs dissolved when a single breeder was removed. Where packs had dissolved, new wolf packs formed in 53% of formerly established territories and the area was taken over by an adjacent pack 21% of the time. Impact of breeder removal was much more intense for recovering wolf population (<75 individuals) than for larger or saturated populations.

Another study investigated breeder loss on social stability, recruitment and population growth of wolves in Alaska using a 26-year dataset of collared wolves (Borg et al. 2015). They found smaller packs and those that lost either the female breeder or both breeders were more likely to dissolve and that breeder loss lowered denning and recruitment rates. However, they noted that breeder mortality and pack dissolution had no significant effects on either immediate or longer-term population dynamics in their study area, indicating that strong compensatory mechanisms may be able to reduce the negative impacts of breeder loss at the population level scale.

A study in the northern Rocky Mountains evaluating how the initiation of harvest affected wolf recruitment found pup survival decreased from 60% to 38%, with recruitment similarly declining from 3.2 to 1.6 pups per pack, in years with harvest (Ausband et al. 2015). Population harvest rates in that study averaged approximately 24%. Additional research by Ausband et al. (2017) showed that composition within a pack can also influence pup survival. The presence of older, non-breeding males and turnover of breeding males from harvest both reduced pup survival.

Using an individual-based spatially explicit model, Stenglein et al. (2015b) evaluated six harvest scenarios to evaluate outcomes of various simulated harvest regimes on the Wisconsin wolf population. They found some harvest rates could potentially face significant population reduction and even extirpation, whereas lower harvest rates resulted in long term population stability. A 30% harvest rate reduced the population, on average, by 65% after twenty years, with some populations going extinct before 100 years, whereas a harvest rate of 14% reduced the population by 4% in the first year but resulted in population maintenance. Without harvest, the population grew to an average equilibrium of 1,242 wolves after 50 years. In a related effort, the same model demonstrated that harvest rates of 5-20% in wolf harvest zones 1-5 (most of the core wolf range in Wisconsin) and 75% harvest rate in wolf harvest zone 6 (those areas mostly outside of wolf range in Wisconsin) could lead to a stable population size of around 1,000 wolves after 20 years, with annual wolf harvests of >90 wolves each year (Stenglein and Gilbert 2012, Stenglein et al. 2015b).

These findings highlight the importance of considering factors outside of abundance that contribute to wolves' long-term fitness and persistence of populations (Rutledge et al. 2010). For example, harvest may lead to reduced pack size, pack persistence and recruitment (Ausband et al. 2015, Ausband et al. 2017, Cassidy et al. 2023) but may also be offset by reductions in other sources of mortality such as lethal depredation removal (Hill et al. 2022, Stenglein et al. 2018). Nevertheless, numerous wolf populations exposed to harvest and other sources of human-caused mortality have been studied over the last several decades and collectively have suggested that wolf populations are remarkably resilient to human-caused mortality, including regulated harvest. Experience with regulated wolf harvest in Wisconsin has largely supported this finding.

Section 2: Human Dimensions And Cultural Significance

Introduction

Understanding the complexities of how the human element intertwines with wolf management is critical to the success of any wolf management program. This section strives to help satisfy that need by providing: 1) a literature review of global human dimensions research from the last decade related to wolf management, 2) a summary of the key findings from the scientific surveys conducted by the department on Wisconsinites' attitudes toward wolves in 2014 and again in 2022 and 3) a section dedicated to tribal perspectives and the cultural significance of wolves as provided by a number of Wisconsin's Tribal Nations.

Part One: Human Dimensions Of Wolf Management: A Literature Review

About This Report

At the request of the department's Bureau of Wildlife Management, Analysis Services staff conducted a review of recent (2014-2022) human dimensions research on gray wolf management. The report summarized peer reviewed scientific research from around the world and highlighted regional Great Lakes findings and Wisconsin specific findings wherever possible. The report places human dimensions research within the context of the history of gray wolves in Wisconsin as well as the ecological, economic and social costs and benefits of wolf populations. The management history, ecology and costs and benefits of wolves are covered in more detail elsewhere in this management plan.

The literature review report is included verbatim (with minor edits for consistency and formatting) below.

Disclaimer: because the purpose of this effort was to provide a comprehensive review of recent human dimensions research, inclusion of a study in the literature review does not necessarily constitute the department's endorsement of the study's findings, especially insofar as they relate to wolf biology, ecology and/or population dynamics. Those aspects are covered more thoroughly elsewhere in the plan.

Human Dimensions Of Wolf Management: A Literature Review

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Introduction

The gray wolf (Canis lupus) is a circumpolar carnivore with a long history of interaction with human communities. The different countries and regions where gray wolves coexist with humans differ in their cultural valuation of wolves, legal protections for wolves and management approaches, as well as the historical and current population densities and geographic distributions of humans and wolves. Generally, the global range of gray wolves has been reduced by approximately one-third due to habitat fragmentation (Hunter, 2019). Despite large remaining areas of ecologically suitable habitat (Mech, 2017), the current distribution and population densities of wolves remain constrained by human intolerance and disagreement over wolf management.

Although they were once widespread throughout North America, state bounty programs decreased gray wolf populations in the western Great Lakes states of Michigan, Minnesota and Wisconsin in the late 1800s and early 1900s. By 1950, it is estimated that fewer than 50 wolves remained in northern Wisconsin. Wolves were considered locally extirpated by 1960 and were listed as endangered under the federal Endangered Species Act in 1973. Under federal protection, wolves from Minnesota slowly recolonized Wisconsin and Michigan and have expanded in range and population density in recent decades. Since the early 2000s, gray wolf populations in the Western Great Lakes have met federal recovery goals and the U.S. Fish and Wildlife Service has removed wolves from the federal endangered species list and placed them under state management at several points. These discrete windows of state management and regulated hunts have allowed for interesting pre- and post-event assessments of public attitudes and opinions toward wolves.

Tolerance for wolves in the Great Lakes region and elsewhere is driven by the combined and interactive effects of spatial coexistence and direct experience with wolves, the real and perceived costs and benefits of wolf recovery, the emotions that wolves may illicit and the basic values and beliefs that individuals hold about wildlife. The Wisconsin DNR conducted a large comprehensive survey of public attitudes and opinions regarding wolves and wolf management in 2014 (Holsman et al., 2014) and again in 2022 (Bradshaw et al., 2022). The literature review that follows seeks to provide a summary of the body of research on the human dimensions of wolf management with a particular emphasis on additions since the department's 2014 survey. The review highlights some of the costs and benefits of maintaining wolf populations, common stakeholder attitudes toward wolves, the underlying values that shape attitudes and group identity, the influence of media portrayal of wolves and potential areas of common ground among various wolf management interest groups.

Costs And Benefits

Wolf recovery and conservation can have a number of benefits for local residents and the tourism industry. Slagle et al. (2019) described that for many people, wolf conservation may be "more about what [wolves] represent than how [wolves] behave on the landscape." The wolf is viewed by many as a symbol of wildness and ecological integrity and its recovery provides certain psychological benefits and spiritual well-being (Wilson, 1997; Slagle et al., 2019). Wolf viewing tourism in the U.S. is typically focused on opportunities within large national parks but has been estimated to contribute several million dollars to the U.S. economy annually and speaks to the interest in and valuation of wolves amongst the general public (Chambers and Whitehead, 2003).

In addition to spiritual and tourism benefits, research has found the ecological services and benefits of wolf recovery to be numerous. Competition and predation by gray wolves can stabilize the population growth of meso-predators (e.g., coyotes [Canis latrans]) and ungulates (Wright et al., 2006; Mech and Peterson, 2007; Ripple et al., 2014; Flagel et al., 2016). In turn, this can reduce significant browsing impacts on forest health and plant diversity as well as damage to human property (e.g., agricultural crops). The cascading effects of wolf presence also reduce disease transmission, such as Lyme disease to humans and chronic wasting disease in white-tailed deer (Wild et al., 2011; Levi et al., 2012; Bergstrom, 2017). Wolf presence also alters prey behavior and landscape use. Recent models have found evidence that predator use of forest roads and edge habitat may decrease deer-vehicle collisions (Gilbert et al., 2017). One such study used data from Wisconsin and found that wolf presence in a county had the net effect of reducing deer-vehicle collisions by 23.7%, saving residents an estimated $375,000 per county per year (Raynor et al., 2021). These authors used predator-prey models and deer abundance data to separately test the population effects of wolves (i.e. predation) from behavioral effects of wolf presence. They found that population effects only explained a 6.3% reduction in deer-vehicle collisions and the remaining 17.4% reduction was attributed to behavioral effects of wolf presence.

Wolf recovery and co-existence, however, is also associated with important costs and conflicts. Limiting the population growth and changing the behavior of ungulates may be undesirable to hunters who view predators as competitors for game species such as white-tailed deer or elk (Cervus canadensis; Ripple et al., 2014; Højberg et al., 2017). Farmers and wolf range residents face the emotional and economic costs of wolf attacks (lethal and non-lethal) on livestock, hunting dogs and family pets (Olson et al., 2015a). However, the state of Wisconsin offers reimbursement for death or injury (i.e., vet bills) caused by wolves to livestock, hunting dogs and pets (Wisc. Stat. 29.888). Indirect impacts to farmers may also include weight loss and reduced reproduction in chronically stressed livestock (Clark et al., 2017) and the costs of preventative measures such as fencing. Additionally, those who live or recreate within wolf range may experience fear based on the actual and perceived risks to self and loved ones that wolves may present (Carter et al., 2019; Schroeder et al., 2020). However, the salience of each of these costs may differ from person to person depending on their perceived control over the situation, emotional response toward wolves, direct experience with wolves, media and news coverage and one's social community (Bruskotter and Wilson, 2014).

Identity Groups And Attitudes

It is well-documented that the costs associated with wolf recovery are borne disproportionately by those living within wolf range. At larger spatial scales, though, attitudes toward wolves are mixed and studies continue to find neutral to positive attitudes about wolves among the general population (Holsman et al., 2014; Anthony and Tarr, 2019; Gosling et al., 2019; Landon et al., 2019; Schroeder et al., 2020). Nested within the general public, positive attitudes toward wolves are more common among urban residents, those living outside of wolf range and self-identified animal rights advocates and conservationists. Though rarely included in academic research, many Native American tribes hold undoubtedly positive attitudes and great respect for the gray wolf. The Ojibwe people consider the gray wolf to be a brother and it features prominently in their creation story (Benton-Banai, 1979, Shelley et al., 2011). In contrast, negative attitudes toward wolves are more common among those living in wolf range, rural residents, livestock farmers and hunters. Community influence and socio-political identity may also be important factors in predicting attitudes toward wolves. Among wolf range residents in Oregon and wolf stakeholders (i.e. issue public) in Michigan,

researchers found political party affiliation to be the best predictor of attitudes toward wolves, an effect that was intensified when one's social community (e.g., friends, family) belonged to the same political party (Hamilton et al., 2020; Lute et al., 2016). In both studies, politically conservative identities were more likely to hold negative attitudes toward wolves.

Notably, negative or positive attitudes are not universally held by identity groups and attitudes toward wolves are not a direct indication of support or opposition toward maintaining populations or use of lethal control. For example, Schroeder et al. (2020) found that 62% of Minnesota livestock producers operating within wolf range held negative attitudes toward wolves but 47% agreed that maintaining a wolf population in Minnesota was important. The same study found that 69% of the general public held positive attitudes toward wolves and 51% were neutral or supportive of a wolf hunting season.

Duration of wolf presence and extent of personal experiences with wolves are two factors that may heavily influence negative attitudes within group identity. Among rural residents living in wolf range, research has found that those in areas with a longer history of wolf presence hold less favorable attitudes than those living in areas where wolves had more recently established (Young et al., 2015; Gosling et al., 2019). In Wisconsin, focus groups conducted with livestock owners, bear hunters and deer hunters and survey results from those living in wolf range have found that positive attitudes toward wolves declined as experience with wolves increased and presumably the novelty of wolf presence diminished (Holsman et al., 2014; Browne-Nuñez et al., 2015; Hogberg et al., 2016). Experiences with wolves vary, ranging from hearing wolf howls, sightings at a distance, multiple or close-proximity sightings, knowing someone who experienced predation issues or personally experiencing the effects of wolf predation or aggressive behavior. Wisconsinites who experienced multiple wolf encounters generally perceived wolves to be more abundant and held heightened concerns for personal safety than those who had fewer encounters (Holsman et al., 2014). Even when predator encounters or conflicts are measurably decreased through preventive measures and sizeable population reductions, for example in communities affected by black bears (Ursus americanus), negative attitudes have persisted (Slagle et al., 2013; Lischka et al., 2019). In other words, past negative experiences or perceptions of potential impacts may play an equal if not larger role on present attitudes than current experiences (Johansson and Karlsson, 2011; Anthony and Tarr, 2019; Landon et al., 2020).

Although tolerance for wolves may be decreasing among those who live in wolf range, favorable attitudes toward wolves among those in the broader population are likely to increase due to urbanization and technological advancements that serve to spatially separate people and predators. Correspondingly, urbanization is likely to shift social values and prioritize environmental concerns (Bruskotter et al., 2017; Manfredo et al., 2020). Nationwide surveys of U.S. wildlife attitudes found that positive attitudes toward wolves increased 42% and positive attitudes toward coyotes increased 47% between 1978 and 2014 (George et al., 2016). Though smaller-bodied predators, coyotes are also a historically persecuted species currently abundant in many urban environments. As such, some researchers have suggested that coyotes could serve as a proxy to gauge how urban residents may respond when faced with the impacts of wolf co-existence. Such studies have found that urban residents were increasingly accepting of coyote presence, preferred preventative education to lethal control and opposed baiting and liberal hunting bag limits (Jackman and Rutberg, 2015; Poessel et al., 2017; Jackman and Way, 2018; Drake et al., 2020).

Underlying Wildlife Values

Beneath group identity, individuals hold different belief systems about the relationships between humans and wildlife (i.e., wildlife value orientations) and these values may be better predictors of tolerance toward wolves than identity group alone. Wildlife value orientations are typically discussed on two dimensions: domination and mutualism (Fulton et al., 1996; Teel and Manfredo, 2009). A strong mutualism orientation (i.e., mutualists) would suggest someone who believes humans have a moral obligation to treat wild animals with respect and that wildlife and humans are part of one community. Those with a strong domination orientation (i.e., traditionalists) may hold beliefs that wildlife exists primarily for human use and benefit and that human needs should be prioritized over animals (Teel and Manfredo, 2009). Similar value orientations typically serve to align groups but, where differences exist or develop, values can also cause rifts at the group level (Bruskotter et al., 2019). A prime example of such rifts can be found in the self-policing of illegal wolf harvests among hunters (Peterson et al., 2019) and the recent formation of hunter coalitions in Wisconsin, Montana and elsewhere that oppose liberal wolf hunting policies on the grounds of hunting ethics. These coalitions have spoken out against other hunter groups that are vocally supportive of such wolf hunting opportunities (Daly, 2021).

Several recent studies have measured value orientations in the public and how values are associated with preferences toward wolf management. Mutualists were less inclined to believe that conservation could have significant drawbacks, whereas traditionalists expressed heightened concern about those drawbacks and focused on human benefits over biodiversity benefits (Slagle et al., 2012; Matzek and Wilson, 2021). Specific to gray wolves, domination-oriented values were correlated with past and current hunting, support for lethal removal of wolves (Manfredo et al., 2020; Straka et al., 2020), opposition to wolf recolonization (Landon et al., 2019), negative attitudes toward wolves and increased risk perceptions of wolves toward both animals and humans (Landon et al., 2020). In contrast, past and current hunting is less common among mutualists and mutualists are more likely to support increases in wolf populations and wolf range and oppose lethal removal.

Value systems are difficult to change in individuals (Manfredo et al., 2017) but may shift over time in society at large. A 2017 nationwide U.S. study found that mutualist wildlife values were more common among urban residents and were correlated with increased income and education, whereas traditionalist values were inversely correlated with these demographic measures (Manfredo et al., 2020). Thus, increasing urban populations may yield higher proportions of mutualists among the general population while domination-oriented values may remain more common among interest groups such as agricultural producers and hunters (Landon et al., 2019; Manfredo et al., 2020).

Media Portrayals Muddy The Water

Recent social science studies emphasize how internet media, including reputable news and social media coverage of gray wolves, influences how individuals gather information and form opinions about wolves and wolf management (Anthony and Tarr, 2019). Because media outlets both sensationalize violence and anthropomorphize wildlife, misinformation can affect stakeholders from across the value and identity group spectrum.

Recent studies found that nearly half of media reports on predators between 2005 and 2016 included graphic content (Bombieri et al., 2018) and news articles containing graphic or sensationalized views of

wolves were distributed more widely on social media websites than those without such content (Nanni et al., 2020). In Spain, wolf damage received 30 times more media coverage than damage from other large predators like bears (Fernández-Gil et al., 2016), despite the fact that bears are more likely than wolves or many other predators to seek out anthropogenic food sources and attack humans (Penteriani et al., 2016). The scale of a news outlet also affects message framing. National news outlets tend to anthropomorphize wolves and represent management issues in a generic manner that may gloss over conflict (Chandelier et al., 2018; Killion et al., 2019). In contrast, local news outlets are more likely to emphasize a human-centered viewpoint and instances of human-wolf conflict. Such differences in the media portrayal of wolves across spatial scales likely serves to further divide stakeholder groups.

Both positive and negative portrayals of wolves in media can impact human attitudes and behaviors. One study found that after watching YouTube videos presenting wolves in a positive or negative light, participants indicated attitudes, acceptance and intended behaviors toward wolves that aligned with those portrayed in the videos (Casola et al., 2020). Media portrayal of wolves and socio-political pressure can also affect wolf management actions. In Spain, where wolves are managed as a game species, the quota of wolves culled in management zones correlated with the number of news articles on wolf damage rather than actual damage costs, which were significantly lower than represented (Fernández-Gil et al., 2016).

Another side-effect of the media portrayal of wolves at local and national levels is the intentional and unintentional creation of straw attitudes (i.e., stereotypes) in sensationalized communications on billboards, news articles and websites. Walsh (2019) analyzed these communications and found that staunchly pro- and anti-wolf interest groups aligned or alienated people by implying that the opposing community was motivated more by politics than by evidence-based decision-making and public opinion. Some groups also employ strategic definitions of "public" trust management in order to include or exclude certain stakeholders depending on where they live, their use of wildlife and the recreation fees and taxes that they may or may not pay (Treves et al., 2017; Walsh, 2019). These approaches, however, are generally ineffective at garnering additional support for a specific viewpoint; not only are extreme arguments and approaches typically ineffective at attracting the attention of those who are unaware or undecided on wolf issues (Hoffmann et al., 2017; Niemiec et al., 2020), but they can also fuel the sentiment that wolf management is a zero-sum game or that one side must lose for another to win.

Common Ground And Management

Many studies have assessed human-wolf conflicts and co-existence and the various wolf management options that might receive the most support. Despite the polarizing nature of wolf management, collectively these findings suggest that there is common ground among stakeholders in several key areas. Evidence from multiple studies suggests that most Great Lakes residents (including hunters and those living in wolf range) are supportive of maintaining wolf populations. Some groups, however, would prefer to maintain wolf populations at a lower level (Lute et al., 2014; Schroeder et al., 2020). Hunters and livestock farmers generally prefer fewer wolves and would prefer that wolves remain in remote wilderness, while those living outside of wolf range would support more wolves and expanded wolf territories (Treves and Martin, 2011; Højberg et al., 2017; Schroeder et al., 2020).

Adequately addressing human-wolf conflicts through management actions may also garner increased support for wolf management options, particularly when considering the use of lethal control. Many people

are innately fearful of large predators like wolves and, though research does not support the perception that wolves have lost their fear of humans (Browne-Nuñez et al., 2015; Olson et al., 2015a; Penteriani et al., 2016; Carricondo-Sanchez et al., 2020), lethal control options (e.g., damage tags) may empower local residents and provide a sense of security. Current support for lethal control is high among rural stakeholders (Lute and Carter, 2020) and is preferred over non-lethal and preventative measures such as guard dogs, lights, fencing or reducing access to human food (Carter and Linnell, 2016; Højberg et al., 2017). Support for lethal control among those who live outside of wolf range is typically limited but might exist or increase if certain conditions were met (Treves and Martin, 2011; Lute et al., 2014; Slagle et al., 2017). For example, harvest quotas aimed only to address conflict and agricultural damage or regulated harvest seasons that prevent or severely limit the use of some practices that may be deemed less humane (e.g., hound hunting, trapping) may increase support for lethal control.

Those in favor of regulated wolf hunts have long argued that managing wolves as a game species will increase tolerance and decrease poaching. One assumption of this argument is that game species hold inherent value for hunters; however, motivations for participating in hunting are individual and may be fundamentally different for wolf hunting than for other types of hunting (Holsman, 2000). Those who have experienced personal or community loss due to wolves are more likely to be motivated to hunt wolves by revenge and other negative emotions (Browne-Nuñez et al., 2015; Pohja-Mykrä, 2016) than, for example, a desire to challenge oneself. Due to the federal protections that have long existed for wolves in the United States, relatively few studies have been able to examine motivations for participating in legal wolf hunting or trapping. However, hunter/trapper questionnaires following Wisconsin's 2012, 2013 and 2014 wolf harvest seasons consistently found that "wanting to reduce the wolf population impact on deer or other game animals" is a top reason for applying for a wolf hunting license (Dhuey and MacFarland 2012, 2013, 2014). With regard to poaching, some data from Wisconsin and Michigan wolf populations suggest that poaching rates did not decrease during periods of government culling and regulated hunting and in fact, unexplained disappearances (i.e., presumed poaching) of collared wolves may have increased during these times (Chapron and Treves, 2016; Santiago-Ávila et al., 2020) although these results have been refuted in the scientific literature (Olson et al. 2017, Pepin et al. 2017, Stein 2017). Other work has found evidence of reduced illegal killing when legal killing is allowed in Wisconsin (Olson et al. 2015), Finland and Sweden (Liberg et al. 2020, Suutarienen 2019).

Another reason hunting may not increase tolerance is because it may not produce the expected result for those living in wolf range. Pre- and post-surveys around the 2012 wolf hunting season in Wisconsin found a decline in tolerance among hunters and non-hunters living in wolf range and a net shift toward statements such as "killing wolves is the only way to stop them from threatening animals and pets" (Hogberg et al., 2016). The effectiveness of lethal vs. non-lethal controls continues to be evaluated. Some work has shown lethal control to be consistently less effective at stopping predation issues when compared to non-lethal control (Treves et al., 2016) whereas other work has demonstrated support for lethal controls as effective (Haight et al. 2002, Stenglein et al. 2015b). Over a seven-year period in Idaho, non-lethal methods were three times as effective at reducing wolf predation than lethal methods (Stone et al., 2017). Lethal measures may even increase predation conflicts because they can alter wolf pack structure and behavior (Borg et al., 2015) and because wolves expanding into newly vacant territories are more likely to be adolescents that are less acclimated to humans (Bradley et al., 2015; Treves et al., 2016). For example, in Spain, livestock damages from wolves increased in accordance with the previous year's wolf culling intensity (Fernández-Gil

et al., 2016). If lethal control and culling of wolves does not solve predation issues to a satisfactory level, some degree of co-adaptation may be necessary (Chapron et al., 2014). Animals and humans both have the capacity to modify their behavior in the short term to the presence of the other (Treves et al., 2017). Tolerance for wolves may increase as research on non-lethal wolf control methods continues to improve and if agencies pair communications on reducing risks with information about the benefits of maintaining wolves on the landscape (Slagle et al., 2013; Lischka et al., 2019; Lute and Carter, 2020).

Joe Ford

Finally, divergent interest groups may find common ground on wolf management when the decision-making process is accessible and transparent and when decisions consider available science. Interest groups would like to feel heard and included in the decision-making process. Studies have found that landowners, hunters, administrators and national wolf-advocates alike prefer evidence-based management decisions (Lute et al., 2014; Walsh, 2019). Crucially, such common ground requires that communities respect the same definitions of tolerable risk and trust the sources of science that inform management policy (Lute and Carter, 2020; Treves et al., 2017). Hunters and landowners in Wisconsin have expressed feelings of powerlessness in wolf management decision making (Browne-Nuñez et al., 2015). Landowners may feel a lack of faith in authorities to appropriately handle wolf-human conflicts and as a result feel that those best equipped to make management decisions about wolves are those who deal with the consequences of wolf recovery (Højberg et al., 2017). In fact, some research suggests tolerance toward wolves may increase with application of more consistent wildlife management efforts (Olson et al. 2015b) including public hunting of wolves (Richardson 2022). Others, however, argue that hunting and agricultural interest groups have long held a disproportionate influence on wildlife management, because such management is funded heavily through their license fees and taxes and would like to see additional interests represented in management decisions (Nie, 2004; Olson et al., 2015b). Building partnerships and trust between the various groups interested in the outcomes of wolf recovery will be crucial to ensuring that management of this species reflects the needs and interests of the public and is grounded in science-based decision-making.

Part Two: Public Attitudes Toward Wolves And Wolf Management In Wisconsin

In 2014, the department conducted a comprehensive scientific study of public attitudes toward wolves and wolf management in Wisconsin. At that time, wolves were under state and tribal management authority and the first modern-day wolf harvest seasons had been conducted during each of the previous two falls. The department's wildlife program requested the department's social science team develop a statewide survey to scientifically measure resident's attitudes toward wolves and the factors that influence those attitudes. The topics on the questionnaire were developed with extensive input from the department's Wolf Advisory Committee at that time. The core study objectives sought to provide data to inform management planning decisions regarding wolf abundance, distribution and conflict reduction strategies. Final sign off and approval to implement the study was granted by the department secretary's office.

An external peer review by three prominent experts in the field of human dimensions of wildlife management all ratified the methodology that was used in the study including the sampling design and the questionnaire wording. The department piloted the use of an option to formally opt out of taking the questionnaire and asked people to indicate their reasoning. This survey methodology innovation was published in the peer reviewed journal Human Dimensions of Wildlife Management. Colleagues in Minnesota have since sought permission and subsequently adopted questions from the Wisconsin survey on their own study of public attitudes toward wolves in 2019.

In 2022, the department conducted another comprehensive scientific study of public attitudes toward wolves and wolf management in Wisconsin. The core objectives of this study were to re-evaluate public opinions and measure any changes that may have occurred since the 2014 statewide study. The 2022 survey retested many of the 2014 questions and incorporated new questions based on literature published since 2014 and current circumstances in Wisconsin.

What follows are brief summaries of key findings from the 2014 and 2022 public attitudes survey as described by the studies' lead authors. The complete survey reports for each study can be found on the department's website.

Reflecting On The 2014 Statewide Wolf Attitudes Study

Robert Holsman, Ph.D.
DNR Social Scientist

The 2014 wolf attitudes study represented the largest household mail survey ever undertaken by the department with a 12-page questionnaire sent to 8,750 residents throughout the state. The department asked people about their general attitudes toward wolves, perceived risks of wolf encounters, opinions about wolf control (including regulated wolf hunting and trapping which was authorized at time of survey) and preferences for wolf abundance at a statewide and county level within existing wolf range. The sampling design of the study included oversampling households in 11 subsample units that included clusters of counties based on their known human population density and estimated wolf abundance. The underlying assumption of the sampling design was that counties with more wolves and/or more people increased the likelihood of human-wolf interactions more than places with fewer wolves and less people. The corresponding hypothesis was that more wolf encounters would produce less favorable wolf attitudes in accordance

with what has been described as “social carrying capacity.” The survey received a 59% response which is considered very robust for a contemporary general public survey. Four of the most significant findings of study are summarized below.

1. Wisconsin residents held positive attitudes toward wolves, by a large margin in counties without existing wolf packs and by a small margin across wolf range counties.

The department measured general attitudes about wolves with several types of measures, including a six-item scale that summed people’s agreement or disagreement with the following statements:

- *Wolves provide no benefits to people. (Negative attitude)*
- *The previous generations were right in eliminating wolves from the landscape. (Negative attitude)*
- *Wolves are a nuisance for people. (Negative attitude)*
- *Wolves are special animals that deserve our admiration. (Positive attitude)*
- *Predators like wolves keep nature in balance. (Positive attitude)*
- *People and wolves should be able to co-exist. (Positive attitude)*

Respondents answered on a 5-pt scale from strongly agree to strongly disagree. The responses to the three negative items were reverse coded so index scores were summed in the same direction with the resulting values ranging from +12 (very positive wolf attitude) to -12 (very negative wolf attitude) with zero representing neutral. The department found most state residents held generally favorable attitudes toward wolves, a finding consistent with what most other studies of public attitudes toward wolves have shown (see “Human Dimensions of Wolf Management: A Literature Review” in Section 2 of this plan). The mean score for residents of non-wolf range counties was 4.8 while the score for residents living in wolf range was 2.6. The distribution of the wolf attitude index scores within and outside wolf range reflects a distribution that skewed positive (Figure 6).

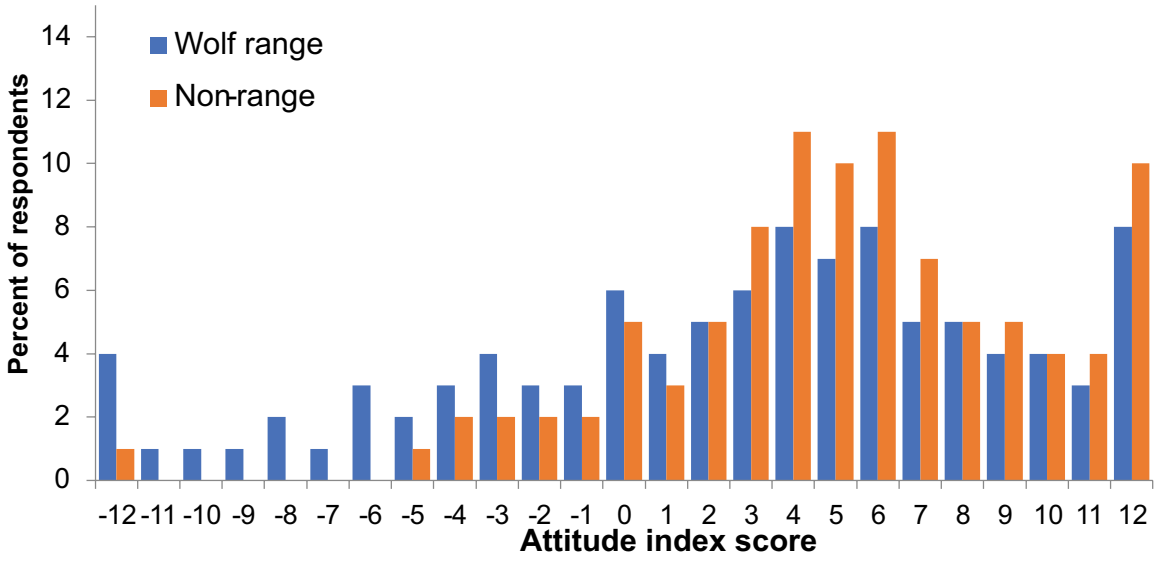

Figure 6. Histogram of wolf attitude scores among wolf range and non-wolf range residents from the 2014 public attitudes study.

2. People generally wanted at least as many wolves as occurred in Wisconsin in 2014 and did not support a population goal of 350 wolves.

The findings of the 2014 survey strongly suggest that few residents supported reducing wolves to a maximum of 350 animals. In fact, a majority of residents wanted the same number or more of wolves that were estimated to occur in 2014 (Figure 7; minimum overwinter count was 809 wolves at the time of data collection in 2013). Also, urban residents — those individuals living outside of established wolf range counties — held higher preferences for more wolves as compared to rural residents. Even within established wolf range, more residents wanted at least as many wolves as 2014 levels than fewer. About 1 in 10 residents within wolf range preferred that wolves be eliminated from the state.

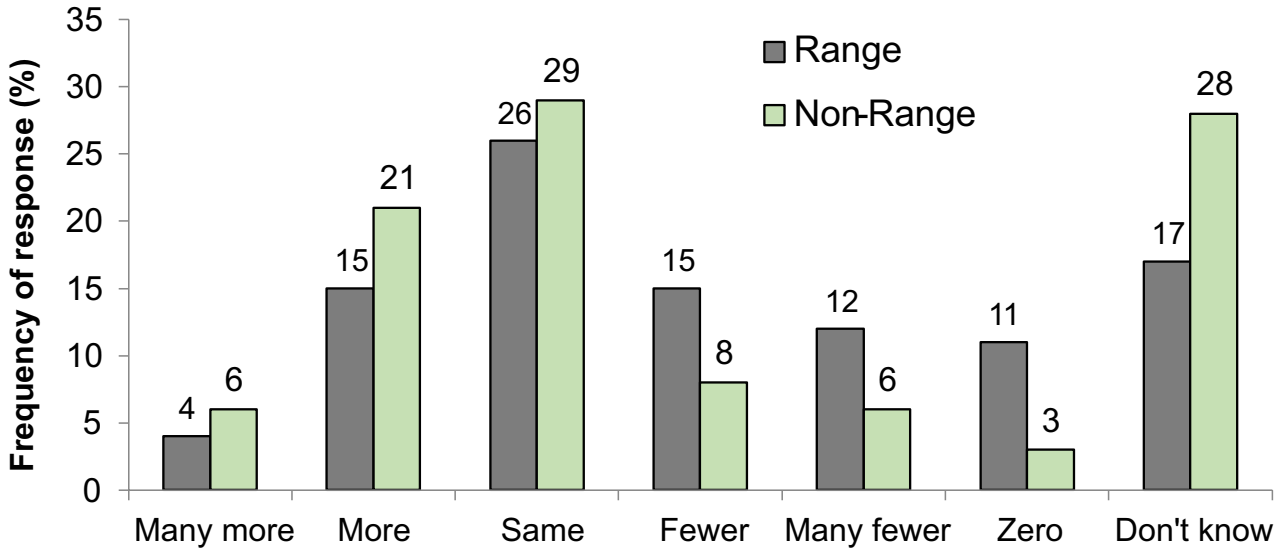

Figure 7. A comparison of frequency of responses from wolf range and non-range residents on their preferences for the number of wolves in the state compared to conditions in the winter of 2014.

With respect to the impact actual wolf density on the landscape had on people's attitudes, the department found mixed support for the hypothesis that more wolves create less favorable attitudes. For example, average attitude scores trended positive and were statistically higher in Douglas County compared to surrounding counties. Douglas County continues to be where wolf density is among the highest in the state and the place where wolves have been established the longest. Douglas County is also considered a metropolitan area by the census. However, in counties that are not classified by the census as urban and have numerous wolves (e.g., Price, Florence), average wolf attitudes tended to be just above neutral. The department's analysis showed that rural and urban differences in wolf attitudes were not entirely straightforward and were influenced as much by where a person grew up as where they lived currently; therefore, exurbanites retiring or living in rural areas tended to bring positive wolf attitudes with them. Ultimately, state residents who consider themselves deer hunters, especially those who hunt in wolf range, were most likely to harbor negative attitudes toward wolves and also preferred to have fewer wolves than existed in 2014.

3. Most people would worry about threats when encountering wolves, but at levels similar to the concern they express about black bears.

There was a keen interest in understanding how the public perceived wolves as a threat to human safety and pets. The department measured perceived risks on the questionnaire related to self, children and pets not only for wolves but also for bears and coyotes to serve as a point reference. The results indicated that both within and outside of wolf range, a majority of residents agreed that they worried about safety to themselves, children and pets while in areas occupied by wolves. Similar to the attitude scale described above, a risk perception index was created based on three questions resulting in scores from +6 (high perceived risks) to -6 (low perceived risks). The distribution of scores reflects that most survey respondents acknowledged worrying about threats posed by wolves (Figure 8). Perceived risks were higher among deer hunters, rural residents, those who experienced loss of an animal or knew someone who did and among those people who perceived wolves to be very abundant or abundant in their home county. As a point of reference, non-wolf range residents were more likely to perceive risks from bears than from wolves. Within wolf range, residents were mixed on whether bears or wolves posed greater risk to public safety depending on the audience segment. Deer hunters in wolf range perceived the highest risks from wolves.

Public tolerance for wolves might be best captured by a question that asked people if they were willing live near wolves. Among residents of counties with established wolf packs in 2014, 49 % said “yes” and 33% said “no” (Figure 9).

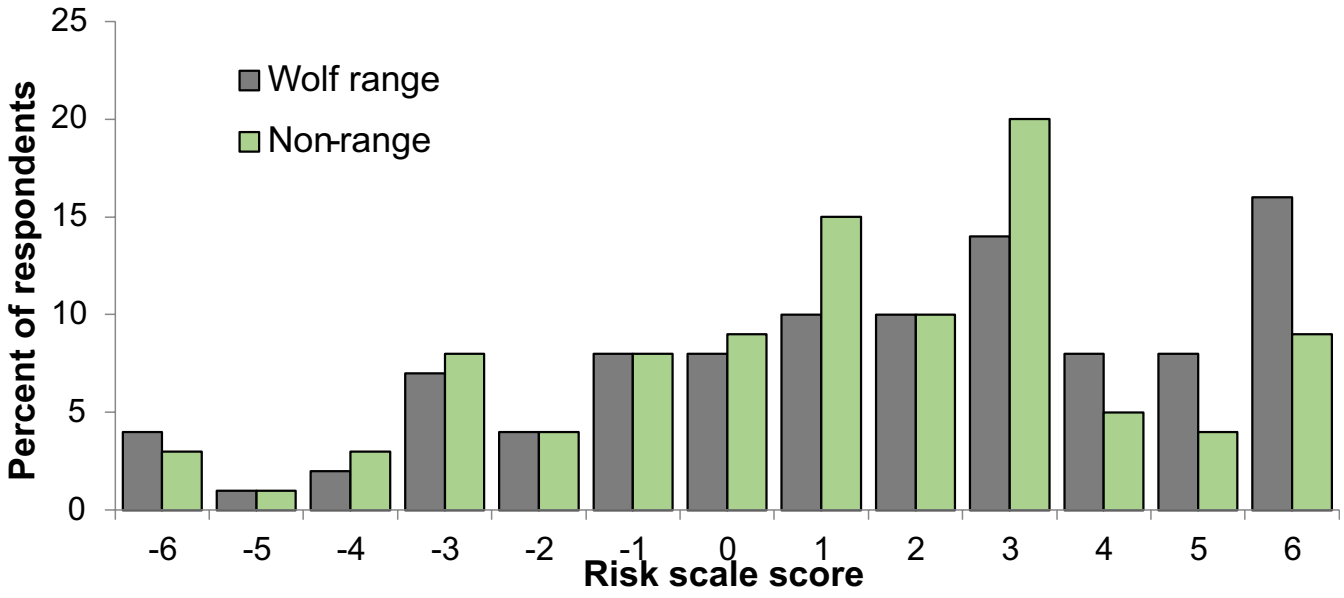

Figure 8. Histogram of wolf risk scale scores among wolf range and non-wolf range residents from the 2014 public attitudes study.

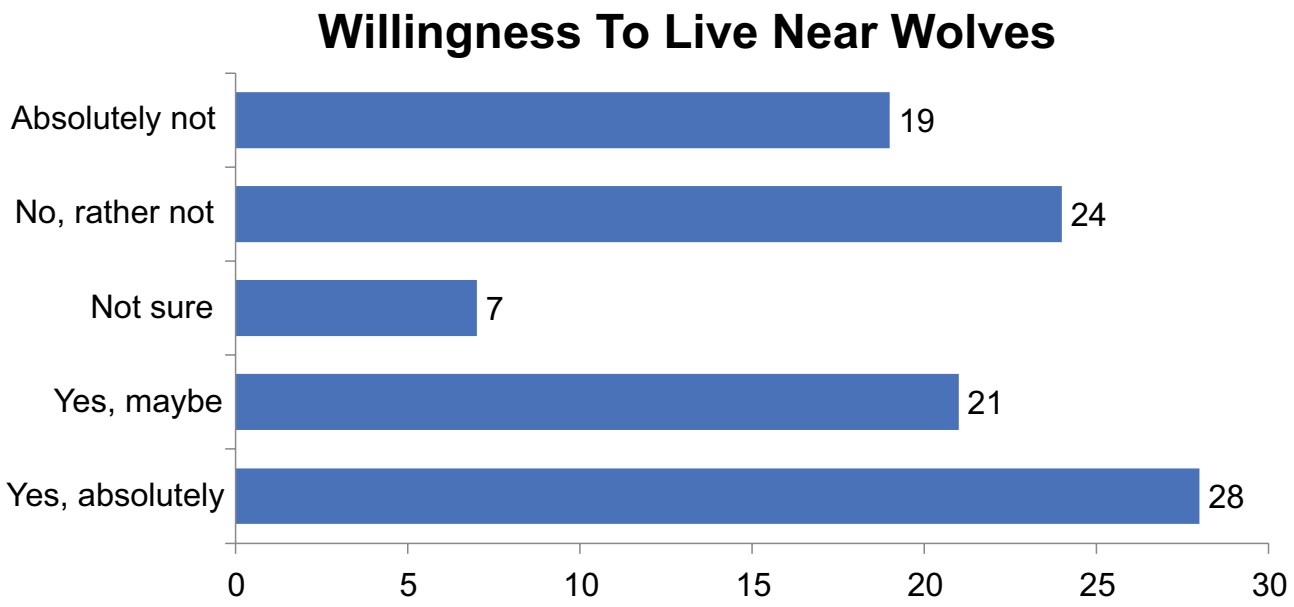

Figure 9. Frequency of the degree to which wolf range residents are willing to accept wolves living near them from the 2014 public attitudes study.

4. The public supported regulated hunting and trapping, lethal control of wolves to reduce conflicts, but support was conditional.

Following the inaugural wolf harvest seasons of 2012 and 2013, the department survey results showed a majority of state residents supported regulated hunting and trapping of wolves. Support was higher among wolf range residents (62%) than it was for residents outside wolf range (51%). But very few survey respondents thought wolf populations should be managed for the purpose of providing recreational hunting. Among those who opposed regulated hunting and trapping of wolves, the majority worried that harvest would "cause wolves to become endangered again." Whether that concern was based on a biological determination of endangerment or a legal classification is not known, though for the lay public that distinction may not be relevant.

Public support for various forms of lethal control of wolves, including a hunting season, as a means of reducing specific human-wolf conflicts was highly variable and conditional. The top two priorities for lethal control of wolves among survey respondents were to respond to cases involving threats to public safety and to eliminate wolves from areas where they were attacking livestock. Public preference for who performed the lethal control tended to lean toward using wildlife professionals rather than the public.

Again, deer hunters were significantly more likely to support lethal control/harvest of wolves for any reason. For example, seven in ten deer hunters indicated that "*Reducing wolf population in northern counties to address deer hunter concerns about predation*" should be a high management priority.

Overview Of The 2022 Statewide Wolf Attitudes Study

Lauren Bradshaw
DNR Social Scientist

As part of the effort to develop an updated state wolf management plan, the department sent an 8-page questionnaire to 8,750 households across the state in summer 2022. Household addresses were randomly drawn within four sampling strata based on whether a county falls within wolf-range (i.e., counties with established wolf packs) as well as a county's U.S. Census designation as metropolitan and micropolitan (grouped together as "urban") or non-metropolitan ("rural"). This sampling protocol was developed to ensure findings from 2022 would be comparable to those obtained in 2014 and to ensure sufficient representation from rural areas, particularly rural areas in wolf-range. The questionnaire assessed Wisconsinites' general attitudes toward wolves, their encounters with wild wolves and concerns for safety, opinions about wolf management (including regulated wolf hunting and trapping), preferences for wolf abundance and distribution and their trust in the department's wolf management. A number of questions from the 2014 survey effort were repeated in 2022 for comparative purposes. The overall response rate was 38% for a total of 3,158 returned questionnaires. This number of responses from each of the four sampling strata allowed for robust statistical comparisons within 2022 results as well as comparisons with 2014 study findings. Key findings from this study are summarized below.

1. Wisconsinites held favorable attitudes toward wolves.

Across nine statements about wolves, the majority of Wisconsinites responded in a way that reflected favorable attitudes toward wolves. Respondents were asked to answer on a 5-pt scale from strongly agree to strongly disagree for each of the following nine statements:

- *Wolves are special animals that deserve our admiration. (Positive attitude)*
- *Wolves provide no benefits to people. (Negative attitude)*
- *People and wolves should be able to co-exist. (Positive attitude)*
- *Wolves are culturally important. (Positive attitude)*
- *The previous generations were right in eliminating wolves from the landscape. (Negative attitude)*
- *It is important to maintain a wolf population in Wisconsin. (Positive attitude)*
- *Predators like wolves keep nature in balance. (Positive attitude)*
- *Wolves have negatively affected deer hunting in Wisconsin. (Negative attitude)*
- *Wolves are a nuisance for people. (Negative attitude)*

When responses across all nine statements are analyzed together to generate an index of favorability, results showed that those who lived in wolf-range held less favorable attitudes than those who lived outside of wolf-range.

Six of the nine statements were held in common with the 2014 survey for comparative purposes.

Comparisons of data from both survey years revealed that attitudes toward wolves have grown more favorable over time both at a statewide scale as well as among wolf-range residents. These findings are consistent with recent literature on the human dimensions of wolf management.

2. Many Wisconsinites have never had an encounter with wild wolves and few had experience with wolf attacks on domestic animals.

The questionnaire gauged past experiences with seven types of encounters with wild wolves ranging from seeing wolf tracks to having a domestic animal killed by a wolf. Respondents indicated whether they had an encounter never, once or more than once. Many Wisconsinites reported they had never heard a wolf howl (45%), had never seen wolf tracks (55%) or had never seen a wolf in the wild (61%). For analysis purposes these three encounter types were collectively referred to as first-degree encounters. Wolf-range residents were more likely than those living outside of wolf range to have first-degree encounters and more likely to report those encounters more than once. Among wolf-range residents, 32% reported they had never heard wolf howl, 40% had never seen wolf tracks and 42% had never seen a wolf in the wild.

Experience with lethal or non-lethal wolf attacks on domestic animals (for analysis purposes referred to as second-degree encounters) were much less common than first-degree encounters. A higher proportion of Wisconsinites reported knowing someone who had a second-degree wolf encounter than reported personal experience with a wolf attack. Among wolf-range residents, one-quarter reported knowing someone who has had a domestic animal killed by a wolf, 5% reported personal experience with a wolf attacking or harassing a domestic animal and 4% reported personal experience with a wolf killing a domestic animal.

A comparison of findings from the 2014 and 2022 surveys revealed that among both wolf-range and non-range residents, those reporting that they have seen or heard wolves or seen tracks have decreased since 2014. Similarly, the proportions of those reporting direct or indirect experience with wolves killing domestic animals have decreased since 2014.

3. Most people would worry for the safety of their pets and children when recreating in areas where wolves live.

The questionnaire measured the extent that Wisconsinites worry for personal safety, the safety of children and the safety of their pets while recreating in areas where wolves live. Respondents were asked to answer on a 5-pt scale from strongly agree to strongly disagree for each of the following circumstances:

- *I would worry about my personal safety while outdoors in areas where wolves live.*
- *I would worry about the safety of my pets while outdoors in areas where wolves live.*
- *I would worry about the safety of children who are outdoors in areas where wolves live.*

A majority of both wolf-range residents and non-range residents agreed that they worried about safety of children and pets. Among both groups, residents were less likely to agree that they worried about their personal safety while outside in areas where wolves live.

Measures of worry for safety increased as the frequency and severity of reported wolf encounters increased. Frequent sightings of wolves or wolf sign or any experience with wolf attacks resulted in a higher than average worry for safety. Comparisons of findings from the 2014 and 2022 surveys revealed that measures

of worry for safety have decreased over the last eight years. This is perhaps correlated to the decrease in reported wolf encounters observed between the two study years.

4. People generally wanted about the same or more wolves as the current level across the same or more area of the state.

The questionnaire measured perceptions of current wolf abundance in the state, preferred wolf abundance in the state, preferred wolf distribution across the state and preferred wolf abundance in the respondents' county of residence. The 2020-2021 overwintering wolf population abundance was estimated at 1,126 wolves with a 95% credible interval of 937-1364 wolves. Relative to abundance at the time of the survey, a plurality of both wolf-range and non-range residents wanted about the same number of wolves (Figure 10). Among those living outside of wolf-range, 35% would like more or many more wolves, 33% would like about the same number and 12% would like fewer or many fewer wolves. Among wolf-range residents 33% would like about the same number of wolves, 27% would like fewer or many fewer and 22% would like more or many more. Very few Wisconsinites indicated they would like zero wolves in the state.

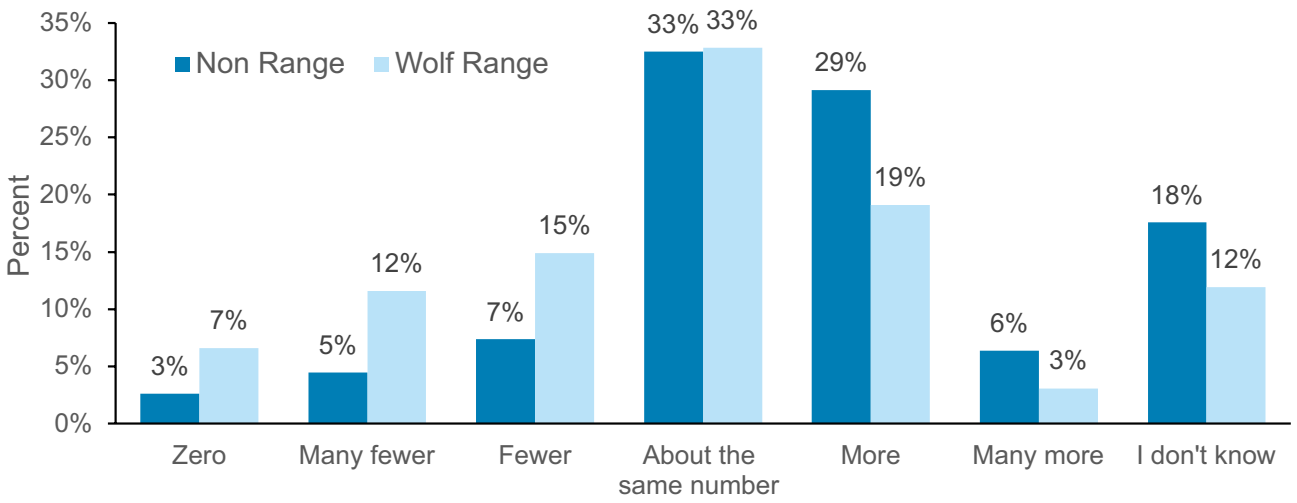

Figure 10. Distribution of 2022 survey results for preferred statewide wolf population size relative to the population level at the time of this study among residents of wolf-range and non-range.

Similarly, a plurality of both wolf-range and non-range residents indicated they would like wolves to occupy *about the same* proportion of the state relative to their distribution at the time of the survey (Figure 11). Among those living outside of wolf-range, 47% would like wolves to occupy the same amount of the state, 22% would like to see wolves occupy *more* or *much more* of the state and 12% wanted *less* or *much less* of the state. Among wolf-range residents, 41% wanted wolves to occupy *about the same* range, 24% wanted *less* or *much less* of the state and 15% wanted wolves to occupy *more* or *much more* of the state. Very few Wisconsinites wanted wolves to occupy *none* of the state or *all* of the state, respectively.

Public preferences for wolf population abundance have changed over the last eight years. Comparisons of 2014 and 2022 results revealed that higher proportions of both wolf-range and non-range residents would like about the same number or more wolves relative to 2022 wolf abundance. Correspondingly, fewer Wisconsinites prefer a decrease or elimination of wolves in Wisconsin in 2022 than did in 2014 (see Figure 7 and Figure 10). The 2014 survey did not assess preferences for distribution of wolves.

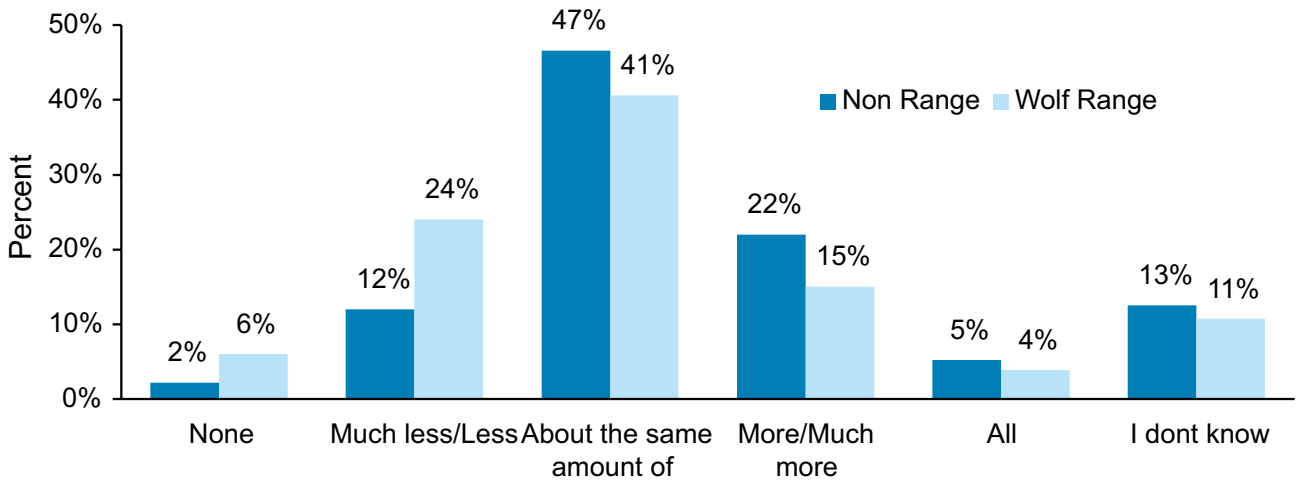

Figure 11. Distribution of 2022 survey results for preferred geographic distribution of wolves relative to the distribution at the time of this study among residents of wolf-range and non-range.

5. More people support regulated wolf hunting and trapping than oppose it and a majority support lethal control to address conflicts, however support was conditional.

The questionnaire measured opinions toward lethal taking of wolves by asking respondents about their support or opposition to a regulated wolf hunting and trapping season and their support for the killing of individual wolves to address four types of wolf-human conflict.

The 2022 survey results showed that support (46%) for a regulated hunting and trapping of wolves is higher than opposition (29%); one-quarter of Wisconsinites were undecided. Support was higher among wolf-range residents (57%) than it was for residents outside wolf-range (43%). While modifications to question design between 2014 and 2022 limited statistical comparisons, informal comparisons suggest that statewide support for a wolf hunting and trapping season has declined over the last eight years. As was found in the 2014 survey, the top reason for opposition in 2022 was concern that wolves would become endangered again. The least selected reason for opposing a regulated wolf hunting and trapping season in both 2014 and 2022 surveys was “I oppose all forms of hunting.”

Few Wisconsinites opposed the killing of individual wolves to address wolf-human conflicts. Regarding the preferred tool or agent to carry out that lethal control, Wisconsinites generally preferred wildlife professionals over landowner permits or a regulated hunting and trapping season. One exception to this was in the case of wolves attacking domestic livestock, for which support for landowner permits to kill individual wolves (59%) was slightly higher than support for wildlife professionals doing so (50%). Comparisons of 2014 and 2022 results revealed that the proportion of Wisconsinites that oppose lethal control to address wolf-human conflicts has increased slightly (5-6%) but meaningful differences in preferences for who carries out that lethal control (wildlife professionals, landowner permits, regulated hunting and trapping) were minimal.

6. The majority of Wisconsinites have trust in DNR wolf management.

The 2022 questionnaire assessed the public's trust in the department using seven statements related to managing the wolf population in Wisconsin. Respondents were asked to answer on a 5-pt scale from strongly agree to strongly disagree for each of the following statements:

With respect to managing the wolf population in our state, I feel that the Wisconsin DNR…

- *can be trusted to make decisions about wildlife management that are good for the resource.*
- *appropriately uses science in and data in decision-making.*
- *listens to the concerns of citizens.*
- *uses reliable methods to estimate wolf populations in Wisconsin.*
- *shares similar values as me.*
- *takes similar actions as I would.*
- *shares similar goals as me.*

The majority of Wisconsinites agreed or strongly agreed that the department *appropriately uses science and data in decision-making* (67%), *uses reliable methods to estimate wolf populations in Wisconsin* (65%), *can be trusted to make decisions about wildlife management that are good for the resource* (64%) and *listens to the concerns of citizens* (59%). A plurality of Wisconsinites neither agreed or disagreed that the department *shares similar values* (42%) and *similar goals* (43%) as them and *takes similar actions* as they would (44%). When responses to all seven trust statements were analyzed together in a single index of trust, results revealed that those living in wolf-range were less likely to trust the department. Results show that those who reported more frequent encounters with wolves or any experience with wolf attacks had lower trust in the department's wolf management. These residents were also more likely to perceive wolf abundance at the time of the survey to be above the department's estimates.

Part Three: Wisconsin Tribal Perspectives And Cultural Significance

As part of the development of this plan, the department formally requested that the Tribal Nations in Wisconsin contribute a written narrative on the cultural significance of wolves to be included in the plan. Acknowledging that it is not possible to speak with one voice for all tribes in Wisconsin, the invitation was extended to all. The request was sent to the Tribal Natural Resource/Conservation Directors and Tribal Historic Preservation Officers of each of the eleven federally recognized tribes of Wisconsin. It was also sent to the Great Lakes Indian Fish and Wildlife Commission.

The purpose of the following portion is to complement the preceding review of human dimensions by further exploring the deep connections and nuanced relationships between humans and wolves, particularly from a First Nations perspective. We hope this section will help provide critical insights and educational opportunities on those relationships shared between the peoples and wolves of the state over the course of time.

Because other sections of the plan focus on policy, informed by various sources of input (including the Wolf Management Plan Committee, on which several tribal representatives participated and government-to-government tribal consultations), the department requested that any contributions to this section focus on the cultural relationships, history and other relevant informational items and avoid discussions or recommendations on policy. It was made clear that this request was separate from and in addition to those efforts. Contributions to this section did not affect any input provided through that process or its influence in developing policy contained the plan. The department further asked that any contributions to this section be prepared in a way that allows them to be copied verbatim into this section.

Below are the four contributions received in response to this request. They have been provided verbatim as they were received.

Forest County Potawatomi

FOREST COUNTY
POTAWATOMI
Keeper of the Fire

PO Box 340
Crandon, WI 54520

Forest County Potawatomi Cultural Statement Regarding Mo' ewé

Foreword: *Opinions are diverse and views regarding Mo' ewé vary. The provided statement reflects what is known to be the beliefs held by the majority of Potawatomi Tribal individuals.*

Cultural and Ecological Significance of Mo' ewé (wolves)

The Potawatomi Tribe hold sacred the Creation Story. In this story, the Original Man was suffering greatly from loneliness. The Creator, recognizing his suffering, provided the Original Man a Mo' ewé. As man and Mo' ewé bonded through playfulness, communication, and exploring, their connection grew to be that of brothers, or even to be one and the same being. Once the connection between Mo' ewé and man solidified, so did their fates. A core message from the Creator, which is a strongly held belief within the Potawatomi Tribe, is that the fate of Mo' ewé is the fate of the Potawatomi.

The bond between Mo' ewé and the Potawatomi extends beyond the spiritual and into the physical realm. Mo' ewé provides an ecological balance that supplies the Potawatomi with a great diversity of plants and animals which helps sustain the people. This supports a strongly held belief that the health of Mo' ewé directly connects with the health of the Potawatomi. As the wellbeing and habitat conditions for Mo' ewé degrades, so does it for the Potawatomi people. What is needed for Mo' ewé to thrive, such as clean water and air, resources, and shelter, has a direct positive impact on the quality of life for the Tribal community. Given such, the Potawatomi Tribe strive to live a life in balance with Mo' ewé.

Since there is a deeply intertwined relationship between the Potawatomi and Mo' ewé, the terms often used within state agency plans are not sensitive to the Tribal culture. Since Mo' ewé are seen as brothers, or even as one and the same being, it is not the Tribes stance to "manage" their brother, but instead provide stewardship or non-lethal co-existence. It is not believed that Mo' ewé need to be dominated, but rather supported so both humans and Mo' ewé can thrive.

Forest County Potawatomi Chairman

Lac Courte Oreilles

Pride Of The Ojibwa
LCO CONSERVATION DEPARTMENT
13394 W Trepania Road Building 1
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PHONE (715) 634-0102 • FAX (715) 634-0107

LCO Cultural Significance of Ma'iingan (wolf)

The significance of Ma'iingan is etched in the Anishinaabeg creation story.

The Creator sent Ma'iingan (Wolf) to be the Peoples' companion and brother. Ma'iingan and Anishinaabeg were instructed to travel together and name everything in nature, including all the plants and animals. After forming a strong relationship and accomplishing this feat of naming all, they returned to the Creator. Ma'iingan and Anishinaabeg were told by the Creator that he would separate them and they would forever walk apart, but that they would live parallel lives. *"What happens to one will also happen to the other,"* the Creator said, a teaching that has often proven true.

This understanding that what happens to one happens to the other is fundamental in understanding this Ojibwe perspective. Whin this perspective words like "minimum viable populations," "population caps," or "manage" sound offensive to one holding the view that a being who is like a brother should be "managed," have a "minimum viable population," or "a population cap." In this perspective it is felt that this group should be able to self-determine their numbers and distribution on the landscape.

Besides the relationship between Ma'iingan and Ojibwe there is substantial traditional ecological knowledge that Ojibwe have from spending centuries sharing this landscape that is current day Wisconsin. The understanding that Ma'iingan present little threat to human health and safety supports an appreciation for the ecological role they play in maintaining the health and diversity within their environments. Ma'iingan have the same purpose today as they did back when the Creator made them and us. Ojibwe today still view them with the same sense of responsibility one has for their brother.

Brian Bisonette
Lac Courte Oreilles Conservation Director

Menominee

The Cultural Significance of the Wolf (Mawaew) to the Menominee Tribe
By David Grignon (Nahwahquaw) Tribal Historic Preservation Officer
Menominee Indian Tribe of Wisconsin

The Menominee people are known as the Omaeqnomenewak or People of the Wild Rice and have lived in what is now Wisconsin and a portion of Upper Michigan since time immemorial. The Menominee also have a name for themselves Kayaes Mamahchitawak or the Ancient Ones.

Throughout the history of the Menominee going back to the tribe's Creation story at Minikani or the mouth of the Menominee River the Wolf is mentioned and is culturally significant to the tribe. The Wolf is one of the five principal clans of the Menominee and its responsibility was hunting and gathering. The Wolf is mentioned in other cultural legends of the tribe.

At a place where the Menominee River meets (Puchiket) the Bay in Spite of Itself (Green Bay) a Great Bear (Maec Awaehsaeh) came out of the mouth of the Menominee River. As he talked to Maec Awaehtok (the Great Spirit). When the Great Spirit saw him he changed him into human form and he was the first Menominee. The bear traveled up river he saw an eagle/thunderer (Kenew) flying above and said brother Eagle come and walk with me and be my brother and as the Eagle descended the Creator changed him into human form and he was the second Menominee. As the Bear and Eagle walked up the river they encountered a Wolf (Mawaew), Moose (Mos) and Crane (Otaeqchia) and they too were changed into human form by the Creator.

At another time Bear was going up the Wisconsin River, and becoming fatigued sat down to rest. Nearby was a waterfall, from beneath which emerged Wolf. While asking Bear why he was there Otaeqchia (Crane) came by. Bear called to him and said: "Crane, carry me to my people at the head waters of the river and I will take you as my younger brother." As Crane was taking the Bear, Wolf called out to Bear saying, "Bear take me also as a younger brother, for I am alone." This is how Crane and Wolf became younger brothers to Bear; but as Wolf afterward permitted Anaem (Dog) and Apaehsos (Deer) to join him, these three are now recognized as a phratry, Wolf still being entitled to a seat in council on the north side with the Bear phratry.

The Thunderers decided to visit the Bear village and asked the Bear to join them. They promised to give corn and fire in return for wild rice which was the property of the Bear and Sturgeon. From this time on the families united into an organized body for mutual benefit.

During the treaty era the Menominee were forced to cede several million acres of land to the US Government. In the treaty of 1848, the government wanted the remaining lands in Wisconsin and called on the Menominee Chiefs to negotiate for their lands. In exchange for the tribe's remaining lands in Wisconsin the government agents offered 600,000 acres of land in Crow Wing, Minnesota, but the Menominee chiefs were reluctant to take the land because what was

Menominee

promised to them did not happen. Instead Menominee Chief Oshkosh, the head negotiator for the tribe, traveled to Washington with a delegation of Menominee chiefs to speak to the President Fillmore and asked for lands on the upper Wolf River in their ancestral territory instead of Crow Wing. The President listened and the Menominee reservation was established in the Treaty of 1854. The Wolf River bisects the 235,523 acre reservation.

The Wolf River (Mawaew Sepew) is sacred to the Menominee people and has much spiritual and cultural significance and the river brought the sacred sturgeon to their traditional spawning grounds at Keshena Falls until dams were built below the reservation.

"Up to the time that the whites placed dams on the Wolf River, Keshena Falls, on the present Reserve, was a great resort of these fish (Sturgeon) Namaew in the spring of the year. Here the high water that follows the thaws and rain beats against a mass of rock, making a drumming noise. Menominee folklore declares that this is the music of a mystic drum belonging to the Awaehtok (Spirit) who owns the cataract. They say that when this drum beats, the toads and frogs begin their mating songs and the sounds call the sturgeon to the pools and eddies below the cataract (at Keshena Falls). There they formerly spawned and were then speared in large numbers and the Wolf River at this point at the falls was celebrated with great ceremony as a breeding place for the Sturgeon".

The Wolf is sacred to the Menominee people and the wolf's cultural and spiritual connection, in many ways, still exists today. To some Menominee the Wolf will guide them to their sacred resting place when it is time to leave this earth as one of our teachings says.

Great Lakes Indian Fish and Wildlife Commission (on behalf of the Ojibwe Tribes of the Great Lakes Region)

The following is provided as received by the Great Lakes Indian Fish and Wildlife Commission
Submitted by Peter David, GLIFWC wildlife biologist (retired)

Tribal Perspectives Toward Wolves

This plan also directly affects Tribal Nations in Wisconsin or those outside of Wisconsin with legal rights on ceded lands within the state.

Tribal members, like non-tribal members, have diverse and nuanced views on wolves and the appropriate wolf/human relationship. Similarly, individual tribal members may hold perspectives or positions which differ from those advanced by tribal governments. However, it is important to remember that treaty rights are tribal rights, not individual rights and the positions of tribal governments supersede individual opinions.

Cultural And Ecological Significance Of Ma'iinganag (Wolves) To The Ojibwe

Ma'iingan has a critical role in the Ojibwe Creation Story, in which the Creator provides a wolf to Original Man – who was suffering from a loneliness of spirit - to walk and talk and play with (Benton-Banai, 1988). A primary teaching from that story is that the Ma'iingan and the Ojibwe developed a deep and powerful relationship. This relationship is often described as being like brothers, while others describe them like being one and the same being. Another primary teaching of the Creation Story is that Ma'iingan and Ojibwe would forever share intertwined fates, with the Creator indicating that *"What shall happen to one will happen to the other,"* a teaching which has often proven true. This understanding of shared fates underlies much of the Ojibwe's relationship with Ma'iingan.

Within this context, terms commonly used in state wolf plans, such as "manage," feel inappropriate from an Ojibwe perspective, for one does not typically manage one's brother. While other terms, such as "stewarding" or "protecting" may come closer, at a broader level, Ojibwe may speak about their *relationship* with ma'iingan, a word that reflects a perspective not of dominion, but of reciprocity and which acknowledges the inherent right of ma'iingan to exist. It also better captures the tribes' sense of *responsibility* to their brother, a responsibility to repay ma'iinganag for the benefits they provide to the people.

In addition to the cultural relationship with ma'iingan, there have long been practical considerations as well, for the Ojibwe have spent centuries sharing the North American landscape with wolves. This imparts substantial traditional ecological knowledge that can inform current ma'iingan stewardship in what is now Wisconsin. There is an understanding that wolves present little threat to human health and safety and an appreciation for the ecological role ma'ingan plays in maintaining the long-term health of prey populations and the health and

diversity of plant communities. This in turn yields strong support for maintaining a fully healthy and ecologically functional wolf population on the land.

This relationship with ma'iingan naturally informs positions taken by tribal governments or commonly included in tribal wolf documents, for when your fate is tied with ma'iingan's, you want the same health for the wolf community as you do for your own. It is generally felt that wolves themselves should be allowed to determine their numbers and distribution on the broader landscape, as opposed to having humans make this determination. In addition, taking a wolf's life is a serious consideration that requires substantial justification. Recreational harvest doesn't meet this threshold and responses to livestock depredation necessitate that preventative actions and non-lethal approaches be pursued before consideration of lethal techniques.

Wisconsin's Ojibwe tribes have unique legal rights related to resource stewardship in many parts of wolf range in the state and elsewhere, so it is important for the state and the tribes to share their knowledge, understandings and perspectives for the benefit of the wolf community. In addition, as sovereign nations, each tribe may have unique views and must be consulted independently regarding wolf stewardship in and around their own tribal lands and/or ceded territories. This path may be difficult at times, but it provides the best opportunity for a healthy relationship with ma'iingan.

Finally, tribal wolf plans also contain a wealth of information on tribal perspectives on the proper human/ma'iingnan relationship and policy positions. Links to some GLIFWC member Ojibwe tribal plans can be found below.

Ma'iingan Relationship Plan: 1837/1842 Ceded Territory (2022):
https://data.glifwc.org/reports/

Bad River Ma'iingan Relationship Plan (2019):
https://www.badriver-nsn.gov/wp-content/uploads/2020/01/NRD_MaiinganPlan_2019.pdf

Red Cliff Wolf Protection Plan (2015):
https://files.ctctcdn.com/363c7c0d401/78e5c30d-97df-4954-9760-dabd0f2c0fb4.pdf

Lac Courte Oreilles Wolf Management Plan (2013):
Contact the LCO Conservation Department. 715-364-0102.

Keweenaw Bay Indian Community Wolf Management Plan (2013):
https://nrd.kbic-nsn.gov/sites/default/files/WolfPlan_FINAL_011013_V9.5awebsite.pdf

Fond du Lac Wolf Management Plan (2012):
Contact the FDL Resource Management Division. 218-878-7103.

Section 3: Gray Wolves In Wisconsin


ISTOCK/LYNN BYSTROM

Historical Overview Of Wolves In Wisconsin

History Of Wolves In Wisconsin

Wisconsin lies at the junction of three ecological biomes: the vast prairies of the Great Plains, the Eastern Woodlands that cover large temperate portions of eastern North America and the Boreal Coniferous Forest that extends north to Hudson Bay. Wisconsin includes a transitional region between northern hardwoods ecosystems and southern prairie and forest, referred to as the tension zone (Curtis 1959). Because of the intersection of these three biomes, Wisconsin contains a remarkably diverse array of both plant and animal communities. Historically, gray wolves (Canis lupus) occurred throughout the state.

Humans have occupied Wisconsin for at least 10,000 years. At the time of European contact in the mid-1600s, at least six tribes of Native Americans lived within the state's eventual borders. These tribes revered gray wolves, as evidenced by the species' prominent role in cultural and spiritual beliefs (David 2009, Radin 1973). Between the mid-1600s and 1848 when Wisconsin was officially designated a state, French, British and later American fur traders plied the state's waterways. Wolves were viewed with indifference by these traders as they neither posed a threat nor were regarded as valuable furbearers (Thiel 1993).

At the beginning of the fur trade period, five ungulate species roamed Wisconsin: bison (Bison bison), elk (Cervus canadensis), moose (Alces alces), white-tailed deer (Odocoileus virginianus) and woodland caribou (Rangifer tarandus). Black bears (Ursus americanas), cougars (Puma concolor), wolves and the native people of this region would have been important historical predators of these ungulates (Wydeven and Pils 2008). Based on estimated ungulate population densities, Wisconsin may have had midwinter abundances of 3,000-5,000 wolves in the early 1800s (Wydeven et al. 2009). However, human exploitation greatly decreased the distribution and abundance of Wisconsin's large mammals and by the 1840s both bison and caribou had been extirpated (Jackson 1961, Thiel 1993). Cougars, elk and moose were also eliminated by the end of the 1800s, while white-tailed deer were limited to heavily forested areas of central and northern Wisconsin (Jackson 1961).

Management Of Wolves Prior To 1970

In pre-Civil War Wisconsin, settlers poured into Wisconsin's prairies and along the western shore of Lake Michigan, altering habitats, harvesting ungulates and bringing in livestock. Wolves began preying upon the settlers' hogs, sheep and cattle. The prevailing perception of the wolf among settlers changed from indifference to dislike: wolves were considered a pestilence that needed to be eliminated (Thiel 1993).

With increased depredations on domestic animals and a reduction in native ungulates, Wisconsin implemented a wolf bounty system. The Wisconsin Territory paid bounties on wolves from 1839-1847. The State of Wisconsin, established in 1848, began offering bounty payments on wolves and coyotes (Canis latrans) in 1865. These bounties ran nearly continuously through 1957, when wolves were designated by the state as protected wild animals.

By the 1880s, wolves had been eliminated from most southern portions of the state. The last were taken from east-central Wisconsin by around 1914 and from the region running from Green Bay through Wausau to St. Croix Falls by 1920. An estimated 150 remained in Wisconsin by 1930, however the population was further reduced to <50 in a few reproductive packs that roamed extreme north-central and northeastern Wisconsin by 1950. The last known wolf in Wisconsin was killed in 1959 (Thiel 1993). Thus, despite lifting of the bounty system and protections given a few years earlier, breeding populations of wolves were functionally extirpated by 1960.

Recolonization Of Wisconsin By Wolves

Following extirpation, no wolf packs were observed in Wisconsin for approximately 15 years. There was never a reintroduction of wolves attempted by the Wisconsin Department of Natural Resources (DNR). An early reintroduction was attempted in the Western Great Lakes in Upper Michigan in 1974; the effort failed when all four translocated wolves died from human-caused mortality within six months of release (Weise et al. 1975). More recently, some wolves were relocated to Isle Royale National Park as part of an effort to re-establish a genetically diverse wolf population on the island (Harvey et al. 2021).

Wolves began naturally recolonizing Wisconsin in the mid-1970s. These animals likely dispersed from the last gray wolf population within the conterminous United States in neighboring Minnesota (Wydeven et al. 1995, Wydeven et al. 2009, Thiel 1993). Five dead wolves were recovered in Douglas County near the Minnesota border between 1975 and 1979 (Mech and Nowak 1981). In 1974, Minnesota Department of Natural Resources biologists reported finding a wolf pack along the Minnesota side of the border (Mech and Nowak 1981, Thiel 1993). Packs likely spread into Wisconsin soon thereafter and the first breeding was documented in Douglas County in the summer of 1978 (Thiel and Welch 1981, Thiel 2001). In 1979, an additional isolated wolf pack was discovered in Lincoln County (Mech and Nowak 1981, Thiel 1993).

The distribution of wolves has increased across the state from the time of recolonization. By the early 1980s, an additional wolf pack was detected in western Oneida and eastern Price County. Thus, in the early 1980s wolves occurred in a few remote areas of four Wisconsin Counties. By the end of the 1980s the population had only expanded slightly, with a new wolf pack establishing in western Bayfield County and a pack near the juncture of Ashland, Price and Sawyer Counties. While a single wolf was also detected in extreme northeast Wisconsin, major pack development did not occur in this region until the 2000s.

Major growth and expansion in the wolf population occurred in the 1990s. By winter 1994-1995, wolf packs were confirmed in Jackson County in Central Wisconsin and some evidence suggests wolves may have been present as early as 1992 (Thiel et al. 2009). In central Wisconsin, wolves traveled across extensive areas of farmland into the central forest from the established wolf range to the north. Recolonization was especially slow in northeast Wisconsin and the first packs in Forest and northeast Vilas Counties were not detected until the winter of 1998-1999.

Between 1991 and 2002, the department removed 32 depredating wolves from Wisconsin farms and, in conjunction with the appropriate landowner/managers, relocated them to national forest land or tribal reservations in Forest, Florence, Price, Bayfield and Menominee Counties. Wolves were moved distances ranging from 32 to 172 miles from the point of capture. These translocated wolves traveled extensively and some joined other packs, but few of these movements resulted in major expansion of the wolf population. In one case, a pair of breeding adults and their five pups were translocated in 2002 to the Menominee Indian

Reservation, resulting in this pack shifting to western Oconto County and eastern Menominee County. While most of the original pack died or dispersed, this area has had near continuous occupancy by wolves since 2002.

Figure 11. 1980 overwinter wolf pack distribution (5 packs, 25 wolves).

Figure 12. 1990 overwinter wolf pack distribution (9 packs, 29 wolves).

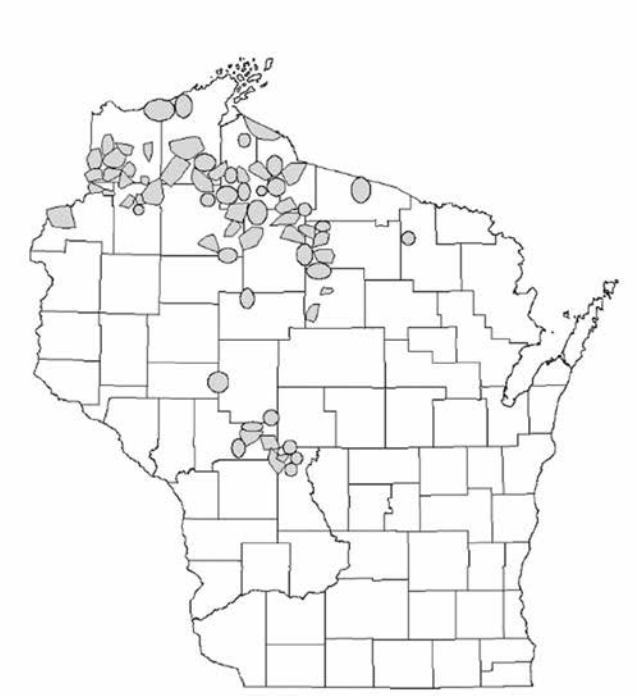

Figure 13. 2000 overwinter wolf pack distribution. (65 packs, 248 wolves).

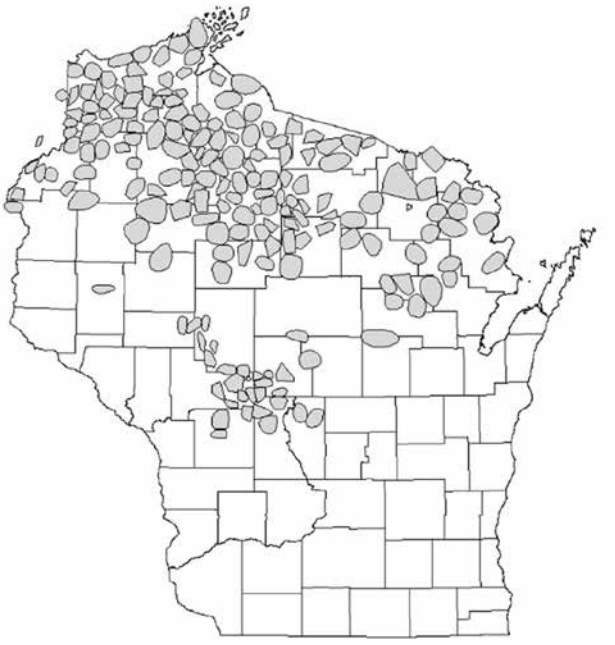

Figure 14. 2010 overwinter wolf pack distribution. (188 packs, 704 wolves).

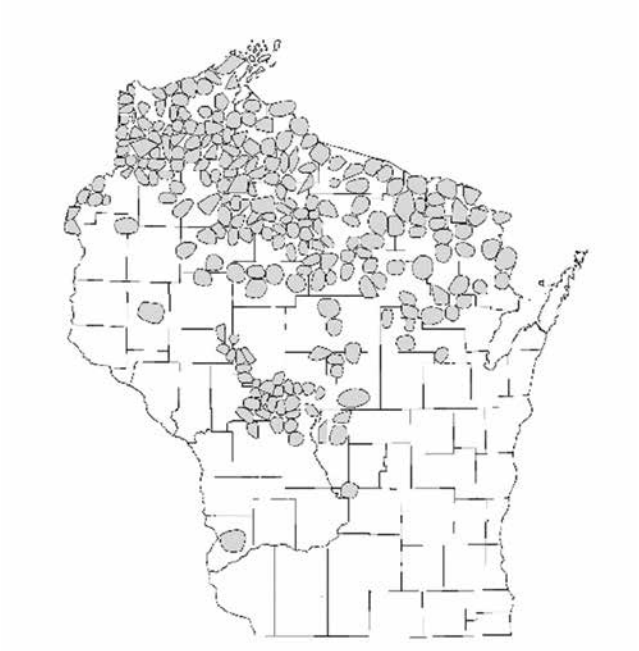

Figure 15. 2015 overwinter wolf pack distribution. (208 packs, 746 wolves).

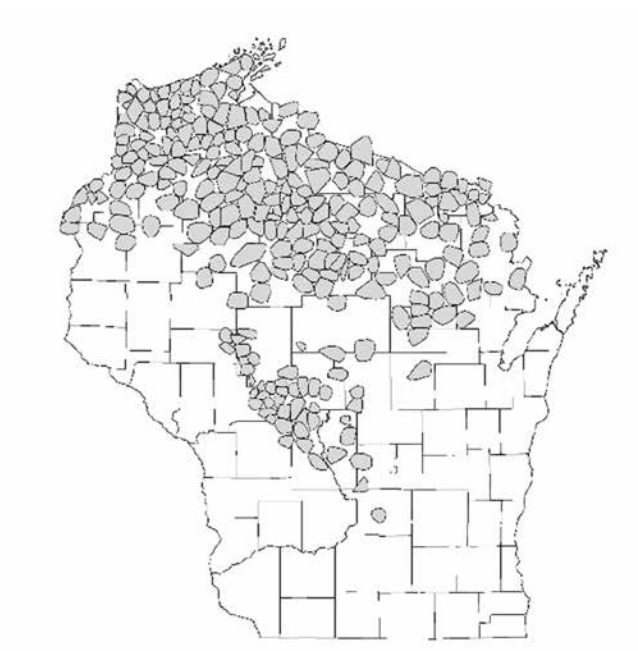

Figure 16. 2020 overwinter wolf pack distribution. (256 packs, 1,034 wolves).

From 2000 through 2010, packs spread through most of the heavily forested areas across northern and central Wisconsin. In 2000, packs occurred in 20 Wisconsin counties and by 2010, packs had started to spread into counties with more fragmented forest parcels such as Dunn, Marathon, Portage, Waupaca and Shawano counties.

By 2015, breeding packs of wolves were present in 35 Wisconsin counties and by 2020 wolf packs were documented in 36 counties, primarily in the northern third and central portion of the state. However, during this same time between 2015 and 2020, range expansion across the state slowed, while the number of packs continued to increase. Most of these packs filled into vacant areas between existing territories, resulting in a slightly higher overall wolf density across the occupied range (Figures 11-16). The cessation of significant range expansion from approximately 2015 to 2020 and beyond serves as an indication that most areas of biologically suitable habitat had likely become saturated with wolf territories and continued expansion is unlikely. However, from time to time, individual packs will likely establish territories in pockets of habitat beyond the current established range, but their long-term persistence is likely to be limited (Simpson et al. 2022).

Population Growth Patterns And Current Status

The department began annual overwinter minimum counts of wolves in the winter of 1979-80. Throughout the 1980s the statewide wolf overwinter minimum count fluctuated between a low of 14 (1985) and a high of 31 (1989; Figure 17). Population growth was hampered by high adult mortality rates (approximately 35% annually) as a result of negative human interactions, low pup survival probably caused by the disease canine parvovirus (Wydeven et al. 1995, 2009) and likely difficulties in finding mates to establish new packs at such low population densities (Stenglein et al. 2015b). However, entering into the 1990s, this pattern of stagnant population growth changed and the overwinter minimum count grew at an annual rate of 22%, reaching 248 wolves by the year 2000 (Wydeven et al. 2009). Annual growth rates declined to an annual average of 12%

between 2000 and 2010, but the population continued to grow, reaching an overwinter minimum count of 704 wolves in 2010. The next decade saw further population growth despite the implementation of three regulated wolf seasons occurring in 2012-14, the first such seasons in modern state history. One of the stated objectives of these 3 seasons was to begin to reduce the wolf population; accordingly, the overwinter minimum count declined by 1% following the first season and declined by 18% following the second season. However, the overwinter minimum count increased 13% following the third season. Across the 3 years with regulated harvest seasons, population growth averaged -2%. In 2015, after litigation resulted in federal protections being restored, population growth resumed with an average increase in the overwinter minimum count of 8% between 2015 and 2020.

In 2020, population monitoring methods shifted, resulting in a change from producing an overwinter minimum count to an overwinter abundance estimate (see Wolf Population Monitoring section). Importantly, estimates derived from the two methods are not directly comparable because one is a minimum count and the other is an estimate of most likely abundance, along with associated credible intervals. The overwinter 2020 population abundance was estimated at 1,195 wolves (95% credible interval of 957–1,573 wolves) and estimated at 1,126 wolves (95% credible interval of 937–1,364) in 2021. The overwinter 2022 population abundance estimate was 972 wolves (95% credible interval of 812–1,193 wolves), indicating a likely drop in abundance from the previous 2 years, although the credible intervals between these estimates largely overlap. This may be a further indication of a population experiencing minimal growth rates and appearing to stabilize, as evidenced by similar overwinter minimum counts observed between 2017–2019 (Figure 17). The following figures (17 and 18) and Table 7 provide more information on the wolf population at the writing of this plan.

For the latest information on wolf population abundance, search for the department's wolf monitoring reports which are produced annually and available on the DNR website. Visit dnr.wi.gov and search "wolf monitoring report."

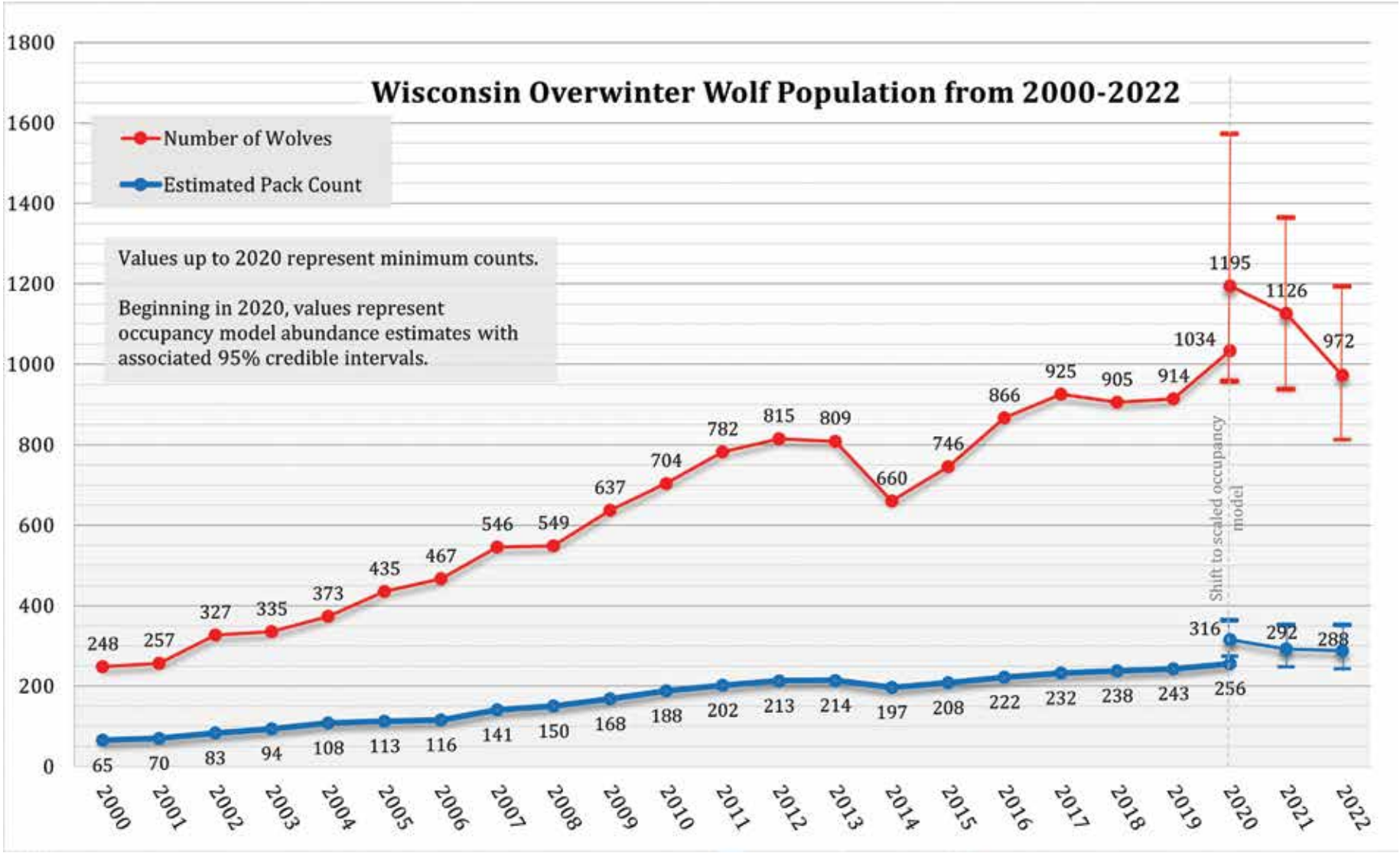

Figure 17. Changes in Wisconsin overwinter gray wolf population 1980–2022. For the latest information on wolf population abundance, search for the department's wolf monitoring reports which are produced annually and available on the DNR website.

Wolf Harvest Zone	Pack-Associated Wolf Abundance Estimate (mode value)	Lower 95% Credible Limit	Upper 95% Credible Limit	Average Pack Size	Lower 95% Credible Limit	Upper 95% Credible Limit
WHZ 1	**363**	304	450	**4.13**	3.80	4.46
WHZ 2	**232**	188	288	**3.31**	2.98	3.63
WHZ 3	**130**	98	168	**3.22**	2.63	3.79
WHZ 4	**66**	50	88	**2.77**	2.26	3.27
WHZ 5	**92**	68	121	**2.85**	2.25	3.43
WHZ 6	**90**	66	124	**2.70**	2.35	3.04
Statewide	**972**	812	1,193	-	-	-
Ceded Territory	**801**	668	976	-	-	-
Non-Ceded Territory	**179**	141	227	-	-	-
Off-Reservation	**940**	788	1,151	-	-	-
On-Reservation*	**37**	29	48	-	-	-
*Tribal reservations for this estimate include Bad River, Lac Courte Oreilles, Lac du Flambeau, Menominee, Red Cliff and Stockbridge-Munsee lands.						
Note: The sums of the zone-specific, Ceded Territory and reservation estimates do not and are not expected to equal the pack-occupied range estimate because each is a summary statistic of a posterior probability distribution. However, we do expect them to be similar, i.e., if we sum the zone-specific posteriors, the resulting distribution should largely overlap with the range-wide posterior.						

Table 7. Wolf abundance and average pack size estimates for the 2021-2022 monitoring period. For the latest information on wolf population abundance, search for the department's wolf monitoring reports which are produced annually and available on the DNR website.

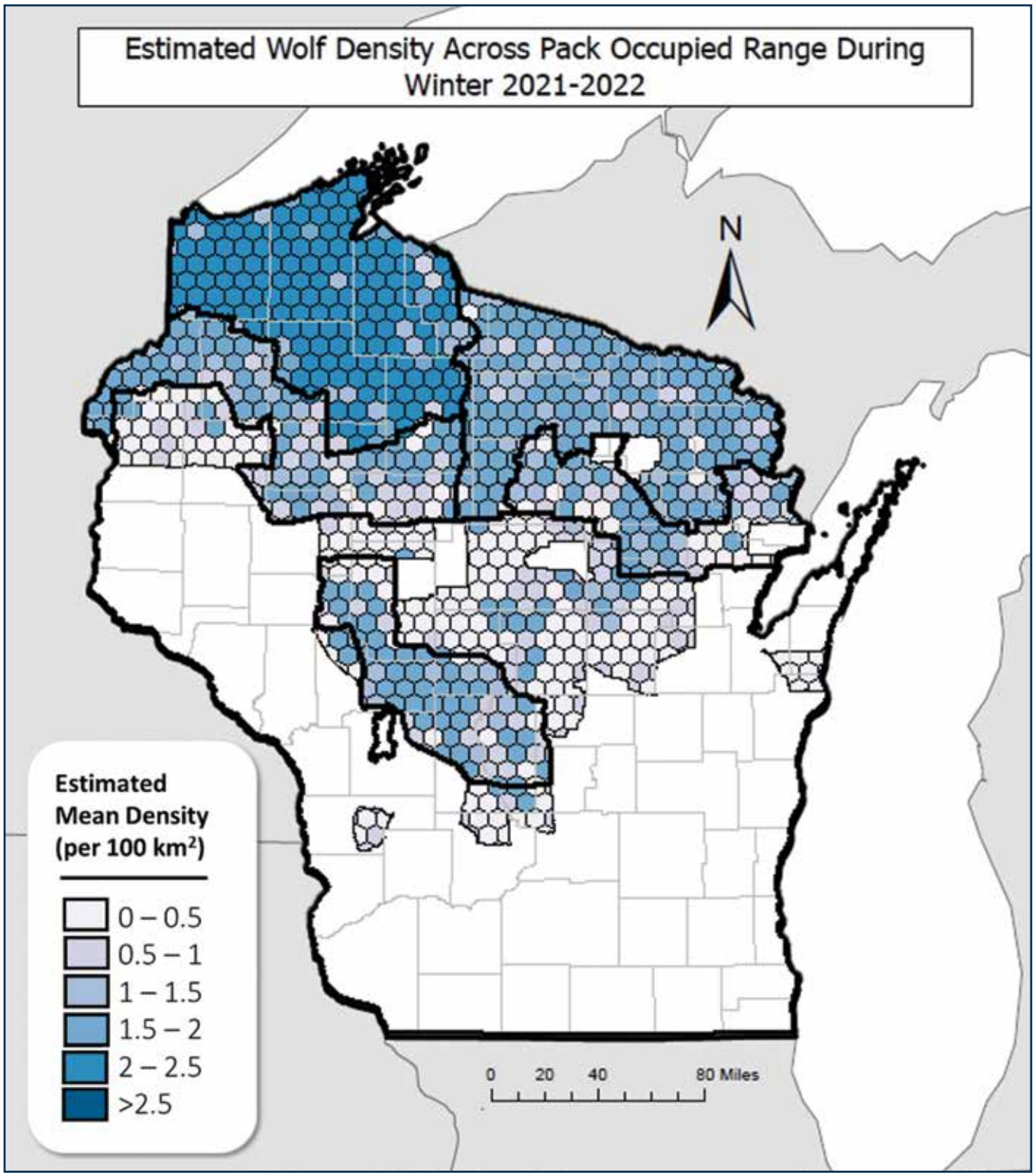

Figure 18. Estimated density of wolves across pack-occupied range during winter 2021-2022. Note: individual wolves may occur anywhere in the state. For the latest information on wolf population abundance, search for the department's wolf monitoring reports which are produced annually and available on the DNR website.

Population Mortality Patterns

Since 1979, the department has recorded data on every known wolf mortality in the state, including radio-collared wolves and those without radio-collars. Necropsies have been conducted on most free-ranging wolves found dead or euthanized in Wisconsin, unless the cause of death was readily apparent (e.g., vehicle collision, legal harvest) or carcass condition did not allow for a necropsy. All known wolf mortalities from 1979 to 2021, including collared and non-collared wolves, are presented in Table 8. However, non-collared wolf mortalities are more difficult to detect and have been heavily biased toward wolves found dead on roadways or killed as part of control actions, but more rarely included wolves killed illegally, dying from diseases or killed by other wolves. Therefore, the sample of radio-collared wolf mortalities is likely more representative of the true mortality rates across the wolf population for wolves 1 year old or older (as pups are typically not collared). Table 9 presents a summary of all documented radio-collared wolf mortalities in Wisconsin from 1979-2021. Among radio-collared wolves found dead in Wisconsin from 1979 through 2022, 61% of known mortalities were due to human causes, 25.4% were from natural causes and 14.5% were from unknown causes (Table 9). Among collared wolf known-cause mortalities, the most common mortality factors were illegal kill by humans (34%), disease (14%), vehicle collisions (13.5%) and other wolves (6.4%). Only 2.9% of wolves were euthanized in depredation situations and 0.9% in perceived human safety concerns.

Because wolf pups generally are not radio collared and those few that have been collared generally were already 4-5 months old, no direct measures on mortality factors on pups from time of birth to 4-6 months exist for Wisconsin. During the summer months, pup survival is typically strong in areas with sufficient food resources and barring any disease. Fall becomes the critical time period, with quickly growing pups experiencing maximum food requirements often paired with diminished prey supply and vulnerability, frequently resulting in starvation for pups during this time (Fuller et al. 2003). After 6 months, pup mortality may start to approach rates seen in yearlings and adults (Fuller et al. 2003). Indirect measures of pup survival were used by Wydeven et al. (2009) to estimate annual pup survival in Wisconsin from birth in spring to mid/late winter at an average of 29% between 1980 and 2007 but ranged from a low of 14% in winter 1985-1986 to a high of 58% in winter 1979-1980 (Wydeven et al. 2009). Specific causes of mortality were not known but likely included disease, starvation, accidents, predation, intraspecific strife, illegal kill, vehicle collisions and depredation controls. The lowest survival rates seemed to correspond to periods of parvovirus outbreak and when sarcoptic mange first affected Wisconsin wolves. In years with public harvest, legal take may become a more important mortality factor for pups in fall and winter.

Utilizing a long-term dataset from 501 radio-collared wolves in Wisconsin, researchers found wolf survival experienced substantial variation by time of year, since initial recolonization and spatially across the state (Stenglein et al. 2018). From 1979-2013, they found radio-collared wolves (at least 1 year old) experienced an average annual survival rate of 76%, similar to documented survival rates of other wolf populations (Fuller et al. 2003). Estimated annual survival rates during this time varied from a low of approximately 60% to a high of 82%, with survival peaking during the period of significant population growth during the late 1990s and 2000s (Stenglein et al. 2018). Annual survival was highest in forested areas of northern Wisconsin where wolves had been established the longest while annual survival decreased toward the periphery of established wolf range (Figure 6a in Stenglein et al. 2018). Based upon radio-collared wolves killed, it was estimated that annually, 9.4% of the wolf population was killed illegally, 5.1% of the wolf population killed due to other human causes and 9.5% of the population was killed from natural and unknown causes (Stenglein

et al. 2018). In other words, the various sources of human-caused mortality accounted for approximately 60% of total mortality, consistent with the findings of similar research in Wisconsin (Treves et al. 2017). The highest risk of mortality for wolves occurred during the late fall and winter months while risk of mortality was lowest during the spring and summer. Illegal killing peaked in late November and early December, aligning with Wisconsin's nine-day gun deer season, while natural mortality peaked in mid-December through February, aligning with the winter months when wolves may be more stressed due to snow and cold as well as reproductive efforts (Fuller et al. 2003). Spatially, the risk of natural mortality was greatest where wolf packs had been reestablished the longest while illegal killing risk was greatest in areas where wolves were still considered scarce or recently reestablished (Stenglein et al. 2015c, Stenglein et al. 2018). Research on wolf recolonization of the Central Forest region of Wisconsin corroborated this, finding those wolf packs occupying territories in more marginal habitats experienced five-times greater human-caused mortalities, smaller pack sizes and reduced annual pack success and viability (Simpson et a. 2022). Finally, researchers found partial compensation among mortality sources in the later years of their study (2004-2013), suggesting that some level of human-caused mortality, including harvest, may be partially offset by some reduction in natural mortality (Stenglein et al. 2018).

All Known Mortality of Wolves in Wisconsin 1979–2022			
Human Causes	*Cause of Death*	*Number*	*% Known Mortality*
	Legal Harvest	746	31.5%
	Vehicle Collision	493	20.8%
	Euthanized (depredation)	387	16.3%
	Illegally Killed	325	13.7%
	Legal Control By Landowner	59	2.5%
	Euthanized (safety)	35	1.5%
	Capture Related	23	1%
	Other Human Causes	9	0.4%
	Total Human Causes	**2,077**	**87.7%**
Natural Causes	*Cause of Death*	*Number*	*% Known Mortality*
	Disease	86	3.6%
	Killed By Other Wolves	39	1.7%
	Unknown Natural Causes	9	0.4%
	Accident	7	0.3%
	Malnutrition/Starvation	4	0.2%
	Birthing Complications	1	0.04%
	Total Natural Causes	**146**	**6.2%**
Total(s)	Known Cause Mortalities	2,223	93.9%
	Additional Unknown Cause Mortalities	145	6.1%
	Total mortality	**2,368**	**100%**

Table 8. Summary of all radio-collared wolf mortalities detected by the Wisconsin Department of Natural Resources in Wisconsin from October 1979–December 2022.

Mortality of Radio Collared Wolves in Wisconsin 1979–2022			
Human Causes	*Cause Of Death*	*Number*	*% Known Mortality*
	Illegally Killed	143	34%
	Vehicle Collision	57	13.5%
	Capture Related	17	4%
	Legal Harvest	15	3.6%
	Euthanized (depredation)	12	2.9%
	Legal Control By Landowner	5	1.2%
	Euthanized (Safety)	4	0.9%
	Other Human Causes	4	0.9%
	Total Human Causes	**257**	**61%**
Natural Causes	*Cause Of Death*	*Number*	*% Known Mortality*
	Disease	59	14%
	Killed By Other Wolves	27	6.4%
	Unknown Natural Causes	8	1.9%
	Malnutrition/Starvation	7	1.7%
	Accident	1	0.2%
	Birthing Complications	1	0.2%
	Total Natural Causes	**103**	**24.5%**
Total(s)	Known Mortalities	360	85.5%
	Unknown Mortalities	61	14.5%
	Total Mortality	**421**	**100%**

Table 9. Summary of all wolf mortalities detected by the Wisconsin Department of Natural Resources, including those with radio collars, in Wisconsin from October 1979 – December 2022.

Biological Carrying Capacity

Biological carrying capacity is the maximum number of animals a habitat can support based upon vital resources such as space, food and social requirements. Once thought to require vast tracts of wilderness as an essential habitat component, it has become clear through time that the role of wilderness provides wolves protection from human-caused mortality rather than any essential requirements of wolves and their behavior (Mech 1995). Early predictions of biological carrying capacity based upon suitable wolf habitat in Wisconsin indicated this level to likely be around some 500 wolves (Mladenhoff et al. 1995). However, in the Great Lakes region, wolves can, and do, occupy areas well beyond the "wilderness" areas to which they were once believed to be restricted (Mladenoff et al. 1995, 2009). This habitat work continued to be refined through time, yet it continued to show that the best predictors of wolf habitat and occupancy include lack of agricultural lands and low road densities (Mladenoff et al. 2009).

Prey abundance is another important limiting factor for wolf population growth. With Wisconsin's largely human-dominated landscape, harvested forests and agricultural lands support high levels of white-tailed deer populations, which in turn supports larger wolf populations than once thought possible in the state (Mladenoff et al 2009). Available literature on wolf population dynamics varies on regulatory factors, with some research suggesting that at some level of prey saturation, wolf social factors provide a larger role to regulate wolf density (Cariappa et al. 2011, Cassidy et al. 2015, O'Neil et al. 2017, O'Neil et al. 2019). McRoberts and Mech (2014) reanalyzed the data using a weighted-regression analysis which showed continued support for wolf density to be limited by available nutrition.

Estimation of biological carrying capacity is also possible through analysis of population growth rates through time. One investigation of biological carrying capacity for the population of wolves living south of Lake Superior determined that growth models with linear density dependence were better supported than more complex models (non-linear density dependence) and null models (no density dependence) (Van Deelen 2009). The supported suite of models from this work predicted that the combined Wisconsin and Michigan wolf population biological carrying capacity to be roughly 1,300 wolves, split approximately in half between states (Van Deelen 2009). However, the author urged appropriate caution in these estimates because there were few observations of population growth at high density available to be included in the models (Van Deelen 2009).

More recently, an individually-based spatially explicit (IBSE) model was developed for the south Lake Superior wolf population and used to evaluate potential biologically carrying capacity (Stenglein et al. 2015b). This model allowed the incorporation of important wolf life-history dynamics relating to pack structure, breeding status, age, sex, kin relationships and spatial relationships to other wolves (Stenglein et al. 2015b). This work predicted the Wisconsin wolf population, without harvest, would stabilize around 1,242 wolves (SD 34) after 50 years. Similarly, the combined southern Lake Superior wolf population would find equilibrium at 2,453 wolves (SD 56) after 60 years without harvest (Stenglein et al. 2015b). These estimates are higher than those developed historically as wolves have proven to occupy more of the state than previously projected.

Wolves may be limited by prey biomass, habitat suitability and intraspecific mechanisms, but human societal acceptance is also an important limiting factor on how many wolves may be tolerated in an area. Given the diverse opinions of various stakeholder groups in Wisconsin, this acceptable range of wolf populations may fluctuate greatly. See Section 2 on "Human Dimensions and Cultural Significance" for more on the human dimensions surrounding wolves in Wisconsin.

Legal Background And Listings

State Classification Of Wolves

Wolves were effectively unprotected from Wisconsin's initial statehood in 1848 until 1957 (Table 10). During much of this time, wolf management took the form of a state legislated wolf bounty system, which ran almost continuously from 1865 to 1957 (Thiel 1993). The intent of the bounty was to reduce or eliminate predatory animals considered injurious to economic interests within the state.

Between 1957 and 1975, the wolf was listed as a state protected species, but statutory provisions still existed which authorized county governments to place bounties on "wolf" and "lynx" (Thiel 1993). The newly enacted state endangered species law of 1973 did not provide protection for wolves until 1975 because the wolf, as an extirpated species, was not listed. In 1975, the wolf was listed as a state endangered species (Thiel 1993).

In 1989, a statewide wolf recovery plan was approved (DNR 1989). The plan called for the wolf to be downlisted to state-threatened status if the mid-winter census remained above 80 animals for > 3 consecutive years. A state wolf management plan was adopted in 1999 and reaffirmed in 2007. This plan established a state-delisting goal of 250 wolves and a management goal of 350 wolves outside of Indian reservation lands (DNR 1999, Wydeven et al. 2009). The management goal was intended to represent the minimum level at which a full array of population control activities could occur including proactive depredation control and the possibility of public harvest (DNR 1999). This plan also established four wolf management zones (Figure 19) across the state to better manage wolves in the state.

Wolves were downlisted to state-threatened status in 1999 upon approval of the management plan (overwinter minimum count = 205 wolves) and were removed from state-threatened status in 2004 (overwinter minimum count = 335 wolves). On Aug. 1, 2004, wolves were listed as a state protected wild animal, a classification given to state non-game animals that are neither endangered nor threatened (Wydeven et al. 2009). Wolves retained that state classification until April 2, 2012, when Act 169 was signed into law and effectively designated wolves as a state game species. Since then, wolves are classified as a state game species any time they are not listed on the federal or state list of endangered and threatened species. However, any time wolves are federally listed, they are protected under Wisconsin's endangered and threatened species law per Wis. Stat. s. 29.604(3)(a) and Wis. Admin. Code NR 27.03(1).

Federal Classification Of Wolves In Wisconsin

Wolves in Wisconsin were first placed under federal protection in 1967. Designated at the time as the Eastern timber wolf subspecies (Canis lupus lycaon), wolves in the Great Lakes region were listed as endangered under the federal Endangered Species Preservation Act, predecessor to the federal Endangered Species Act (ESA). In 1974, the U.S. Fish and Wildlife Service (USFWS) listed two wolf subspecies, including the Eastern timber wolf subspecies, as endangered under the ESA following its passage in 1973 (Table 11). In 1976, the USFWS listed two additional wolf subspecies as endangered. Through the listing of these 4 gray wolf subspecies, most wolves in the lower 48 states received federal ESA protections (Refsnider 2009). In 1978, the USFWS reclassified the 4 distinct gray wolf subspecies listings into a single gray wolf species which was listed as endangered across the lower 48 states (except in Minnesota, where wolves were listed as threatened).

The federal Eastern Timber Wolf Recovery Plan was approved by the USFWS in 1978 and amended in 1992. The plan's defined recovery goal included (1) an assurance of the continued survival of wolves within Minnesota and (2) the re-establishment of a second viable population of at least 100 animals if within 100 miles (160 km) of another (i.e., the Minnesota) population or at least 200 animals if located more than 200 miles from Minnesota (USFWS 1992). Wolves colonizing northwestern Wisconsin at that time and soon thereafter in the neighboring Upper Peninsula of Michigan, were within the 100-mile limit (Refsnider 2009).

The joint Upper Peninsula and Wisconsin wolf population first met the Eastern Timber Wolf Recovery Plan's goal of re-establishing a second population within 100 miles of Minnesota's population in the winter of 1992-93 when 114 wolves were counted in the bi-state region.

On April 1, 2003, the USFWS designated the Eastern Distinct Population Segment (DPS), which included Wisconsin and Michigan. At the same time, the USFWS downlisted wolves within this DPS to federally threatened status (6 68 Fed. Reg. 15,804, 15,859 [Apr. 1, 2003]), allowing both states greater flexibility in implementing their respective state management plans. Subsequently, two legal actions were initiated in Oregon on Jan. 31, 2005 and Vermont on Aug. 19, 2005, to challenge the downlisting of the Eastern DPS of gray wolves. Federal judges ultimately vacated the final rule (*Defenders of Wildlife v. Sec'y, U.S. Dep't of the Interior*, 354 F. Supp. 2d 1156 (D. Ore. 2005); *Nat'l Wildlife Fed'n v. Norton*, 386 F. Supp. 2d 553 (D. Vt. 2005)). As a result, the Eastern DPS was voided and the classification of wolves in Wisconsin and Michigan as endangered was restored, while their classification as threatened in Minnesota remained unchanged (Refsnider 2009).

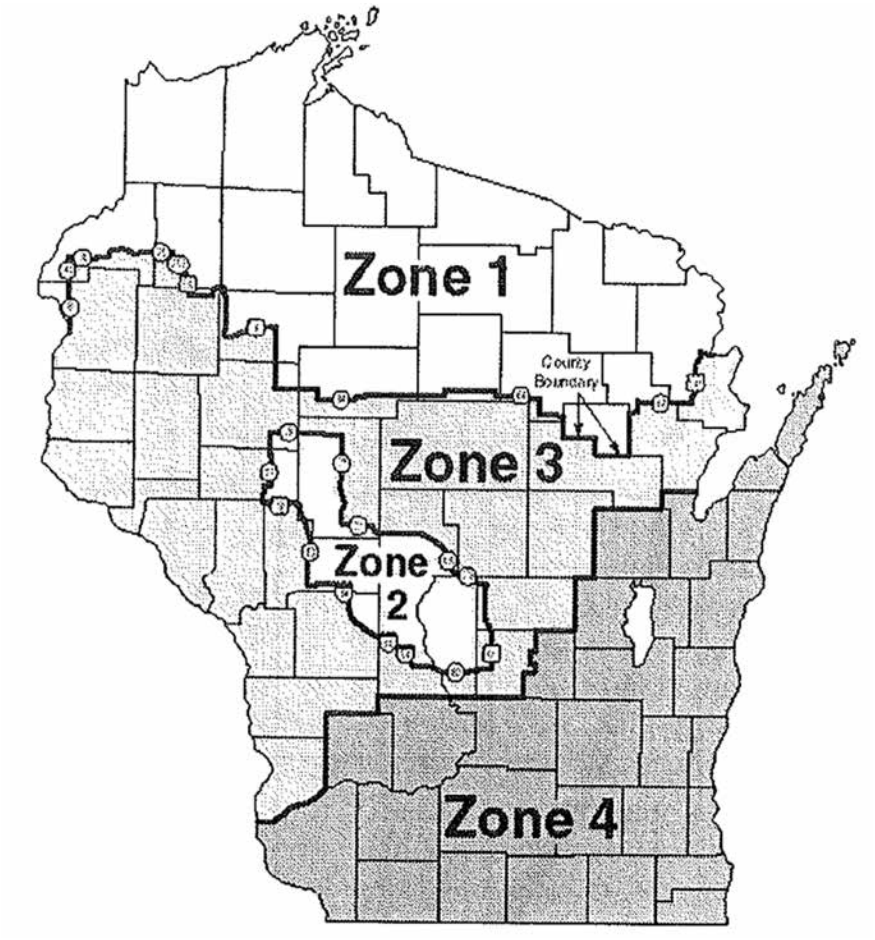

Figure 19. The four wolf management zones established in the 1999 Wisconsin Wolf Management Plan. The designation of these zones was to provide higher protections for wolves in areas deemed mostly suitable habitat (Zones 1 and 2) while allowing flexibility for controlling wolves in less suitable areas where conflict potential was assumed to be higher (Zones 3 and 4). See 1999 Wisconsin Wolf Management Plan for full definition of zones and associated management priorities.

During the period in which the Eastern DPS remained in effect and wolves within this DPS were downlisted, a total of 82 wolves were euthanized in Michigan and Wisconsin in response to depredation cases. The USFWS ruled that such take, allowed while wolves were briefly classified federally as threatened, had no negative population impact on recovery (Refsnider 2009). Rather, the joint population increased from approximately 685 to 830 wolves during this same 2-year period.

As a result of the 2005 federal court rulings, in the spring of 2005 and 2006 the two states petitioned and received from the USFWS special permits under provisions of the ESA (Section 10 Permits) authorizing the taking of depredating wolves. Plaintiffs favoring "no take" provisions successfully sued the USFWS both years, on procedural grounds in September 2005 (Defenders of Wildlife v. Norton, Civ.No. 05–1573 (D.D.C. 2005)) and challenging whether the ESA allowed the USFWS to authorize the lethal take of an endangered species for depredation control purposes in August 2006 (Humane Soc'y of the United States v. Kempthorne, 481 F. Supp. 2d 53 (D.C. Cir. 2006)). Therefore, Michigan's and Wisconsin's take permits were revoked both years, but were in effect for major portions of the livestock grazing season each year when most depredations occurred (Refsnider 2009).

On March 12, 2007, the USFWS designated and delisted the Western Great Lakes DPS, an area encompassing the tri-state region of Wisconsin, Michigan and Minnesota (72 Fed. Reg. 6052, 6052 [Feb. 8, 2007]). This rule was also challenged in and vacated by a federal court (Humane Soc'y of the U.S. v. Kempthorne, 579 F. Supp. 2d 7 (D.D.C. 2008)). As a result, on Sep. 29, 2008, wolves were again listed as endangered in Wisconsin and Michigan and as threatened in Minnesota.

On May 4, 2009, the USFWS again designated the Western Great Lakes DPS and delisted wolves within the DPS (574 Fed. Reg. 15,070 (Apr. 2, 2009)) in an update to its 2007 delisting rule to address concerns expressed by the federal court in 2008. Because the USFWS failed to hold public hearings on this updated rule, however, the rule was vacated pursuant to a settlement order (Humane Soc'y of the U.S. v. Salazar, No. 1:09-CV-1092 (D.D.C. July 2, 2009) [settlement order]) on July 1, 2009, which restored the classification of wolves as endangered in Michigan and Wisconsin and threatened in Minnesota and again voided the Western Great Lakes DPS.

Wolves retained their status as federally endangered through 2011 while the USFWS continued development of a new delisting rule to designate and delist the Western Great Lakes DPS. The rule was finalized on Dec. 28, 2011 and went into effect on Jan. 27, 2012 (76 Fed. Reg. 81,666 (Dec. 28, 2011)). The rule was subsequently vacated by a federal court in the District of Columbia (Humane Soc'y of the U.S. v. Jewell, 76 F. Supp. 2d 69, 110-13 (D.D.C. 2014)). The DPS was voided yet again and wolves reverted back to federally endangered status on Dec. 19, 2014.

On March 15, 2019, the USFWS published a proposed rule to delist the 2 gray wolf entities listed at that time: gray wolves listed as threatened in Minnesota and gray wolves listed as endangered in parts or all of 44 U.S. States and Mexico, including Wisconsin. Following an extended public comment and review period, the final rule was published on Nov. 3, 2020 and took effect on Jan. 4, 2021 (85 Fed. Reg. 69,778 (Nov. 3, 2020)). Soon after, several challenges to the delisting rule were filed and consolidated into a single case before a federal district court in the District of Northern California. On Feb. 10, 2022, the court issued a ruling which vacated the USFWS delisting rule and again restored the federal protections for gray wolves previously in place under the federal ESA (Defenders of Wildlife v. U.S. Fish and Wildlife Serv., No. 4:21-CV-00344- (N.D. Cal. Feb. 10, 2022)).

History of State Gray Wolf Listing in Wisconsin 1839–July 2022		
Time Period		Status
1839 (Territorial Government)	1848 (Wisconsin Statehood)	Unprotected – Territorial Bounty in Place until 1847
1848	Feb. 24, 1865	Unprotected – No Bounty
Feb. 24, 1865	June 6, 1957	Unprotected – State Bounty Established
June 6, 1957	Jan. 4, 1974	Protected Wild Animal
1960	1974	Considered Extirpated
1975	1998	State Endangered
1999	Aug. 1, 2004	State Threatened
Aug. 1, 2004	April 2, 2012	Protected Wild Animal
April 2, 2012	Dec. 19, 2014	State Game Animal
Dec. 19, 2014	Jan. 4, 2021	State Endangered
Jan. 4, 2021	Feb. 10, 2022	State Game Animal
Feb. 10, 2022	Present (July 2023)	Included on State Endangered list due to Federally Endangered Status (Wis. Stat. 29.604(3)(a))

Table 10. State legal listing status of gray wolves in Wisconsin 1839–2022.

History of Federal Gray Wolf Listing in Wisconsin 1967– July 2023		
Time Period		Status
March 11, 1967	Jan. 4, 1974	Listed on ESA predecessor legislation
Jan. 4, 1974	April 1, 2003	Endangered under ESA
April 1, 2003	Jan. 31, 2005	Threatened under ESA
Jan. 31, 2005	March 12, 2007	Endangered under ESA
April 1, 2005	Sep. 24, 2005	Federal Lethal Control Permit Issued
April 24, 2006	Aug. 9, 2006	Federal Lethal Control Permit Issued
March 12, 2007	Sep. 29, 2008	Delisted from ESA
Sep. 29, 2008	May 4, 2009	Endangered under ESA
May 4, 2009	July 1, 2009	Delisted from ESA
July 1, 2009	Jan. 26, 2012	Endangered under ESA
Jan. 27, 2012	Dec. 19, 2014	Delisted from ESA
Dec. 19, 2014	Jan. 4, 2021	Endangered under ESA
Jan. 4, 2021	Feb. 10, 2022	Delisted from ESA
Feb. 10, 2022	Present (July 2023)	Endangered under ESA

Table 11. Federal listing status of gray wolves in Wisconsin 1974–July 2023. "ESA" refers the federal Endangered Species Act of 1973. Note: changes in federal status since 2005 are the result of federal rulemaking and/or court invalidation of those rules and not new listings under the ESA.

Post-Delisting Monitoring

When any species is delisted from the ESA due to its recovery, Section 4(g) of the ESA requires the USFWS to monitor the status of the newly delisted species for a minimum of five years. This period is known as Post Delisting Monitoring (PDM) and its intent is "to determine whether the species should be proposed for relisting under the normal listing procedures, relisted under the emergency listing authority of the Act or kept off of the list because it remains neither threatened nor endangered (p.1, USFWS 2008)." Should an emergency listing become necessary, the full protections of the ESA can be restored immediately upon publication of such a rule in the federal register and remain in effect for 240 days to allow the USFWS to further evaluate the threats to the species well-being (Refsnider 2009).

A PDM plan for wolves in the Great Lakes region was developed in 2008 with the assistance of the Eastern Timber Wolf Recovery Team. The PDM plan focused "on reviewing and evaluating (1) population characteristics of the DPS, (2) threats to the DPS and (3) implementation of legal and management commitments that are important in reducing threats to the DPS or maintaining threats at sufficiently low levels" (p. 1, USFWS 2008). To achieve these objectives, the plan requires relevant data to be collected by state departments of natural resources, tribes and federal land management agencies in Wisconsin, Minnesota and Michigan and provided annually to the USFWS. The USFWS then conducts annual reviews based upon this information to evaluate potential threats. At the end of the PDM period, a final internal review will be completed to determine whether to relist, continue PDM or end PDM (USFWS 2008). The annual wolf monitoring reports provided by the department to USFWS as part of the PDM are posted annually to the department website and are available for public review.

Post-Delisting Monitoring In Wisconsin

The 2008 PDM indicates that the Wisconsin DNR (as well as Michigan and Minnesota DNR) are expected to annually provide the following data (p. 9, USFWS 2008):

- population estimates, pack numbers, occupied area
- mortality data
- disease/parasite occurrence in wolves
- verified or probable depredation incidents and follow-up actions
- changes to regulatory mechanisms affecting the protection or management of the species, its prey and its habitat
- law enforcement investigations of wolf mortality
- other relevant information including any recent population estimates or indices for primary wolf prey, white-tailed deer (Odocoileus virginianus) and moose (Alces alces)

Based upon numeric recovery goals from the 1992 Recovery Plan, below are the events identified in the 2008 PDM that may cause the USFWS to investigate whether relisting or emergency relisting may be warranted (p. 10-11, USFWS 2008).

- A decline that reduces the combined Wisconsin-Michigan (excluding Isle Royale and the Lower Peninsula) late winter wolf population estimate to 200 or fewer wolves.
- A decline that brings either the Wisconsin or the Michigan (excluding Isle Royale and the Lower Peninsula) wolf estimate to 100 or fewer wolves.
- A decline that brings the Minnesota winter wolf population point estimate or lower end of the 90% confidence interval to 1500 or fewer wolves.

Similarly, other factors that may be considered by the USFWS as potential causes of concern and/or further actions include the following (p. 11, USFWS 2008):

- A rapid and large decline (for example, 25 percent or more from the previous year) in the late winter wolf population estimate for Wisconsin or Michigan.
- Any wolf population decline in Wisconsin Zones 1 and 2 (zones refer to those found in the 1999 wolf plan) or the Upper Peninsula of Michigan of three years or more in duration.
- A substantial and widespread increase in mortality from known or unknown causes.
- Evidence of a new wolf disease or substantial increase in virulence of a previously known wolf disease, even in the absence of noticeable demographic impacts on the wolf population.

- A substantial decline in the wolf prey base across a large portion of the occupied wolf range in the DPS.
- A significant adverse change in wolf, wolf prey or wolf habitat management practices or protection across a substantial portion of the occupied wolf range in the WGLDPS. (p. 11, USFWS 2008).

Actions that may be taken by the USFWS to address events and concerns include (p. 11, USFWS 2008):

- extend the PDM period.
- add new components to the PDM.
- initiate a comprehensive status review of the species within the DPS.
- investigate or remedy the cause(s) of the decline.
- USFWS may also determine none of the above are appropriate and consider alternative or no action.

The 2008 PDM was implemented following the 2012 federal delisting and was in effect until wolves were relisted in 2015. Upon delisting again in 2021, the same PDM was utilized and was to be implemented for a minimum of five years. Although the document references the Western Great Lakes Distinct Population Segment, a legal designation which no longer exists, the USFWS found no new information that changed the substance of the monitoring plan (USFWS 2008).

Legal Authority And Laws Influencing Wolf Management

Wolf management in Wisconsin is guided by a combination of federal treaties and conventions, federal laws, state statutes, state administrative code and department policies. A brief description of each of these items is provided below.

The Ojibwe tribes of the Great Lakes Region ceded much of their ancestral lands to the United States federal government in the mid-1800s. The Treaties of 1837 and 1842 ceded approximately 22,400 square miles of territory located in what is today northern and central Wisconsin. These lands are referred to collectively as the Ceded Territory (Figure 20). Through the treaties, the Ojibwe tribes specifically reserved off-reservation hunting, fishing and gathering rights on certain lands and waters within the Ceded Territory. These treaty rights have been re-affirmed in several state and federal court cases over the years, including Lac Courte Oreilles Band of Lake Superior Chippewa Indians v. State of Wisconsin, 775 F.Supp. 321 (1991). The exercise of off-reservation treaty rights was and continues to be fundamental to the Ojibwe tribes' culture and way of life (GLIFWC 2018). The Great Lakes Indian Fish and Wildlife Commission (GLIFWC) collaborates with the department to implement Ojibwe off-reservation treaty rights across the Ceded Territory with respect to wolf management and harvest. In addition, all federally recognized tribes in Wisconsin maintain status as sovereign nations and may engage in government-to-government relations with the department concerning wolf management.

Figure 20. The Ceded Territory, shown in green on the map, encompasses approximately 22,400 square miles of northern Wisconsin that were ceded to the United States by the Lake Superior Ojibwe Tribes in the Treaties of 1837 and 1842. Through the treaties, the Ojibwe tribes specifically reserved off-reservation hunting, fishing, and gathering rights on certain lands and waters within the Ceded Territory.

The ESA establishes federal laws and policies for the protection and recovery of imperiled species and the ecosystems upon which they depend. Its application to terrestrial species is administered by the USFWS. Section 4 of the Act requires the USFWS to implement a system in cooperation with the states to monitor species that have been removed from the list of threatened and endangered species for at least five years after listing (see post-delisting monitoring section above). Any change(s) in the federal listing status of wolves may trigger the application of additional sections of the Act and may affect the applicability of various state statutes, regulations and policies related to wolf management.

The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) is an international agreement between governments designed to ensure that the international trade of wild animal and plant specimens does not threaten the survival of protected species. The inclusion of a species in CITES Appendix I, II or III has implications for state regulation of specimen import and export. Wolves are currently regulated as Appendix II species—one which may become threatened with extinction if international trade is not regulated.

Pursuant to s. 29.014(1), Wis. Stats., the department has broad authority to maintain open and closed seasons for game species, as well as harvest limits, size limits, rest days and other conditions governing the taking of game that will conserve the game supply and ensure the citizens of this state continued opportunities for good hunting and trapping. This broad authority applies to wolves, except insofar as provided by other statutes.

Wisconsin 2011 Act 169 was signed into law in April 2012. Act 169 created s. 29.185, Wis. Stats., concerning wolf management and harvest. Among other things, s. 29.185, Wis. Stats., directs the department to allow the hunting and trapping of wolves in accordance with the statute when wolves are not listed on the federal or state list of threatened and endangered species and to implement a wolf management plan. The department is authorized to limit the number of wolf hunters and trappers and the number of wolves that may be taken by issuing wolf harvesting licenses. The department is directed to establish a single annual open season for both hunting and trapping wolves that begins on the first Saturday in November of each year and ends on the last day of February of the following year. The department is further directed to divide the entire state into wolf harvesting zones and to identify the zones in its wolf management plan. Each zone is required to be open to both hunting and trapping, unless the department determines that a closure is necessary to effectively manage the wolf population and the department follows specifically enumerated closure procedures. Section 29.185 further establishes requirements related to license applications, issuance, fees and transfers and establishes an option to apply for a preference point in lieu of entering the license lottery. Finally, the section authorizes the use of certain harvest methods/equipment and identifies any associated restrictions with those methods. Authorized activities include hunting wolves with firearm, bow or crossbow, hunting with the aid of dogs beginning with the first Monday that follows the last day of the regular season that is open to hunting deer with firearms (i.e., the first Monday after Thanksgiving), use of predator calls, use of bait that does not include animal parts/byproducts and trapping including the use of cable restraints.

Act 169 also created s. 29.888, Wis. Stats., concerning wolf depredation and control. Section 29.888, Wis. Stats., directs the department to administer a wolf depredation program at times when the wolf is not listed on the federal or state list of threatened and endangered species. Under the program, the department may make payments to persons who apply for reimbursement for death or injury caused by wolves to livestock,

hunting dogs which are not being actively used in the hunting of wolves and pets and for management and control activities conducted by the department for the purpose of reducing such damage caused by wolves. The section further directs the department to establish maximum amounts that will be paid depending on the type of animal that suffered the death or injury and authorizes the department to prorate payments if the value of the claims exceeds the funds available. From authorities granted by the legislature, the department may promulgate administrative rules following the procedures and requirements established in Chapter 227 of the Wisconsin Statutes. Regulations concerning the management of wolves as a game species are generally housed in Chapters 10, 12 and 16 of Wisconsin Administrative Code. Such regulations have addressed topics including the following:

- Wolf Harvest Season
    - Harvest zone boundaries
    - Harvest quotas
    - Number of licenses to be issued
    - Zones in which licenses are valid
    - Management objectives
    - Trap type and timing restrictions
    - Zone closure criteria
    - Harvest tagging, reporting and registration requirements
    - Wolf hunting hours
    - Baiting and training regulations
- Wolf Conflict Program
    - Authority of landowners, lessees or occupants of private land to shoot wolves in the act of killing, wounding or biting a domestic animal on private land
    - Compensation procedures including eligibility, reporting and verification procedures and payment types and amounts
- Captive wildlife including regulation of captive wolves and hybrids

Funding

The cost of state wolf monitoring, management, research and conflict response is significant and paid for through a variety of federal, state and privately donated funds, with specific funding sources sometimes depending on the listing status of wolves (Table 12). In the first few decades of wolf recovery in Wisconsin, federal funds included grants from the U.S. Endangered Species Act and U.S. Forest Service funds. Endangered Species grant money was discontinued in 2004. In more recent years, federal funding has mainly come from the Federal Aid in Wildlife Restoration Act, also known as the Pittman-Robertson program. The Pittman-Robertson program is funded by an 11% excise tax collected on the nationwide sale of sporting arms, ammunition and archery equipment. Additional federal funds have included various grants, such as Livestock Demonstration Project grants administered through the U.S. Fish and Wildlife Service. To receive federal funding, states generally must provide a cost-sharing match. State funds for wolf management and

federal matches have typically come from the Wisconsin Natural Heritage Program (i.e., the check-off on Wisconsin income taxes and sale of Endangered Resources license plates; formerly called the Endangered Resources Program), the sale of state hunting and trapping licenses and private donations. Over the years, donations toward wolf management have been received from private individuals, Timber Wolf Alliance, Defenders of Wildlife, National Wildlife Federation, Milwaukee Zoo, Timber Wolf Information Network, as well as the Menominee Indian Tribe of Wisconsin, Ho-Chunk Nation, Stockbridge-Munsee Community and the Ojibwe tribes.

Wolf depredation compensation funding is further specified in state law. When wolves are not listed on the federal or state list of endangered and threatened species, wolf damage compensation funds come from the sale of wolf harvesting licenses and application fees. During periods when wolves are state or federally listed, those funds come from the Wisconsin Natural Heritage Program as well as federal grants if available. Note: funds donated to the Natural Heritage Program are segregated and are not used to pay for wolf depredation compensation.

Since 2010, wolf management expenditures, excluding compensation payments, have averaged approximately $750,000 annually. Annual wolf depredation compensation payments have averaged approximately $183,000 since 2010. Since 1985, DNR has paid more than $2.9 million in total wolf damage compensation payments.

Wisconsin Gray Wolf Program Expenditures by DNR Fiscal Year (FY)				
Fiscal Year	**All State or Donated[1]**	**All Federal[2]**	**Total Management Expenditures**	**Depredation Compensation Payments[3]**
1979-80	$5,000.00	$15,000.00	$20,000.00	-
1980-81	$5,425.00	$16,275.00	$21,700.00	-
1981-82	$7,734.00	$35,000.00	$42,734.00	-
1982-83	$13,013.44	$35,200.00	$48,213.44	-
1983-84	$27,905.18	$51,440.00	$79,345.18	-
1984-85	$11,804.38	$28,125.00	$39,929.38	$200.00
1985-86	$23,625.24	$60,600.00	$84,225.24	-
1986-87	$44,128.80	$56,305.00	$100,433.80	$2,500.00
1987-88	$14,864.00	$62,592.00	$77,456.00	-
1988-89	$23,887.60	$18,069.00	$41,956.60	$400.00
1989-90	$20,410.94	$48,319.47	$68,730.41	$2,500.00
1990-91	$15,508.40	$95,198.40	$110,706.80	$187.55
1991-92	$25,768.83	$67,442.88	$93,211.71	$1,535.00
1992-93	$38,650.75	$58,893.00	$97,543.75	$1,600.00
1993-94	$19,005.61	$68,893.00	$87,898.61	$6,125.00
1994-95	$19,404.31	$91,264.75	$110,669.06	$1,800.00
1995-96	$30,818.99	$112,118.50	$142,937.49	$4,163.12

1996-97	$29,908.92	$120,450.21	$150,359.13	$7,465.45
1997-98	$31,283.68	$98,038.62	$129,322.30	$16,081.97
1998-99	$40,358.72	$160,506.58	$200,865.30	$19,787.19
1999-00	$48,423.15	$210,251.08	$258,674.23	$71,450.47
2000-01	$43,059.61	$209,117.83	$252,177.44	$22,808.20
2001-02	$54,637.44	$219,124.67	$273,762.11	$60,940.20
2002-03	$46,888.69	$170,997.18	$217,885.87	$54,585.37
2003-04	$172,861.62	$136,213.19	$309,074.81	$67,715.43
2004-05	$195,746.86	$153,224.97	$348,971.83	$76,867.32
2005-06	$173,808.36	$286,615.12	$460,423.48	$67,724.66
2006-07	$278,317.83	$280,184.58	$558,502.41	$118,027.73
2007-08	$182,895.56	$358,400.41	$541,295.97	$85,683.30
2008-09	$218,250.57	$320,502.81	$538,753.38	$105,957.06
2009-10	$394,360.16	$236,566.77	$630,926.93	$132,416.06
2010-11	$301,605.05	$408,991.35	$710,596.40	$186,523.47
2011-12	$548,838.32	$495,394.11	$1,044,232.43	$338,299.04
2012-13	$672,926.17	$258,705.42	$931,631.59	$139,174.31
2013-14	$561,136.69	$507,381.30	$1,068,517.99	$101,333.36
2014-15	$387,661.98	$743,135.55	$1,130,797.53	$138,784.85
2015-16	$101,458.45	$825,927.24	$927,385.69	$201,637.55
2016-17	$145,179.50	$724,936.30	$870,115.80	$206,732.40
2017-18	$110,330.43	$787,187.03	$897,517.46	$109,719.72
2018-19	$169,926.04	$662,408.47	$832,334.51	$129,887.76
2019-20	$332,915.70	$481,992.96	$814,908.66	$225,952.93
2020-21	$315,266.36	$745,309.25	$1,060,575.61	$242,528.36
Totals	$5,905,001.33	$10,522,299.00	$16,427,300.33	$2,949,094.83

1. Any funding from State Sources, Gifts/Donation or Public/Private Grants

2. Any funding from Federal Sources

3. Depredation Compensation payments are a mix of state and federal funds from Columns A and B and are included in the "Total Management Expenditures" column. They are shown here separately to reflect specific annual payment totals for compensation claims.

Table 12: Gray wolf program expenditures by DNR fiscal year.

Wolf Population Monitoring

The state's wolf monitoring program monitors the wolf population through a variety of science-based techniques including as winter track surveys, radio-collared wolves, assessment of mortalities, summer howl surveys and public observation reports. The resulting population information is necessary to determine whether wolf management objectives are being realized and to inform future management decisions.

A significant shift in the state's wolf population monitoring occurred in 2020. While the objective of the program remains the same, the methodologies used to monitor the population were updated. The following describes the methods used to monitor the Wisconsin wolf population from 1979-2020 followed by the new methodology employed since 2020.

1979–2020

In 1979, the department commenced a wolf monitoring project which has effectively run continuously to the present (Wydeven et al. 2009). Its objectives were to produce a midwinter minimum count of the wolf population, to determine the distribution of reproductive wolf packs within the state and to obtain data on population mortality and productivity trends. This was accomplished using a territory mapping with telemetry technique, winter snow track surveys, summer howl surveys, recovery of dead wolves, depredation investigations and collection of public observation reports. A full description of methods is provided by Wydeven et al. (2009).

WISCONSIN DNR

Wolf with a radio collar.

Radio tracking of collared individuals is one of the most precise ways to monitor wolf populations (Mech 1974). By observing collared wolves with other pack members, complete counts can be made of wolf packs in winter (Mech 1974). To deploy radio collars, wolf live-trapping was performed each spring and summer (approximately May 1 to Sep. 10) by the department, USDA Wildlife Services and Tribal Conservation Departments. Typically, between 5 to 35 wolves were caught and radio-collared each year, with most wolves captured by foothold traps during spring and summer (Kuehn et al. 1986) with a limited number trapped with cable restraint devices in winter (Olson and Tischaefer 2004). Along with trapping and collaring by agency personnel, some wolves captured incidentally by private fur trappers have also been collared by agency biologists and technicians. Radio-collared wolves were generally located by airplane once per week. Collared wolves were typically able to be located for up to 5 ½ years before battery failure. In many years, about 10-20% of wolves and 30-40% of packs in the population had actively transmitting radio collars during the winter (Wydeven et al. 2009), although collaring rates declined as the population increased.

Despite the many benefits of radio-collared wolves, the presence of a collared wolf was not always a guarantee that the whole pack would be monitored. Collared wolves may disperse prior to winter or a pack may have occurred in dense conifer cover where few observations were possible. In these cases, snow

tracking was used to estimate pack size and supplement telemetry data (Thiel and Welch 1981, Wydeven et al. 1996, Wydeven et al. 2009). Snow track surveys were conducted by agency biologists and by trained volunteers beginning in 1995, resulting in between 4,000 to 18,000 total miles tracked annually (Figure 21). The volunteer carnivore tracking program (Wydeven et al. 1996) proved to be very useful in helping determine the distribution of wolves across the state and producing the annual midwinter minimum count. More information on the volunteer tracking program is provided in the Volunteer Carnivore Tracking Program section below.

Summer howling surveys were used to determine summer home sites for wolves and pup production (Harrington and Mech 1982). These surveys were done mainly from July to October each year. Although howling surveys rarely allowed for precise counts, the technique allowed assessment of relative numbers and helped distinguish separate packs as well as individual packs' reproductive status.

WISCONSIN DNR

Wolf tracks in the snow, observed along a roadway during a winter tracking survey.

Wolf mortality was monitored through field observation, radio collars and mandatory reporting of control and harvest mortalities. Cause of death for wolves reported dead in the field was determined through field investigation or by necropsy when illegal activity was suspected or where cause of death was not evident during field investigation. This information was used to evaluate potential health threats as well as factoring into the annual midwinter minimum count.

Wolf observation reports were collected from the public and agency staff. These reports were evaluated based on provided evidence and classified as either verified wolf, probable wolf, possible wolf or as not likely wolf. These reports were used to direct winter snow tracking efforts, monitor statewide wolf distribution and were incorporated into the annual midwinter minimum count.

2020 To Present

The techniques described above were reliable methods for producing a midwinter minimum wolf count in Wisconsin for 41 years. However, as Wisconsin's wolf population increased in distribution and abundance, the amount of effort and resources required to map every pack's territory and determine each pack's size also increased. While territory mapping was feasible and warranted when the population was smaller and more scattered during the early years of recovery, the need for a new method of monitoring wolves in Wisconsin became evident in more recent years.
Recognizing this need, department researchers worked with the University of Wisconsin-Madison to develop

a new population abundance estimate approach based on a scaled occupancy model. This model uses data from the systematic winter tracking surveys and collared wolves to estimate the total area occupied by wolf packs. The model then combines average pack territory size with the zone-specific average pack size to estimate the state's wolf population. Because winter snow tracking data remains a cornerstone of this method, winter snow tracking surveys continue to be conducted by a combination of state, federal and tribal biologists, along with numerous certified volunteer trackers.

The occupancy model offers several improvements over the minimum count methodology. For example, the approach does not rely on potentially subjective pack assignments and accounts for the fact that wolves may be present, but undetected, in a sample unit. The final estimate also accounts for the uncertainty in all model parameters, including mean home range size and pack size. Further details on the occupancy model development and approach can be found in Stauffer et al. 2021 (see literature cited) and in the annual Wisconsin wolf monitoring reports available on the department's website.

For three years (2018-2020), the department calculated both the annual minimum count using the territory mapping method and the population abundance estimate using the scaled occupancy model. Each year, the minimum count fell within the occupancy model's population estimate range, giving department researchers confidence that the new model was a reasonable and reliable alternative to territory mapping for Wisconsin's wolf population. After multiple years of research and testing, the department wolf monitoring program fully transitioned to this new monitoring technique in 2021. Since then, department has reported the wolf population abundance estimates and associated uncertainty derived from the occupancy model and no longer produced an overwinter minimum count.

WISCONSIN DNR

Tagging a wolf with a radio collar.

Another change, which occurred in 2020, was the cessation of summer howl surveys by the department. The decision to discontinue these surveys followed a critical evaluation of current howl survey methodology and a review of data needed for management decisions. Howl surveys have continued to voluntarily be completed on smaller scales by various groups (including the Timber Wolf Alliance and Timber Wolf Information Network) for educational or scientific purposes.

The other core program activities of radio-collaring and mortality monitoring remain, although both have continued to evolve as well. Wolf live-capture efforts continue annually and include trapping by department and USDA Wildlife Services staff in the spring and early summer, along with occasional collaring of wolves captured incidentally by private fur trappers in the fall and winter. Importantly, as collar technology has improved over the years, the simpler VHF radio transmitter collars have been replaced by GPS collars. Although significantly more expensive, these GPS collars provide a much greater level of detail in the data collected and open new doors for data analysis. GPS collars were first deployed in about 2014 in Wisconsin and since 2020, GPS collars have exclusively been deployed on live-captured wolves. Because of this, routine flights to monitor radio-collared wolves were discontinued in 2020.

Similarly, wolf observation reports continue to be collected from the public and agency staff. Public reports are primarily collected via the Wildlife Observation tool available on the department's website, direct messages to department staff and the Snapshot Wisconsin program. Snapshot Wisconsin is a citizen-science partnership to monitor wildlife year-round using a statewide network of volunteer-managed trail cameras. More information on Snapshot Wisconsin is available on the department's website. Snapshot Wisconsin data was first explicitly incorporated in the wolf monitoring program in 2018. Collectively, this data is used to help determine wolf occupied range across the state and direct winter tracking efforts.

Volunteer Carnivore Tracking Program

WISCONSIN DNR

Following wolf tracks in the snow to collect data during a winter tracking survey.

In addition to surveys conducted by the department, federal and tribal wildlife biologists, the department has incorporated the use of trained citizen scientists to assist in monitoring important wildlife populations, including wolves, since 1995. The volunteer carnivore tracking program was originally developed to increase the capacity to collect important data and offer interested people the opportunity to become involved in the state's wolf and wildlife monitoring program. The current goals of the program are to: 1) collect wolf presence and count data for use in the state's wolf monitoring program, 2) promote collaboration among agencies and citizens in monitoring wildlife across the state and 3) collect monitoring data of other carnivore species on the landscape, including the potential existence of rare species such as Canada lynx, cougar and wolverine. To participate, individuals must complete a series of educational courses to become a certified volunteer tracker and then complete regular recertification courses to ensure volunteers are kept up to date with any survey modifications. Several conservation organizations, particularly the Timber Wolf Alliance and Timber Wolf Information Network, have played important roles in supporting the volunteer tracking program and offering their own track training courses. Once certified, volunteers are assigned one or more tracking blocks and asked to complete a minimum of three surveys over the winter months when conditions allow. Data collected by the volunteer tracking program is crucial to the wolf monitoring program (Figure 21).

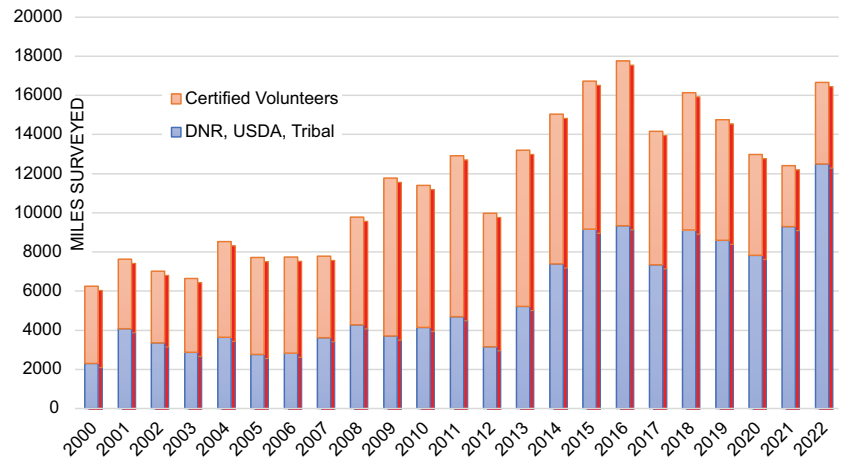

Figure 21. Number of miles surveyed during annual winter carnivore tracking season by certified volunteer trackers and natural resource professionals, 2000–2022.

Wolf Harvest Management

Background

The passage of Act 169 in 2012 effectively classified wolves as a game species in Wisconsin by providing that the department shall administer a regulated wolf harvest season in Wisconsin whenever wolves are not a federally or state listed species. Refer to the "Legal Authority and Laws Influencing Wolf Management" section for more information on the specifics of the laws and authorities guiding wolf harvest in Wisconsin.

Quota Setting Process

Since establishing Wisconsin's first regulated wolf harvest season in 2012, the department has considered numerous factors while developing wolf harvest quotas. These factors have included wolf population estimates and trends (not including reservation wolves, as defined by administrative rule), population goals established in the previous wolf management plan, projected impacts of wolf harvest quotas on the wolf population, management to reduce conflicts in areas with agricultural land use, the ecological importance and ecological impacts of wolves, the take of wolves for depredation management purposes, previous levels of harvest, the impact of disease, illegal harvest, other sources of mortality, recreational demands for wolf hunting and trapping, wolf harvest management in adjacent states, consideration of conservation genetics and off-reservation treaty rights.

Harvest management of any game species requires careful integration of biological and social information when considering harvest decisions. Effective quota-setting begins with accurate estimates of population size and these have been provided by annual wolf monitoring efforts (described in the Wolf Population Monitoring section above). To evaluate the potential impacts of various quotas on population change, department biologists have relied on published scientific research. The relationship between annual human-caused mortality and the rate of change in wolf population sizes has been studied and published numerous times for North American wolf populations (Fuller et al. 2003, Adams et al. 2008, Creel and Rotella 2010, Gude et al. 2012). Because there has been some debate in the form of this relationship, traditionally the department has used two of these published relationships, Fuller et al. (2003) and Adams et al. (2008), in assessments for comparison. Fuller et al. (2003) identified 19 published studies, including data from Wisconsin, of 'exploited' wolf populations (human-caused mortality was a source of death for wolves) in North America and fit a line between the annual rate of population increase, lambda, versus the observed annual human-caused mortality rate. Adams et al. (2008) looked at those same 19 studies but identified when there were shifts in population trends or harvest and split the records when there were shifts. The result was 41 data points (3 determined to be outliers) that were fit with a curvilinear model (Adams et al. 2008). The curvilinear shape of the Adams model, as opposed to the linear shape of the Fuller model, also allows for a level of compensatory mortality. Both Adams and Fuller models were created with data from exploited wolf populations and each data point represented 2-9 years of data.

Year	Overwinter Minimum Count	Number Known Killed By Humans	% Known Killed By Humans	% Population Growth
Winter 2011-2012	815	NA	NA	NA
Winter 2012-2013	809	224	27%	-1%
Winter 2013-2014	660	358	44%	-18%
Winter 2014-2015	746	207	31%	13%
Winter 2015-2016	866	31	4%	16%
Winter 2016-2017	925	26	3%	7%
Winter 2017-2018	905	20	2%	-2%
Winter 2018-2019	914	28	3%	1%
Winter 2019-2020	1034	38	4%	13%

Table 13. Wisconsin wolf annual population growth and percent known human-caused mortality, 2011 – 2020. Data from annual Wisconsin Gray Wolf Post-Delisting Monitoring reports.

To evaluate how these relationships have predicted recent wolf population changes in Wisconsin, department biologists have plotted each year's data from 2012 (first wolf season) until 2020 (Table 13). For each of those years, the relationship between annual population change and human-caused mortality in the Wisconsin wolf population was predicted within the 80% prediction interval for the Adams curvilinear relationship, including all three years with fall harvest (2012-14). The Fuller linear model predicted the Wisconsin data points in 8 of those 9 years within the 80% prediction interval but failed to predict the population change following the 2014 harvest season (Figure 22). To further assess whether the Adams or Fuller relationship were better predictors for Wisconsin's wolf populations, we cross-validated each model with data from Wisconsin that was not used to develop the relationships. We calculated the root mean squared error (RMSE), which measures the average prediction error made by the model when predicting the outcome for an observation. When comparing the two models, the lower RMSE of the Adams model (RMSE = 0.09) indicated that it is preferred over the Fuller model (RMSE = 0.12). Based on this review, the relationship observed in Wisconsin to date has been better represented by the curvilinear relationship of the Adams model than the linear relationship of the Fuller model.

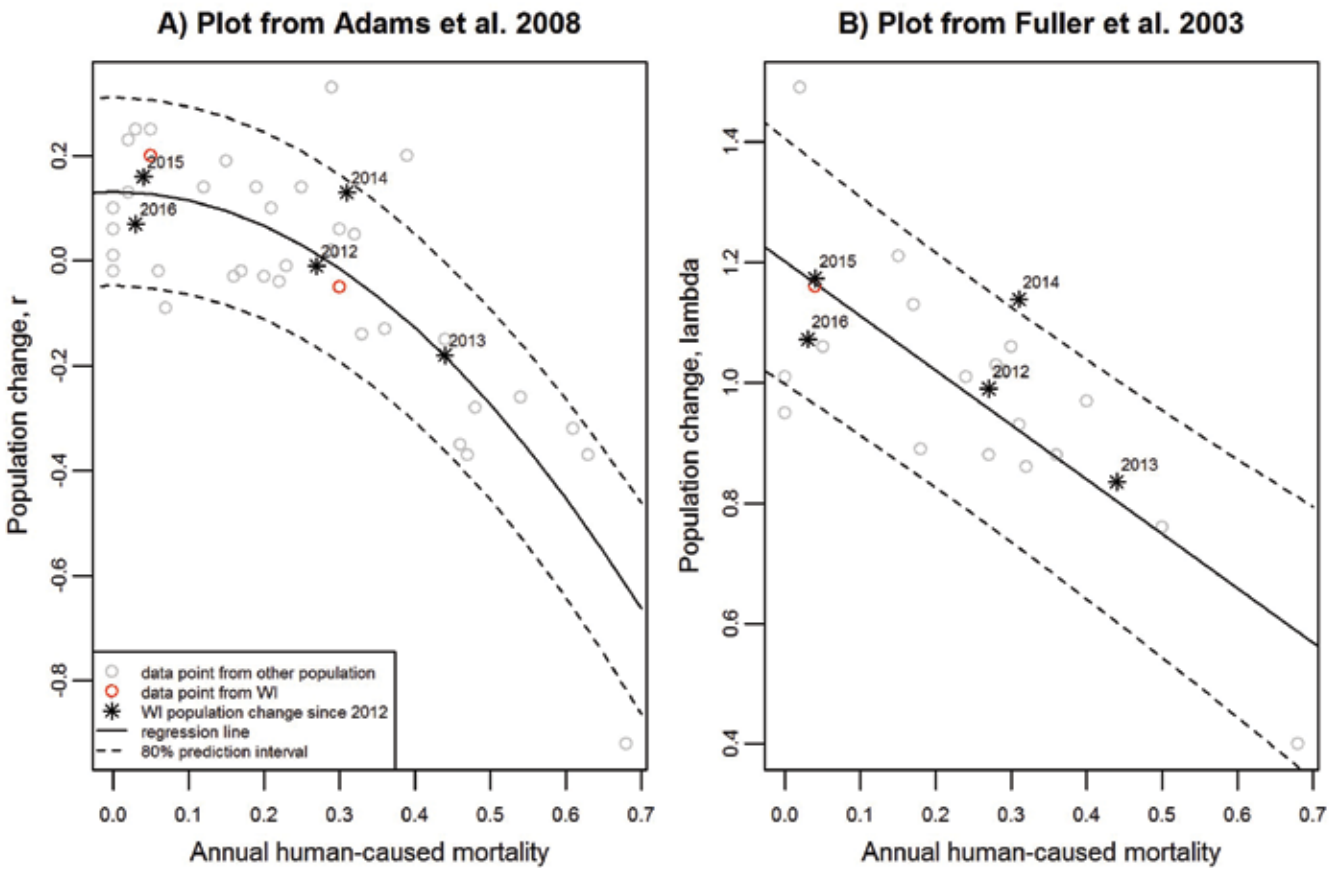

Figure 22. The relationship between annual population changes and human-caused mortality for North American wolf populations as analyzed by A) Adams et al. (2008) using a curvilinear model and B) Fuller et al. (2003) using a linear model. The open data points from other populations and from Wisconsin (WI) were used to fit the relationships. The stars represent recent years of Wisconsin data points plotted on each of these relationships to assess prediction accuracy. The labels for the Wisconsin data indicate the first year in the winter tracking season range, i.e., 2019 represents the change in the population size from the 2018–2019 tracking season to the 2019–2020 tracking season.

Wolf population estimates and the expected population responses can therefore be used to determine quotas which, if met, are most likely to achieve management objectives. Population management objectives have been developed by the department based upon the past management plan, along with input from wolf stakeholder committees and consultations with tribal partners. However, substantial agreement on these objectives has proven elusive due to opposing values related to wolves and wolf harvest.

Upon determination of a suitable quota, the total quota is allocated among the six wolf harvest zones (Figure 20). The application of harvest pressure geographically may further be informed by different philosophical and management objectives. See the section below for more on Wolf Harvest Zones.

Once the total quota has been distributed among the six harvest zones, the Ojibwe tribes, in accordance with federally affirmed off-reservation treaty rights, are entitled to declare for up to half of the available annual wolf harvest quota within the Ceded Territory of Wisconsin. The department works with the Great Lakes Indian Fish and Wildlife Commission to facilitate this declaration process.

Wolf Harvesting Zones

Since 2012, the state has been divided into six wolf harvesting zones used to distribute quotas and harvest (Figure 23). These zones were different from the four management zones established in the 1999 Wisconsin Wolf Management Plan (Figure 19). These wolf harvesting zones were delineated to 1) provide core range critical to wolf population viability, primarily the heavily forested portions of northern and central Wisconsin, where harvest rates would be lower than prescribed elsewhere (Zones 1, 2, 5), 2) provide secondary range in areas where forest transitions to greater agricultural use, where greater conflict potential exists and where wolves would be managed at a lower density (Zones 3 and 4) and 3) manage the rest of the state at very low wolf densities through liberal harvest prescriptions (Zone 6). Tribal reservations with federally recognized exterior reservation boundaries, including Bad River, Red Cliff, Lac Courte Oreilles, Lac du Flambeau and Menominee, as well as the designated Stockbridge-Munsee wolf area, were designated as zero quota areas for state wolf harvest. Zone boundaries generally followed major roads and rivers.

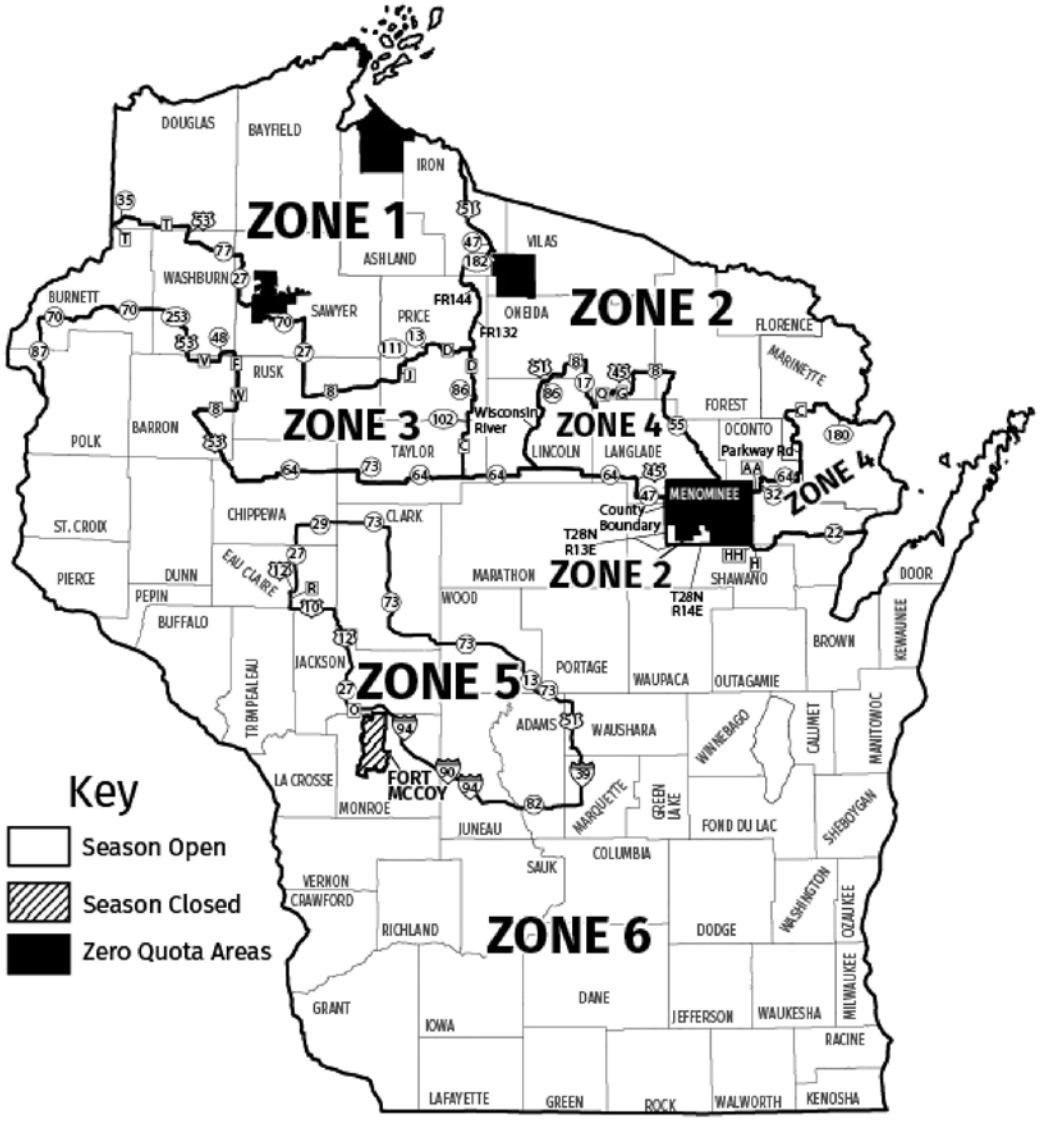

Figure 23. Wolf harvesting zones and designated zero quota areas in use since 2012 in Wisconsin.

Wolf Harvesting License Issuance

Another critical step in the harvest season development process is to determine the number of wolf harvesting licenses to make available to achieve the state harvest quota. In past Wisconsin wolf seasons, this has ranged from a high of 20 licenses made available for each wolf in the quota (20:1 ratio) for the February 2021 wolf season to 10 licenses made available for each wolf in the quota (10:1) for the 2012, 2013 and 2014 wolf seasons. In essence, a 10:1 ratio assumes a hunter/trapper success rate of 10%. The further the true hunter/trapper success rate deviates from 10%, the greater the potential for either exceeding or failing to achieve the established quotas. True hunter success rates can be difficult to estimate, but information collected from annual wolf season harvest surveys is critical to better informing this metric.

Wisconsin statutes require persons to obtain a wolf harvesting license to harvest a wolf. Residents and nonresidents are both eligible for wolf harvesting licenses and treated equally through the drawing process. Licenses are issued through an application and two-stage drawing process as described in state statute. The initial drawing for 50% of the available licenses is orchestrated through a random lottery in which all applicants are entered. The remaining 50% of the available licenses are issued based upon the cumulative preference points of applicants, providing unsuccessful applicants from prior years a greater chance to obtain a license. Each license allows the license holder to harvest one wolf by the method(s) authorized by the license. Legal methods include trapping with foothold traps and cable restraints, hunting with the use of electronic calls, bait and with the aid of dogs to track/trail wolves. Each of these legal methods are subject to specific regulations regarding use including when each method is allowed within the overall season.

Wolf Harvest Registration And Hunter/Trapper Surveys

Wolf harvesting licenses have historically authorized hunting and trapping in any open zone (Figure 23). Wisconsin Statute s. 29.185(5)(c) provides the department with the authority to close wolf zones to both hunting and trapping of wolves if the department determines that the closure is necessary to effectively manage the state's wolf population. Zone closures require a minimum of 24 hours public notice before going into effect. Zone closure decisions are based upon harvest registration data.

Hunters and trappers successful in taking a wolf have been required to complete a two-step registration and certification process to lawfully meet harvest reporting requirements. The first step is harvest registration which is done by the hunter/trapper via website or phone and legally has had to be completed within 24 hours following harvest. Data provided via wolf harvest registration is critical to monitoring wolf harvest numbers and progress toward harvest targets, but also provides important descriptive data such as location, sex and method of harvest.

The second component has required successful hunters and trappers to complete an in-person certification process with a department conservation warden or wildlife biologist following harvest. During this in-person certification, department staff complete the certification process by marking the pelt with a uniquely numbered tag to certify it as a legal harvest, collect additional harvest and biological information and may collect any biological samples. The collection of data through this two-step process provides critical information on the biological parameters of the harvest.

The department has also surveyed successful license applicants following the completion of each wolf season to collect more data on hunter/trapper activities. This data provides more information on hunter

effort and success, use and timing of various legal methods, hunter/trapper experiences and preferences and applicant motivations. These surveys provide data to paint a fuller picture of the social parameters surrounding the wolf harvest season.

Comprehensive post-season harvest reports and hunter/trapper survey results are available on the DNR's website (search wildlife reports). Table 14 below provides a summary of past Wisconsin wolf seasons.

Harvest Season	Fall 2012	Fall 2013	Fall 2014	February 2021
Population	Population Estimate 2012-2014 represent an overwinter minimum count, Feb. 2021 refers to the most likely value from the scaled occupancy model population estimate.			
	815	809	660	1,126
	Applications			
Resident Harvest License	16,728	11,917	9,195	17,660
Resident Preference Point	2,733	4,433	4,859	8,211
Nonresident Harvest License	626	191	139	843
Nonresident Preference Point	184	131	146	437
Total Resident Applicants	19,461	16,350	14,054	25,871
Total Nonresident Applicants	810	322	285	1,280
Grand Total Applicants	20,271	16,672	14,339	27,151
	Quota And Harvest Levels			
Total Quota	201	275	156	200
State Quota	116	251	150	119
State Licenses Awarded	1,160	2,510	1,500	2,380
State Licenses Purchased	893	1,879	1,139	1,548
State Harvest	117	257	154	218
	Season Dates			
Open	Oct. 15	Oct. 15	Oct. 15	Feb. 22
First Zones Closed	Nov. 16	Oct. 23	Oct. 18	Feb. 23
Last Zones Closed	Dec. 23	Dec. 23	Dec. 5	Feb. 24
	Sex And Age Structure Of Harvested Animals			
Males	59%	52%	57%	53%
Females	41%	48%	43%	47%
Young Of The Year (~6 mo.)	50%	56%	63%	9%
Subadult (~1.5 yr.)	25%	21%	15%	51%
Adult (~2.5 yr. and older)	25%	23%	22%	39%
	Method Of Take			
Foothold Trap	52%	70%	80%	3%
Cable Restraint		0	0	2%
Hunt/Pred. Call	48%	16%	14%	9%
Aid of Dogs	n/a	14%	4%	86%
Archery	-	1%	2%	-

Table 14. Summary of past regulated wolf hunting and trapping seasons in Wisconsin.

Wolf-Related Conflicts

Background And History

As trustee of wildlife resources for the benefit of the public, the department protects and maintains a sustainable population of wolves in the state. Similar to other wildlife species, conflict management is an important component of the department's wolf management program. The objectives of the department's wolf conflict management program are to prevent and minimize wolf/human conflicts and fairly compensate domestic animal owners for verified losses as required by state law.

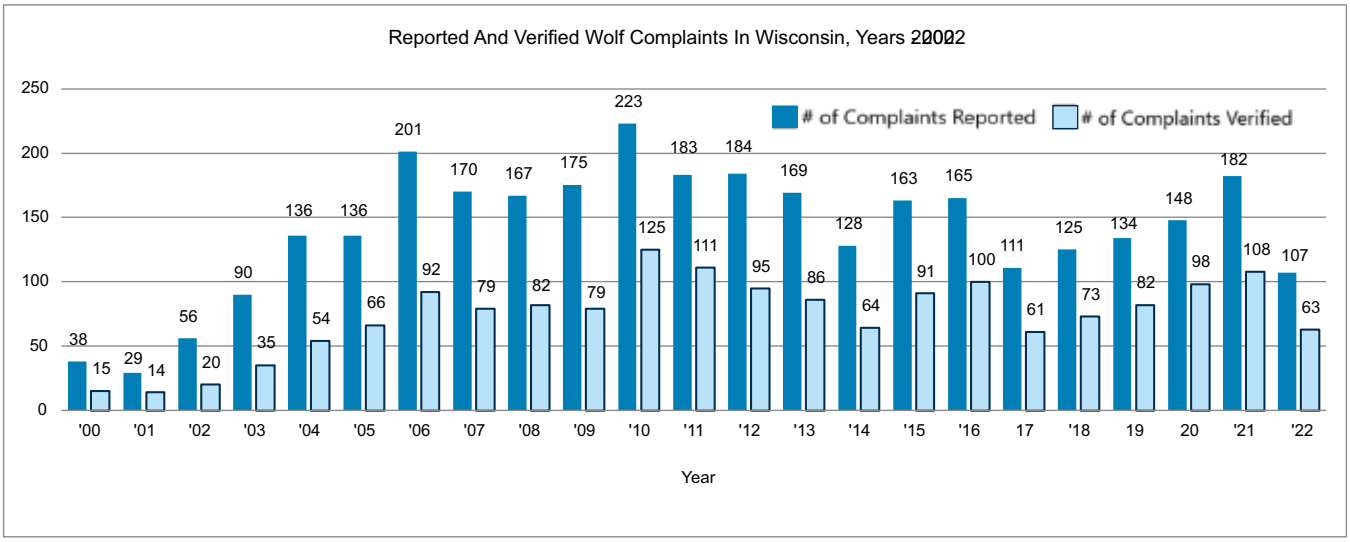

Figure 24. Number of wolf complaints received by USDA Wildlife Services and number of complaints verified.

To accomplish program objectives, the department maintains a Cooperative Services Agreement with USDA Wildlife Services (USDA WS) for responding to and investigating reported wolf complaints and implementing an integrated conflict program incorporating both lethal and non-lethal abatement strategies when appropriate for resolving conflicts. As part of the cooperative services agreement, USDA WS maintains toll free numbers that are regularly monitored seven days a week, including holidays. Upon receiving a complaint, USDA WS staff conduct an onsite visit to verify the complaint (Figure 24). Wolf investigations are separated into four categories depending on the resource type and/or activity being conducted: livestock, hunting dog, pet or human health and safety. During the onsite visit, USDA WS will determine a confirmation status based upon the evidence during their investigation. Following the visit, reports are categorized by resource type (livestock, hunting dogs, pets, human health/safety) and classified as one of the following: verified wolf conflict (confirmed or probable depredation, injury, harassment or threat by wolves), verified non-wolf conflict (conflict where a species other than wolves was verified) or unconfirmed complaint (insufficient evidence to determine cause or cause does not meet other criteria).

Federal Or State Endangered Species Status	Non-Lethal Abatement	Lethal Abatement
Endangered	Yes	No*
Threatened	Yes	Yes
None	Yes	Yes

*Except in verified cases of human health and safety conflict.

The federal and state legal classification of wolves in Wisconsin determines available options for conflict management. If wolves are listed as a federally endangered species in Wisconsin, conflict response is limited to non-lethal abatement options (unless a wolf is sick/injured or in defense of human life), regardless of state listing status. If wolves are listed as a federally threatened species, but also listed as state threatened or endangered, conflict response may include both lethal and non-lethal controls, insofar as it is permitted under state law and consistent with federal law. If wolves are not federally listed, but are state listed as threatened or endangered, wolf conflict response options would be governed by state law only. Finally, if wolves are neither federally or state listed, wolf conflict would be guided by state law and currently would include an integrated program consisting of both lethal and non-lethal controls. In addition, when wolves are not state or federally listed in Wisconsin, NR 10.02(1)(b) gives landowners, lessees or occupants of the land or any person with permission of the landowner, lessee or occupant, the authority to shoot wolves that are in the act of killing, wounding or biting a domestic animal on private property. These abatement options are discussed in greater detail in the following sections.

Wolf/Livestock Conflict

Wolf depredations on domestic animals are well documented in Wisconsin (Ruid et al. 2009). Wolf conflicts were less common during the early phase of wolf recovery in Wisconsin (1976-2000), but as the wolf population grew and expanded, conflicts also increased. The number of farms with verified wolf depredations has averaged about 29 farms from 2012-2022. The highest number of individual farms with verified wolf depredations to date occurred in 2021 with 48 farms (Figure 25). While depredations have occurred across wolf range in Wisconsin, most wolf/livestock conflicts occur in areas that have high interspersion of forest, agricultural and pasture lands, often in areas on the edges of wolf range in the state (Treves et al. 2004, Treves et al. 2011, Olson et al. 2019). Two specific areas of historic and concentrated wolf depredation on livestock in Wisconsin have been the Lake Superior Coastal Plain in the northwestern portion of the state and portions of Adams, Wood, Portage and Clark Counties in the central area of the state (Figure 26).

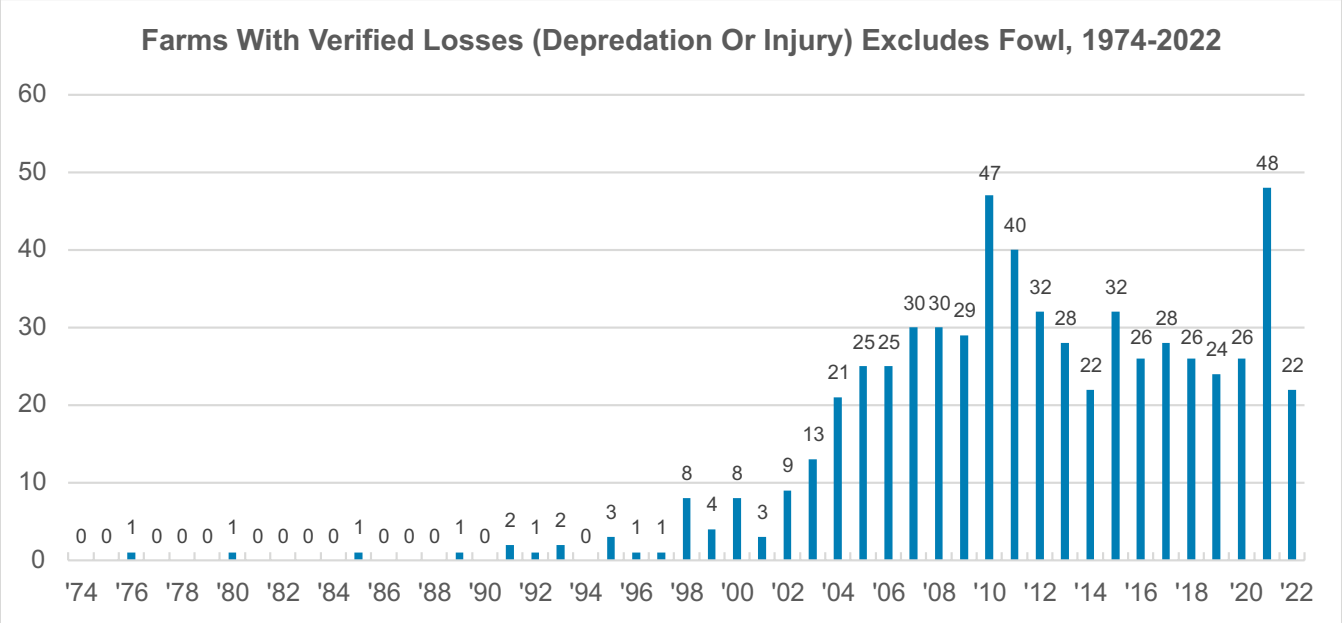

Figure 25. Number of individual farms that experienced verified losses (depredation or injury) of livestock (excluding fowl) to wolves from 1974 to 2022.

Even though the total number of farms and livestock involved in wolf depredation and harassment incidents across Wisconsin are numerically low, the costs to individual livestock producers can be high, particularly in areas of chronic depredation activity. Direct losses of livestock due to depredation are conspicuous and economically significant; however, in some cases this metric underestimates the total economic impact because it does not consider the non-depredation impacts. Shelton (2004) suggested that the value of depredated livestock from predators is the "tip of the iceberg" concerning the actual costs that predators can impose on afflicted livestock producers.

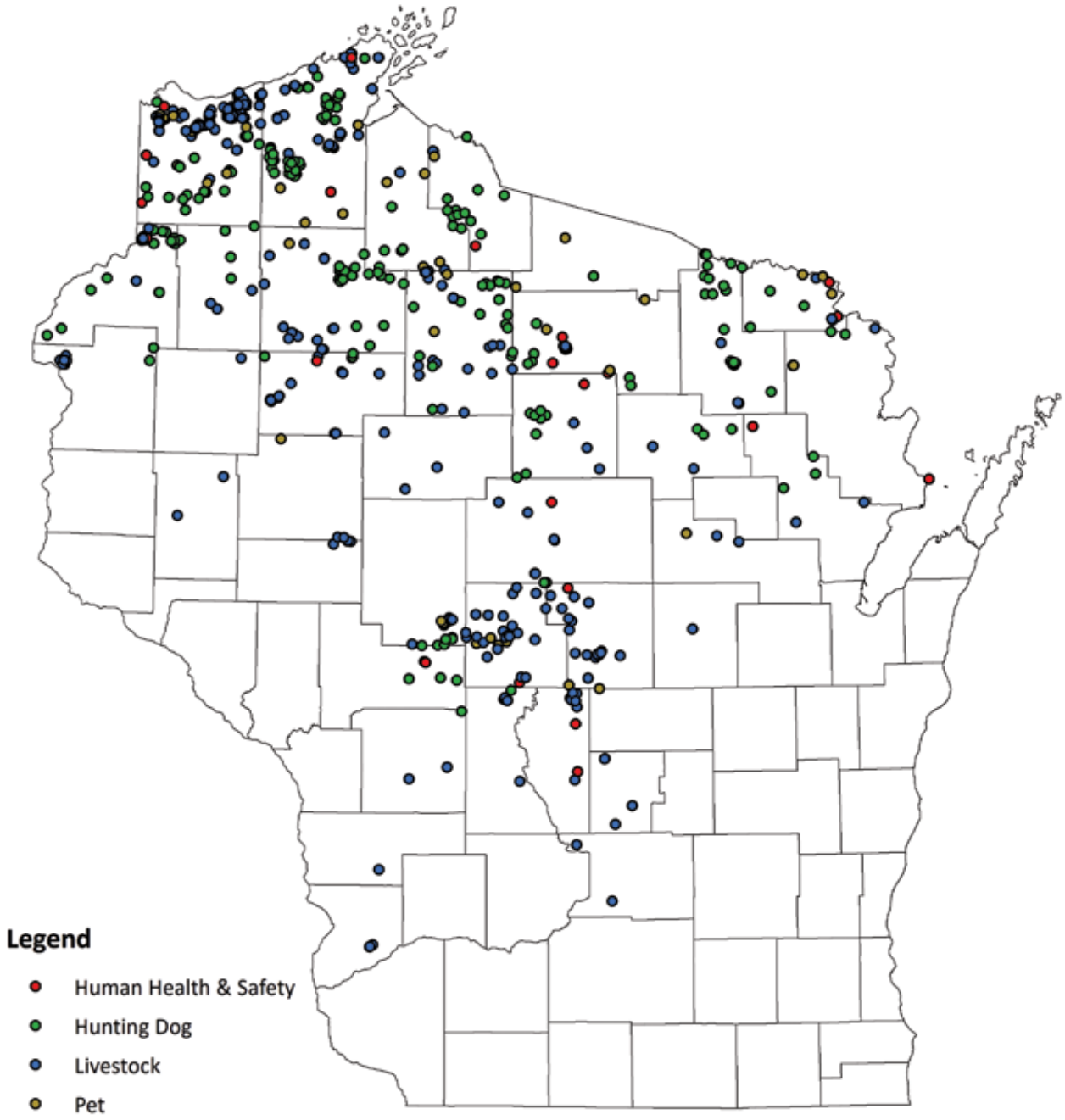

Figure 26. All verified and probable wolf depredation and harassments by type, 2013–2021.

Non-Depredation Impacts On Livestock

In addition to direct losses of animals by depredation, a variety of other impacts extending beyond direct losses have been documented in various studies. The presence of wolves near cattle can invoke a fear response in cattle. Fear is a strong stressor (Grandin 1999) and can result in disease, reduced productivity, weight loss and reduction of meat value in cattle (Muller and von Keyserlingk 2006). Livestock that are exposed to or harassed by predators may have lower than normal weight gains due to increased energy expenditure associated with higher activity and running, increased vigilance, selection of poor grazing habitat, (e.g., cattle relocate nearer to roadways in the presence of or following encounters with wolves), increased grouping and possibly decreased rumination time (Howery and DeLiberto 2004, Kluever et al. 2008, Kluever et al. 2009, Laporte et al. 2010, Muhly et al. 2010, Ramler et al. 2014). Ramler et al. (2014) found beef calf weights were 22 pounds less on ranches in Montana that had verified wolf depredations compared to ranches that did not have verified wolf depredations. Kluever et al. (2008) found cows that had their calves depredated by wolves reduced their foraging rate from 88.5% to 43.5%, up to 10 days after their calf was depredated. Chronic stress can also inhibit immune responses which may increase illness and decrease performance of livestock. Many infectious diseases can result from a combination of viral and bacterial infections and are brought on by stress (Faries et al. 1997).

Increased activity can also occur when cows attempt to defend their offspring from predators. This activity may increase heat stress during warm weather and risk of cold stress during cold periods (Lehmkuhler et al. 2007). Chebel et al. (2004) found that heat stress (>29 degrees Celsius) prior to artificial insemination resulted in lowered conception rates in dairy cows. Dairy cows exposed to high heat index values during peri-implantation may also have a greater risk of pregnancy loss (García-Ispierto et al. 2006). Wolf depredations in Wisconsin overlap the calving and subsequent breeding seasons of spring-calving beef herds (Ruid et al. 2009), with the peak of spring-calving season in Wisconsin typically occurring during the months of April and May.

Harassment by predators can also cause livestock to become nervous or aggressive and make them more difficult to handle. When harassed, cattle may destroy fences while attempting to flee. This can result in injuries to cattle and lost time spent repairing fences and gates. Regrouping cattle after they have been stampeded is difficult, time consuming and stressful to the animals. Cattle have also damaged row-crops after being harassed by wolves. In studies of movement of livestock to sale, it was found that agitated livestock can hurt humans and other cattle near them as well as stress other cattle, reducing their performance (Ellington 2002). Stress prior to slaughter may also cause reduced glycogen in muscle tissue impacting the color of the meat, these “dark-cutters” are discounted because they are difficult to sell (Fanatico 1999). Harassment and depredation by wolves can also affect the way cattle respond to livestock handling dogs and the ability of the dogs to control cattle movements (Howery and DeLiberto 2004). Reducing fear can improve welfare and safety for both humans and animals (Grandin 1999).

Some recommendations which may improve cattle herd health include avoiding overcrowding and rotating cattle to fresh areas (Lehmkuhler et al. 2007). Laporte et al. (2010) found that cattle were more likely to form groups and were more sinuous in response to the presence of wolves; they postulated that this is likely an anti-predator defense mechanism. Keeping cattle near buildings can be beneficial to avoid depredation but may also result in increased risk of exposure to pathogens (Lenehan et al. 2005) and possibly increased need for supplemental feed. Concentrating cattle in small areas can increase the risk of transmitting food

borne pathogens due to both the increase in bacterial populations around the cattle and immunosuppression caused by the stress of crowding (Lehmkuhler et al. 2007).

Managing these indirect effects of predation takes resources away from other needs of a farm (Lehmkuhler et al. 2007). Livestock producers who have experienced wolf depredations or harassment can spend extra hours on herd surveillance, repairing fences, attempting to locate missing calves and coordinating depredation investigations and other issues with agency staff. Livestock production typically is a small profit margin industry and increased labor outputs related to wolf conflicts increases cost of production resulting in reduced economic return (Lehmkuhler et al. 2007).

Abatement Options

There are a variety of both lethal and non-lethal abatement options available to help address wolf/livestock conflict. The primary non-lethal abatement methods implemented at conflict sites, particularly livestock depredation sites, include visual and auditory harassment tools, predator-proof and electric fencing and alteration of animal husbandry practices (Figure 27). Visual and auditory harassment tools include fox lights, scare radios, turbo fladry and Radio Activated Guard Boxes (RAG Boxes). Predator-proof fencing is woven wire fencing that is 75" tall with a 42" horizontal apron and electric fencing (scare wire) is typically a single strand electrified wire approximately 8" off the ground below the bottom strand of an existing barbed-wire fence but may include other configurations. Alteration of animal husbandry practices is implemented by the livestock producer and may include moving livestock to a different pasture, night penning livestock, proper livestock carcass disposal, increasing vigilance and/or the use of guard dogs.

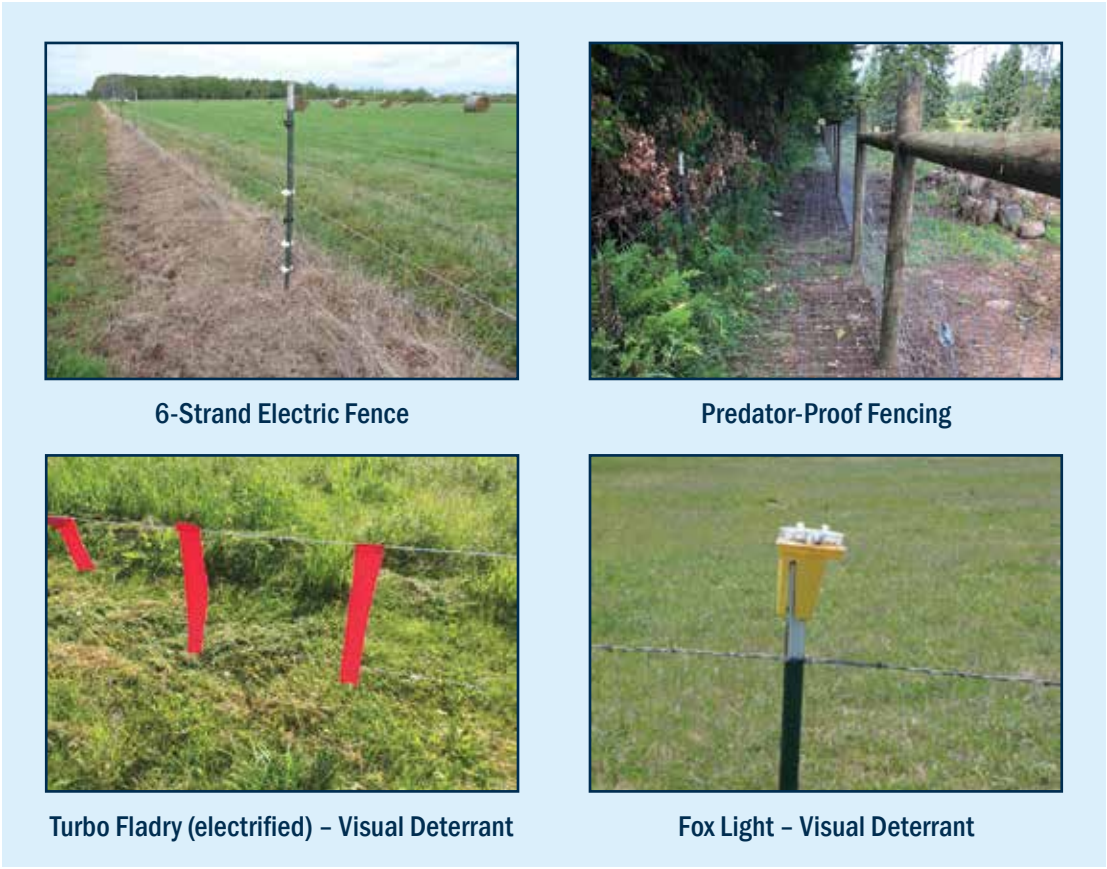

Figure 27. Examples of non-lethal wolf depredation abatement tools.

Lethal controls may also be considered (when allowed by wolf legal status) in response to verified livestock conflicts (Figure 28). These options can include trapping and removal efforts by USDA WS or the issuance of a wolf removal permit to the livestock owner. In addition, Wisconsin Administrative Code authorizes the landowner, lessee or occupant of a private land parcel or any other person with permission of the landowner, lessee or occupant, to shoot and kill wolves in the act of killing, wounding or biting a domestic animal. Those shootings must be reported within 24 hours to a department conservation warden. Additionally, wolf carcasses are required to be turned over to the department.

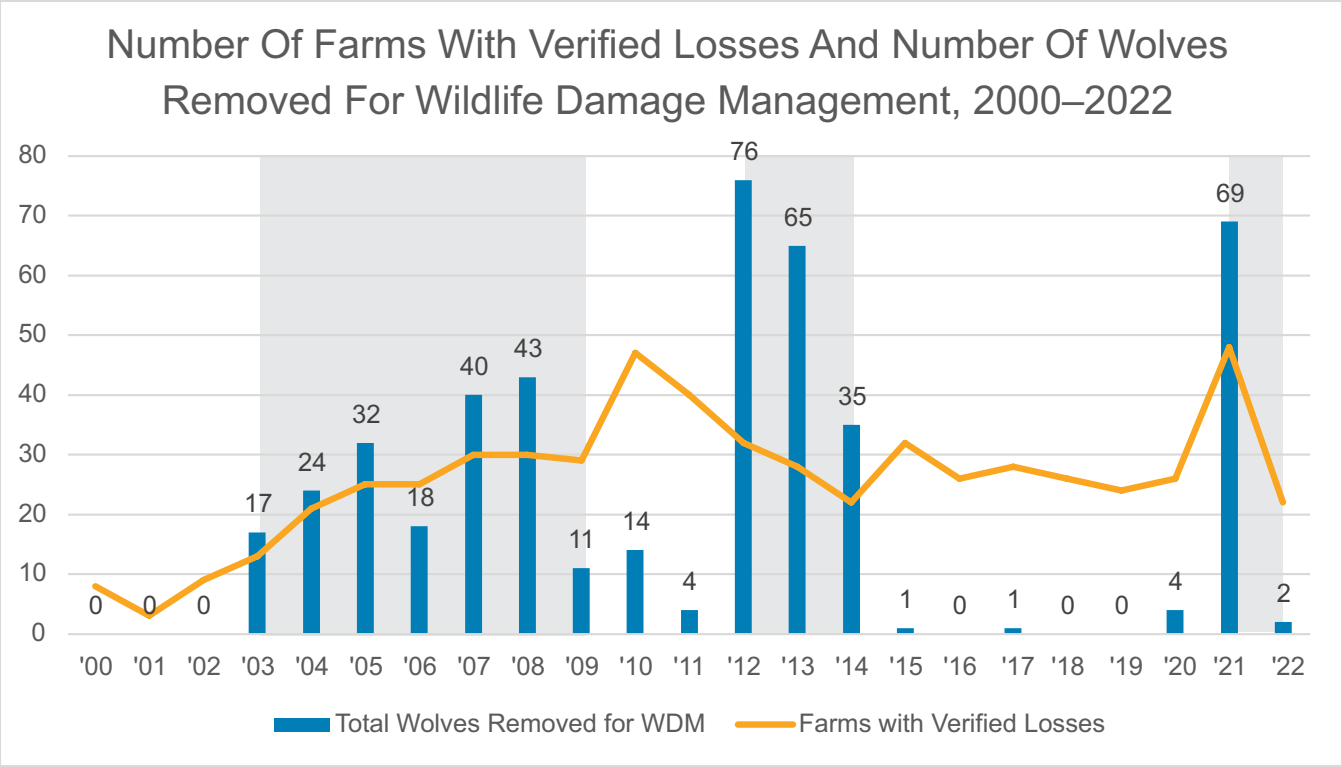

Figure 28. The total number of farms with verified losses and the number of wolves removed for wildlife damage management efforts per year, 2000–2022. The gray shaded regions are the years that the federal and state status or wolves alllowed for integrated wolf management at some point during the year. The years not shaded had limited management tools available for wildlife damage management.

Finally, research has shown that wolves will utilize livestock carcass dumps, including altering their diet, activity and movements (Petroelje et al. 2019, Mech et al. 2000, Bradley and Pletscher 2005). Although the specifics of the relationship remain unclear, improper disposal of livestock carcasses has been suggested to predispose farms to depredations. Wisconsin law requires farmers to properly dispose of livestock carcasses within 24 hours from April – November and 48 hours from December – March. Common recommendations for disposal include burial, incineration, composting and rendering. However, rendering facilities rarely service areas in northern Wisconsin where most depredations occur and burial can be impractical and pose ground water contamination and bio-security hazard risks. Composting is often recommended, but can be costly and requires proper site selection, a facility and equipment.

Hunting Dog And Pet Conflicts

The first wolf depredation on a dog in Wisconsin occurred in 1986, about 10 years after wolf re-colonization began. From then until 2022, 664 dogs (all breeds) have been documented as injured or killed by wolves in Wisconsin. Of these, 491 dogs have been killed and 173 have been injured in non-wolf hunting situations. Additionally, 60 pet dogs have been killed and 63 pet dogs injured by wolves. From 2011-22, an average of about 24 dogs have been killed and 8 more injured each year, with hunting dogs accounting for about 85% of these conflicts. Wolf attacks on hunting dogs (primarily bear-hunting hounds) are the second-most common type of depredation on domestic animals, following livestock, in Wisconsin. Figure 29 depicts the number of domestic dogs injured or killed in wolf conflicts during the period from 2000 to 2022.

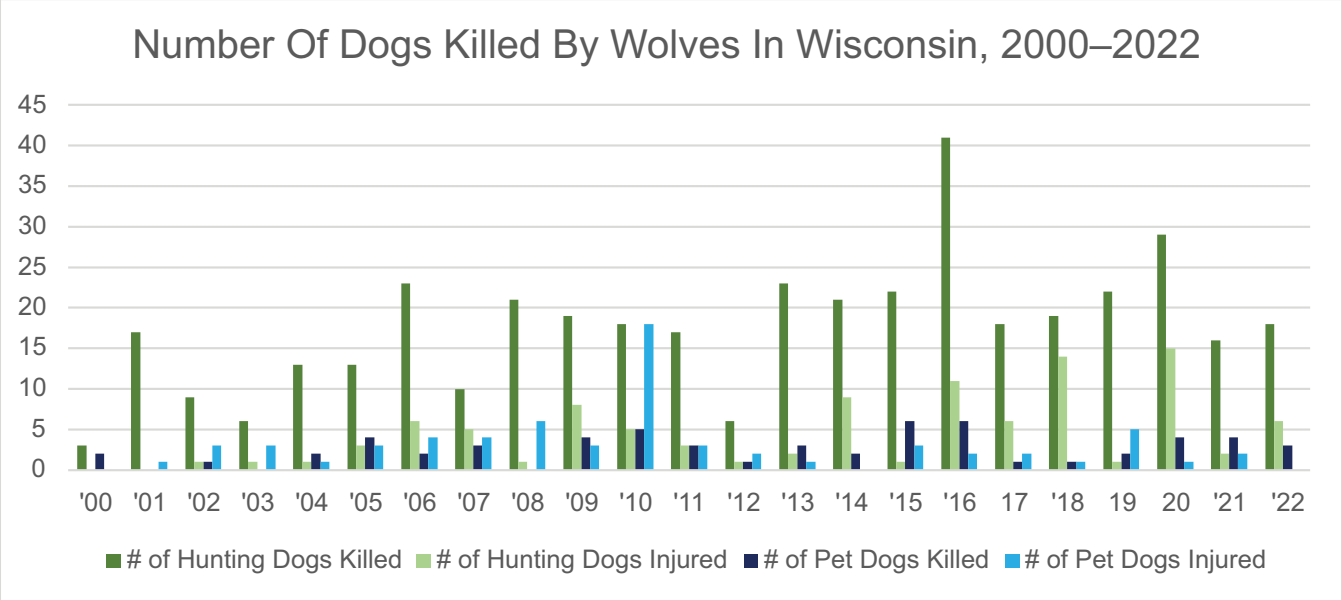

Figure 29. Number of dogs (both hunting and pet) confirmed depredated or injured by wolves from the period of 2020 to 2022.

In Wisconsin, most attacks on dogs are on those used in hunting or training for bear hunting but have also included dogs used in hunting coyote, bobcat, snowshoe hare, raccoon and grouse (Figure 30). Training of bear hounds occurs annually during July and August while bear hunting occurs annually from early September through early October. Wolves utilize rendezvous sites during July through early October (Fritts and Mech 1981) and will aggressively defend these sites (Ballard et al. 2003). In addition, bear hunters commonly use baits to aid in harvesting bears. In Wisconsin, bait sites can be established beginning on April 15 each year. Wolves using bear bait sites for food have been documented by trail cameras, tracks and in one-instance stomach contents of a captured wolf (D. Ruid, unpublished data). Wolves may defend such bait sites from other predators, including bear hounds and this can potentially lead to increased conflict between bear hounds and wolves (Bump et al. 2013).

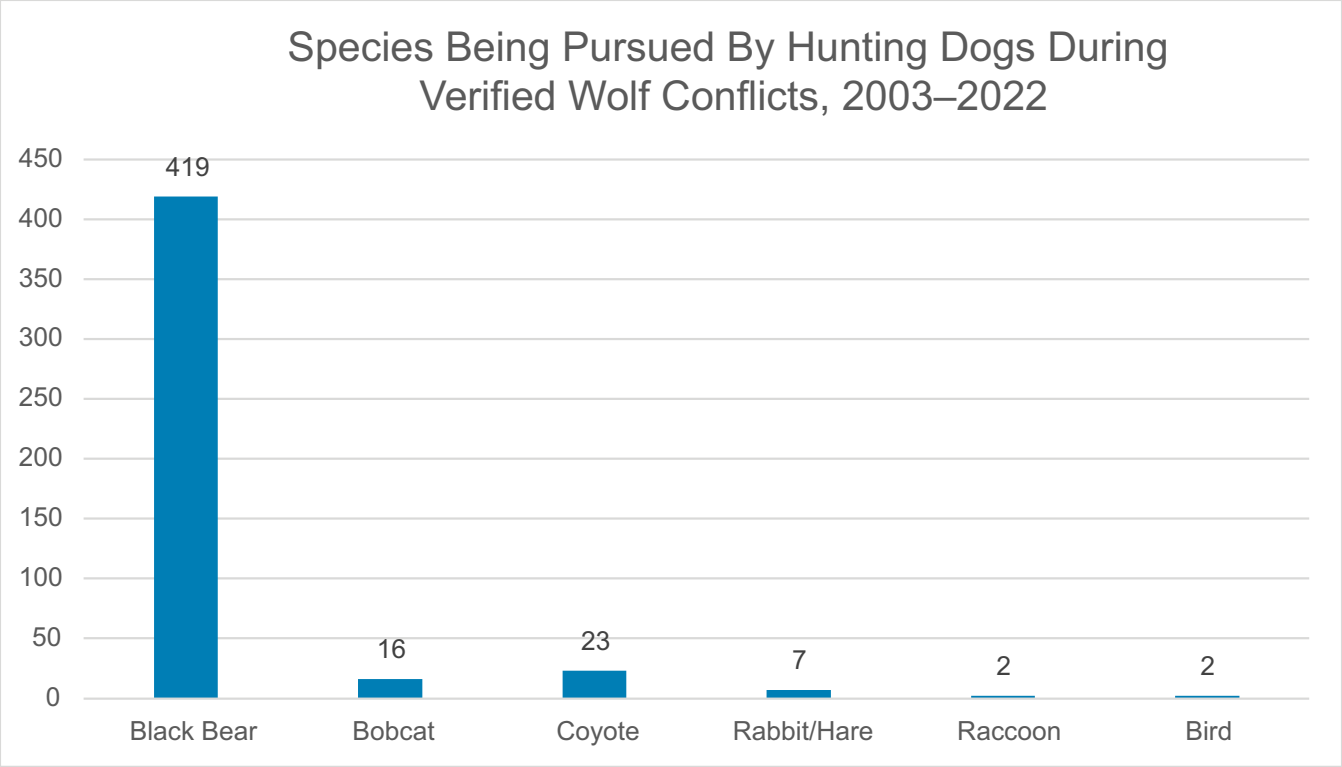

Figure 30. Number of hunting dogs injured or killed in verified wolf conflicts during legal hunting and training exercises based on species being pursued from 2003-2022. Data on species pursued was not collected prior to 2003.

Wolf attacks during hunting and training activities generally occur on lands open to public hunting when hunters/trainers are not in close proximity to the dogs. A study by Olson et al. (2015) compared differentiating variables between wolf attacks on hounds versus pets (non-hounds) and how the landscape of risk changed over time. The risk of wolf attacks on hounds increased during the black bear hound training season with closer proximity to the center of larger wolf pack territories in areas of less developed land but more public access. While hound depredations tend to occur in more suitable wolf habitat, non-hound or pet dog depredations are less predictable spatially, but tend to occur in areas with lower residential densities adjacent to large wildland areas (Olson et al. 2019).

Despite the annual occurrence of wolf conflict with hunting dogs and pets, it is a relatively small percentage of all wolf packs which actually depredate dogs (Wydeven et al. 2004). Larger packs have been shown to be more likely to attack hunting dogs and to attack in subsequent years (Wydeven et al. 2004). Larger wolf packs might be more apt to attack dogs to secure and defend territories, defend their pups or defend bait/kill sites. Nonetheless, oftentimes dogs killed by wolves are either partially or completely consumed. In early wolf recolonization in Wisconsin, it was recommended that hunters avoid areas occupied by wolves. As wolf abundance and distribution has increased in Wisconsin, it has become increasingly difficult for hunters to limit hunting/training activities to areas that are not occupied by wolves.

The primary response to hunting dog conflicts has focused on increasing public education/awareness when and where conflicts are verified. To help accomplish this, the department creates Wolf Caution Area maps with a four-mile buffer around the location of the verified conflict. This is to raise awareness and help

hunters make informed decisions about locations of conflict. Experience has shown once a pack has killed dogs in their territory, they will frequently continue to attack dogs during the remainder of the same season. These caution area maps are posted on the department's website and sent via email and/or text to the more than 12,000 subscribers currently. In addition, the department maintains a "Sharing the Land with Wolves" informational document which is available on the department's website and contains guidelines that individuals can follow to decrease the risk of conflicts with wolves. See the Public Education and Outreach section below for more details on these products.

For verified conflicts with pet dogs, an integrated approach (when allowed by wolf legal status) is used which may include both lethal and non-lethal controls. Non-lethal controls include but are not limited to the establishment of Wolf Caution Areas and automated notification by email and/or text, keeping pets on leashes, avoiding letting pets out at night or unsupervised, reducing attractants such as pet food around residences or other modification of pet handling procedures. Lethal controls may also be considered in response to verified pet conflicts and may include trapping and removal efforts by USDA WS or the issuance of a wolf removal permit to the owner of the pet dog. In addition, under Wisconsin Administrative Code and when wolves are not federally protected, on private land, the landowner, lessee or occupant of the land or any other person with permission of the landowner, lessee or occupant may shoot and kill wolves in the act of killing, wounding or biting a domestic animal. Those shootings must be reported within 24 hours to a department conservation warden and the carcass must be turned over to the department.

Human Safety And Risk Perceptions

Linnell et al. (2002) reviewed global data on wolf attacks on humans and identified criteria classifying types of aggressive behavior. Linnell et al. (2002) reported a total of 19 North American incidents in the 20th century; all but two were in Alaska or Canada (two aggressive encounters occurred in Minnesota, neither of which resulted in injury). No deaths were reported in North America in the 20th century. They concluded, "When the frequency of wolf attacks on people are [sic] compared to that from other large carnivores or wildlife in general it is obvious that wolves are among the least dangerous species for their size and predatory potential."

McNay (2002) also reviewed the historical record of wolf attacks in Alaska and Canada. These results are similar to those reported by Linnell et al. 2002. McNay reported 51 aggressive encounters in 20th century North America. Of those, 19 incidents were considered unprovoked wolf aggression (consistent with the results of Linnell et al. 2002) with habituation playing a role in 11 incidents. Bites were reported in all 11 of the habituated cases and 2 of the 7 non-habituated cases. Bites were severe in four cases, all involving habituated wolves. No fatalities were reported. Food conditioning was cited as the primary source of habituation. McNay concluded, "Injuries to humans inflicted by wolves are almost totally preventable because they are rare and the circumstances under which they occur are often predictable." He recommended negative conditioning and preventing access to human food to prevent habituation (McNay 2002).

Linnell et al. updated their 2002 work with data from the period 2002-2020 (Linnell et al. 2021). They found and categorized global cases of wolf attacks on people during this period, involving a total of 489 human victims, with most of the attacks involving wolves with rabies across Eurasia. Among all the documented attacks, 67 were categorized as predatory attacks, 380 as rabid attacks and 42 as provoked/defensive attacks (Linnell et al. 2021; Figure 31).

The report also detailed the two confirmed and well-documented fatal wolf attacks in North America during the 21st century. The first occurred in Saskatchewan in 2005, when a 22-year-old male was killed by wolves (McNay 2007). The second occurred in March 2010 when a 32-year-old female was attacked and killed while jogging in Chignik Lake, Alaska (Butler et al. 2011). Several wolves were lethally removed in response and genetic analysis confirmed their responsibility for the attack (Butler et al. 2011). Nonetheless, like the 2002 study, the authors concluded that "it is apparent that the risks associated with a wolf attack are above zero, but far too low to calculate."

To date, there have been no human injuries from wolves documented in Wisconsin. However, while wolves have never caused physical injury to anyone in the state, concerns for human safety have been reported. The first concern for human safety report in Wisconsin was received in 2001. From 2001-2022, there have been 78 reports of concern for human safety where wolves were confirmed to be present (Figure 32).

Attack type	Outcome	Number	Distribution
Predatory	Fatal	9	Canada 1, USA 1, Iran 6, Tajikistan 1
	Non-fatal	58	Canada 3, USA 1, Poland 4, Italy 1, Kosovo 1, Iran 36, Israel 10, India 1, Kyrgyzstan 1
Rabies	Fatal	14	Turkey 9, India 4, Kazakhstan 1
	Non-fatal	366	Croatia 1, Ukraine 57, Belarus 9, Moldova 2, Russia 20, Turkey 94, India 88, Mongolia 2, Iran 52, Iraq 4, Armenia 5, Azerbaijan 16, Kazakhstan 1, Kyrgyzstan 9, Israel 6
Defensive / provoked	Fatal	3	Turkey 3
	Non-fatal	39	North Macedonia 1, Iran 17, Turkey 11, Kyrgyzstan 3, Kazakhstan 2, Ukraine 1, Russia 3, Saudi Arabia 1

Figure 31. Overview of wolf attacks on people (expressed as number of victims) from the period 2002-2020, with special focus on 2015-2018. From Linnell et al. 2021.

When an individual reports wolf conflict and concern for human safety, USDA WS staff investigate the site to determine if wolves are involved and if a risk to human health and safety is present. Such reports can vary in severity from observation of a naturally behaving wolf, which typically do not result in classification as a human health and safety conflict, to reports of bold or unafraid wolves lingering near occupied buildings. When investigating these reports, USDA WS considers the behavior, level of habituation the wolf is exhibiting, the proximity to human-occupied dwellings, the frequency of wolf presence and other unique factors, such as presence of children, etc. There is no standardized evaluation of risk; therefore, the reports reflect both the risk perception of the persons involved as well as the professional evaluation of the totality of the circumstances.

Figure 32. Number of verified wolf conflicts classified as human health and safety conflicts (78 total) in Wisconsin by year. No reports were received prior to 2001.

All indications are that wolf attacks on humans are exceedingly rare. This becomes even more apparent when put into context with attacks/incidents involving other species such as black bear, domestic dogs, coyotes and even vehicle collisions with white-tailed deer. For example, Linnell et al. (2002) also summarized research on black bear attacks in North America, chronicling 500 attacks between 1960 and 1980 and 25 fatal bear attacks between 1900 and 1989. Black bear attacks are uncommon in Wisconsin but have been documented on several occasions, including nine (all non-fatal) between 2013 and 2021 (DNR, unpublished data). Domestic dogs are by far the most dangerous canid in the United States with an average of 4.6 million people bitten per year, resulting in 316,200 emergency room visits in 2008 alone (Holmquist and Elixhauser 2010). In the United States, there were 367 documented coyote attacks reported between 1977-2015 (Baker and Timm 2017), including 2 fatalities (Conover 2019). Finally, vehicle collisions with white-tailed deer resulted in an average of 522 injuries and 10 fatalities per year in Wisconsin between 2006 and 2010 (WI DOT).

While risk of an aggressive wolf encounter is low, the perception of risk remains high for some Wisconsin residents (see Section 2). In August 2014, the department conducted a scientific public attitudes survey including an evaluation of the perception of risk among Wisconsin residents regarding wolves. Of the respondents, 44% were worried for their personal safety, while 37% did not indicate worry and the remaining 19% were neutral. Not only did some residents express concern for themselves, 64% of respondents who lived within wolf range worried about the safety of the children and 72% were worried about the safety of their pets, increasing up to 78% if walking their pets where wolves live. Only 16% of respondents expressed no concern about their pets' safety in wolf range. The department conducted a similar scientific assessment in 2022 (Bradshaw et al. 2022) and found that worry for personal, pet and child safety while outdoors in areas where wolves live had decreased since 2014. Nevertheless, a majority of respondents indicated they would feel worried for safety of pets and children while outdoors in areas where wolves live. Clearly, it is important to recognize this perception and provide science-based information for the public to understand the relative risks associated with wolves and best practices to avoid negative interactions.

Integrated Wolf Conflict Management

A fully integrated wolf conflict program refers to a program which includes both proactive efforts to prevent conflict along with reactive efforts by responding to wolf conflicts using non-lethal and/or lethal control options. In determining a conflict management strategy, preference is typically given to non-lethal methods when they are deemed practical and effective. However, non-lethal methods may not always be applied as a first response to each conflict. The most appropriate initial response to a wolf conflict could be a combination of nonlethal and lethal methods. Other times, such as a farm experiencing chronic depredation by wolves which have been conditioned to non-lethal techniques, the most appropriate strategy may be application of lethal methods alone. The decision to use either non-lethal, lethal or a combination of the two methods must consider the constraints and nuances of each situation. For example, lethal control techniques may not be practical in areas that have high human or domestic pet activity, while some non-lethal methods may be inadequate in some scenarios, such as the use of fladry at conflict sites greater than 200 acres. Regardless, it is important to note that no abatement measure, whether lethal, non-lethal or a combination thereof, has been proven to be 100% effective in eliminating wolf conflict. Decades of experience in addressing depredation conflict Wisconsin have shown that using both lethal and non-lethal abatement techniques is more effective in reducing livestock conflicts than a solely non-lethal approach. Therefore, a fully integrated approach which allows the broadest range of options to be tailored to each conflict scenario typically offers the most practical and effective conflict reduction program.

The highly selective lethal removal of individual wolves or wolf packs by governmental agencies is considered by many professional biologists to be an important part of recovery and conservation programs for wolves (Breck and Meier 2004, Ruid et al. 2009). David Mech wrote, “lethal control will remain the ultimate means of curbing wolf damage to livestock and pets,” and, “direct lethal control is still usually the only practical course under most conditions” (1995). The Wildlife Society stated in their technical review of the restoration of wolves in western North America that, “control of wolves preying on livestock and pets is imperative and should be prompt and efficient if illegal killing is to be prevented and human tolerance of the presence of wolves is to be maintained” (Peek et al. 1991). A more recent review of large carnivore management by The Wildlife Society in 2012 stated, “…a large share of the North American public tolerates their presence (large predators) and realizes that management (harvest/agency control) at some level is at times necessary” (Peek et al. 2012). In a scientific public attitudes survey conducted by the department in 2014, “Eliminating wolves from areas where they are attacking domestic livestock,” was the second most frequently selected “high priority” management objective. The humane killing of wolves in response to conflicts with domestic animals or human safety was also supported by a majority of respondents (Holsman et al. 2014). Similar research conducted in 2022 (Bradshaw et al. 2022) found an overall slight increase in opposition to lethal control of wolves in response to wolf-related conflict, yet the majority of respondents indicated support for some type of lethal control in each wolf conflict scenario.

In addition to onsite conflict management, the department’s wolf conflict program also focuses on proactive public education efforts designed to promote coexistence with wolves and prevention of negative interactions. These efforts include an interactive mapping application displaying the location of verified wolf conflicts, two education brochures, annual depredation summary tables, development of Wolf Caution Area maps around verified hunting dog and pet depredations and email and text message alerts to subscribers. The department and USDA WS have also worked with farming and ranching organizations to host training

sessions designed to discuss animal husbandry practices, fencing, carcass management and agency implemented non-lethal wolf conflict deterrents. See the Public Education and Outreach section below for more on these materials.

Compensation For The Loss Of Domestic Animals

The department began compensating for wolf damages in 1984 as a result of legislation established in the 1983-1985 state budget (1983 Wisconsin Act 27). This legislation required that the department provide compensation for damages caused by all species listed in the state as endangered or threatened and that funding for damage compensation be provided by the Endangered Resources program. In the 1999-2001 state budget (1999 Wisconsin Act 9), funding from the sale of the Endangered Resources license plate was added as an additional revenue source for wolf damage compensation and it also directed that the department continue to provide compensation for wolf damages even after wolves were delisted.

From 1984 through 2004, the department's Bureau of Endangered Resources administered the compensation program and during that time, there were relatively few claims each year. In 2005, as a result of an increasing number of claims and some disagreement between livestock and pet owners and the department on the value of depredated animals, the department promulgated administrative rules in Chapter NR 12, Subchapter III. This subchapter of code guides the wolf compensation program and details processes for establishing compensation limits and other claim eligibility requirements. Under these rules, livestock owners are compensated for the fair market value of the animal lost as determined by a panel of three livestock experts (one each from the Wisconsin Farm Bureau Federation, UW Extension and Wisconsin Department of Agriculture, Trade and Consumer Protection). Hunting dog and pet owners are compensated up to $2,500 per animal for the loss of hunting dogs or pets. Veterinary costs resulting from injury to livestock, hunting or pet dogs are also eligible for reimbursement.

The same administrative rules also established eligibility requirements for producers claiming the loss of missing calves. The department provides reimbursement for calves that are lost above the normal loss rate (2.3% for natural causes of mortality) for a beef cow-calf operation for probable wolf depredation as determined by the department or its agent. There have been a few studies on missing calf rates and detectability demonstrating that wolf-caused mortalities can be difficult to detect. Detection rates can vary depending on habitat, operation location (e.g., proximity to forested lands, fenced pastures or open private pastures) and animal husbandry practices. Both Oakleaf et. al (2003) and Bjorge and Gunson (1985) reported one out of every 6.7 missing cattle were able to be recovered during their studies in Idaho.

Following federal delisting of wolves in January of 2012, the state legislature passed 2011 Wisconsin Act 169 which in part directed the department to continue providing damage compensation for death or injury caused by wolves to livestock, to hunting dogs other than those being actively used in the hunting of wolves and to pets. However, unlike the previous wolf compensation program, funding for damage compensation comes from the sale of wolf hunting/trapping applications and license sales when wolves are not listed as threatened or endangered at the state or federal level. If the funding generated from wolf hunting application and license sales is not sufficient to pay for all wolf depredation claims in a given year, each claim is prorated according to available funding. Through proration, claimants receive a percentage of the compensation they are eligible for. In the first three years of the new funding source, revenue was sufficient to pay for all wolf claims. Along with the change in funding sources for wolf damage payments, the department wolf damage

management and wolf damage compensation programs transitioned from the Bureau of Endangered Resources to the Bureau of Wildlife Management, the latter of which continues to administer the program today.

Between 1985 and 2021, the department has paid out over $3 million for reimbursements of confirmed or probable wolf damages. Between 1985-2020, the department has provided compensation for 1,250 missing calves along with verified losses of 684 verified calves, 406 hunting dogs, 262 sheep, 243 chickens, 150 turkeys, 149 cattle, 69 captive white-tailed deer, 67 pet dogs, 26 horses/donkeys, 23 goats, 4 llama and 2 pigs (Appendix C). Additional compensation has been paid out for veterinary expenses related to livestock, dog and pet injuries. It is also important to acknowledge these figures represent only livestock where the owner requested compensation and do not include depredations where compensation was not requested or depredations that were not reported to or verified by the department or USDA WS. Livestock producers are not compensated for non-depredation impacts caused by wolves (Wisc. Stat. 29.888).

Public Education And Outreach

Wolf education programs have played an integral role in wolf recovery in Wisconsin (Troxell et al. 2009) and will continue to be an important part of wolf management into the future. Education efforts by the department have included providing wolf-related information on the agency website, periodic news releases, email alerts, social media, contributing to news and media and delivering wolf presentations. Other efforts have included collaborating with other agencies, tribes and non-governmental organizations on various education fronts and developing resource pamphlets to provide targeted, practical guidance to producers, hunters, recreationalists, homeowners and the general public.

Online Resources And Targeted Outreach

The department website serves as a centralized location to find wolf-related information, updates and resources. Those interested in learning more about wolves in Wisconsin can visit the department's website and visit several wolf-specific webpages which include a variety of information on topics from gray wolf biology and history of wolves in Wisconsin, to depredation and conflict reports, to updates and information on wolf harvest seasons.

Publications

Over the years, the department has periodically worked with partner groups to develop or distribute various educational publications. Two recent such documents contain guidelines and practical steps to be taken to lessen the chance of wolf habituation and/or conflict. The first, titled "Sharing the Land with Wolves," contains a variety of advice on common scenarios and activities, such as working, hunting, camping, raising livestock and keeping pets safe while in wolf country. The second, titled "Wolves in Farm Country in Wisconsin," is catered directly to livestock producers and includes technical advice on preventing wolf conflict and what to do in the event of wolf/livestock conflict. Both documents contain contact information for those who want to learn more.

Wolf Depredation Reports, Maps And Caution Areas

The department website also contains several webpages dedicated to sharing information on wolf involved conflicts across the state, including guidance for preventing and reporting conflict and summaries of annual

wolf damage payments per year. The webpage also hosts an interactive Wolf Depredation and Threats Map which allows users to visually display the locations of verified wolf depredations and threat conflicts between 2013 to the present (Figure 33). The mapping tools allow users to customize maps and the ability to display individual years or a series of years and the conflict types they want to display. Conflict types are separated into the following categories: livestock depredations, hunting dog depredations, pet depredations, threats to livestock and non-livestock threats. Non-livestock threats include any human health and safety complaints.

The department also establishes Caution Areas with a four-mile radius surrounding locations of verified injuries or depredations to hunting dogs and pets that occurred on lands open to the public (Figure 34). A caution area is established to warn hunters or others who may be recreating in an area where conflicts between wolves and a dog or group of dogs have been documented. Individuals accessing these areas are urged to exercise greater caution if they plan to train or hunt wild game with dogs or allow pets to run off-leash, especially in areas where multiple conflicts have been documented.

Email And Text Alerts

In addition to the website resources, anyone can subscribe for free to the department's email and text messaging update system to receive timely alerts and updates on a variety of topics (Figure 35). This enables subscribers to easily receive current information on topics of interest. Topics on wolves include wolf harvest season updates, management plan updates and wolf conflict notices. Wolf conflict notices include the type, date and general location of verified conflicts to share awareness and potentially reduce future conflicts in the area. Conflict notices include verified livestock depredations and harassments, verified dog depredations (both hunting dogs and pets) with caution areas and any conflict deemed a human health and safety risk. There are currently more than 3,500 individuals that receive the livestock depredation alerts and more than 12,000 individuals that receive the hunting dog and pet depredation alerts.

Figure 35. Anyone may sign up to receive free email and/or text alerts from the department on a variety of topics, including wolf harvest season updates and depredation alerts.

Wolf Ecology And Track Training Courses

Since 1995, the department has enlisted the help of certified volunteer citizen scientists with conducting carnivore snow tracking surveys to help monitor wolves across the state (see Wolf Population Monitoring section). Traditionally, courses in both wolf ecology and comprehensive carnivore tracking have been held each fall and winter by department staff. In addition to recruiting and training volunteer trackers, the other primary benefit of the courses is an outreach tool to anyone simply interested in learning more about wolves or tracking wildlife in the snow. Several partner organizations including the Timber Wolf Alliance, Timber Wolf Information Network and Northland College have offered parallel courses to increase education and training efforts (see below). The wolf ecology and carnivore tracking classes cover a variety of topics such as history of wolves in Wisconsin, biology and ecology of wolves, management of wolves, monitoring wolves, tracking basics, carnivore tracking and proper survey protocol and techniques.

Education And Outreach Partnerships

Numerous conservation organizations and dedicated individuals have been involved in supporting wolf conservation and education efforts in Wisconsin over the last several decades. Perhaps chief among these important contributors in Wisconsin have been the Timber Wolf Alliance and the Timber Wolf Information Network.

The Timber Wolf Alliance (TWA), hosted by the Sigurd Olson Environmental Institute at Northland College in Ashland, Wisconsin, has been promoting science-based information and public education efforts on wolves in the Great Lakes Region since 1987. TWA's mission is to use science-based information to promote an ecologically functional wolf population within areas of suitable habitat and promote human coexistence with emphasis on Michigan and Wisconsin. Among their many activities, TWA has sponsored and delivered numerous educational workshops and presentations. TWA has created and distributed posters featuring award-winning wolf art to help annually commemorate Wolf Awareness Week in Wisconsin and across the US and North America since 1990. TWA has also participated on various department wolf advisory committees and sponsors workshops to train citizen scientists interested in participating in the department volunteer carnivore tracking program.

The Timber Wolf Information Network (TWIN) is a non-profit wolf education group founded in 1989. TWIN is based in Central Wisconsin with a sole focus on science-based educational outreach. Their mission is to increase public awareness and acceptance of the wolf in its natural habitat and its ecological role in the environment. TWIN offers numerous Wolf Ecology Workshops each winter which include lectures and field trips led by wolf experts. TWIN has also been instrumental in wolf research collaring and howl surveys in the Central Forest region of Wisconsin over the years.

Wolf Trapper Education

Basic trapper education has been a mandatory requirement for anyone wanting to trap in Wisconsin since 1992 (with some exemptions for landowners, farmers and those grandfathered in). Trapper education is a collaborative effort between the Wisconsin Trappers Association (WTA) and the department and is serviced through the Wisconsin Cooperative Trapper Education Program (WCTEP). This program provides important information on basic biology, trapper responsibility, rules and regulations, traps and trap systems and trapper ethics to thousands of interested participants annually. Through this cooperative program, advanced wolf trapper education workshops have also been offered in some years at facilities across the state. Like the basic trapper education program, advanced wolf workshops focus on traps, trap systems, trapper responsibility and rules and regulations. Throughout the program, there is an emphasis on respect for the animal as well as respect for other citizens.

A core component of wolf trapper education curriculum is focused on the Best Management Practices for Trapping. Best Management Practices (BMPs) are carefully researched educational guides to address animal welfare and increase trappers' efficiency and selectivity (AFWA 2019). First initiated by the Association of Fish and Wildlife Agencies in 1997, with support from all fifty states, BMPs for trapping are intended to inform people about traps and trapping systems considered to be state-of-the-art in animal welfare and efficiency. Development of BMPs has been ongoing with a strong focus on the identification of practical traps and trapping techniques that continue to improve efficiency, selectivity and the welfare of trapped animals. Through this program, specifications for traps are provided that meet or exceed all five criteria of

efficiency, selectivity, safety, practicality and animal welfare. The BMP program provides wildlife management professionals and the public with the data necessary to ensure appropriate animal welfare in regulated trapping programs. It also promotes regulated trapping as a modern-day wildlife management tool and instills public confidence and support through the sharing of science-based information.

The wolf trapping BMP, updated in 2019 and readily available online, is the product of ongoing trap research in Wisconsin, Minnesota and several Canadian provinces. Both the department and Wisconsin Trappers Association have been active in contributing to the development and dissemination of BMPs.

Wolf Population Health And Captive Wolf Management

Wisconsin wolves have been exposed to a number of diseases since the population has reestablished itself following extirpation. Evidence from morbidity and mortality investigations, collaring data and population estimations suggest that there have been limited impacts on the population from disease in recent decades. However, there is the potential for gray wolves to be exposed to several pathogens (bacterial, viral and fungal) as well as parasitic diseases and toxins and it cannot be predicted whether a disease outbreak may occur in the future that would have population level impacts. Wolf health monitoring is an important component of the management program to determine disease presence and potential impacts including population-level changes.

It is also important to note that changing environmental landscapes, global travel and increased contact between wildlife and domestic species has resulted in a number of emerging diseases as well as the translocation of diseases worldwide (Daszak et al. 2000, Bengis 2004). Because it is difficult to predict which diseases may emerge and impact our wolf population, it is imperative that populations be monitored and mortalities be investigated when warranted (Jones et al. 2008). As the transmission of many diseases can be multi-factorial (age, species susceptibility, social structure, previous exposure, increased contact with carrier populations, density-dependent, magnified by distress, etc.) population dynamics should also be monitored and evaluated. Community relationships should continue to be fostered that allow citizens to report unusual lesions, mortality events, unusual/abnormal behavior or population changes to assist in monitoring diseases of known concern as well as those that may be emerging.

The physiologic similarities between domestic and wild canids (most notably wolves and coyotes) have indicated that these wild canid species are susceptible to many of the infectious organisms that domestic canid species are. However, susceptibility, level of exposure and ability for an infection to be maintained and be a source of infectious agents for others aren't always the same. The exposure of wildlife populations to disease agents, how they are maintained in certain populations, when they cause disease and how these agents cycle are ongoing questions. Improvements in technology are allowing researchers better tools to address the questions and should assist in future management decisions.

Primary Disease Agents Of Concern To Wolves In Wisconsin

The following section provides an overview of the disease agents that gray wolves may be exposed to in Wisconsin as well as possible past and future impacts. Individuals should be alert of the presence of sick or dead gray wolves on the landscape so that disease occurrences can be identified and appropriate response measures taken, if warranted. Monitoring mortalities within the wild gray wolf population can help provide

information on the impacts of disease. This in turn leads to better management of these populations through both increased knowledge of possible health implications and identification of areas where knowledge needs to be expanded through research.

Canine Parvovirus

Canine parvovirus (CPV) is a highly contagious virus that has been known to infect multiple wild carnivores. Infection with CPV is through contact with feces containing the virus or contact with fomites (other objects) that have been contaminated with the virus. CPV is highly contagious and resistant to many common detergents and disinfectants.

Clinical signs typically develop within 3-7 days of infection and can include lethargy, anorexia and fever followed by vomiting and hemorrhagic diarrhea as the virus infects and destroys cells in the small intestine.

First detected in domestic dogs in 1978, this virus spread quickly through the world (Hoskins 1998). Wisconsin wolves were first noted to be impacted by CPV in the early 1980s and it was apparently a factor that caused the wolf population to drop from 25 wolves in 1980 to 14 in 1985 (Wydeven et al. 2009). A drastic decline in the gray wolf population on Isle Royale where the population dropped from 50 in 1980 to 14 in 1982 was first attributed to parvovirus; however, subsequent review of the data indicated that malnutrition and other factors offered a more accurate explanation of the decline (Peterson 1995, Mech 2011). The department tested for titers to canine parvovirus through 2004 and generally found that the vast majority of wolves in the state have been exposed to the virus. Testing for exposure to the agent was discontinued because the exposure prevalence in the adult population appeared constant and the exposure seemed to have little effect on population growth. Mortality investigations should continue to take into consideration CPV and test for the agent when appropriate.

Mech and Goyal (2011) examined seroprevalence of canine parvovirus for a wolf population in northeast Minnesota from 1973 through 2007. They determined that the main period when the disease affected pup survival and population change was 1987 through 1993. While seroprevalence remained at about 70% through more recent years, little effect was documented on wolf population growth. The pattern was probably similar in Wisconsin, with the greatest impact on the wolf population in the 1980s and little impact in the 1990s when the wolf population averaged a 22% annual increase despite finding that most wolves tested had antibodies to canine parvovirus.

As there are multiple strains of canine parvovirus and it is widespread in domestic dogs and other wildlife, it is quite possible that a more virulent strain may emerge to which the Wisconsin wolf population is more susceptible. As such, future impacts on the population could be significant and population estimations and mortality monitoring should continue.

Humans are not susceptible to canine parvoviruses.

Canine Distemper Virus

Canine distemper virus (CDV) is a contagious, systemic, viral disease that has been documented in Canidae, Mustelidae, Mephitidae and Procyonidae in Wisconsin. Mortality in populations is highly variable and is dependent on the virus strain and the susceptibility of the population.

CDV is an enveloped virus that needs the envelope to be infective. This envelope is made of lipids that are easily removed by many disinfectants. As such, most infections occur from close contact with an animal that is actively shedding the virus or from fomites when conditions are suitable for the virus to survive.

As CDV can infect multiple families in the order Carnivora, vertical transmission between multiple wildlife populations is possible. Signs are influenced by the virus strain and its virulence, environmental conditions, host age and immune status as well as the species infected. Clinical signs can include conjunctivitis (inflammation of the tissues surrounding the eye), pneumonia, diarrhea, anorexia, severe dehydration, neurologic changes and hyperkeratosis (or thickening of the skin).

CDV has been documented as the cause of death in necropsies of gray foxes, raccoons, skunks and ermine in Wisconsin. CDV has been implicated in high wolf pup mortality in 1999 and 2005 in Yellowstone National Park (Almberg et al. 2009). Nelson et al. (2012) concluded that the lack of exposure to CDV in pups and yearlings, compared to canine parvovirus, in the Canadian Rocky wolf population was likely due to the higher virulence of CDV and the resultant higher mortality in pups. Similar to canine parvovirus, CDV will likely continue to be a mortality factor in the Wisconsin population; however, the effect on the population could vary greatly dependent on the ability of the remaining wolf population to absorb the impacts of CDV-associated pup moralities.

Humans are not susceptible to Canine Distemper Virus.

Rabies

Rabies is a contagious viral disease of mammals that results in acute fatal encephalomyelitis (inflammation of the brain and spinal cord). Skunks and bats serve as the reservoir populations for rabies in Wisconsin, however, transmission to other species can occur.

The rabies virus replicates in the nervous tissue and then is passed into the salivary glands, making saliva infectious. The most common route of transmission occurs when an infected host bites an uninfected animal, creating an opening into the body for the rabies virus in the saliva to enter. Rabies can also enter the body of a susceptible host through contamination of open skin wounds with infectious saliva or brain material. Documentation of rare events such as contamination of mucous membranes, aerosol transmission and corneal and organ transplantations have been reported (CDC 2013).

There are no clinical signs that are specific to rabies infection (Rupprecht 2001). Any behavioral abnormalities that are associated with neurologic function should indicate that rabies could be a diagnosis.

Rabies has potential to affect wolves, but has yet to be detected in wild wolves in Wisconsin and other states of the Western Great Lakes region of the U.S. It has been detected in eastern wolves (Canis lycaon) in Ontario, with 15 cases between 1960 through 1994 (Theberge et al. 1994). Generally, rabies is rare in wolves south of the Arctic region in North America, but in northern environments it can be a major limiting factor on wolf populations (Ballard and Krausman 1997).

Humans are susceptible to rabies. In Wisconsin, skunks and bats are the most likely to carry the rabies virus but it has been documented in dogs, cats, foxes, raccoons and livestock (Wisconsin Department of Health Services). If an individual is bitten by any animal, they should thoroughly clean the bite wound and contact their local health department.

Heartworm

The primary worm that is encountered in the US is Dirofilaria immitis. It is a nematode that resides primarily in the pulmonary arteries but can also be found in the right ventricle of the heart. These worms can stimulate an inflammatory response and in severe infection, cardio-pulmonary disease. The burden of worms is primarily dependent on the number of infected mosquitoes that the animal comes into contact with. Over 70 species of mosquito are competent intermediate hosts for the parasite. The larval stages are more apt to develop in the mosquito from L2-L3 when "the average ambient temperature is >81 F and the relative humidity is 80%" for 10-14 days (Atkins, Merck Veterinary Manual, 2020).

Adult worms typically live 3-5 years. It takes approximately six months for a heartworm larva to develop into an adult worm once a susceptible host has been bitten. This has impact on tests, especially as the available live animal tests only pick up infections that contain female heartworms that have reached maturity.

Coyotes and domestic dogs have long been considered a definitive host. As early as 1959, wild canids have been found with heartworm infections (Gier, Technical Bulletin, Kansas Agricultural Experiment). Many wild canids have been shown to be able to have patent infections (the worms can infect the canid, reproduce and release mircofilaria into vascular system for ingestion by mosquito host) including wolves, coyotes, red foxes and gray foxes. However, prevalence of D. immitis infection varies geographically, temporally, by host species, age of host species, density of mosquito vectors and climate. Further, infection with heartworm does not always equal clinical disease. The heartworm burden (number of adults) as well as the presence or absence of other health related conditions and immune responses can be related to the development of clinical responses to the infection.

Southwestern states have been identified as having the highest prevalence of infection in wild canids, most specifically coyotes, with prevalence of infection documented from 37% in California to 71% on the Texas/ Louisiana border in the early 1980s (Brown et al. 2012, Custer 1981).

The Minnesota Department of Natural Resources identified a prevalence of 7% in adult gray wolves in a sampling period extending from 2007-2013 (Carstensen et al. 2017). In a study using banked blood samples from Wisconsin wolves, researchers indicated that the prevalence in Wisconsin for heartworm infection was 9.2% on samples tested that were collected from 2001-2013 (Jara et al. 2016). However, when the study evaluated samples from a single year to compare with previously collected data, they identified that in 2003, 25% of the adults that were in the sample had heartworm infections. Evaluation of twenty-two diagnostic necropsies that were conducted from 2018-2020 by the department or submitted to pathology departments revealed adult heartworms in four of those wolves (18%). Very few wolves submitted for necropsy have had heartworm burdens that are considered severe enough based on visual and microscopic evaluation to have been a possible factor in the death (two of 90 necropsy submissions of wolves > six months old) in the last 10 years (Wisconsin DNR, unpublished data).

In the past, many northern states defined the optimum time for the transmission of heartworm larvae from mosquitoes to canids as being in the months of July through October, however climate change and associated temperature and humidity patterns could impact or increase the amount of time transmission can occur as well as composition of mosquito populations. Further evaluation of the prevalence of infection and/or changes in prevalence and possible impacts on wolf health could be promoted through research opportunities.

Sarcoptic Mange

A highly contagious disease of canids worldwide, sarcoptic mange is caused by a mite whose entire life cycle is spent on its host and is usually species specific. Sarcoptic mange mites are external parasites that are adapted to different hosts (humans have their own that causes scabies). These mites infect the skin causing itchiness, hair loss, scabbing and make the skin prone to secondary infections from bacteria and yeast. Depending on the host response to these mites, the infection may be mild or severe.

Transmission typically occurs through direct contact; however, infestation by indirect contact is possible as dislodged larval and nymph stages of the mite can remain infective in the right microclimate (high humidity and mild temperatures; Bornstein et al. 2001).

Typically, intense pruritus (itching) is noted with sarcoptic mange. Papules, thick crusts and secondary bacterial and yeast infections are also common. If the infection continues, oiliness as well as severe thickening of the skin can occur. It is also possible that asymptomatic carriers exist.

Sarcoptic mange was first identified in Great Lakes wolves in 1991 along the Wisconsin/Minnesota border and may have been a factor in a minor decline in the state wolf population in 1993 (Wydeven et al. 2009). Between 1991 and 1996, 27% of wolves handled showed sign of mange mite infestation. As the population has grown, generally <10% of handled wolves have signs consistent with mange; in 2010, only one of 35 (3%) wolves had signs consistent with mange.

Sarcoptic mange will likely continue to be a disease of concern for wolves in Wisconsin and adjacent states. The effects of mange may change dependent on population and climate dynamics as well.

Humans can become infested with sarcoptic mange. However, it requires close contact to an infected animal and the mite cannot reproduce in humans making the infestation self-limiting (CDC 2014). Staff working with wolves that are exhibiting skin lesions or hunters/trappers that harvest a wolf with skin lesions should wear appropriate personal protective equipment such as gloves and other clothing to cover their skin.

Toxins

Wolves are unlikely to be exposed to any serious environmental contaminant issues while in their natural habitat. Reports of wolves being exposed to environmental contaminants have been published in the scientific literature but are rare in North America. Existing reports are often associated with exposure to PBT (persistent, bioaccumulative and toxic) chemicals, which is not surprising given that wolves are apex predators and any exposure would likely be the result of accumulation through the food chain. Research is ongoing on the impacts these chemicals may have on wildlife and whether adverse health impacts occur.

While exposure to harmful levels of environmental contaminants have been considered relatively rare for wolves in Wisconsin, there have been documented cases of intentional poisoning resulting in mortality events. These illegal poisoning events were the result of landowners using pesticides and other poisons to kill wolves they perceived as a nuisance. Unfortunately, in addition to wolves, many other wildlife species are also killed after exposure to these contaminants.

Other Concerns

Wolves are susceptible to a wide variety of disease and parasites in addition to those described in this section (Kreeger 2003), but these are unlikely to have any major population effects on Wisconsin's wolves. As an example, Jara et al. (2016) tested stored blood samples collected from wild Wisconsin wolves between 1985 and 2011 for exposure to three tick borne bacteria in addition to heartworm infection. Their results indicated that wolves were exposed to the agents responsible for Lyme disease and anaplasmosis in a similar geographic distribution in the state as has been reported for humans and domestic dogs. The proportion of the samples that showed exposure were 65.6% and 47.7% respectively. While an increase in Lyme disease exposure has been noted, there is no evidence to suggest that it has impacted wolf populations in Wisconsin to this point.

Climate change may also cause wolves to be exposed to new disease agents or possibly change the virulence of existing diseases. For these reasons, disease monitoring should continue to be an important part of wolf management program.

Rehabilitation

The rehabilitation of wolves or wolf-dog hybrids has historically not been permitted in Wisconsin and is noted in Wis. Admin. Code s. NR 19.80(1)(8). Reasons for this prohibition include the difficulty in differentiating between wolves and wolf-dog hybrids, associated public safety concerns regarding wolf-dog hybrids and the lack of suitable release sites for rehabilitated wolves.

Captive Wolves

No person may possess a captive live, wild wolf or captive live wolf-dog hybrid unless the person holds the appropriate license or other approval as required under Ch. 169, Wisc. Stats. and is otherwise in compliance with Ch. 169, Wisc. Stats. and related administrative rules. The department may issue a Captive Wild Animal Farm License (CWAFL) to allow the possession of captive raised wild animals, but this license is not intended for animals taken from the wild. However, as stated in Ch. 169, Wisc. Stats., there are some public facilities exempt from the need to have a CWAFL to possess any wild animal. Examples of exempt facilities include a public zoo or aquarium (Wisc. Stats. 169.04[5]). Captive animal facilities may also be required to have licenses from other agencies, such as the U.S. Department of Agriculture and/or Wisconsin Department of Agriculture, Trade, Consumer Protection. There may be also local ordinances and regulations in place regarding the possession of captive wild animals including wolves or wolf-hybrids.

Wolf-Dog Hybrids

Wisconsin Administrative Code s. NR 16.11(5) designates hybrids of gray wolves (Canis lupus), eastern wolves (C. lycaon) or red wolves (C. rufus) and domestic dogs (Canis familiaris) as harmful wild animals. As such, wolf-dog hybrids or 'wolf dogs' are regulated consistent with provisions of Ch. 169, Wis. Stats., relating to harmful wild animals, including the possession, taking, transporting, propagating, buying and selling of wolf-dog hybrids. Any person wishing to possess a wolf-dog hybrid in Wisconsin must obtain a CWAFL, be in compliance with captive wildlife pen specifications and transportation standards and meet application, record-keeping and reporting requirements. Additional federal, state and local restrictions may also apply.

Section 4: Wolf Management In Wisconsin: From Recovery To Sustainable Management


ISTOCK/LYNN BYSTROM

Background

Historically, Wisconsin's wolf recovery and management plans have used numeric winter minimum population counts as the primary measure of success and to determine appropriate management strategies in response. The primary benefit of this approach is that such goals are easily defined and readily measured via population abundance surveys. Ideally, numeric goals should accurately reflect the intersection of biological and cultural carrying capacities for the species. However, defining and measuring this intersection, regardless of species, is incredibly challenging. For example, wildlife populations are often adaptable and biological conditions are ever-changing. Every individual person may have a different perception of species abundance, species benefits and impacts, and a personal set of experiences deeply rooted in their values that inform their perspective. Additionally, numeric population goals, whether applied statewide or regionally, may unnecessarily restrict decisions and lead dialogue away from the underlying issues requiring attention. Further, estimating the abundance of wildlife populations with enough precision to determine whether the population is meeting a narrow numeric goal typically demands high resource and financial investments and may be impractical in the long-term. These difficulties may lead to illusions of success or failure regardless of actual conditions on the ground. Therefore, although numeric population goals may effectively account for basic biological requirements, they can easily fail to account for changing biological conditions, evolving social factors and public attitudes, and advancements in scientific understanding.

An alternative to numeric population goals is to prioritize management actions in response to existing biological and social considerations as observed in the field and scientific data. This approach strives to find an effective balance between potentially competing objectives associated with wolf management (i.e., facilitating wolf-related benefits while minimizing wolf-related conflicts). Implementation of various management actions, including whether to maintain, increase or decrease a population in a specific management zone, would be based upon specific factors reflecting important biological and social factors in that zone. Benefits of this approach include the ability to tailor management regionally, increased focus on stated objectives and observed outcomes, and greater ability to adapt management actions based on real-life conditions. Drawbacks include less defined target population levels and disagreement on the priority of metrics used to guide decision-making. However, this type of approach to wildlife management continues to grow in use across North America, adding rigor and transparency to decision-making processes and resulting in increased public confidence and buy-in to management actions (Fuller et al. 2020).

This approach is already in use for a variety of other harvested wildlife species in Wisconsin including black bears, wild turkey, ruffed grouse and white-tailed deer. The lone exception is elk management in Wisconsin which is currently guided by numeric goals for each elk herd. However, elk in the state continue to be managed in a recovery status, as were wolves in the past, and numeric goals may not be appropriate for Wisconsin elk in the future.

Since the previous state wolf management plan was developed in the late 1990s and reaffirmed in the mid-2000s, wolf population size and distribution in the state have increased significantly. Alongside that growth, a wealth of scientific research and wildlife management experience has been accumulated leading to a vastly improved understanding of the wolf population, the various influences wolves have on the landscape and the effects of various management actions. Despite the benefits of this knowledge, it remains abundantly clear that the social, biological and legal landscapes in which wolf management and stewardship occurs are likely to continue to evolve.

Wolf Management Plan Goal

The preceding sections of this management plan provide a foundation of science-based information on wolves in Wisconsin and describe the current biological, social and legal contexts in which wolf management occurs. The following section formalizes a recommended path forward that demonstrates the state's dual commitments of maintaining a sustainable and ecologically functional wolf population to provide the benefits therein, while also being responsive in addressing wolf-related conflicts and concerns. Where past state wolf management plans have largely focused on wolf recovery, this plan recognizes the biologically recovered status of gray wolves in Wisconsin. Accordingly, this plan turns attention from wolf recovery to long-term stewardship and sustainable management of the state's wolf population.

The goal of the Wisconsin Wolf Management Plan is to:

Ensure a healthy and sustainable wolf population
that fulfills the numerous ecological, cultural and recreational benefits of wolves,
while being responsive in addressing and preventing wolf-related conflicts
and recognizing the diverse values and perspectives of all citizens in Wisconsin.

To do so, this plan recommends a management framework based upon the principles of adaptive wildlife management. Six specific objectives have been developed to focus efforts toward achieving this goal. These objectives focus on core areas of management priority while explicitly recognizing that inherent tradeoffs exist among some of the objectives. Within each objective, the plan outlines a series of strategies and products to link the objectives to on-the-ground implementation. In essence, strategies are intended to provide direction whereas products are specific actionable items or processes in support of a strategy.

These objectives (and their associated strategies and products) were developed by the department in accordance with current state and federal law and informed by principles of wildlife management, the scientific literature and input and discussion from the department's Wolf Management Plan Committee, results of social science surveys, public input and consultations with Tribal Nations.

Detailed objective descriptions and metrics for evaluation are provided with each objective. These descriptions and metrics provide a clearer understanding of what is represented by each objective, how they may be measured and what conditions constitute satisfactory progress toward meeting the objectives.

Note: The objectives include arbitrary letter designations for organization; the objective letter designations and order in which they are presented do not indicate a level of importance among the objectives. Indeed, they are all important components of a holistic approach to stewardship and management of the state's wolf population.

Implementation Of The Wolf Management Plan

To effectively implement the plan, the use of a formal yet adaptable approach to evaluating objectives and guiding decision-making is recommended. This process should be values-based, informed by science and include routine evaluation aimed at measuring progress toward the management plan goal and objectives (Figure 36). This style of adaptive management ultimately strives to balance public preferences regarding population sizes and related benefits with potential and realized negative interactions with wolves by adjusting management actions and methods, such as conflict abatement and public harvest, in response to conditions observed in the field.

The plan recommends engaging the department's Wolf Advisory Committee in the process to annually assist the department in reviewing data, metrics and trends related to existing conditions on the ground in each wolf management zone. It is recommended to evaluate conditions in each zone against plan objectives based upon the information contained in the plan. The department's Wolf Advisory Committee can serve to help evaluate progress toward plan objectives, provide valuable input from a variety of perspectives and deliver preliminary recommendations to department decision-makers when requested. When existing conditions are found to be satisfactory or trending in a positive direction based on scientific data, management activities would be recommended to generally continue status quo or with minor modifications to encourage further progress. However, if a review determines progress toward more objectives in one or more zones is found to be unsatisfactory, the plan recommends discussions be had to identify the factors driving the lack of progress. Once identified, resources may be directed toward alternatives (i.e., modification or addition of management actions) designed to address the situation. Over time and with accumulated experience, additional metrics may be developed to help measure conditions and progress. It is recommended that these actions (including prescribed harvest) be implemented, their outcomes monitored and the results evaluated again the following year (or otherwise as appropriate) as part of the adaptive management process (Figure 36).

This process can be applied broadly and to a variety of areas related to wolf management, including development of harvest quotas. In years with regulated harvest, this plan recommends the department's Wolf Advisory Committee provide input and preliminary recommendations to the department on harvest objectives and quotas. To do so, the Wolf Advisory Committee should be provided relevant scientific information and data for review and discussion, including science-based population modeling and projections to demonstrate how the population may respond (i.e., annual population increase, maintenance or decline) to various harvest levels, with measures of uncertainty inherent in those estimates. Next, zone-specific management objectives and recommendations should be developed that would be most likely to improve or maintain satisfactory progress toward meeting the plan's objectives. These recommendations should be informed by the zone-specific evaluations described above and consistent with the information contained in this plan. Doing so encourages dialogue aimed at determining the most appropriate quota based upon the totality of the factors involved.

This plan's goal is focused on a holistic and pragmatic approach to wolf management, conservation and stewardship. A primary advantage of this process is that it is designed to identify relevant successes and failures, more efficiently direct resources and encourage new and creative solutions. This approach also increases the likelihood that discussions are elevated toward addressing the important concerns required to

successfully meet all objectives. Finally, it is scientifically defensible and therefore more likely to support the long-term maintenance of full management authority upon future wolf delisting.

Effect Of Listing Status On Wolf Management

The historic and ongoing pattern of changes in the legal status of gray wolves predicts that during the lifetime of this plan, wolves may be under the full management authority of states and tribes in some years while under federal protections in other years. In Wisconsin, this changing status directly affects the ability of the department to fully achieve the goal and objectives of this plan. Specifically, if wolves in the state are included on the federal or state endangered species list and whether they are classified as endangered or threatened, directly affects the availability of lethal control (such as landowner removal permits or agency removal efforts) as an abatement option in response to wolf-related conflict and whether a public wolf harvest season can occur in Wisconsin (Table 15). Because these two items are critical components of a responsive approach to management and necessary to fully realize the goals of this plan, it is crucial that any actions outlined in the plan demonstrate the state's long-term commitment to sustainably and responsibly managing the wolf population once delisted.

This plan recognizes the value and biologically recovered status of gray wolves in Wisconsin. Accordingly, the plan supports long-term, collaborative and science-based wolf management in Wisconsin to allow full realization of the goal, objectives, strategies and products identified in the plan and within the scope of the law. This management plan describes the principles intended to guide the department's management of wolves when wolves are not listed on the federal and/or state list of endangered and threatened species. During times when wolves in Wisconsin are listed on the federal and/or state list of endangered and threatened species or there is a change in the listed status of wolves, the department will evaluate whether and to what extent the various components of this plan may be applied to ensure consistency with the listed status, the department's authority and applicable laws.

Federal Or State Endangered Species Status	Available Responses To Wolf-Related Conflicts	Public Wolf Hunting And Trapping Season In Wisconsin
Endangered	Non-lethal only*	No
Threatened	Non-lethal and lethal	No
None	Non-lethal and lethal	Yes

*Except in verified cases of human health and safety conflicts.

Table 15. A summary of how the federal or state endangered species status affects available conflict responses and public hunting and trapping of wolves in Wisconsin.

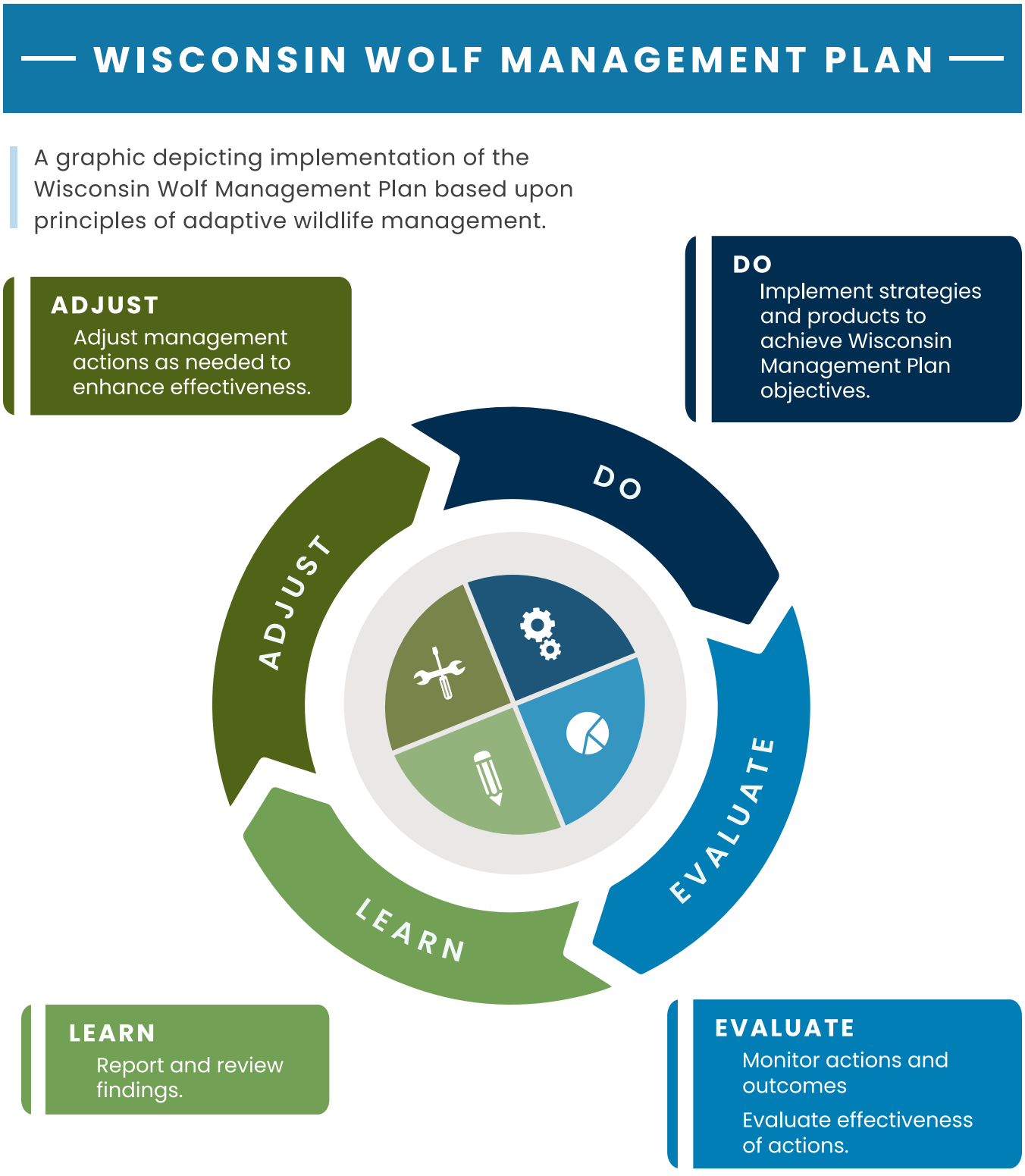

Figure 36. A simplified graphic depiction of the implementation process of the wolf management plan based upon principles of adaptive wildlife management.

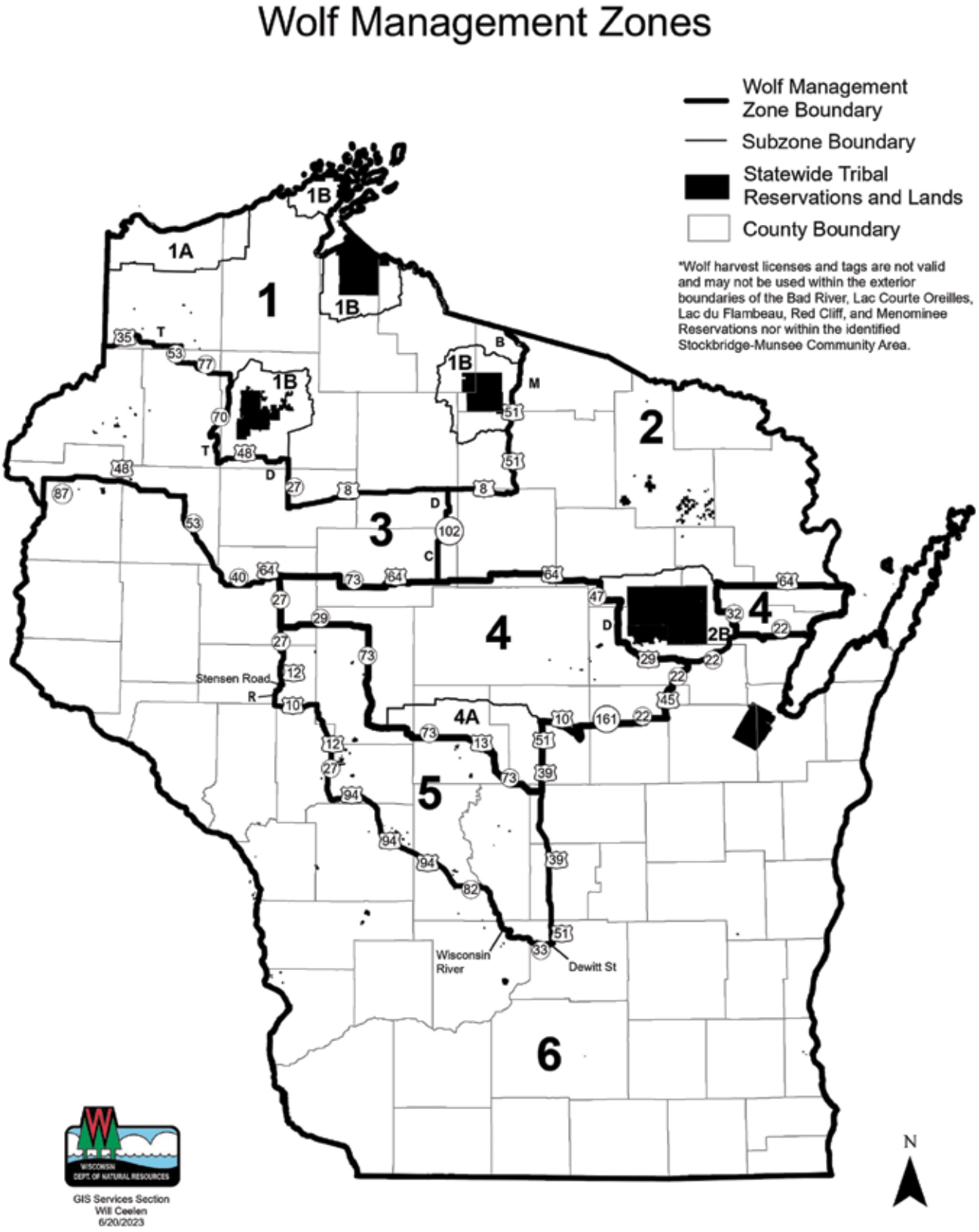

Figure 37. Wisconsin's wolf management zones as outlined in this management plan. See Appendix A for detailed zone maps. To respect tribal sovereignty, the tribal reservations of Bad River, Red Cliff, Lac Courte Oreilles, Lac du Flambeau, Menominee and the identified Stockbridge-Munsee Community Area will continue to be designated as zero quota areas for state wolf harvest on the state zone map.

Wolf Management Zones

Recognizing variability in habitat availability, conflict potential, land use and ownership, public tolerance and other biological, social and legal factors across the state, this plan outlines the use of wolf management zones. The use of wolf management zones has been an integral part of wolf management in Wisconsin for decades and is recommended to be continued. The purpose of wolf management zones is to delineate boundaries that generally encompass variation in habitat availability, conflict potential, land use and ownership, and other relevant factors, thus allowing management objectives and actions to be tailored on a regional basis to ultimately increase their effectiveness. However, zones often cover large areas of the state and wolf habitat quality and therefore wolf occupancy is not necessarily the same in all areas within a zone (e.g., areas of development or agriculture within a zone; Figure 39). In such areas of reduced habitat quality within a zone, relatively high levels of wolf mortality and reduced pack persistence are likely and long-term wolf presence is not expected or encouraged in these areas.

Wolf Management Zone Characteristics

This plan recommends dividing the entire state into wolf management zones consisting of a six-zone structure with four additional subzones identified within the larger zones (Figure 37; see Appendix A for detailed zone maps). These zones would apply to all management actions, including harvest. Previously, the department separately delineated wolf management zones and wolf harvesting zones. The plan recommends the use of the same zone structure and uses the broader term “wolf management zone” to encompass both concepts.

Identified zone boundaries typically follow established game management unit boundaries or major roads or rivers for ease of identification and law enforcement. Consistent with the current distribution of wolves and prior management actions, the density of wolves should generally be highest in the forested northern and central regions of the state (Zones 1, 2 and 5), intermediate in the agricultural/forested transition areas (Zone 3 and 4) and lowest in the more agricultural and human-dominated southern areas of the state (Zone 6). This approach also reflects results of the 2022 public attitudes survey which found the most common preference regarding wolf distribution was for wolves to occupy about the same amount of the state as their current geographic distribution (Figure 38).

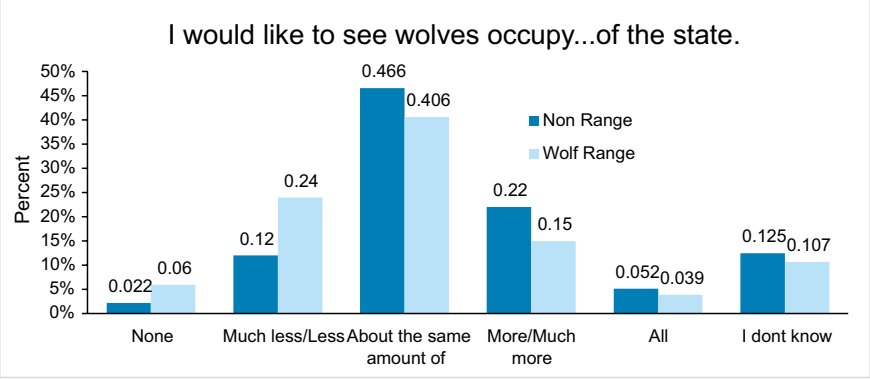

Figure 38. Preference for statewide wolf population distribution among range and non-range residents as measured by the department’s 2022 scientific survey of statewide public attitudes towards wolves.

In consideration of tribal sovereignty, to respect tribal values associated with wolves and to avoid potential jurisdictional confusion regarding management and enforcement, this plan recommends continuing to designate the Bad River, Red Cliff, Lac Courte Oreilles, Lac du Flambeau and Menominee reservations and an identified Stockbridge-Munsee Community Area (encompassing the majority of lands owned by or held in trust for the Stockbridge-Munsee Community) as zero quota areas for state wolf harvest on the state wolf harvest zone map.

Below are descriptions of the wolf management zones' characteristics and associated management priorities. While Objectives A, B and C are prioritized differently among the zones to reflect differences in habitat quality and conflict potential, the plan recommends that Objectives D, E and F be prioritized equally in all zones as part of a holistic and adaptive approach to management and stewardship.

- **Zones 1, 2 and 5:** These zones comprise the areas considered primary wolf range in the state. These areas are largely forested, contain numerous tracts of public lands and generally encompass the lowest human densities in the state (Table 17, Figures 39 and 40). Also within these zone boundaries are tribal reservations with federally recognized exterior boundaries and the designated Stockbridge-Munsee Community Area which are identified in this plan as zero quota areas for state wolf harvest, along with much of the off-reservation tribal trust land in the state.

  The plan recommends that the leading objective within these zones be to ensure a healthy and sustainable wolf population to fulfill its ecological role (Objective A). Addressing and reducing wolf-related conflict (Objective B) and providing multiple benefits associated with the wolf population (Objective C) are also recommended be considered in these zones, but decision-making should primarily be guided by the leading objective (A). Wolf-related conflicts should typically be addressed with site-specific abatement measures, except no abatement measures would typically be taken in cases involving wolf conflict occurring on public wildland areas (except any conflict deemed health and human safety). Wolf-related recreation is recommended to be encouraged in these zones, yet harvest be specifically considered secondary to ensuring the long-term sustainability and ecological functioning of the wolf population in these zones. Accordingly, wolf harvest is recommended to occur in these zones, but at rates generally lower than prescribed elsewhere.

- **Zones 3 and 4:** These zones comprise areas considered secondary range for wolves in the state due to the greater interspersion of agricultural and developed lands, less forested and public lands and increased human densities in these areas (Table 17, Figures 39 and 40). These transitional areas contain patches of quality habitat and are likely to continue supporting wolf populations in such portions of these zones, along with providing regional connectivity between core wolf habitats in the north and central parts of the state. However, other portions of these zones are largely agricultural or otherwise developed with low probability of wolf occupancy (Figure 43). Accordingly, wolf occupancy should not be encouraged in these areas of reduced habitat quality due to higher potential for conflict (Simpson et al. 2022). In particular, the western portion of zone 4 is largely agricultural and low-quality wolf habitat, more similar to zone 6 (described below). However, this area was included as part of zone 4 because of its position of being largely surrounded by more suitable wolf habitat making it unique from those areas contained in zone 6. Wolves are likely to occur throughout these zones, but in a sporadic fashion and at an overall lower density than in zones 1, 2 and 5.

The plan recommends that the leading objectives within these zones be twofold: addressing and reducing wolf-related conflicts (Objective B) and providing multiple benefits associated with the wolf population (Objective C), particularly wolf harvest opportunities. Ensuring a healthy and sustainable wolf population to fulfill its ecological role (Objective A) is also recommended to be considered in these zones, but decision-making is recommended to primarily be guided by the leading objectives (B and C). Accordingly, wolf harvest rates in these zones are recommended to be generally higher than prescribed in zones 1, 2 and 5 to provide ample harvest opportunity and potentially reduce wolf densities in less suitable areas of these zones, while simultaneously not jeopardizing the long-term persistence of some wolf packs within these zones.

- **Zone 6:** This zone encompasses much of the Driftless Area in the southwestern part of the state along with the highly agricultural and developed areas of southern Wisconsin, including most of the major urban centers of the state (Table 17 and Figure 39). These factors combine to significantly reduce the habitat quality for wolves in these areas. Individual packs have become established in pockets of more suitable habitat within this zone in the past and this is likely to continue. However, due to greater interactions with people and developed areas (e.g., highways), both the potential for conflict and wolf mortality rates are expected to be high in this zone and result in greater pack turnover rates and reduced pack persistence. In general, wolf pack occurrence and persistence in this zone is likely to be limited.

  The plan recommends the leading objective within this zone usually be addressing and reducing wolf-related conflicts (Objective B). Providing multiple benefits associated with the wolf population (Objective C) through harvest is also recommended to be considered in this zone, but decision-making is recommended to be primarily guided by the leading objective (B). Because wolf packs will generally be naturally limited in this zone due to reduced habitat quality, ensuring a healthy and sustainable wolf population to fulfill its ecological role (Objective A) is recommended to be given a reduced role in decision-making for this zone. Accordingly, the plan recommends that wolf harvesting licenses be readily available in this zone to allow local control over wolf occupancy and density in this zone.

Within the larger six-zone structure, two types of subzones designed to address localized concerns are recommended. The first two subzones (1A and 4A) would be used to reserve the ability to direct greater harvest pressure into those areas which have been historical areas of wolf/livestock conflict. The second two subzones (1B and 2B) would be designed to affect public wolf harvest levels in areas adjacent to large tribal reservations which support wolf packs primarily on these reservations.

- **Subzones 1A and 4A:** These two areas, the Lake Superior Coastal Plain east of Superior and portions of Adams, Wood, Portage and Clark Counties in central Wisconsin, have historically experienced concentrations of chronic wolf/livestock conflict (Figure 41). The plan recommends delineating these subzones to give managers the ability to affect harvest pressure in these areas to reduce local wolf densities in support of site-specific abatement measures intended to mitigate and prevent wolf depredations. This may be accomplished in several ways such as offering additional wolf harvesting licenses valid only within the subzone, allowing any valid wolf harvesting license to also be valid in a subzone or some other alternative or combination of options. It is expected that these subzones would be in effect by default to encourage proactive reduction of wolf densities in these

specific areas. However, if livestock conflict becomes reduced over time to lower levels deemed more tolerable, one or both subzones could be deactivated such that it would effectively function as part of the greater zone. Their use may also be restricted if public harvest pressure interferes with site-specific conflict abatement efforts (e.g., wolves becoming 'educated' to trapping efforts and reducing abatement trapping effectiveness).

In years when the subzones are active (expected to be most years), addressing and reducing wolf-related conflicts (Objective B) is recommended to be the leading objective within these zones and given priority status in decision making. In years when one or both subzones are not active, it is recommended those areas be considered as part of the larger surrounding zone and follow those zone objectives accordingly.

- **Subzones 1B and 2B:** The plan recommends delineating these two subzones to encompass the areas immediately surrounding the exterior boundaries of those tribal reservations and areas within wolf range which are designated as zero-quota areas and support reservation wolf packs. Subzone 1B would be a non-contiguous subzone located within the larger zone 1 and containing subunits consisting of lands adjacent to the Bad River, Red Cliff, Lac Courte Oreilles and Lac du Flambeau Ojibwe reservations. Subzone 2B would be located within the larger zone 2 and encompass lands adjacent to the Menominee reservation and designated Stockbridge-Munsee Community Area.

  These subzones would be designed to decrease the likelihood of harvesting wolves from reservation wolf packs whose territories extend beyond reservation borders by limiting the total amount of public wolf harvest which may potentially occur in these areas annually. Their use would be intended to respect tribal interests in these areas while also continuing to allow reasonable public wolf harvest opportunities. Together, these subzones are intended help balance competing social and biological factors unique to these areas and ultimately increase the department's ability to effectively manage the wolf population.

  These subzones would be open to public hunting and trapping of wolves on both public and private lands by individuals with a valid wolf harvesting license, consistent with the surrounding wolf management zone and quota. For example, individuals with a valid zone 2 wolf license could pursue wolves anywhere in zone 2, including those areas within subzone 2B. However, the areas within these subzones would be subject to early closure (i.e., before the full zone is closed) if a certain level of harvest was met anywhere within the subzone ("subzone harvest limit") at a time when the broader zone quota has not yet been met. Harvest in the remainder of the zone would remain open to fulfill the remaining zone quota. If the subzone harvest limit fails to be met, the subzone would remain open to wolf hunting and trapping as part of the larger wolf management zone, with the subzone closing when the zone it falls within closes. With this approach, wolf harvest opportunity is provided in these areas and wolves may or may not actually be taken within the subzones. If harvest does occur within the subzones and the predetermined subzone harvest limit is met, the early closure of the subzone would limit the total harvest specifically within these areas.

  The two subzones (1B and 2B) are recommended to have separate subzone harvest limits and operate independently of each other. The plan recommends that the subzone harvest limits for each subzone be established based upon past levels of wolf harvest within these areas. During the four

regulated wolf seasons held in Wisconsin between 2012 and 2021, annual total harvest within these subzones averaged 7.5 wolves (range 2-14) in subzone 1B and 1 in subzone 2B ([range 0-2]; Table 16). Based on these averages, the subzone harvest limit for subzone 1B is recommended to be four wolves and the subzone harvest limit for subzone 2B is recommended to be two wolves. In addition, to mitigate the total potential impact on any one subunit of subzone 1B, the plan recommends that if two wolves are taken within any single subunit of subzone 1B, the department should close that individual subunit to further harvest. In this scenario, the other three subunits would remain open to further harvest, pending the remaining subzone 1B harvest limit. The subzone limit values may be periodically reviewed as more experience is accumulated or in response to changing wolf population conditions, but they are not expected to be modified annually. Any such periodic review is recommended to be done in conjunction with the department's Wolf Advisory Committee and in consultation with affected tribal governments and the Great Lakes Indian Fish and Wildlife Commission. Further, because they are limits rather than quotas, the limits are not subject to the harvest declaration process.

It is recommended that only wolves legally harvested by licensed hunters or trappers during the wolf season (i.e., not those removed for depredation controls, vehicle kills, etc.) count toward the subzone harvest limit. This is because these subzones are designed only to affect public harvest in these areas and including wolves killed in the subzone by other sources (such as vehicle kills or depredation removals) could result in subzone limits being met before the season would be set to begin, thereby resulting in no reasonable harvest opportunity.

Any landowner or individual suffering wolf-related conflict within the boundaries of a subzone would be able to receive the same conflict abatement through the conflict program as those outside the subzone. The potential reduction in wolf harvest in these areas is not expected to increase wolf-related conflict because these areas have generally been occupied by wolves for years and significant additional wolf population growth is unlikely.

Finally, the plan recommends the department promptly initiate early closure of a subzone if and when harvest data indicates that a subzone harvest limit has been fully met. Closures would be consistent with the procedures used for standard zone closures identified in state law (i.e., 24-hour effective time and public notice via a press release and updates on the department website and phone), recognizing there is potential for some additional harvest to occur legally during the statutorily required delay in closure effective time.

Total Wolves Harvested By Season Within Subzone 1B And 2B Boundaries						
Subzone	2012	2013	2014	Feb. 2021	Total	Annual Average
1B	2	14	12	2	30	**7.5**
2B	1	2	0	1	4	**1.0**

Table 16: The total number of wolves harvested within the subzones during the past wolf seasons.

Zone	Area (mi2)	% Forest Cover and Wetland	% Agriculture	% Developed	% Other Landcover Type
1	7,897	90%	4%	1%	5%
2	7,089	87%	6%	1%	6%
3	4,446	77%	15%	2%	6%
4	4,957	49%	42%	4%	5%
5	3,247	73%	19%	2%	6%
6	28,440	34%	52%	7%	7%
Total	56,076	55%	34%	5%	6%

Zone	Area (mi2)	% Tribal Land	% Within Ceded Territory	% State Owned Or Managed Land	% MFL Open Land	% Federal Owned Or Managed Land	% County Forest Land	% Public Access And Ownership
1	7,897	6%	100%	13%	9%	16%	18%	56%
2	7,089	6%	79%	11%	8%	15%	13%	47%
3	4,446	<1%	100%	5%	4%	5%	14%	28%
4	4,957	<1%	63%	3%	<1%	<1%	2%	6%
5	3,247	<1%	11%	9%	2%	5%	17%	33%
6	28,440	<1%	8%	4%	<1%	<1%	<1%	5%

Table 17. Summary of size and important wolf habitat and land ownership considerations for the plan's six wolf management zones. See Figures 39 and 40 for visualization of landcover and land ownership types by recommended wolf management zone. Zone analysis in this table includes the subzones within the greater management zones. Landcover categories are derived from Wiscland 2 Land Cover Project, 2016. Forest cover category includes forested wetlands and wet meadows, agriculture category includes forage grassland and pasture and other landcover type category includes open water, barrens, shrubland and wetlands characterized by floating aquatic vegetation. Area of tribal lands includes both reservation and off-reservation trust lands of the federally recognized tribes in Wisconsin.

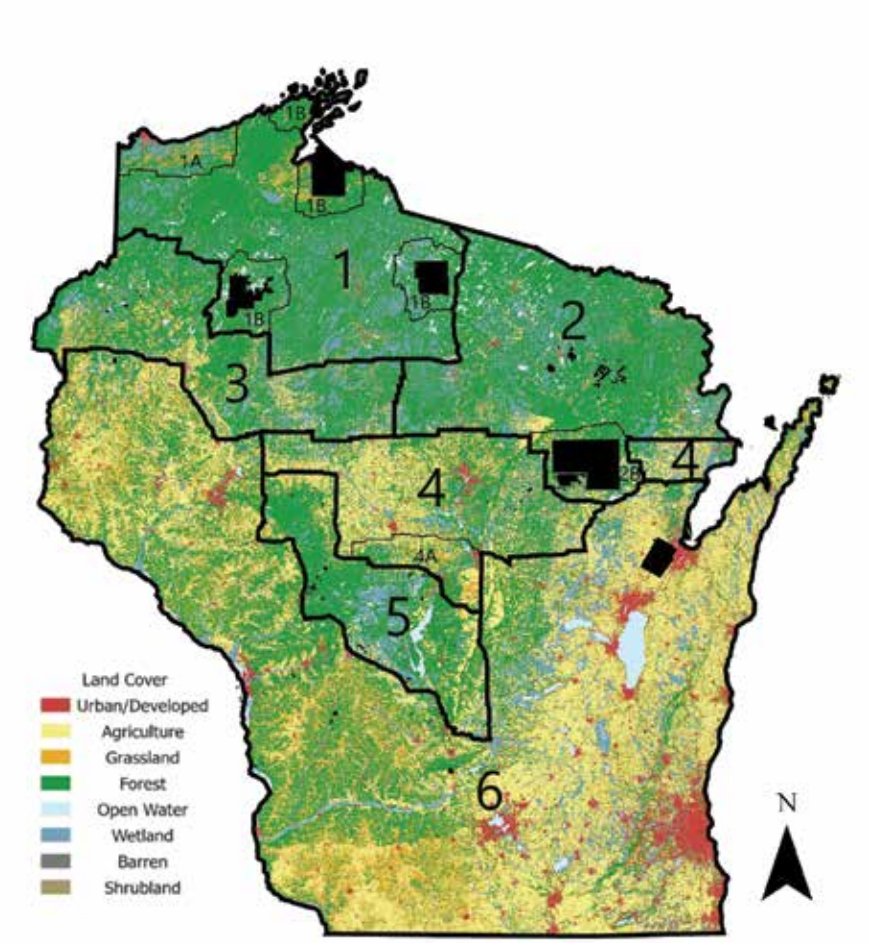

Figure 39. Recommended Wisconsin wolf management zones, statewide tribal lands, and landcover types.

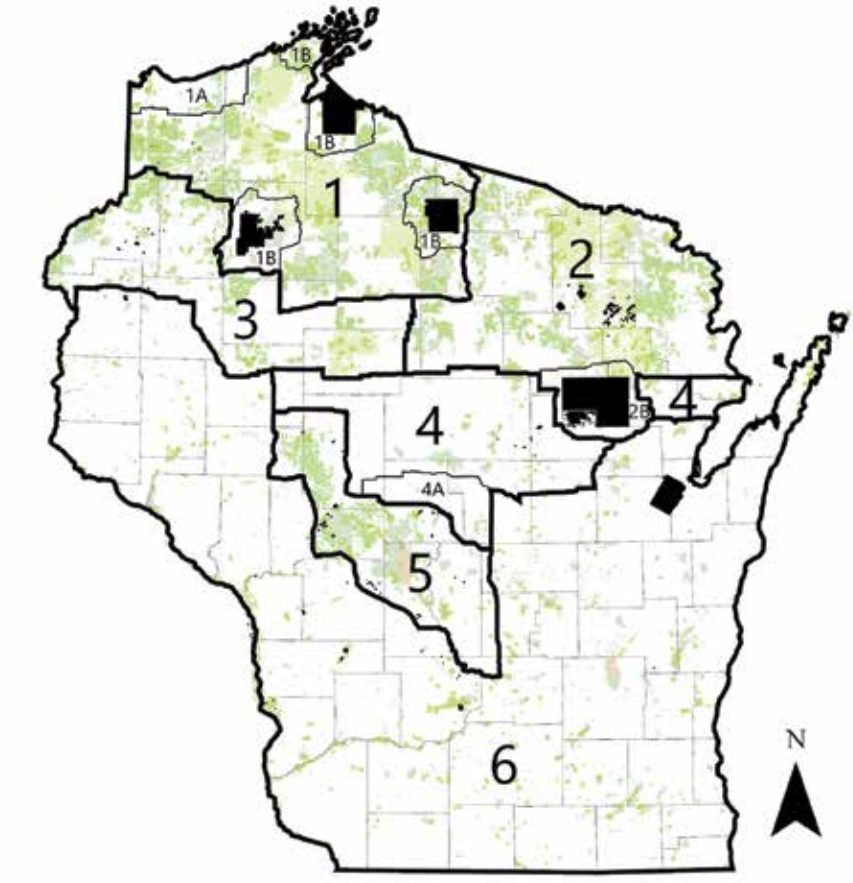

Figure 40. Recommended Wisconsin wolf management zones, statewide tribal lands, and large tracts of public lands In Wisconsin. Public lands depicted on the map include national forests, USFWS lands, DNR managed lands, state forests, state natural areas, BCPL lands, and county forests. MFL lands that are privately owned but publicly accessible for hunting activities are not included on the map.

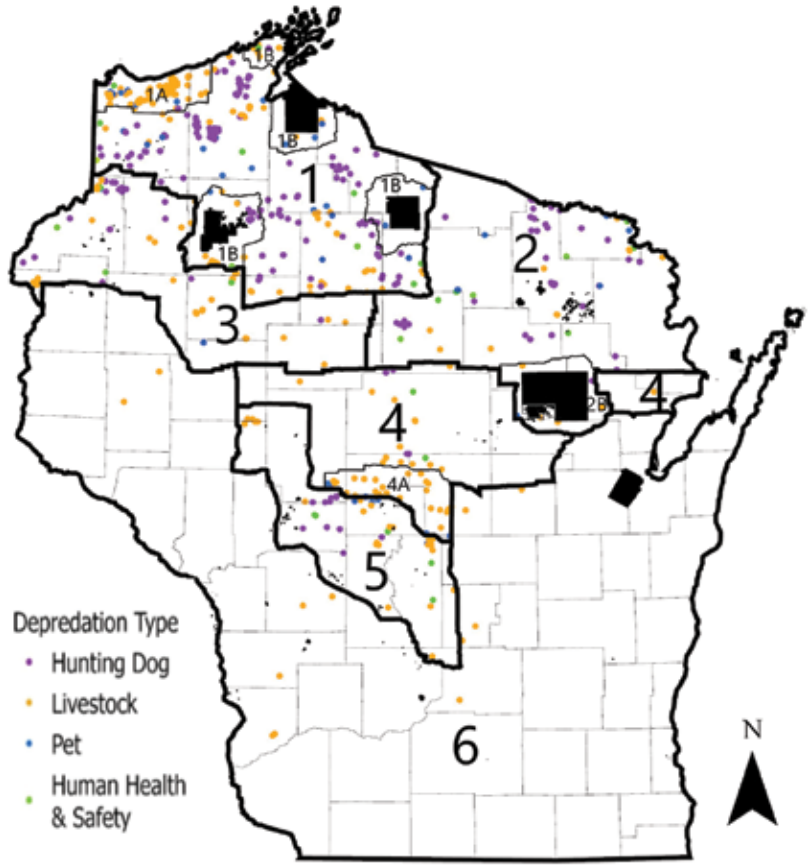

Figure 41. Recommended Wisconsin wolf management zones, statewide tribal lands, and all verified and probable wolf depredation and harassments by type, 2013–2021.

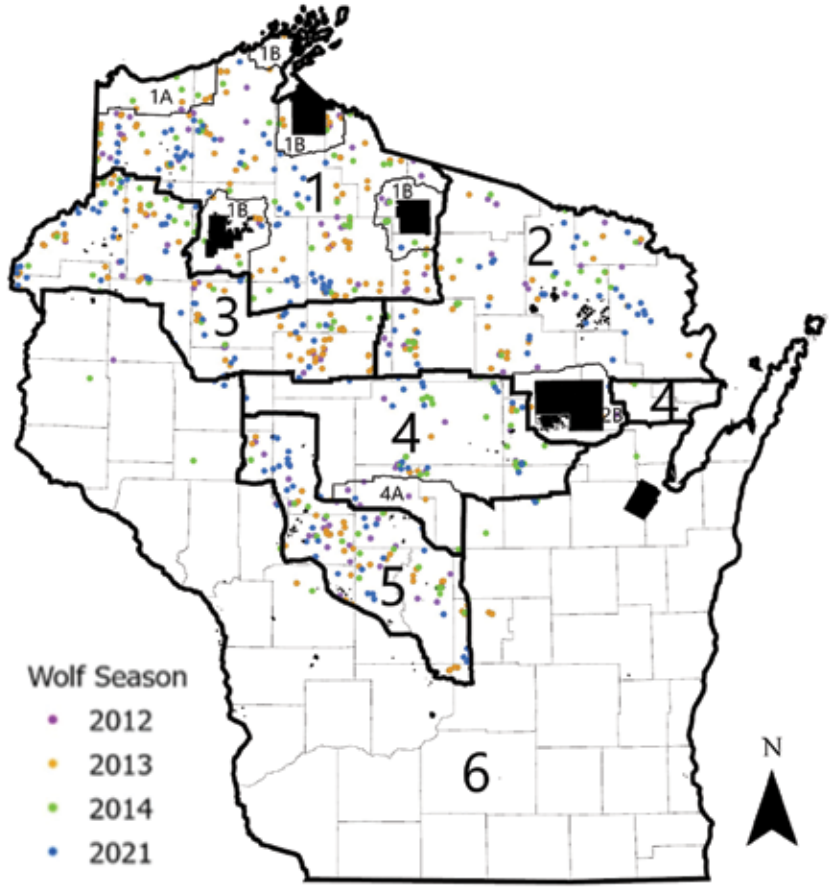

Figure 42. Recommended Wisconsin wolf management zones, statewide tribal lands, and locations of state wolf harvest by year from the four regulated wolf harvest seasons held between 2012–2021.

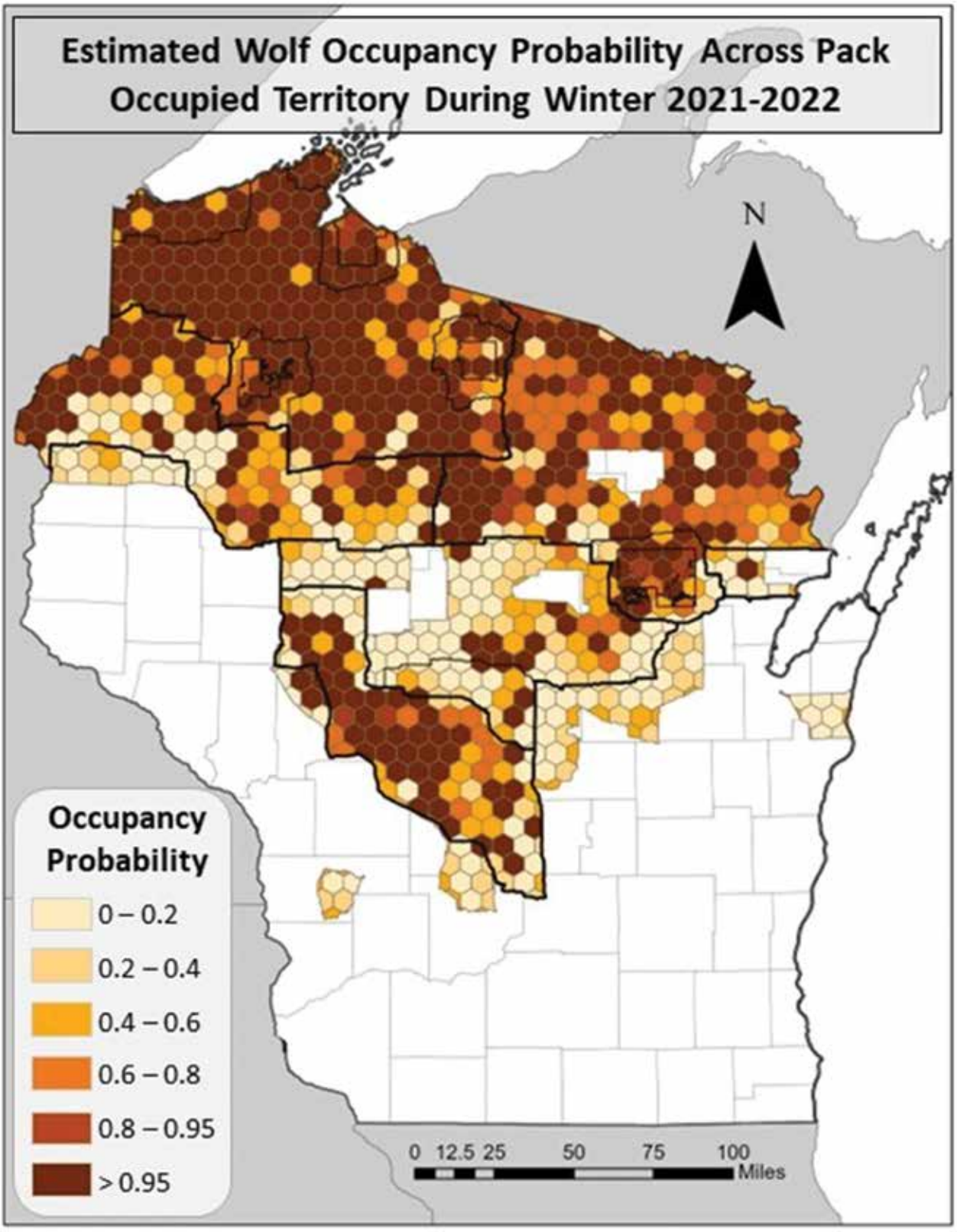

Figure 43. Wolf occupancy probabilities across pack-occupied range during the winter of 2021-2022 and the plan's recommended wolf management zones. The blank areas in the map are tracking blocks without a recent history of wolf pack activity and therefore not included in the 2021-2022 winter estimate. In addition, individual transient wolves may appear anywhere in the state.

Objective A: Ensure A Healthy And Sustainable Wolf Population To Fulfill Its Ecological Role

Definition: Most Wisconsinites hold attitudes generally favorable toward wolves, place importance on maintaining a wolf population in Wisconsin and agree that wolves keep nature in balance (Bradshaw et al. 2022). A wolf population that is healthy and ecologically functional will continue to provide various ecosystem benefits and services across the range of the species in Wisconsin. However, social tolerance and acceptance for wolves at the local level is also a necessary component to ensure sustainable wolf populations in the long-term. Because it is inherently difficult to precisely define what constitutes a healthy and sustainable wolf population, the following metrics and corresponding potential measures have been identified to help assess the health and sustainability of the wolf population and help evaluate whether this objective is being met. Importantly, this objective and associated metrics acknowledge that both wolf population increases and/or decreases may occur over time, whether naturally or via management actions, while maintaining a population that is deemed healthy and sustainable.

Objective A: Ensure A Healthy And Sustainable Wolf Population To Fulfill Its Ecological Role	
Metrics	**Potential Measures**
Wolf abundance	Estimates of mid-winter population abundance, population trends, estimated number of packs, average pack sizes
Wolf distribution	Estimates of pack-occupied range, statewide wolf observation reports
Genetic connectivity and flow	Periodic genetic assessments, radio-collared wolf movements
Illegal activity	Number of illegally killed wolves, law enforcement investigations
Wolf population health	Current and emerging wolf disease threats

Strategy A1: Manage the wolf population at sustainable and ecologically functional levels that reflect public preferences regarding wolf-related benefits and wolf-related conflicts. This plan does not define an upper population limit, targeted population size or a population goal to represent a healthy and sustainable statewide wolf population. Such broad abundance goals are often ineffective and unnecessary in balancing the social and biological wildlife management objectives that underlie them. Instead, the plan recommends striving to balance public population preferences at the zone level, including possible population growth and reductions, as warranted, while maintaining a healthy and sustainable population of wolves in Wisconsin.

> ***Product A1a: Ensure the late-winter wolf population abundance is responsibly maintained above federal and state listing thresholds.*** The federal Eastern Timber Wolf Recovery Plan from 1992 includes a defined recovery goal of 100 wolves for the combined Wisconsin-Michigan population. Current post-delisting criteria for the western Great Lakes region indicates emergency relisting may be warranted under various circumstances including if the combined Wisconsin-Michigan wolf population were to decline to 200 or fewer wolves or if the Wisconsin population declined to 100 or fewer wolves. Similarly, the current state threatened species level set by the 1999/2007 state wolf management

plan is a late winter count of 250 wolves in the state outside of tribal reservations. However, these thresholds are significantly below what would be likely considered a healthy population based on more recent scientific information (Stenglein et al. 2015b, Section 3 of this plan) and are also not consistent with recent social science results indicating these levels are well below the population sizes preferred by most Wisconsin residents (Bradshaw et al. 2022). This plan recommends the department demonstrate dedication to long-term sustainable management of wolves in the state by avoiding any actions and mitigating any issues which may result in the wolf population approaching these thresholds.

Product A1b. Adaptively manage wolf population abundance and distribution at the statewide level to reflect public preferences and ensure population viability. Much of the public feedback on the draft version of this plan centered on uncertainty in what future wolf population sizes and population management strategies might look like under the adaptive management approach laid out in the plan. In response, a table with possible wolf population sizes and corresponding likely population management objectives has been developed (Table 18). This table is intended to address these public concerns and provide transparency and accountability in what future wolf population sizes and likely population management outcomes designed to help meet this balance may look. Because the biological carrying capacity of wolves in Wisconsin is unlikely to be static, it is important to note that the information in the table may require updating in the future to reflect scientific developments or improved understanding of biological carrying capacity. The table also reflects the social science findings that most Wisconsinites would like *about the same number* of wolves or more in the state (approximately 1,000 wolves at the time of the survey; Bradshaw et al. 2022). The survey found 33% would like *about the same number*, 27% would like *more* wolves and 6% would like *many more* wolves in the state, whereas fifteen percent of Wisconsinites would like *fewer* (9%) or *many fewer* (6%) wolves

General guidance in anticipated future population sizes and likely statewide management outcomes for the Wisconsin wolf population.	
Statewide Off-Reservation Wolf Population Abundance Estimate	**Likely Statewide Population Management Outcome**
<650	Growth
650 – 799	Growth
800 – 999	Growth/Stable
1,000 – 1,199	Stable/Decline
1,200+	Decline

Table 18. This table provides guidance only and does not establish any population size as a management goal. It has been developed in response to public input and feedback received during the development of this management plan centered on population sizes and management goals. The information in the table was informed by the body of contemporary wildlife science including the best estimate of maximum biologically sustainable carrying capacity in the state of approximately 1,250 wolves and reflects the department's social science findings that most Wisconsinites would like about the same number of wolves or more in the state (approximately 1,000 wolves at the time of the survey).

and 4% would like to have *zero* wolves in the state. Sixteen percent were unsure about how many wolves they would like to have in the state. Although there were clear differences in opinions between those living in wolf range and those living outside of wolf range, the most common response remained a preference for about the same number of wolves as today (Figure 44, Bradshaw et al. 2022).

This table was developed based upon the prevailing wildlife science and a full suite of biological and social factors. The expected range of population sizes was informed by the body of contemporary wildlife science. This includes the best estimate of maximum biologically sustainable carrying capacity in the state of approximately 1,242 wolves (Stenglein et al. 2015b) and the population dynamics best practice of maintaining wildlife populations above 50% carrying capacity to ensure population viability.

The table also reflects the social science findings that most Wisconsinites would like *about the same number* of wolves or more in the state (approximately 1,000 wolves at the time of the survey; Bradshaw et al. 2022). The survey found 33% would like *about the same number,* 27% would like *more* wolves and 6% would like *many more* wolves in the state, whereas fifteen percent of Wisconsinites would like *fewer* (9%) or *many fewer* (6%) wolves and 4% would like to have *zero* wolves in the state.

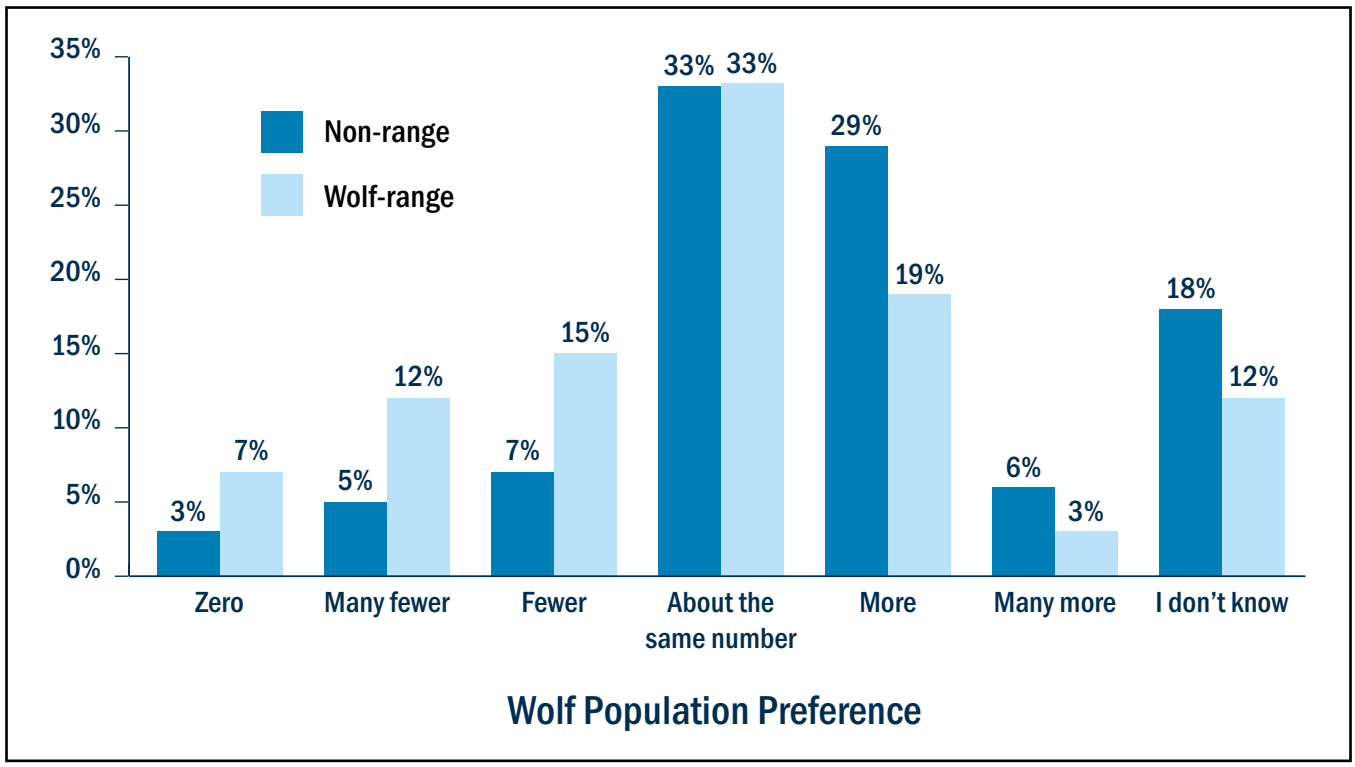

Figure 4A. Distribution of preferred statewide wolf population sizes relative to the population at the time of study (~1,000 wolves) among residents of wolf-range and non-range in Wisconsin (Bradshaw et al. 2022).

Sixteen percent were unsure about how many wolves they would like to have in the state. Although there were clear differences in opinions between those living in wolf range and those living outside of wolf range, the most common response remained a preference for about the same number of wolves as today (Figure 44, Bradshaw et al. 2022).

Product A1c: Adaptively manage wolf population abundance, distribution and interactions at the zone level to effectively balance public preferences. This plan also recommends adaptively managing population abundance and distribution at the management zone scale to effectively balance public preferences regarding the benefits of wolves and wolf harvest with the potential negative impacts of wolves. Changes in wolf population abundance and distribution would be the result of natural wolf population dynamics as well as varying levels of regulated public harvest of wolves (when legally allowed) informed by this plan and designed to help meet this balance. This approach is expected to generally maintain statewide wolf abundance and distribution at levels comparable to recent years (overwinter estimates of approximately 800 to 1,200 wolves) while explicitly allowing for fluctuations in local wolf densities, including population reductions as warranted.

Strategy A2: Continue rigorous annual wolf population monitoring. Population monitoring serves as the foundation of the wolf management program. The department has used a variety of methods to annually monitor the wolf population across the state since 1979. Resulting information must be of sufficient quality and resolution to support management decisions. This is especially true for low density populations like wolves.

Product A2a: Maintain annual and year-round wolf monitoring program. It is recommended the department continue to collect population monitoring data through a variety of means and on a year-round basis. Current sources of data include snow tracking surveys, radio-collared wolves, public observation reports and documenting all known wolf mortality through field observation of dead wolves, mandatory harvest registration and mandatory reporting of control mortalities. These data would continue to be used to inform critical information needs such as estimating wolf population abundance, evaluating sources and levels of mortality, monitoring statewide wolf distribution and providing a data-driven foundation for decision making. Additional or alternative methods and data may be incorporated in the future as needed.

Product A2b: Continue monitoring for threats to the recovered status of wolves following completion of federal post-delisting monitoring requirements. Following a federal delisting, provisions in the Endangered Species Act require the state to abide by US Fish and Wildlife Service Post Delisting Monitoring Requirements (see Section 3 of this plan; USFWS 2008) for a period of at least five years or until such requirements are lifted by the Service. Following the completion of required post-delisting monitoring requirements, this plan recommends the department continue to meet this high standard and commitment to monitoring and evaluating potential threats to wolf population security. This can be accomplished by following the strategies outlined within Objective A of this plan.

Product A2c: Continue annual winter snow tracking surveys to collect data on the midwinter wolf

population. Collection of data from these structured surveys serves as a central input to the wolf monitoring program and scaled occupancy model used to estimate the midwinter wolf population abundance. These surveys are recommended to be continued, while also exploring ways to improve efficiencies in data collection and considering how climate change may affect future snow conditions.

Product A2d: Continue emphasis on radio-collaring wolves. Radio-collaring wolves has been a crucial component of the department's wolf program for decades. Radio-collared wolves provide data on wolf movements, survival, health and more. In recent years, the department has transitioned from the use of VHF radio-collars (those collars which emit a radio signal that must be actively located by an observer to provide data) to GPS collars which collect and transmit an abundance of data via satellite. Although more costly and more prone to mechanical failure, these GPS collars open new doors to data collection and analysis and their use is recommended to be continued. The plan recommends the department continue deploying collars to assist in detecting illegal activity, documenting sources of mortality and collecting data for future analysis. To maintain sufficient sample sizes of radio-collared wolves, it is recommended the department continue to partner with USDA WS to live-capture and collar wolves annually while also maintaining department staff trained and proficient in wolf collaring activities. In addition, the plan recommends the department continue efforts to engage with private licensed trappers to deploy collars on incidentally captured wolves and consider contracting reputable private trappers to livetrap wolves for collaring on an as needed basis.

Product A2e: Prepare annual summaries of wolf program activities to communicate wolf population status and management outcomes. The department has prepared annual summaries describing wolf program activities since official monitoring began in 1979. Information provided in these reports includes summaries of wolf monitoring activities, population abundance and distribution, wolf mortality, wolf territory size estimates, wolf health, wolf/human conflict, law enforcement and wolf prey. Such reports are recommended to be continued annually and shared publicly via the department's website and department's Wolf Advisory Committee to allow for timely assessment and decision making.

Product A2f: Promote citizen science efforts in wolf population monitoring. Public observations and reports of wolves from across the state have played an important role in monitoring the state's wolf population. Since 1995, the department has also incorporated trained volunteer citizen scientist trackers to assist in completing annual winter carnivore track surveys. The plan recommends the department maintain opportunities for public involvement in the collection of wolf population data, including the collection of public observation reports to guide monitoring efforts and document changes in wolf distribution, encouraging participation in the volunteer carnivore tracking program and striving to involve citizens from diverse backgrounds and affiliations.

Strategy A3: Use science-based and data-driven methods to estimate wolf population characteristics. Population assessment techniques that deliver information relevant to management are foundational to effective conservation decision-making. The department invests significant resources to ensure decisions are grounded in sound scientific data. The department uses such data and mathematical models to estimate wolf population status, trajectory and predicted population-level responses to varying levels of mortality, including harvest. Importantly, these models also provide measures of uncertainty surrounding outputs, inherent in biological systems and this can allow effective risk tolerance assessment related to likely

outcomes and management decisions.

Product A3a: Continue to use a scaled occupancy model to estimate midwinter wolf population abundance and evaluate population-level responses to management actions. The department has used a scaled occupancy model to estimate wolf population abundance and associated measures of uncertainty since 2020 (Stauffer et al. 2021). Use of this model to derive wolf population abundance and trends is recommended to be continued to provide annual wolf population information at sufficient resolution (i.e., zone-specific) to evaluate population-level responses to harvest and other management actions and to support future management decisions. In addition, given the importance of this information, review and assessment of the model's performance should be a priority (see Strategy E1).

Strategy A4: Support law enforcement in enforcing existing laws and ensure effective and appropriate legal protection for wolves. Legal protections afforded to wolves in Wisconsin through both federal and state laws have been a crucial factor in both their recovery and continued sustainability. At times when wolves are not federally listed on the Endangered Species Act, wolves would continue to be afforded various protections under state law to regulate legal take and prevent illegal killing. Effective enforcement of the law will continue to be a critical component of safeguarding wolf recovery into the future.

Product A4a: Continually review and update regulations to ensure effective and appropriate legal protections for the wolf population. As described in Section 3 of this plan, wolf management and conservation in Wisconsin is guided by a combination of federal law, state law and department policy. Within its authorities granted by law, the plan recommends the department continually review and update regulations to provide effective and appropriate legal protections to wolves that reflect their legal and biological status.

Product A4b: Support voluntary compliance with existing laws. To achieve a successful enforcement program that promotes voluntary compliance, department Conservation Wardens utilize community involvement, education and enforcement. In addition to the efforts of law enforcement personnel, other actions to support voluntary compliance of the law are recommended to be encouraged. Examples of these actions include making hunting and trapping regulations widely available, advertising how to report potential illegal activity (i.e., 1-800-TIP-DNR hotline) and ensuring those experiencing wolf-related conflict are aware of the programs that exist to provide relief, including contact information.

Product A4c: Investigate potential violations of wolf-related laws. This plan recommends potential wolf-related illegal activity be investigated in a reasonable and timely manner by trained department law enforcement professionals and include cooperation with tribal and/or GLIFWC law enforcement personnel as appropriate. Annual summaries of wolf-related law enforcement activities are recommended to continue being compiled and reported annually (see product A2e).

Product A4d: Pursue administrative rulemaking to prohibit intentional destruction of occupied wolf dens and provide guidance to help mitigate potential den disturbance. The 1999 Wisconsin Wolf Management Plan recommended protections for both wolf dens and rendezvous sites in areas of suitable habitat. In the 2007 management plan addendum, protections for rendezvous sites were found to be unnecessary unless wolf recolonization was just beginning in an area or wolf pup survival was found to be poor. This plan similarly does not recommend specific protections for rendezvous

sites, but due to their biological importance during pup rearing season, disturbance to rendezvous sites should generally be minimized. Over the years, known den locations have been recorded to allow assessment of potential impacts to wolf den locations as part of various project planning efforts. However, such a list is likely to be incomplete and assuming only some fraction of dens received protection in the past, lack of protection among the rest of active dens appears to not have negatively affected the wolf population. Accordingly, the department does not plan to conduct searches for wolf dens. Instead, this plan recommends pursuing administrative rulemaking to make illegal the purposeful destruction of occupied wolf dens. The intent of this regulation would be to provide adequate protection (and appropriate penalties for violation) for wolf dens during the time of year when they are occupied and when their location becomes known, without undue burden on those planning or conducting activities within wolf range. In addition, the department should develop technical guidance with recommendations on mitigating disturbance to den sites and make it available to project planners and other partners.

Strategy A5: Protect and monitor wolf population health. Health monitoring is important to assess the impact of diseases and/or parasites on the wolf population. Over the years, the health monitoring component of the wolf program has included collection and analysis of biological samples from live-captured wolves, analysis of wolf scats, necropsies of wolf carcasses and the collection of biological samples from harvested wolves.

Product A5a: Work with department wildlife health staff to assess current and emerging threats to wolf population health. Although no current diseases or parasites appear to be threatening the security of the wolf population, routine health monitoring is recommended to be continued. Not only can endemic diseases increase in prevalence, but new diseases may also be introduced. Further, emerging threats, such as the potential impacts of climate change on wolves, their prey and their habitats, must be considered and require a nimble approach to respond appropriately. However, consideration should also be given to the distinction between disease exposure levels (i.e., prevalence among individuals) and population-level impacts resulting from the disease. Monitoring protocols are recommended to be developed and implemented, as needed, in conjunction with department wildlife health staff to provide information on disease prevalence and impacts on wolf population health.

Product A5b: Maintain routine health evaluations of live-captured wolves. Assessment of general body condition, presence of ectoparasites and noting any injuries has been a part of routine evaluations conducted on wolves live-captured by the department for research purposes. In addition, blood, tissue, fecal or other biological samples may be collected as needed. This health assessment, with option for additional collection if needed, is recommended to be maintained as part of standard department capture protocols as well as those of any study conducted on wild wolves in Wisconsin.

Product A5c: Conduct necropsies on wolves found dead of unknown or suspicious causes. As part of year-round monitoring of observed wolf mortality, the plan recommends that wolves found dead of unknown or suspicious causes continue to be necropsied, when necessary and carcass conditions allow, to determine cause of death.

Product A5d: Work with department wildlife health staff to review department wolf capture and handling protocols to maximize animal welfare and minimize risks. The plan recommends

department wolf program staff consult with department wildlife health staff to routinely review current wolf live-capture and handling protocols to ensure they are consistent with accepted animal welfare guidelines and best management practices. These protocols are recommended to be implemented as they are updated by both department staff and USDA WS staff conducting wolf live-captures for research purposes.

Product A5e: Continue to not allow wolf rehabilitation. As noted in Wis. Admin. Code s. NR 19.80(1)(8), the department does not authorize the rehabilitation of wolves or wolf-dog hybrids in Wisconsin.

Strategy A6: Maintain sustainable populations of wolf primary prey. White-tailed deer provide the primary prey base for wolves in Wisconsin. Management of white-tailed deer in the state is guided by numerous social and biological factors, not the least of which is high demand for recreational deer hunting. To date, Wisconsin's wolf population has shown no indications of inadequate prey on the landscape. With continued public expectation for quality deer hunting opportunities associated with abundant deer herds, it is unlikely white-tailed deer population abundance will fail to provide an adequate prey base for wolves in the state. However, public concerns regarding the impacts of wolves on white-tailed deer populations (whether real or perceived) will continue to require attention to maintain and/or improve public support for wolves.

Product A6a: Support efforts to manage for healthy white-tailed deer populations. White-tailed deer populations face many potential challenges in Wisconsin including chronic wasting disease, aging forest habitats, robust predator guilds, severe winters and climate change. While prescribing specific deer management strategies is beyond the scope of this plan, it is important nonetheless to support efforts to manage for healthy white-tailed deer populations to ensure prey abundance does not become a limiting factor for the wolf population nor cause public support for wolves to erode. Perhaps chief among these would be promotion of healthy habitats necessary to sustain adequate prey abundance including white-tailed deer. For example, encouraging forestry practices that result in early successional forests, such as new growth aspen stands, will provide both high quality nutrition and predator escape cover for white-tailed deer as well as elk.

Product A6b: Support continued research into wolf food habitats and seasonal prey resource utilization in Wisconsin. The dynamics between wolves and their prey are complex and variable through space and time. Further research, especially work taking advantage of newer technologies such as GPS radio collars, genetic analysis and remote cameras, is recommended to be undertaken to support a better understanding of how wolves utilize prey resources in Wisconsin. See Strategy E5 for more.

Product A6c: Consider elk management objectives in relation to wolf management objectives. Elk undoubtedly hold significant social, cultural and economic value to the people of Wisconsin. Over the last quarter century, shared conservation efforts have supported elk resuming their historical role as an integral component of Wisconsin's native wildlife community, especially true within and near Wisconsin's elk management zones. To date, although wolf predation on elk has contributed to slower-than-anticipated elk population growth rates, annual recruitment has nonetheless exceeded mortality, resulting in elk population growth. Both elk management zones are likely near a saturation point with wolf packs and have been for some time, meaning wolf numbers in elk zones are unlikely to change drastically. As elk numbers increase, the impacts of wolves as a limiting factor on elk population growth

is likely to diminish with each year of elk population increase. However, the plan recommends giving consideration to elk management objectives and any documented wolf impacts when developing wolf management recommendations around elk zones. This may be particularly important during any years of low deer numbers when elk may become more important prey for wolves or if wolf predation is identified as significantly affecting elk population growth.

Strategy A7: Consider wolves in habitat management planning and decisions. Wolves are adaptable habitat generalists that can persist in a variety of habitat types within the limits of prey availability and human persecution (see Section 1 of this plan). Therefore, despite little need for habitat planning specific to wolves, land management actions taken for wildlife management (see Product A6a) or other purposes may have varying influences on wolves and these are recommended to be considered.

Product A6a: Encourage the maintenance of large tracts of public forested lands. Large tracts of publicly owned, forested lands provide some of the best quality habitat available to wolves due in large part to providing refugia with reduced levels of human activity. These areas can support high quality den sites, provide linkages and connectivity among regional populations and provide core areas with reduced human-caused mortality rates. Despite the fact that wolves are less sensitive to roads and other anthropogenic development than historically thought, it remains important to consider and encourage the maintenance of forested blocks of land in the state.

Product A6b: Conduct an updated wolf resource selection and habitat suitability analysis. See Product E5c.

Objective B: Address And Reduce Wolf-Related Conflict

Definition: A critical component of wolf conservation in human-dominated landscapes is effective management of wolf-related conflicts to ensure long-term support and compatibility within those areas. Some level of wolf-related conflict occurrence will likely be inevitable given that a wolf population of any size continues to exist in Wisconsin. Therefore, it is unrealistic to expect management actions to reduce conflict levels to zero. Instead, this objective focuses on effective conflict response and prevention. The following metrics and corresponding potential measures have been identified to help assess wolf-related conflict and help evaluate whether this objective is being met.

Objective B: Address And Reduce Wolf-Related Conflict	
Metrics	**Potential Measures**
Livestock conflict	Trends of verified livestock conflicts, farms affected, farms with chronic conflict
Hunting dog conflict	Trends and distribution of verified hunting dog conflicts
Pet conflict	Trends and distribution of verified pet conflicts
Human health and safety conflict	Trends and distribution of verified human health and safety conflicts
Effective administration and implementation of the conflict program	Public awareness of available resources (number of website visits, phone calls, media efforts), communication and collaborative efforts with partners, adequate funding levels for the conflict program,
Public support for the conflict program	Results from periodic social surveys, other public input

Strategy B1: Maintain an integrated wolf conflict program. The implementation of an integrated conflict program, including the application of lethal and non-lethal conflict mitigation strategies (to the extent allowed by law), is critical to the success of the wolf conflict program for resolving wolf conflicts.

> ***Product B1a: Implement lethal and non-lethal abatement measures where practical and appropriate based on experience, science and characteristics of conflict sites.*** The plan recommends continuing to implement an integrated wolf conflict management program based on the results of wolf conflict investigations and department policies (e.g., the 'Guidelines for Conducting Wolf Conflict Management in Wisconsin' document). This should include application of a variety of cooperator employed methods (e.g., increased vigilance, improved fencing, proper carcass disposal, altered husbandry practices,) and agency employed methods (e.g., auditory or visual harassment tools, electric or permanent fencing, issuance of landowner removal permits, agency removal efforts) designed to be most effective given the unique characteristics of a particular conflict situation and within the context of current law. A flowchart summarizing typical wolf conflict complaints and corresponding responses is provided in Appendix D.

Product B1b: Review and update staff guidance depredation control guidelines. The Guidelines for Conducting Wolf Conflict Management in Wisconsin document has served as technical guidance for staff and partners in responding to wolf-related conflict. The guidelines for were originally developed by the Wisconsin Wolf Science Committee consistent with the 1999 Wolf Plan and 2007 Wolf Plan Update and most recently reviewed in 2014. The current guidelines were reviewed by DNR and USDA WS staff during the development of this updated wolf plan. Recommended changes from the 2014 document include elimination of proactive control areas, clarifications in classifying various types of wolf conflict (see Product B1g) and language updates to improve clarity. Further, the plan recommends that the department periodically review and update its guidance to reflect the most current management options and processes for staff responding to complaints about wolves.

Product B1c: Continue to review literature and test the applicability of new abatement methods. The plan recommends department staff attend wolf management conferences and trainings, review scientific literature and consult with colleagues to identify new and/or improvements to abatement methods as part of an integrated wolf conflict program. The plan recommends that new methods be evaluated and utilized based on cost, practicality and effectiveness.

Product B1d: Continue to evaluate chronic conflict sites to determine the suitability of permanent fences as long-term solutions for preventing conflicts. Chronic conflict sites are defined as those farms which have had verified wolf depredation in two or more years in the past five-year period. Addressing depredation on chronic farms is recommended to remain a priority, including evaluation of permanent fences as long-term solutions when feasible.

Product B1e: Continue to work with producers and those affected by wolf depredation to develop and improve animal husbandry practices to prevent future conflicts. While there are no practices guaranteed to prevent wolf-related conflict, several preventative options exist which may reduce conflict potential. These include maintaining healthy, well-fed animals, conducting calving/lambing activity near a barnyard and proper livestock carcass disposal. The plan recommends the department encourage these practices through educational efforts and providing technical advice.

Product B1f: Utilize the wolf harvest zones/subzones and public harvest season to help address conflicts by directing licensed wolf hunters and trappers to areas of conflict. The plan recommends the department, in cooperation with USDA WS, provide wolf conflict information to the department's Wolf Advisory Committee on a regular basis and should consider conflict information when establishing wolf harvest quotas consistent with the objectives of this plan. In addition, the plan recommends the department, in cooperation with USDA WS, maintain a list of properties open to the public during the wolf harvest season and provide that information to the licensed wolf hunters and trappers upon request.

Product B1g: Review and update wolf complaint classifications. The plan recommends reviewing current wolf conflict classifications and the development of new classification levels for Wolf/Human Health and Safety complaints, including incorporation of the new classifications into wolf complaint data tracking systems, Gray Wolf Investigation Reports completed by USDA WS and department guidance. These changes are intended to improve data clarity and improve decision making.

Product B1h: On farms with chronic wolf conflicts, develop Wolf Conflict Mitigation Plans that focus on non-lethal abatement and can be implemented by the livestock producer and by the department/designee to prevent additional conflicts. This plan recommends the department work with USDA WS and individual producers to develop Wolf Conflict Mitigation Plans. These plans are recommended to be tailored to specific farms (or several neighboring farms) in consideration of the factors unique to those farms. Abatement strategies could include alterations in animal husbandry practices, the implementation or improvements on fencing or other non-lethal abatement methods.

Strategy B2: Administer a wolf damage compensation program. Wisconsin Statute s. 29.888 directs the department to administer a wolf depredation program, including providing reimbursement for verified death or injuries caused by wolves to livestock, pets and hunting dogs other than those being actively used in the hunting of wolves. Funding sources for program activities vary depending on the state and federal listing status of wolves.

Product B2a: Ensure livestock producers are being fairly compensated for verified losses. This plan recommends continuing to utilize the three-member livestock compensation panel to establish maximum compensation limits based on the current fair market value of livestock and an individual producer's operation. The panel includes three agriculture experts, one each from the Wisconsin Department of Agriculture, Trade and Consumer Protection, University of Wisconsin-Madison Agricultural Extension and the Wisconsin Farm Bureau Federation. In addition, the plan recommends increasing the compensation rate from 1x fair market value to 1.25x fair market value for livestock producers that have multiple depredations in a year. Research shows that continued wolf presence can stress cattle causing lower weight gains. The increased compensation rate is intended to help lessen the impact of multiple losses in a year and account for potentially lost gains.

Product B2b: Ensure claims and reimbursements for losses are processed in a timely manner, based on funding levels and in compliance with state statutes. This plan recommends department staff review the current deadlines for submission of missing calf claims to facilitate more-timely processing of reimbursement payments to producers.

Product B2c: Provide compensation for loss of hunting dogs (excluding those hunting wolves) and domestic pets as required under state statute. Wisconsin Statute s. 29.888 requires that the department provide compensation payments to persons who apply for reimbursement for verified death or injury caused by wolves to hunting dogs (other than those hunting wolves) and pets. Administrative rules place a $2,500 compensation limit on each hunting dog/pet and this is recommended to be continued.

Product B2d: Verify depredation claim submission deadlines are practical given the time of treatment need for injured animals. Depredation events are variable by their nature and deadlines to submit depredation claims are recommended to be flexible to accommodate unusual circumstances, particularly in the cases of injured animals requiring extended veterinary care.

Product B2e: Maintain rules allowing for compensation for missing calves at a rate of up to five missing calves for each verified depredation and utilizing the national mortality rate for beef calves. Research shows that in some cases, calves can be depredated by wolves with no evidence

or detection of the depredation. In Wisconsin, there is a 5:1 compensation limit on claiming missing calves where livestock owners are eligible for up to 5 missing calves for each verified wolf depredation. The 5:1 ratio was established in 2012 in consultation with the Wisconsin Cattleman's Association after reviewing livestock depredation detection rates in the scientific literature and reviewing historic claims for missing claves in Wisconsin. The ratio was used in the processing of missing calves claims while wolves were delisted in 2013, 2014 and 2021 and is recommended to be continued.

Strategy B3: Maintain a cooperative services agreement with USDA Wildlife Services to provide timely and effective wolf conflict assistance. Since 1988, the department and USDA WS have cooperated to provide effective assistance to individuals experiencing conflicts with wolves, as well as other forms of wildlife conflict. USDA WS specialists investigate wolf complaints, assess losses, make abatement recommendations and implement lethal and non-lethal control activities as appropriate. This relationship has proven to be effective in providing professional and timely assistance to those suffering wolf conflict.

Product B3a: Continue to work cooperatively with USDA WS to fulfill wolf conflict management in Wisconsin. The plan recommends that the department continue to partner with USDA WS to provide services for wolf conflicts as directed by the department and current law. The cooperative services agreement between the department and USDA WS is recommended to be reviewed regularly and updated as necessary.

Product B3b: Maintain toll-free wolf complaint reporting phone hotlines. As part of the department's cooperative services agreement with USDA WS, each USDA WS office maintains toll-free hotline numbers for citizens to report wolf complaints. These hotlines are monitored seven days per week to ensure quick and efficient response to conflicts and have provided an accessible, consistent and timely mechanism for the public to report wolf conflicts and receive assistance. This plan recommends that these hotlines be continued.

Product B3c: Support USDA WS in maintaining adequate staffing to respond to reported wolf conflicts statewide. This plan recommends that the department continue to support USDA WS in maintaining staff that are trained and equipped with the necessary tools to respond to reported wolf complaints throughout the state.

Product B3d: Ensure transparent and timely collection and sharing of wolf conflict data, including timely completion of wolf investigation reports. This plan recommends that the department continue to cooperate with USDA WS to ensure wolf conflict data is entered into the department's Wildlife Damage Database in an accurate and efficient manner to support wolf management decision making and transparency.

Strategy B4: Ensure adequate funding for the wolf conflict program.

Product B4a: Proactively pursue additional funding for non-lethal deterrents from NGOs and other potential funding sources. There is currently not a specific funding source dedicated for wolf abatement expenses. Partnering with non-governmental organizations (NGOs) and other groups may provide funding that can be used for non-lethal abatement projects that would otherwise not be funded.

Product B4b: Continue applying for and securing federal grants to fund compensation and nonlethal abatement. The plan recommends the department continue to apply for funding through USFWS's Wolf Livestock Demonstration Grant program. Grant applications should request assistance for livestock depredation compensation funding and funding for non-lethal abatement projects/ supplies as necessary.

Product B4c: Support increased congressional funding for USDA Wildlife Services. To the extent possible, the plan recommends that the department support increased congressional funding for USDA WS. This includes regular appropriations for USDA WS operations, staffing and funding for non-lethal large carnivore abatement.

Product B4d: Explore additional funding options to prevent the need to prorate wolf damage claims. If approved depredation claims exceed the funds available in a given year, claims must be paid on a prorated basis per state law. Although this scenario has not occurred to date, it remains a possibility, particularly in years without the sale of wolf harvesting licenses or preference points. Therefore, the plan recommends that the department explore additional funding options to attempt to minimize the likelihood of this scenario.

Strategy B5: Continue to research conflict mitigation, prevention measures and develop new techniques for addressing conflicts. Given the importance of addressing wolf-related conflict for both the affected individuals as well as the maintenance of overall public support toward wolves, it is crucial that resources be directed to continually developing, testing and evaluating new and evolving measures designed to address such conflicts.

Product B5a: Continue to cooperate with universities, USDA WS's National Wildlife Research Center and the department's Office of Applied Sciences to evaluate new techniques for wolf conflict management. See strategy E3 and associated products below for more details.

Strategy B6: Increase public awareness of wolf conflict program and abatement techniques. Recent social science and public input suggest there is general congruence between the department's conflict program activities and prevailing public desires regarding addressing conflict. It will be important to continue to evaluate public support and promote awareness of the wolf conflict program into the future.

Product B6a: Continue support for USDA WS non-lethal abatement specialists to proactively implement non-lethal abatement options at historic conflict sites. USDA WS has employed several staff members (varies by funding levels) as non-lethal abatement specialists, including as part of USDA WS's Non-lethal Initiative for Livestock Protection program, specifically intended to address livestock/ carnivore depredation with non-lethal methods. The plan recommends the department continue to support these efforts.

Product B6b: Develop and offer workshops for livestock owners on proper implementation of non-lethal deterrents to prevent future conflicts. The plan recommends educational workshops tailored to livestock producers and intended to demonstrate practical and effective use of non-lethal conflict deterrents be developed and offered. Such workshops and information are intended to empower livestock owners with practical guidance to proactively reduce their risk of wolf-related conflicts.

Product B6c: Work with livestock producer organizations, county extension specialists and other relevant groups to increase visibility and effectiveness of the wolf conflict program. The plan recommends the department develop communication and outreach plans to better inform the public on wolf conflicts and conflict mitigation efforts, including targeted messaging tailored for specific farming and ranching media and organizations to increase producer awareness of the wolf conflict program.

Product B6d: Work with hunting dog organizations to promote wolf conflict awareness and avoidance techniques. Hunting various species with the aid of hounds and other dogs has a long and rich history in Wisconsin. However, hunting dogs in wolf occupied areas face a level of risk to injury or death by wolves during the course of a hunt. This risk can often be reduced by owners having current and appropriate information to make informed decisions. To that end, the plan recommends the department continue to work with hunting dog organizations to raise awareness of wolf conflict avoidance techniques and the associated resources.

Product B6e: Regularly review department wolf webpages and conflict guidance materials to ensure information and guidance being provided to the public is current and accurate. It is important to share accurate and current information related to wolf conflict via the various department communications channels. See Objective D for more details on comprehensive communication, education and outreach strategies.

Product B6f: Maintain the online interactive depredation map, establish and promote wolf caution areas and send conflict notifications by email and text message and on the department's website. These tools (detailed in the Wolf-Related Conflicts portion of Section 3) are recommended to continue being utilized and potentially expanded (also see Product D1b).

Product B6g: Continue to educate the public on the need for an integrated wolf conflict abatement program. The plan recommends department staff continue presenting factual wolf conflict information at various public venues, including the benefits and limitations of various kinds of abatement methods.

Product B6h: Provide wolf conflict management training to department staff and tribal staff as requested. Wolf conflict management topics are recommended to be included in the training curriculum for new department wildlife biologists and conservation wardens. This is important for providing a consistent and timely response to wolf complaints. This training should also be made available to tribal and inter-tribal staff as requested.

ProductB 6J: Develop educational displays and/or workshops to educate the public and NGO's on wolf abatement techniques and efforts being implemented to reduce and prevent wolf conflicts. Wisconsin has been a leader in developing and implementing effective wolf abatement techniques for many years. For example, Wisconsin first deployed fladry as wolf abatement in 2004, the second state nationally to do so. There is a public appetite to learn more about the efforts underway in Wisconsin to reduce and prevent wolf conflict. The plan recommends the department continue collaborating with USDA WS and other partners as appropriate to develop educational displays and/or workshops to draw on this vast experience and showcase wolf abatement efforts in the state.

Objective C: Provide Multiple Benefits Associated With The Wolf Population

Definition: Consistent with the North American Model of Wildlife Conservation (Organ et al. 2012), the Public Trust Doctrine and Wisconsin state law, all wildlife (including wolves) is held in trust by the government for the benefit of present and future generations. However, maximum consumptive and non-consumptive exploitation of wildlife can lead to harmed resources and ecosystems as well as diminished potential for future generations to enjoy them. This objective strives to provide opportunities to appreciate and draw multiple benefits from the wolf population, including a regulated harvest of wolves consistent with state and federal law, while also safeguarding the resource for current and future generations. Current Wisconsin state law requires the department to implement a wolf harvest season whenever wolves are not listed as a state or federally threatened or endangered species. The preponderance of current scientific evidence demonstrates that the Wisconsin wolf population is capable of safely supporting some level of public harvest. In addition, results from the department's 2022 scientific public opinion survey indicated that support for regulated hunting and trapping of wolves (46%) was higher than opposition (29%); one-quarter of Wisconsinites were undecided on their level of support. The survey also found support was higher among wolf-range residents (57%) than it was for residents outside wolf range (43%; Bradshaw et al. 2022). Other recent research has supported the notion that legal harvest of wolves can increase local tolerance of wolf populations (Richardson 2022), potentially reduce conflicts with humans (Hill et al. 2022) and may lead to reductions in illegal killing of wolves (Liberg et al. 2020, Olson et al. 2015, Suutarinen 2019). Nevertheless, public harvest of wolves remains perhaps the most highly controversial aspect of this plan, so it is critical that this legislative directive is carried out in a highly regulated manner consistent with management plan objectives, while also considering the public's diverse preferences and values. The following metrics and corresponding potential measures have been identified to help evaluate whether this objective is being met.

Objective C: Provide Multiple Benefits Associated With The Wolf Population	
Metrics	**Potential Measures**
Wolf harvest opportunities	Ability to offer a wolf harvest season, number of licenses made available to meet harvest targets
Non-harvest recreational opportunities	Availability of non-harvest recreational opportunities (e.g., tracking, howling, wolf viewing, etc.)
Effective wolf harvest season implementation	Post-season survey scores related to wolf hunter/trapper satisfaction, number of days before zone closures, ability to effectively meet harvest quotas

Strategy C1: Provide an effectively regulated wolf harvest season consistent with public preferences and management plan objectives. Current Wisconsin statutes require the department to implement a wolf harvest season whenever wolves are not listed as a state or federally threatened or endangered species. Nevertheless, public harvest of wolves remains highly controversial. The department's 2022 scientific assessment of public attitudes indicated overall support for a wolf hunting and trapping season in Wisconsin has declined from 2014 to 2022, yet statewide cumulative support for a season (46%) still outweighed statewide cumulative opposition (29%). Support for a wolf season remained higher among wolf-range residents (57%) than non-range residents (43%) in 2022 and it is important to recognize this dynamic as

local support for wolf management is a necessary component for an effective wolf management program (Hill et al. 2022, Pettersson et al. 2021, Olson et al. 2015b, Richardson 2022). Among those who opposed a wolf season, common reasons included a concern that wolves would become endangered again and concerns related to specific harvest methods (e.g., use of traps, hounds) and not broad anti-hunting sentiment (Bradshaw et al. 2022). Therefore, it is critical that this legislative directive is carried out in a highly regulated manner consistent with management plan objectives, while also considering the public's diverse preferences and values.

Product C1a: Implement a well-regulated public wolf harvest season to provide public recreational opportunities associated with the wolf population. As required by current state statute, this plan calls for implementing a regulated public wolf hunting and trapping season as part of a holistic and adaptive wolf management program in the state when wolves are not state or federally listed. These seasons will offer the interested public an opportunity to legally harvest wolves, provide the primary mechanism to manage wolf abundance and distribution at the landscape scale and responsibly do so without jeopardizing the long-term sustainability of wolves in the state.

Product C1b: Develop transparent and scientifically informed wolf harvest quotas to meet socially and biologically responsible management objectives.

A key area of public feedback on the draft version of this management plan focused on wolf harvest, underscoring the high level of interest in this aspect of wolf management. In response, this product has been specifically developed to provide more clarity in how future wolf harvest quotas would be developed under this plan. Any future wolf harvest recommendations should consider the objectives and metrics of this management plan, wolf population estimates and trends, wolf-related conflict levels and trends, annual estimates of observed and expected wolf mortality, population modeling projections, outcomes of previous years' harvests, legal requirements including off-reservation treaty rights and on-reservation jurisdiction of Native American tribes, relevant scientific developments and other relevant biological and social factors. The department's wolf advisory committee should play a key role in this process (see Product C2e) to ensure inclusion of all perspectives during these discussions.

Current science suggests wolf populations can sustain total human-caused mortality rates of up to ~30% of winter population estimates each year before experiencing decline (see Gray Wolf Population Dynamics, Section 1 of this plan). This total includes known vehicle-killed wolves, known illegally killed wolves, wolves removed for lethal depredation controls and wolves taken via legal harvest (when implemented). Data is recorded on all known wolves killed in Wisconsin. Over the last decade, the observed wolf mortality rate from human causes other than harvest has ranged from 2-13% of the overwinter population estimates in Wisconsin, with most of the annual variation resulting from differences in the number of wolves removed in depredation controls. With this knowledge, generally allowable total harvest levels for the statewide population can be determined by considering annual data on these sources of mortality, adjusting harvest rates to achieve some level of total expected human-caused mortality, and reviewing expected population response projections.

Once a recommended statewide quota or harvest target is determined, it must also be distributed among the wolf management zones. To do so, evaluation of the metrics and objectives identified in this

plan are recommended to be completed on a zone-by-zone basis to formulate relevant zone-specific management objectives (i.e., decrease, increase or maintain the wolf population in a given zone) and allocate the statewide harvest quota accordingly. In this way, adaptive harvest management can occur at the zone scale while accounting for the likely statewide population response. However, as with most wildlife species, the ability to precisely control the abundance of a wolf population is not realistic. While scientifically informed population model projections would be used to help predict how the population will likely respond to various levels of harvest, it is critical to recognize some amount of uncertainty remains inherent in the management of wildlife populations and the expected population response may not occur in a given year, even if harvest targets are met exactly.

Finally, during the development of this plan and elsewhere, many of Wisconsin's Tribal Nations expressed firm opposition to any wolf harvest seasons. The department acknowledges these concerns and has attempted to respect and address these concerns elsewhere in the management plan. The department will continue to engage with Wisconsin's Tribal Nations regarding wolf management and harvest. The Ojibwe Tribes, in accordance with federally affirmed off-reservation treaty rights, are entitled to declare for harvest up to one-half of the available annual wolf harvest quota within the Ceded Territory of Wisconsin. The department works with the Great Lakes Indian Fish and Wildlife Commission to facilitate this declaration process.

Product C1c: Continue to exclude 'reservation wolves' from harvest consideration when developing wolf harvest quotas. The department has historically excluded those wolves and wolf packs predominately living within the exterior boundaries of federally recognized reservations from the wolf population estimate when establishing quotas (average count of ~30-40 wolves in the last decade, referred to as "reservation wolves"). This is to recognize tribal sovereignty and the cultural importance of wolves to Tribal Nations and because the previous wolf management plan identified management actions which applied to wolves "outside of Native American reservations." Reservation wolves have previously been defined (ER 1210) as "a wolf or wolves that have at least 50% of their territorial range located within the boundary of a reservation or for whom 50 percent of their rendezvous sites or a den site, are located within the boundary of a reservation." This plan recommends maintaining the practice of excluding reservation wolves from the population estimate when developing harvest quotas. However, given the recent change in the department's population monitoring methods described earlier in the plan, reservation wolves should now be estimated by deriving estimated wolf abundance from the department's population model in those areas. This is expected to result in similar estimates of reservation wolves as previous years. Consistent with past practice, these reservations include Bad River, Red Cliff, Lac Courte Oreilles, Lac du Flambeau, Menominee and the designated Stockbridge-Munsee Community Area.

Product C1d: Continue to support the Wisconsin Cooperative Trapper Education Program. The Wisconsin Cooperative Trapper Education Program (WCTEP) is jointly administered by the Wisconsin Trapper's Association and the department to provide quality trapper education to individuals wishing to pursue trapping or learn more about the activity. The course provides participants information on biology and ecology of numerous species, how to engage in trapping safely and humanely and includes a focus on ethics and regulations. Completing the course is required for those wishing to purchase a trapping license in Wisconsin (with some exceptions). In years with a regulated wolf harvest season,

the WCTEP has also sponsored supplemental courses focused on providing participants a deeper understanding of wolves, including instruction on humane and safe wolf trapping techniques from experienced wolf trappers. The plan recommends the department continue to support this program, including wolf-specific content, to encourage responsible, safe and ethical trapping behavior, including those interested in pursuing wolves via trapping.

Product C1e: Develop wolf educational materials and provide such materials to all wolf harvesting license holders. The plan recommends that the department, in cooperation with partners, develop educational and reference materials to be provided to successful applicants awarded a wolf harvesting license. Because acquiring a wolf harvesting license is likely to occur relatively infrequently for most applicants, successful applicants may often be inexperienced in specifically pursuing wolves. Therefore, these materials can provide reliable resources to become more familiar with the activity and should be distributed directly to license holders in advance of the season to allow ample time for review. These materials could include items such as current wolf hunting and trapping regulations, wolf biology and identification, the Association of Fish and Wildlife Agencies' Best Management Practices for wolf trapping and other considerations for the ethical pursuit and taking of wolves.

Strategy C2: Evaluate wolf harvest season structure and implementation. Public input and tribal discussions during the development of this management plan indicated a desire among many to review and modify features of wolf season implementation. Many aspects of Wisconsin's wolf harvest season are established in state statute (Wis. Stat. s. 29.185) including the requirement to implement a wolf season when wolves are not listed on the federal or state list of threatened or endangered species, season opening and closing dates, allowed methods of take including use of traps and use of dogs and zone closure procedures. While these items are beyond the scope of the department's current authority and this plan, others are within the scope of the department's current authority and do not require legislative action to implement. The following products have been developed in response to those desires and to increase the department's ability to effectively manage the wolf population.

Product C2a: Continue mandatory harvest registration and in-person certification requirements; pursue administrative rules to reduce registration time to eight hours. The plan recommends the department continue mandatory harvest registration and in-person certification requirements. These processes provide critical harvest data and increase compliance with regulations. Further, retaining the in-person certification requirement will allow the opportunity to collect additional biological data or samples from harvested wolves as needs may arise. These data should be collected as needed to fill information gaps and or inform management decisions without putting undue burden on hunters/trappers.

The plan also recommends the department engage in rulemaking to require harvest registration to occur no later than eight hours following recovery of the harvested wolf. This change will increase the department's ability to monitor harvest data and inform timely zone closures as needed without putting an impractical expectation on successful hunters/trappers.

Product C2b: Maintain carcass tag requirements. Currently, wolf hunters and trappers must possess a carcass tag while hunting or trapping, validate the tag immediately upon killing a wolf and affix the tag to the wolf carcass in the manner described on the tag. These requirements assist with law

enforcement efforts and are recommended to be continued.

Product C2c: Issue wolf harvesting licenses which are only valid in the specific zone(s) specified on the license. Currently, wolf harvesting licenses are valid in any wolf harvest zone which remains open. This serves to increase opportunities for license holders as they may pursue wolves statewide in any open zone. However, this also has contributed to accelerated zone closures in past wolf seasons as hunter and trapper efforts become concentrated in zones which remain open and ultimately reducing opportunity. Further, there is limited ability to regulate harvest pressure by zone and difficulty to estimate success rates. Therefore, this plan recommends the department issue wolf harvesting licenses which are valid only in the specific wolf management zone(s) specified on the license. Such zone-specific licenses would allow the number of licenses issued to be tailored within each zone according to zone-specific factors, ultimately allowing better regulation of harvest rates and season lengths. Such zone-specific licenses are currently in use for other limited draw species in Wisconsin including black bear, bobcat, fisher and turkey, meaning hunters and trappers are familiar with this type of license application and issuance system.

Product C2d: Maintain consistency with license application timing for wolves with limited draw furbearer species. Currently, applications for the wolf license lottery match that of bobcat and fisher, with applications becoming available on March 1 and a deadline to apply of Aug.1. Despite potential benefits of an earlier application period for wolves (e.g., allow successful applicants more time to plan for the upcoming wolf season, including satisfying trapper education requirements), the wolf license lottery cannot be executed, and successful applicants cannot be notified, until license numbers are finalized. Wolf license numbers cannot be determined until updated wolf population estimates are available, typically by mid-summer of a given year. Therefore, there is limited ability to move the application deadline or complete the lottery much earlier in the year. Therefore, it is recommended to maintain consistency with the limited draw furbearer species to avoid creating a special wolf deadline. Wolf license applicants should be reminded at the time of application of the need to satisfy hunter and trapper education requirements to ensure they can plan accordingly.

Product C2e: Engage the department Wolf Advisory Committee in the annual review of data, evaluation of progress toward objectives and development of harvest quota recommendations. This plan recommends that the department continue to engage department's Wolf Advisory Committee in the development of wolf harvest quota recommendations. The committee is charged with engaging in science-based discussions and embodying the interests of the organizations they represent during committee dialogue to strive for substantial effective agreement on any recommendations coming from the committee. See Objective F below for more on the department's Wolf Advisory Committee.

Product C2f: Maintain consistency of regulations related to wolf hunting, trapping and shooting hours with those of similarly pursued species. Currently, methods of take for wolves mandated by state statute include the use of cable restraints, foothold traps, predator calls, aid of bait and aid of dogs. Each of these methods has further restrictions related to when, how, where and by whom they may be implemented. To the extent possible and appropriate and subject to periodic review, this plan recommends maintaining consistency among method-specific restrictions with those of restrictions currently in place for other species. Doing so will support law enforcement, reduce potential confusion, aid in voluntary compliance, provide similar opportunities across species and is unlikely to

result in significant biological ramifications. Specifically, but not limited to, this plan recommends the department retain administrative rule language which 1) restricts cable restraint placement for wolves until Dec. 1; 2) maintains current restrictions on foothold trap jaw spread width (max 8 inches) and timing of placement (max 7 inches spread width until Nov. 30); 3) maintains restrictions on wolf bait (including no animal by-products, 10 gallons or less, enclosure requirements and that authorization to bait begins the day after bear season ends and closes in each zone or subzone upon closure of the zone or subzone to wolf harvest; 4) maintain a prohibition on hunting wolves outside of daylight shooting hours until after the close of the nine-day deer gun season, at which time shooting hours only apply to those hunting wolves with aid of dogs; and 5) maintains consistency with marten restoration area trapping restrictions, currently allowing the use of foothold traps provided the traps have a pan tension of four pounds or greater to minimize the risk of incidental marten capture.

Product C2g: Determine the number of licenses to be issued for each zone based upon evaluation of zone-specific quotas, projected harvest and success rates, hunter and trapper satisfaction, and opportunity and timing of past zone closures. In past wolf seasons, wolf harvesting licenses were issued at license to quota ratios of 20:1 or 10:1 and were valid in any open wolf zone. Experience has demonstrated that harvest rates (and therefore season lengths) can vary widely based upon several factors, including this level of license issuance, ultimately making it difficult to precisely estimate true hunter/trapper success rates or when zone closures may occur. This increases the chances of underachieving/exceeding state harvest quotas, can result in low hunter/trapper satisfaction resulting from very short season lengths and may generate concerns about impacts to wolf reproduction or data collection if seasons extend well into late winter. Therefore, the number of licenses made available in each zone ideally would maximize hunter/trapper opportunity and satisfaction while minimizing the likelihood of exceeding state quotas or seasons extending into late winter. To do so, this plan recommends the number of licenses made available in each zone (assuming zone-specific tags, Product C2c) to achieve the state quota be based upon several factors including zone-specific quotas, projected harvest and success rates, hunter and trapper satisfaction, and opportunity and timing of past zone closures. This information is recommended to be analyzed with each harvest season to inform the development of future seasons.

Product C2h: Pursue administrative rules to establish a designated season for dog owners to train for wolf hunting activities. Currently, the training of dogs on wolves is allowed when wolves are not federally or state listed. To continue to allow some regulated opportunity for those interested in training dogs for wolf hunting purposes, while also considering potential biological impacts to wolves, this plan recommends the department engage in administrative rulemaking to establish a designated season to allow dog owners to train for wolf hunting activities. The plan recommends that in years when there is a harvest season, training dogs to hunt wolves would be allowed beginning when state law authorizes the use of dogs for hunting (currently the Monday following the closure of the regular gun deer season) and closing in each zone or subzone upon closure of the zone or subzone to wolf harvest. The purpose of ending training activities with the closure of the season in each zone or subzone is in response to potential impacts of training on wolves during the late winter breeding season, especially when that year's wolf season has already concluded in the particular zone or subzone. While engaged in training activities, participants would be required to follow all dog regulations in place for wolf hunting activities including the number of dogs allowed in pursuit, tagging and vaccination requirements and shooting

hours. Finally, the plan recommends that additional baiting beyond the harvest closure date for training purposes not be authorized.

Strategy C3: Encourage and recognize other forms of recreation and positive interactions with the wolf population.

Product C3a: Support non-consumptive recreational opportunities and wolf-related tourism. Many people already experience and benefit from the wolf population through opportunities to view, photograph, listen to or encounter wolves and their sign. Wolf-related tourism in Yellowstone National Park provides millions of dollars annually to surrounding states and communities (Duffield et al. 2006). Although such economic analysis has not been completed in Wisconsin, demand for such wildlife ecotourism opportunities in Wisconsin is evidenced by examples such as the growing popularity of viewing elk herds and sharp-tailed grouse leks in the state. While the forested landscapes of northern and central Wisconsin are not conducive to the same live-viewing environments of Yellowstone, wolf-related ecotourism can still be a valuable source of enjoyment for many and is recommended to be encouraged. With wolves, such ecotourism is likely to attract people to local communities within wolf range, ultimately resulting in local economic benefits and fostering public education, appreciation and value for wolves. A number of conservation groups, nature centers and other organizations (e.g., Timber Wolf Alliance, Timber Wolf Information Network, Wisconsin Natural Resources Foundation, etc.) have led wolf tracking and howling tours and workshops over the years. Such efforts should be encouraged and tracked to support these forms of positive interactions with the wolf population.

Product C3b: Recognize the existence, cultural and bequest values of wolves. Social science studies and public input have consistently found that most people agree that wolves have a right to exist in Wisconsin (existence value). In addition, many tribal members and non-tribal individuals hold deeply spiritual and cultural connections with wolves in the state. Further, there are people in the state and beyond who will likely never directly interact with the wolf population yet may engender a sense of satisfaction and thereby draw a benefit, by simply knowing a wolf population exists in the state. While such bequest values (defined as interest in and satisfaction derived from preserving natural and cultural heritages for future generations) are relatively understudied in the wildlife scientific literature, it is clear that they are a part of the fabric of society. Collectively, these existence, cultural and bequest values among many people of varying backgrounds are an important component of wolf management and are recommended to be recognized and given due consideration when making management decisions.

Objective D: Increase Public Understanding Of Wolves In Wisconsin

Definition: Recent scientific studies and experiences reveal the pervasiveness and impact of misinformation, sensationalism and rumors which may be generated among those across the full spectrum of stakeholders and the public (see Section 2 of this plan). This pattern appears consistent throughout wolf range, including Europe (Theodorakea and von Essen 2016). Even some scientific wolf-related research is not immune to the effects of subtle bias (positive and negative) entering the work (Mech 2012). Unfortunately, these portrayals can muddy the reality of wolves and further be weaponized by special interest groups with either strong pro- or strong anti-wolf agendas. Ultimately, these narratives only do a disservice to wolves and fail to contribute to long-term sustainable management of the species. Perhaps unsurprisingly, the specific management objective which received the highest degree of importance among all Wisconsinites as measured by the 2022 public attitudes survey was "to educate people about wolves and wolf behavior," with 91% of respondents indicating this was a very or somewhat important management action (Bradshaw et al. 2022). In response, this objective aims to provide science-based information to the public to ultimately improve awareness and understanding of the myriad ways wolves influence Wisconsin's landscapes and people. The following metrics and corresponding potential measures have been identified to help evaluate whether this objective is being met.

Objective D: Increase Public Understanding Of Wolves In Wisconsin	
Metrics	**Potential Measures**
Active and passive outreach efforts to share accurate information on wolves	Number of DNR led or supported outreach efforts on wolves (e.g., news releases, social media posts, popular articles, public presentations, workshops, partner projects, etc.), number of views on the DNR wolf webpages
Public knowledge of how to responsibly live, work or recreate in wolf range	Results from periodic social science surveys on safety perceptions, tolerance, best practices, etc., related to wolves

Strategy D1: Provide public education and understanding of wolves by ensuring information is accurate and readily available to the public. Public outreach and educational activities are an integral part of wolf recovery success in the Upper Great Lakes region (Troxell et al. 2009). A multifaceted and collaborative approach is recommended to encourage wolf education and outreach in Wisconsin that promotes factual, science-based information on wolf ecology and their management.

Product D1a: Review the department's wolf webpages to enhance transparency, navigability and accessibility of information and webpages. The department's website serves as a go-to source of reliable information related to wolves and wolf management in the state. The plan recommends department wolf program staff work with department communications staff to review the webpages and identify ways to streamline delivery of information.

Product D1b: Continue to utilize email and text notifications to communicate timely wolf-related information to the public. The department provides email and text updates to subscribers on a wide range of topics. Specific to wolves, subscribers can receive instant email and/or text message related to occurrences of wolf conflict, scheduled public meetings, wolf harvest updates and more. The plan

recommends department wolf program staff continue to promote and use this system to deliver important and timely information to the public.

Product D1c: Ensure the 2023 Wisconsin Wolf Management Plan is widely available to the public. Much of this document aims to provide a strong educational foundation related to wolves in Wisconsin, including a detailed scientific overview of gray wolf ecology, human dimensions surrounding wolves and the history of wolf management in Wisconsin. The plan also provides a guide to decision-making and management in the years ahead. Therefore, this plan serves as an effective outreach tool to increase public understanding of wolves and help citizens better understand wolf management in the state. It is recommended that this plan be posted on the department website and physical copies made available at agency offices and service centers to meet demand. Consideration should also be given to developing a simplified or summary version of the document so it is more digestible to general audiences or specific age groups.

Product D1d: Develop materials to assist local department and customer services staff in providing accurate and consistent information to wolf-related inquiries. Department conservation wardens, wildlife biologists, customer service and communications staff often serve as the primary conduit between the department and citizens. These interactions can take many forms including in-person public interactions, questions via phone, email and social media and requests from the media. Therefore, the plan recommends that department wolf program staff continually communicate accurate and relevant information to these staff statewide to enable them to provide confident and informative responses to these inquiries.

Product D1e: Continue providing wolf specimens (skulls and pelts) to serve as educational, scientific and cultural resources. For many years, department wolf program staff have attempted to utilize suitable wolf carcasses resulting from management actions or found dead in the field to serve as educational, scientific or cultural resources. Over the years, many wolf pelts and skulls have been transferred to research institutions, such as the University of Wisconsin-Zoology Museum in Madison, while others have been provided to schools, nature centers and department offices to serve as educational displays. It is recommended that department staff continue this practice by maintaining a list of requests for specimens and working to fulfill those requests. Generally, unless needed for law enforcement, scientific research or health monitoring, wolf education and Native American cultural use should typically be the priorities for wolf specimens. Native American use should especially be prioritized in cases of wolf specimens originating from within or near tribal reservations. Pelts and skulls should be made available for various entities including but not limited to tribal governments, schools, nature centers, state parks, department and other agency offices, tribal centers and wolf education organizations. To prevent incentivization of illegal kill or abuse of depredation control permits, department staff are encouraged to use careful discretion in providing wolf specimens to property owners who find a dead wolf on their property or kill a wolf under landowner depredation permits.

Product D1f: Share scientific information and research results via popular media outlets and in-

person presentations. Peer-reviewed publication of research results is a vital part of disseminating scientific results. However, public access to these journals and articles is typically limited via subscriptions and fees and further hindered by scientific jargon. This plan recommends department staff strive to effectively communicate relevant scientific research results, from Wisconsin and elsewhere, through popular media outlets such as newspapers, magazines, radio, television and social media platforms. Further, it recommends department staff continue to attend and provide presentations at various conferences and meetings.

Strategy D2: Ensure educational materials are reflective of the latest science and accumulated management experience. Wisconsin's wolf population has recovered over the course of more than four decades and much scientific information and practical management experience has been accumulated during that same time. Effective communication and outreach will require skillful delivery of the message (see Strategy D1). However, equally critical to success will be ensuring the message is informed by both the decades of experience in Wisconsin as well as the latest scientific findings.

Product D2a: Conduct a comprehensive review of the department's wolf webpage content and associated educational materials. A wealth of information is available related to wolves, wolf management and preventing wolf conflict is available on the department wolf webpages. In addition to reviewing the webpages to improve delivery of information (see Product D1a), this plan recommends department wolf program staff also conduct a comprehensive review of the content of the webpages and associated materials.

Product D2b: Continue to provide Wolf Ecology Courses. Traditionally delivered as part of the training to become certified volunteer carnivore tracker, wolf ecology courses have been offered by the department for many years. Wolf conservation partner groups, such as Timber Wolf Alliance and Timber Wolf Information Network, have developed and delivered similar wolf ecology courses over the years. Together, these courses have provided high-quality educational opportunities for many people interested in wolves. These courses are recommended to continue being offered by the department, including continued support and collaboration for courses delivered by partner groups. Department staff should also critically review the current course to identify potential improvements in course content, structure and delivery.

Product D2c: Foster relationships with partner groups to deliver science-based educational materials to the public. Cooperation between the department and numerous partner groups in delivering scientific and fact-based information on wolves has been instrumental to wolf recovery in Wisconsin. Continuing these relationships and collaborative educational efforts into the future is recommended. Examples of past cooperative efforts include department sponsorship of the Timber Wolf Alliance's promotion of Wolf Awareness Week, coordinating with agricultural organizations such as the Wisconsin Farm Bureau Federation to include wolf conflict guidance in member newsletters and participating in invited public presentations on wolves (e.g., Wolf Info Now's wolf panels at the Milwaukee Journal Sentinel Sports Show).

Strategy D3: Encourage the use of creative and forward-thinking outreach tools to reach new and

broader audiences. The ways in which people receive information is evolving at a rapid pace and is likely to continue to do so. To be effective, communications and outreach must also evolve.

Product D3a: Identify and participate in non-traditional and emerging platforms to share wolf-related information. The use of traditional outlets, such as print and digital media and broadcast radio and television, will continue to be a central component of any communications strategy. However, the skillful use of social media, podcasts, videos, etc., has the potential to greatly enhance the reach and impact of educational messaging and is recommended to be encouraged. Similarly, engagement in live events such as forums, sports shows, state/county fairs and invited presentations has shown to be an effective strategy for disseminating information and these practices are recommended to be continued.

Product D3b: Explore collaborative efforts with natural resources educators to develop classroom lesson plans focused on Wisconsin's native wildlife, including wolves. Wolves are a charismatic part of Wisconsin's fauna, yet they remain often misunderstood. As part of a forward-thinking education strategy, this plan recommends department staff explore collaborative efforts to develop classroom materials on wolf ecology tailored toward various school age groups. Collaborating with organizations such as the Wisconsin Association for Environmental Education, Wisconsin Society of Science Teachers, FIELD Edventures and/or the Wisconsin Center for Environmental Education, to develop and distribute classroom educational resources may serve to help demystify wolves for the next generation.

Objective E: Conduct Scientific Research To Inform Wolf Stewardship

Definition: For the purposes of this plan, stewardship is defined as the careful and responsible management of resources. Effective stewardship of wildlife requires a scientific foundational understanding of a species' ecology, population dynamics and impacts on human interests. Science-based research is the vehicle to acquire, test and build this knowledge base. Wisconsin has a long and rich history of using wildlife research to inform wildlife management, including with respect to wolves. It will be important to continue this tradition well into the future to support wolf management and remain adaptive to always shifting biological and social realities. This objective outlines a non-exhaustive list of research projects, existing information gaps and program efforts related to contemporary wolf management issues. These efforts are intended to build upon the existing knowledge base and support continued science-based wolf stewardship in Wisconsin. Research projects or topics not included on this list may be identified and prioritized in the future as needs arise. The following metrics and corresponding potential measures have been identified to help evaluate whether this objective is being met.

Objective E: Conduct Scientific Research To Inform Wolf Stewardship	
Metrics	**Potential Measures**
Wolf-related scientific research	Scientific research projects funded, supported or completed by the DNR, scientific research conducted by external researchers
Addressing information gaps	Completion of products identified in this plan (or other priority needs that arise) to inform management decisions
Communicate scientific findings	Publication of monitoring reports, technical analyses, peer-reviewed science and articles in popular media

Strategy E1: Continue to evaluate and improve methods used to monitor wolf population size and abundance. Wolf population models provide critical information on the population and ultimately drive many aspects of decision making. Given this level of importance, continual evaluation of model performance should be a priority to ensure results are robust and scientifically defensible.

> ***Product E1a: Regularly conduct scientific reviews of population model performance, information needs, potential data sources and new quantitative methods.*** The current scaled occupancy model was developed in collaboration between department research scientists and the University of Wisconsin-Madison. This methodology was published in the respected and peer-reviewed Journal of Wildlife Management (Stauffer et al. 2021). However, all models are simplifications of reality and should be subject to scientific evaluation and improvements. Therefore, this plan recommends department staff work with the Wolf Advisory Committee, GLIFWC, and natural resources staff from Tribal Nations to routinely evaluate the performance of current models, identify information needs and potential ways to incorporate new data (such as camera data from Snapshot Wisconsin and other public observations of wolves) to improve the model and explore the utility of new methods and tools as they are presented in the scientific literature.
>
> ***Product E1b: Evaluate the potential effects of variability in territory size on population model estimates.*** Estimates of average territory size, derived from GPS collared wolves, are a critical piece of

information in the scaled occupancy model used to estimate wolf population abundance. Wolf territory sizes often vary due to a number of factors including prey density, habitat composition and regional density of wolves. The plan recommends department research staff continue to evaluate how this variability may influence model results (Stauffer et al. 2021). Additionally, in deploying GPS collars (see product A2d), emphasis on a distribution of collars across wolf range to help develop estimates of wolf territory sizes that reflect the spatial heterozygosity in prey, wolf density and habitat types across wolf range is recommended.

Product E1c: Investigate the development of a wolf population estimate independent of the scaled occupancy model to enable comparisons. Accurate estimation of wolf population abundance and distribution is paramount to evaluating the results of population management actions and achieving plan objectives. The plan recommends department staff investigate the feasibility of developing a wolf population estimate through a means independent of the scaled occupancy model, such as a non-invasive genetics project, to enable comparisons between results.

Strategy E2: Evaluate social and economic implications related to wolves in Wisconsin.

Product E2a: Conduct comprehensive scientific surveys of Wisconsin residents' attitudes toward wolves and wolf management. As detailed in Section 2 of this plan, scientific assessments of the general public's attitudes toward and wolf management activities in Wisconsin were conducted by the department in 2014 and again in 2022. Having an accurate understanding of the level of ongoing public support for wolves and wolf management or where that support is lacking, is a vital ingredient in the continued long-term wolf conservation and management in the state. In collaboration with department social scientists, this plan recommends department staff regularly (e.g., every ~5-10 years) conduct similar scientific human dimensions studies to estimate current attitudes, gain insights on current issues and evaluate potential shifts in public attitudes.

Product E2b: Develop a recreational behavior and economic analysis to explore the ways that wolves influence the attitudes and behaviors of various recreational user groups. Currently, wolf distribution covers over a third of the state, including vast areas of public lands which simultaneously support many forms of recreation, tourism and sources of economic stimuli. It is therefore important to better understand the net effects of wolf presence across the state on recreational users. For example, many dog owners may choose to recreate (hunt, hike, etc.) in areas away from wolves to avoid conflict and this may result in a net opportunity loss for those users and redirection of spending. Others may quit hunting or recreating with their dogs entirely due to fear of losing a dog to wolves. Still other users, such as winter recreationists, campers or hikers, may be indifferent to or even selecting for areas with wolf presence. Finally, those driven to see or observe wolves (ecotourism) are likely to be drawn to areas with wolves. An improved understanding of this dynamic would help improve holistic recreational planning, ensure consideration and support for all forms of wolf-related recreation, identify educational and outreach needs, support hunter recruitment and retention efforts and provide information to help support local economies.

Product E2c: Evaluate the potential impacts of wolves and wolf presence on recreational land values. Department staff routinely hear from some members of the public during individual interactions and at various meetings (such as County Deer Advisory Council and Conservation Congress meetings)

that the presence of wolves and the implied reduction in hunting opportunities have reduced recreational land values and created economic loss and hardship to these landowners. The plan recommends this dynamic be explored further to determine the extent to which this may or may not be occurring.

Strategy E3: Continue to research conflict mitigation, prevention measures and develop new techniques for addressing conflicts.

Product E3a: Continue to cooperate with universities, USDA WS's National Wildlife Research Center and the department's Office of Applied Sciences to evaluate and develop new techniques for wolf conflict management. Wisconsin has a long history of being involved in the development and testing of conflict abatement measures, including non-lethal techniques, which are widely deployed today (Ruid et al. 2009). This plan recommends that the department continue to support efforts to research and develop techniques designed to reduce and prevent wolf/human conflict. One such example is the ongoing evaluation of solar-powered light deterrents attached to the ears of livestock (i.e., flashtags) to help protect them from depredation.

Product E3b: Evaluate the short- and long-term effectiveness of various conflict abatement techniques. Wisconsin has decades worth of information regarding wolf-related conflict and associated abatement measures implemented. Further analysis of this information may shed light on the effectiveness of various measures in reducing subsequent conflict, including site-specific and short/long-term scales. These historical data are recommended to be reviewed and appropriately analyzed to provide insights toward ultimately improving the efficiency and effectiveness of wolf conflict abatement in Wisconsin.

Product E3c: Continue research into the drivers of and strategies to reduce hunting dog depredations by wolves. Wolves killing and injuring hunting dogs, particularly dogs engaged in bear training and hunting activities, continues to be a significant issue in Wisconsin. Several studies have been conducted to date on this subject providing insight into the factors that elevate or minimize risk of wolf/hunting dog conflict. Further research into this topic is warranted, particularly additional work to develop, implement and evaluate practical strategies for hunters to reduce wolf/hunting dog conflict.

Strategy E4: Continue to assess effects and patterns of regulated wolf harvest on Wisconsin's wolf population.

Product E4a: Produce a report analyzing wolf harvest activities from past seasons. The plan recommends department staff compile and analyze existing data from items such as post-season reports and surveys from past wolf seasons in Wisconsin to support future wolf season planning. This report could include detailed reviews of items such as where hunting and trapping effort and harvest have occurred across the gradient of private and public lands, patterns in hunter and trapper methods and success, summaries of biological data from harvested animals and data illustrating any potential impacts on wolf packs and population stability.

Product E4b: Continue to evaluate Wisconsin wolf population growth and mortality patterns and integrate data with published studies. As detailed in Section 3 of this plan, the relationship between annual human caused mortality and the rate of change in wolf population sizes has been studied

and published numerous times for North American wolf populations. The plan recommends that the department's Office of Applied Science staff continue to analyze how the Wisconsin wolf population responds to various levels of mortality and integrate such data into these models to continually improve their predictive power.

Product E4c: Conduct wolf hunter/trapper surveys following each regulated wolf season to capture data on hunter/trapper behaviors, attitudes and experiences. The use of post-season surveys sent to a sample of license holders from a particular season is a common practice in wildlife management. Such surveys have been completed for each wolf seasons conducted in Wisconsin to date and this effort is recommended to be continued to support information needs and management activities.

Strategy E5: Carry out research on the population dynamics and ecological influences of wolves in Wisconsin.

Product E5a: Support research into the role wolves may play in relevant ecological processes such as forest regeneration and disease transmission. Wolves play a keystone role in the landscapes they inhabit, and this includes many indirect ecological influences that may currently be poorly understood or altogether unknown. The plan recommends the department continue to support research that investigates such ecological relationships. Examples include further research into how wolves shape forest succession and biodiversity, the role wolves may play in chronic wasting disease prevalence and transmission among white-tailed deer and/or elk, and the implications of how wolves may affect vector-borne diseases such as Lyme disease.

Product E5b: Support research investigating predation effects on white-tailed deer and elk population dynamics in Wisconsin. Predator-prey dynamics are incredibly complex, including how the suite of predators in Wisconsin (including wolves) impacts the population dynamics, habitat use and behaviors of deer and elk in Wisconsin. The plan recommends the department continue to build upon previous research conducted in Wisconsin and elsewhere investigating the myriad of ways in which predation affects deer and elk herds. Examples include how wolves may influence deer and elk habitat use, effects of predation on deer and elk population growth and the potential interactions between winter severity, habitat quality and predation on herd dynamics.

Product E5c: Investigate wolf habitat and resource selection to better define suitable wolf habitat in Wisconsin. Estimates of available habitat suitable to support wolves have been key drivers of past wolf conservation and planning in Wisconsin. The rise of GPS collars in recent years allows a more nuanced and rigorous analysis of how wolves use the landscape and the features that support and inhibit wolf use. The plan recommends the department support research examining wolf habitat suitability and resource selection patterns to support information gaps and future decision making.

Product E5d: Develop research to examine wolf food habits. A wealth of studies has examined the diets of wolves in North America over the last several decades. However, most of these have relied on traditional methods of scat and stomach content analysis or kill site investigation, each of which may be plagued by limitations in spatial and temporal resolution. There is high public interest in wolf predation and better information on wolf diets in Wisconsin, including seasonal, spatial and species variation among wolf packs, would provide better information to evaluate the effects of predation on

wolves' prey species. The plan recommends the department support research to examine wolf food habits in Wisconsin. An example of which may be through the use of stable isotope analysis which has successfully been used to analyze wolf food habits in Canada in recent years.

Strategy E6: Communicate scientific findings from research conducted in Wisconsin and elsewhere.

Product E6a: Publish research findings in peer-reviewed scientific research journals. Sharing research findings in peer-reviewed scientific journals is a crucial step in contributing to the body of scientific knowledge. This plan recommends supporting department staff and partners to publish wolf research findings in reputable scientific journals.

Product E6b: Develop a communications strategy to provide science-based information on wolves to the public. The plan recommends department wolf program staff collaborate with department communications staff to develop a communication strategy to effectively share scientific findings with the public (see product D1f).

Product E6c: Attend professional wildlife conferences and symposiums to share findings and connect with others engaged in wolf management. This plan encourages department staff to attend professional wildlife conferences to share research findings and management experiences and collaborate with other professionals to foster information sharing and gain insights into the latest developments relevant to wolf management.

Objective F: Provide Leadership In Collaborative And Science-Based Wolf Management In Wisconsin

Definition: The recovery of gray wolves in Wisconsin could not have occurred without the combined and sustained efforts of numerous local, state and federal governmental entities, Tribal Nations, non-government organizations and the residents of the state. The recovery of gray wolves in Wisconsin should be applauded for the conservation success story it represents. While the path has at times been difficult and controversial, findings from the department's 2022 scientific assessment of public attitudes suggest most Wisconsinite's feel the department appropriately uses science and data in decision-making (67%), uses reliable methods to estimate wolf populations in Wisconsin (65%), can be trusted to make decisions about wildlife that are good for the resource (64%) and listens to the concerns of citizens (59%). As the focus now moves from wolf recovery to ongoing sustainable management, it will be crucial for the department to continue to provide leadership, maintain and build trust through high levels of collaboration and relationship building, apply innovative thinking to address ongoing and emerging issues and rely upon science to inform decision-making.

Objective F: Provide Leadership In Collaborative And Science-Based Wolf Management In Wisconsin	
Metrics	**Potential Measures**
Engaging the public in wolf management	Regular meetings of the Wolf Advisory Committee, number of opportunities for the public to provide public input on wolf management
Collaboration with partners	Regular collaboration and professional engagement on wolf management with Tribal Nations, government agencies, conservation organizations, universities, and other partners

Strategy F1: Provide leadership for science-based wolf management in Wisconsin. Protections afforded to wolves in Wisconsin from the federal endangered species list have facilitated the recovery of the species in the state. However, continued legal battles and changes in management authority can lead to inconsistent management responses, frustration among those suffering wolf-related conflict and ultimately may erode some public support for wolves in the state. Scientific findings and biological indicators point to the wolf population as being biologically recovered in Wisconsin.

Strategy F2: Utilize the department's Wolf Advisory Committee to advise on implementation of the Wisconsin Wolf Management Plan. The department has historically engaged an advisory committee, including department staff, other government agencies, non-governmental organizations, tribal representation and conservation groups, for the purpose of providing input and recommendations related to wolf management to the department. This committee has taken on various forms and functions over the years, but the contributions have nonetheless proven to be an important component of wolf management in Wisconsin. This plan recognizes the importance of the Wolf Advisory Committee and provides stated dedication to continuing this avenue for collaboration. Note: the Wolf Management Plan Committee brought together to provide input on the development of this plan will complete its charge and dissolve upon approval of this plan, with a new committee to follow (see Product F2a).

Product F2a: Establish and maintain a department Wolf Advisory Committee that is inclusive of the views of all stakeholders, tribes and partners.

Department species advisory committees exist to review and provide recommendations regarding policies, plans, season structures, harvest quotas and project funding as assigned by the department's Bureau of Wildlife Management Wildlife Leadership Team. Their recommendations are to be science-based, within the bounds of the department's authority and involve consideration for various social, economic and institutional concerns. The diversity of membership is designed to provide broad social, economic and ecological considerations and input. Involvement of stakeholders and partners should increase the probability that recommended policies are sustainable with maximum implementation potential.

This plan recommends maintaining the use of a single department Wolf Advisory Committee to provide input regarding the department's implementation of the plan. The use of a single committee structure maintains a familiar advisory committee structure that is consistent with other current wildlife advisory committees, increases transparency by clearly defining roles and being more inclusive and will foster knowledge sharing and relationship building by having biologists, partners and stakeholders engaging in the same discussions.

Committee Membership and Expectations:

This plan recommends the department develop a committee charter to communicate specific charges, memberships and expectations. The committee is recommended to be chaired by the department's large carnivore specialist and sponsored by a member of the department's Bureau of Wildlife Management Wildlife Leadership Team. The committee is recommended to have one department wildlife field staff from each administrative district to represent the district and serve as a conduit between department field staff and the committee. Other department membership may include staff whose technical expertise is required and members from any relevant partner bureaus. Attendance and participation by other department species specialists (deer program specialist, elk specialist, furbearer specialist, etc.) may be encouraged to foster cross-program communication and information sharing.

The balance of the initial committee membership is recommended to be developed through a two-step invitation and application process. First, invitations to participate on the committee would be sent to various government and tribal natural resource agencies with a history of involvement in wolf management and as determined by the department. An exception to this process must be extended to the Ojibwe tribes of Wisconsin which have a legal right to representation on the advisory committee. Second, a competitive application process would be developed to allow interested stakeholder organizations and individuals to apply for one of a limited number of stakeholder seats. For this committee, stakeholder seats are recommended to be grouped into five defined categories (see below). Organizing stakeholder seats in this manner strives to balance inclusivity, fairness and overall committee size. It is recommended that the department review these applications and award stakeholder seats based upon, but not limited to organization qualifications, knowledge of wolf management and science, application responses, history of past involvement in wolf management and congruency between the applicant's and department's mission. Stakeholder advisory committee seats are recommended to be three-year commitments (by organization) and occur on a staggered

timeline over a three-year period to allow the occasional opportunity for changes in membership while minimizing the number of new individuals annually.

Stakeholder Group Definitions:

- Hunting and Trapping Organizations: Organizations whose mission includes ensuring the hunting and trapping heritage in Wisconsin remains strong while embracing changing societal values, specifically promoting the use of regulated harvest as a primary tool to manage wildlife species.
- Agricultural and Ranching Organizations: Organizations whose mission includes ensuring the rural agricultural or ranching lifestyle in Wisconsin remains strong, specifically promoting the use and advancement of a wide array of abatement measures to effectively resolve wolf conflicts.
- Environmental Organizations: Organizations whose mission includes ensuring the conservation/ preservation of wildlife and wildlife habitats in Wisconsin, specifically promoting wolf-related coexistence as part of maintaining healthy ecosystems and natural landscapes.
- Conservation Science and Education Organizations: Organizations whose mission includes the conservation of wildlife in Wisconsin through science-based management and educational outreach, specifically promoting sound science in wildlife management decision-making and sharing science-based public educational outreach on wolves.
- At-Large, Unaffiliated Residents: Available to any Wisconsin residents who are generally interested in and/or affected by wolves and wolf management. These would be available to anyone not already a member of any of group directly active in wolf-related activities (as detailed on their application and determined by the department), although they may be involved in other groups not specifically involved with wolf management (e.g., Ducks Unlimited, Nature Conservancy). It is expected these members would provide viewpoints that may not be captured by other organizations representing specific interests.

Product F2b: Ensure communication with and among the department's Wolf Advisory Committee is timely and sufficient to support representative input and effective wolf management decision-making processes. To ensure committee members can adequately review information and solicit feedback, this plan recommends department staff strive to provide reports on population monitoring, harvest, conflict and other pertinent data as far ahead of time as possible (ideally >1 week). However, sometimes circumstances may hinder such advanced sharing and committee members should be kept informed in those cases to respect their time and contributions.

Product F2c: Convene the department's Wolf Advisory Committee at least annually and regardless of listing status. The committee is recommended to meet at least once a year to stay abreast of current issues and develop input and recommendations on relevant topics. Additional meetings could be scheduled on an as-needed basis and may be particularly important when considering harvest quotas. These meetings are recommended to occur regardless of federal or state listing status of the species.

Strategy F3: Support science-based wildlife management and increase capacity through collaboration with other government agencies, tribes, conservation organizations, universities and residents.

Product F3a: Recognize the value and importance of tribal relationships and the cultural significance of wolves in wolf management, conservation and stewardship. This plan acknowledges the importance of the many cultural views and relationships with wolves held among Wisconsin's Tribal Nations. This plan also recognizes the valuable contributions over the years to wolf recovery and management by the tribes including data collection, information sharing and financial contributions. The department should continue to pursue and foster meaningful and cooperative relationships with the tribes and their designated natural resource managers and intertribal entities, including the Great Lakes Indian Fish and Wildlife Commission and the Voigt Intertribal Task Force. The department also recognizes and respects tribal sovereignty and reserved treaty rights and is committed to implementing this plan in a manner that acknowledges and honors the established rights of tribal entities.

Product F3b: Promote intergovernmental collaboration on wolf management. The plan recommends the department continue to regularly meet and discuss issues, challenges and successes associated with wolf management with other government and tribal natural resource agency partners. This includes regular communication and information sharing with federal, state, county and tribal government and natural resource agencies. It is recommended that department wolf program staff invite increased participation in wolf monitoring and data collection efforts among these entities and continue to meet as needed with biologists and scientists to engage in technical and scientific discussions among professional staff biologists. Similarly, formal data sharing agreements may be reviewed and/or developed to protect and share sensitive data. Additionally, recognizing that the Wisconsin component of the Great Lakes wolf population is interconnected and influenced by our neighboring states, efforts should be made to regularly communicate and share information with wolf managers in adjacent jurisdictions.

Product F3c: Maintain partnerships with colleges and universities to support collaborative research on Wisconsin's wolf population. The plan recommends department continue to partner with colleges and universities, both within and outside of Wisconsin, to conduct science-based research in support of decision making and addressing information gaps.

Product F3d: Continue fostering alliances with conservation organizations. The department wolf program has a history of successfully partnering with several non-government conservation organizations in support of wolf recovery and management, including the Timber Wolf Alliance (TWA), Timber Wolf Information Network (TWIN), International Wolf Center (IWC) and the Wisconsin Trappers Association (WTA). These relationships are recommended to be continued while pursuing additional partnerships with organizations which share the department's mission.

Product F3e: Apply for CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora) authority. Gray wolves are included as an Appendix II species under the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). As such, legally harvested wolves cannot be moved out of the United States without the proper CITES tag. Wisconsin, as most states, does not have CITES authority for wolves. The state registration tag provided by the department for legally harvested wolves is sufficient to cross state lines but not international borders.

The plan recommends the department consider applying to the USFWS for CITES authority for wolves to further demonstrate interest in long-term sustainable management of wolves and reduce potential administrative burden on legal wolf hunters and trappers in the future.

Product F3f: Host a science-based wolf summit to affirm commitment to long-term, sustainable wolf management policies collaboratively developed in Wisconsin and for Wisconsin. This plan recommends the department and the department's Wolf Advisory Committee periodically host a wolf summit to share science-based information and updates related to wolf management. This summit could create a platform for sharing wolf management successes, challenges and outreach efforts from across the state. Attendees could include county, state, federal and tribal partners and include representatives from such entities as tourism, forestry, business and others that interface with the state's wolf population. Attendance by policy makers, politicians and interested citizens may also be encouraged.

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Appendix A. Maps of Wisconsin's Wolf Management Zones

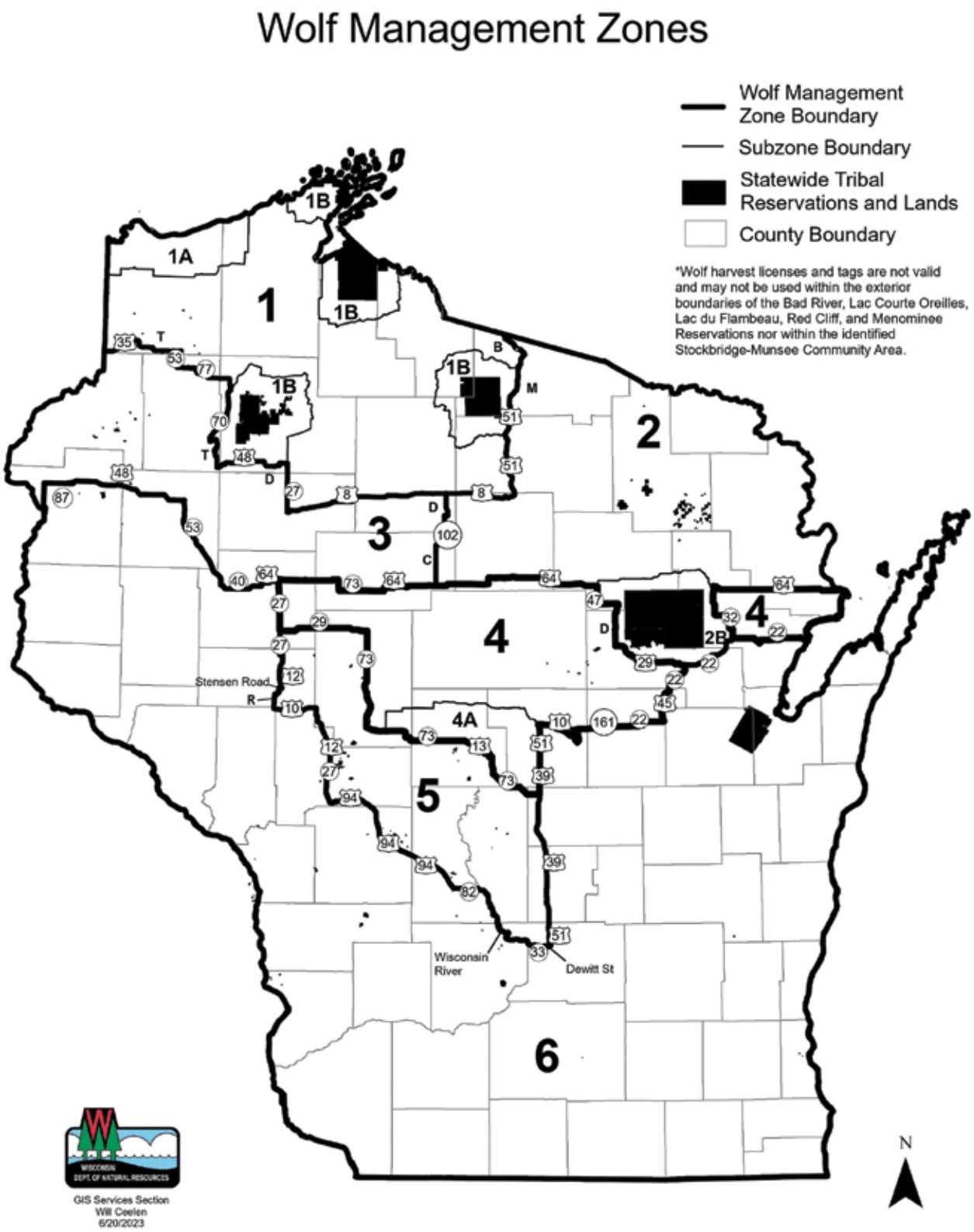


Figure A1. Wisconsin's wolf management zones as outlined in this management plan. To respect tribal sovereignty, the tribal reservations of Bad River, Red Cliff, Lac Courte Oreilles, Lac du Flambeau, Menominee and the identified Stockbridge-Munsee Community Area will continue to be designated as zero quota areas for state wolf harvest on the state zone map.

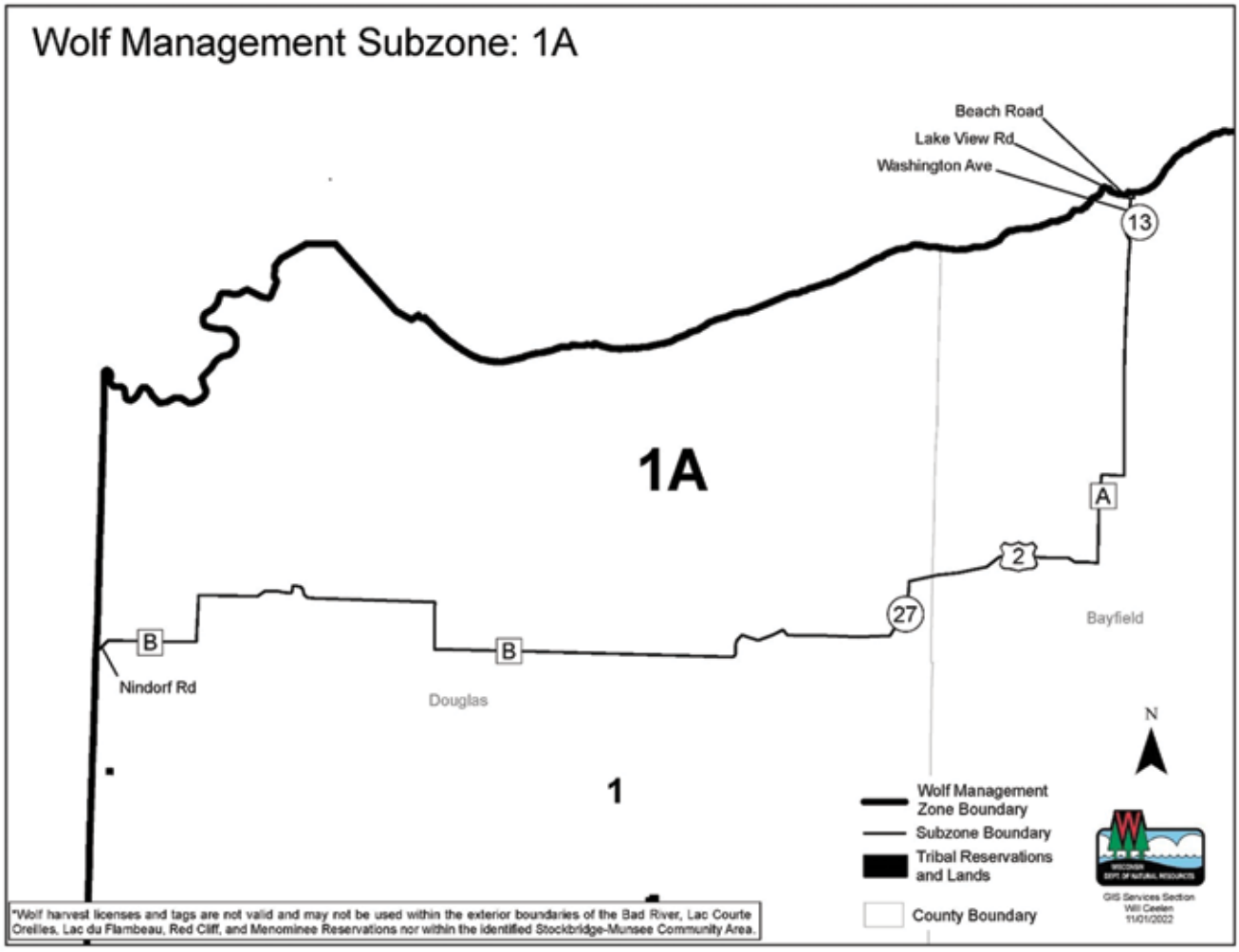


Figure A2. Boundaries of wolf management subzone 1A in Douglas and Bayfield Counties, Wisconsin.

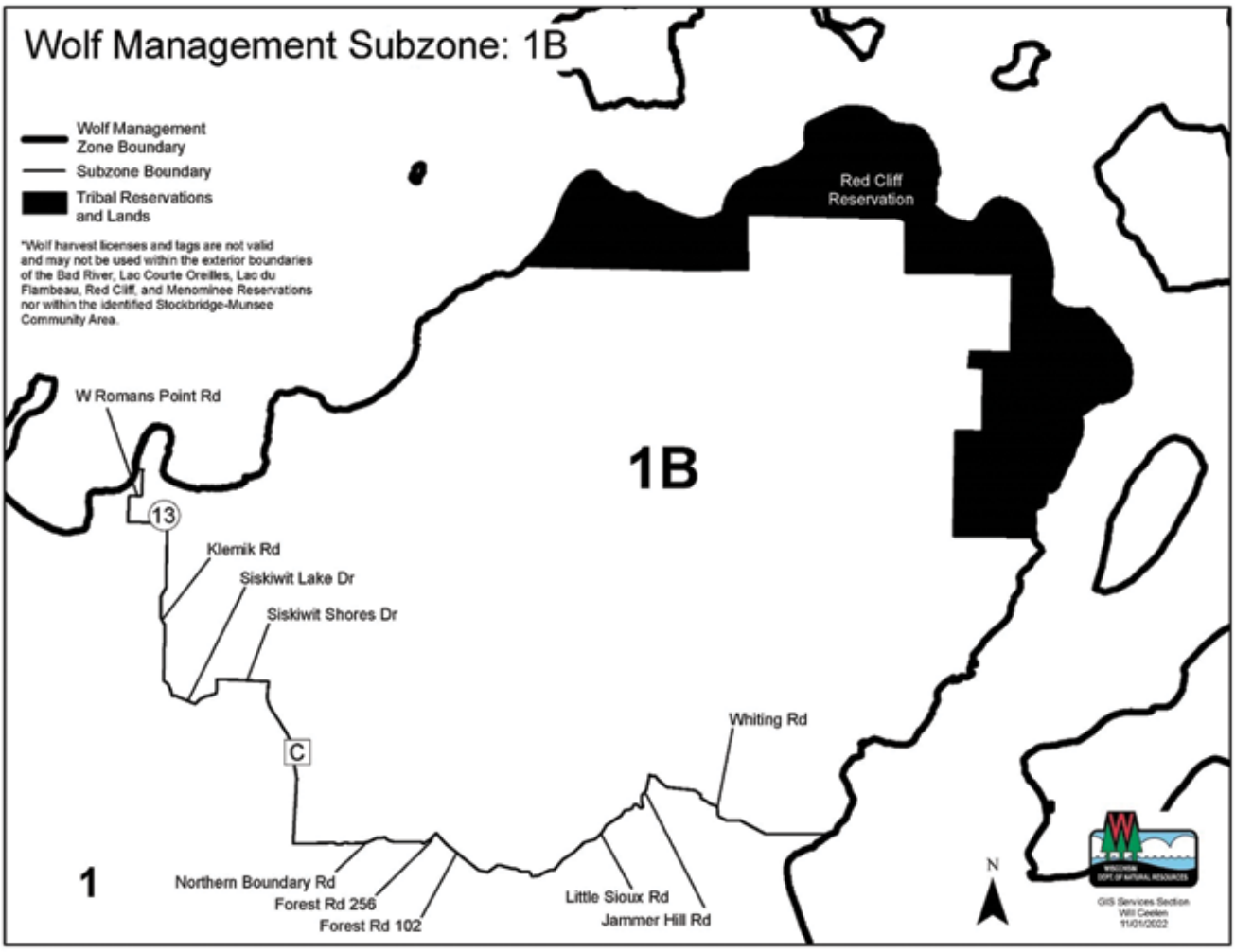


Figure A3. Boundaries of the portion of wolf management subzone 1B Bayfield County, Wisconsin.

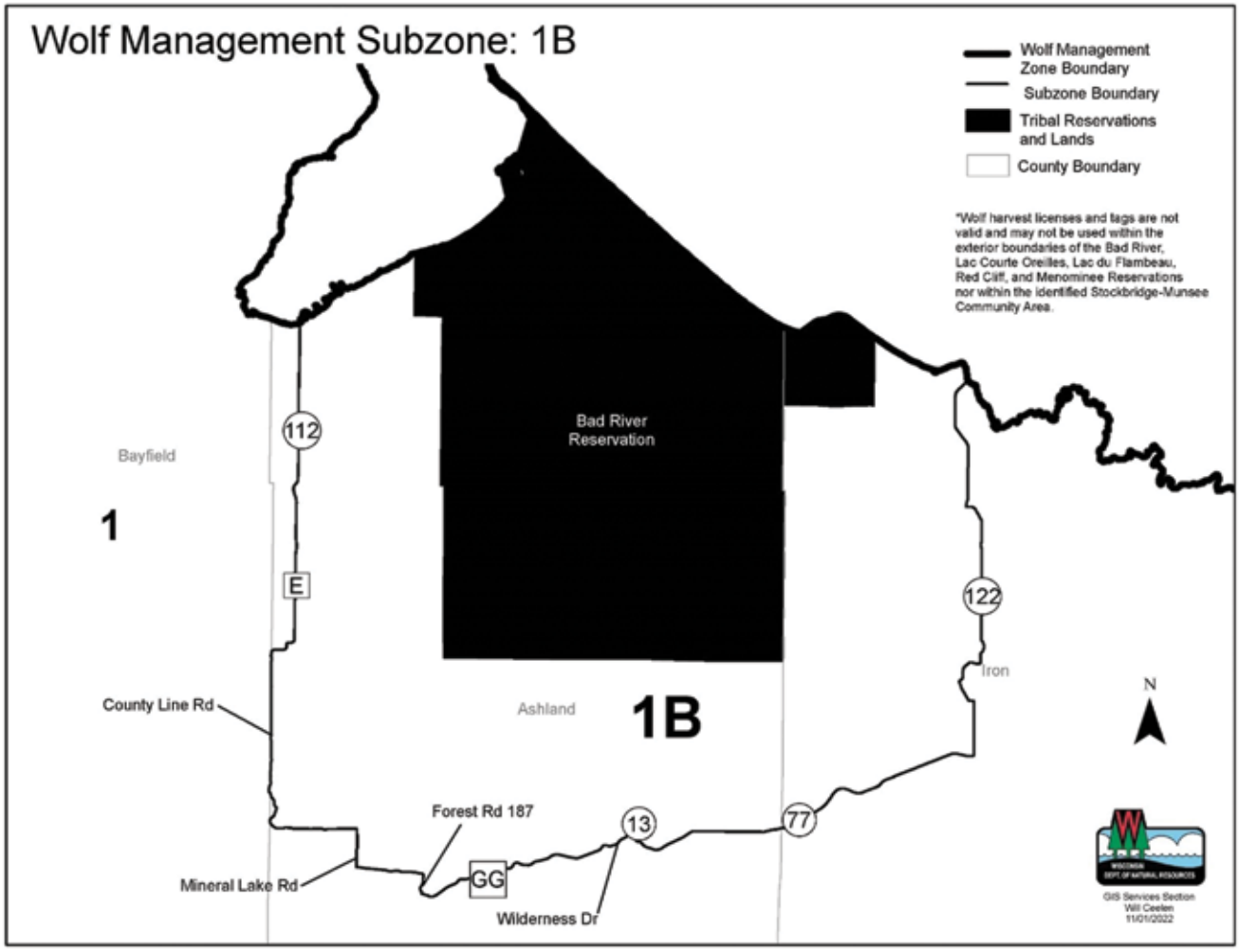


Figure A4. Boundaries of the portion of wolf management subzone 1B in Ashland and Iron Counties, Wisconsin.

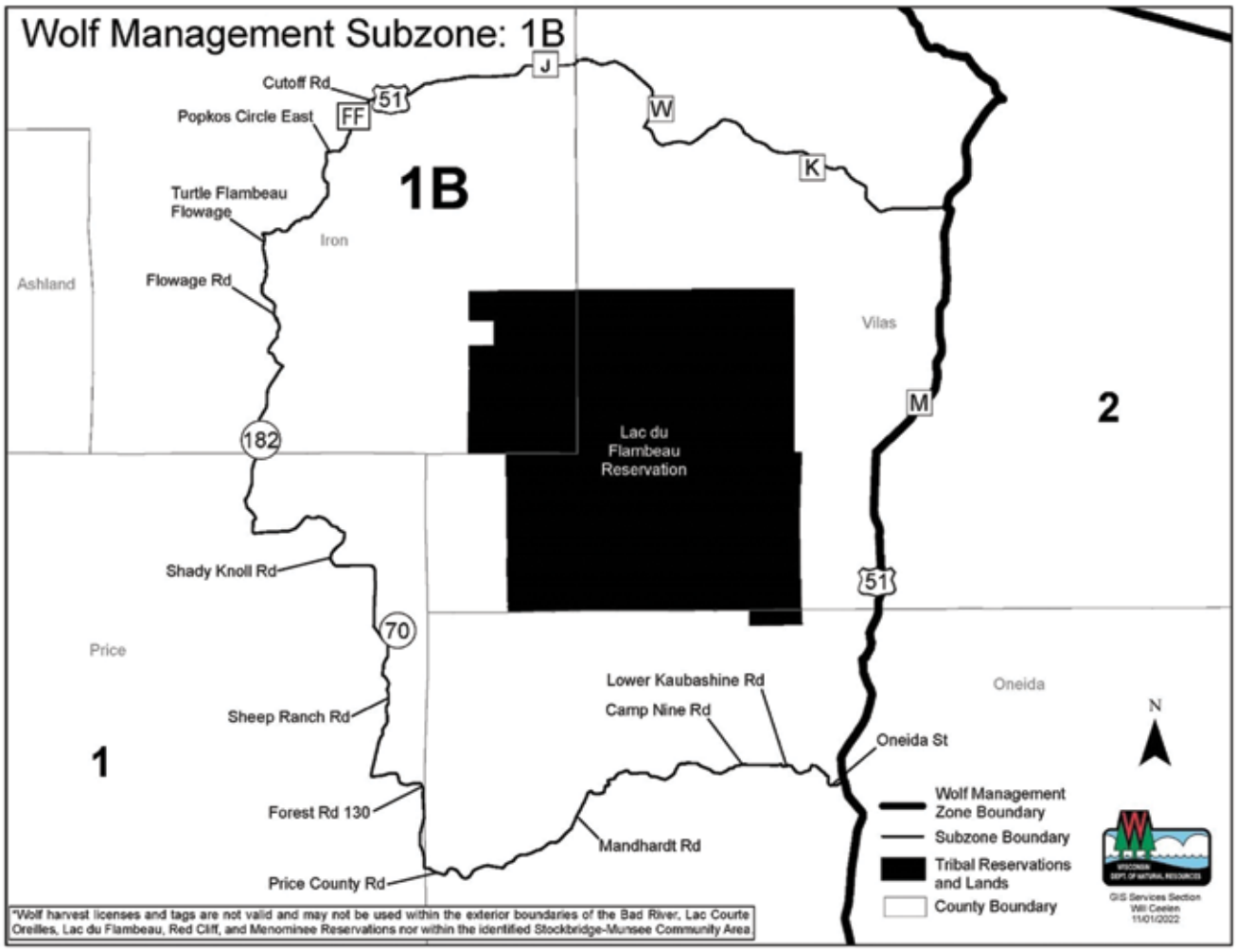


Figure A5. Boundaries of the portion of wolf management subzone 1B in Vilas, Iron, and Oneida Counties, Wisconsin.

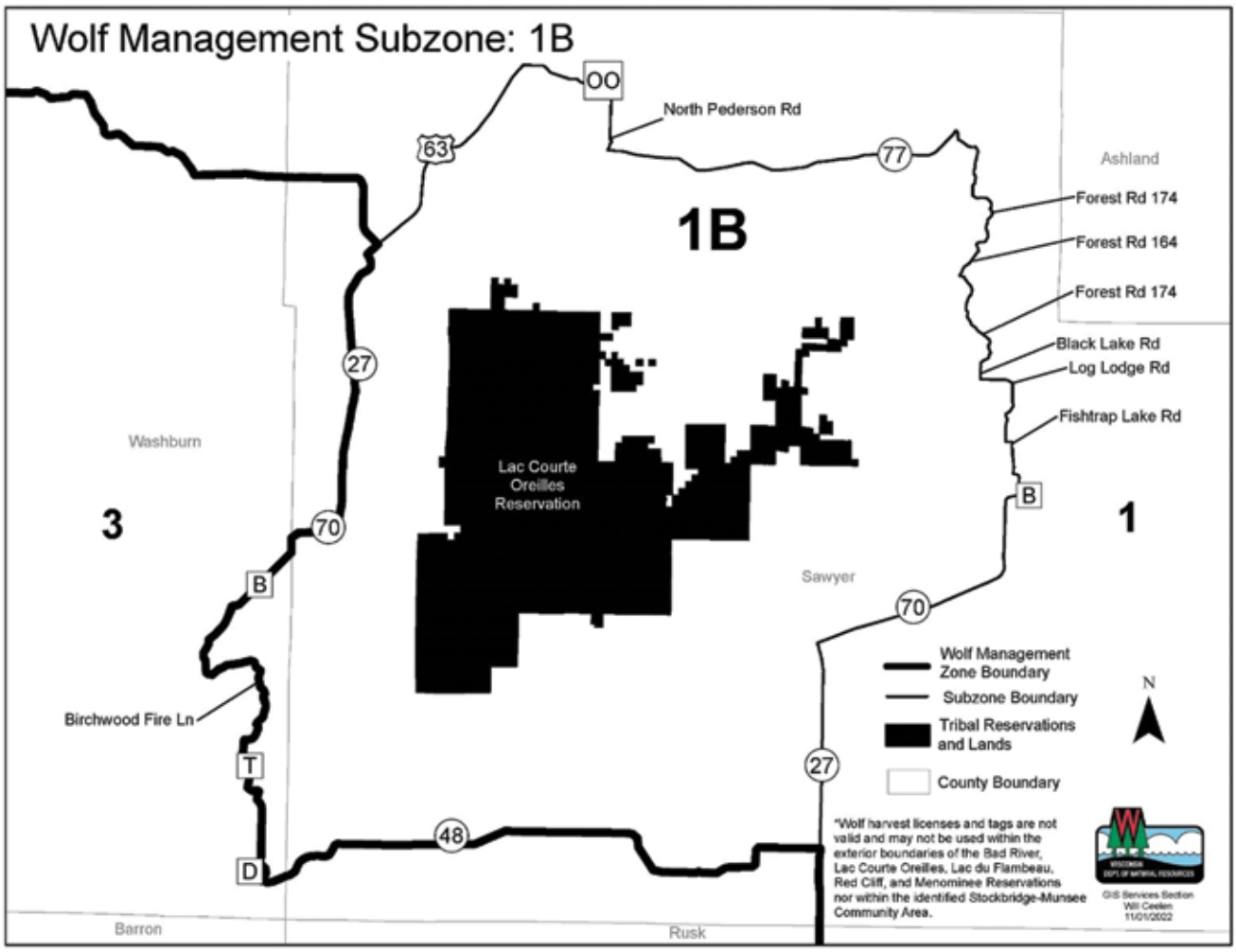


Figure A6. Boundaries of the portion of wolf management subzone 1B in Sawyer and Washburn Counties, Wisconsin.

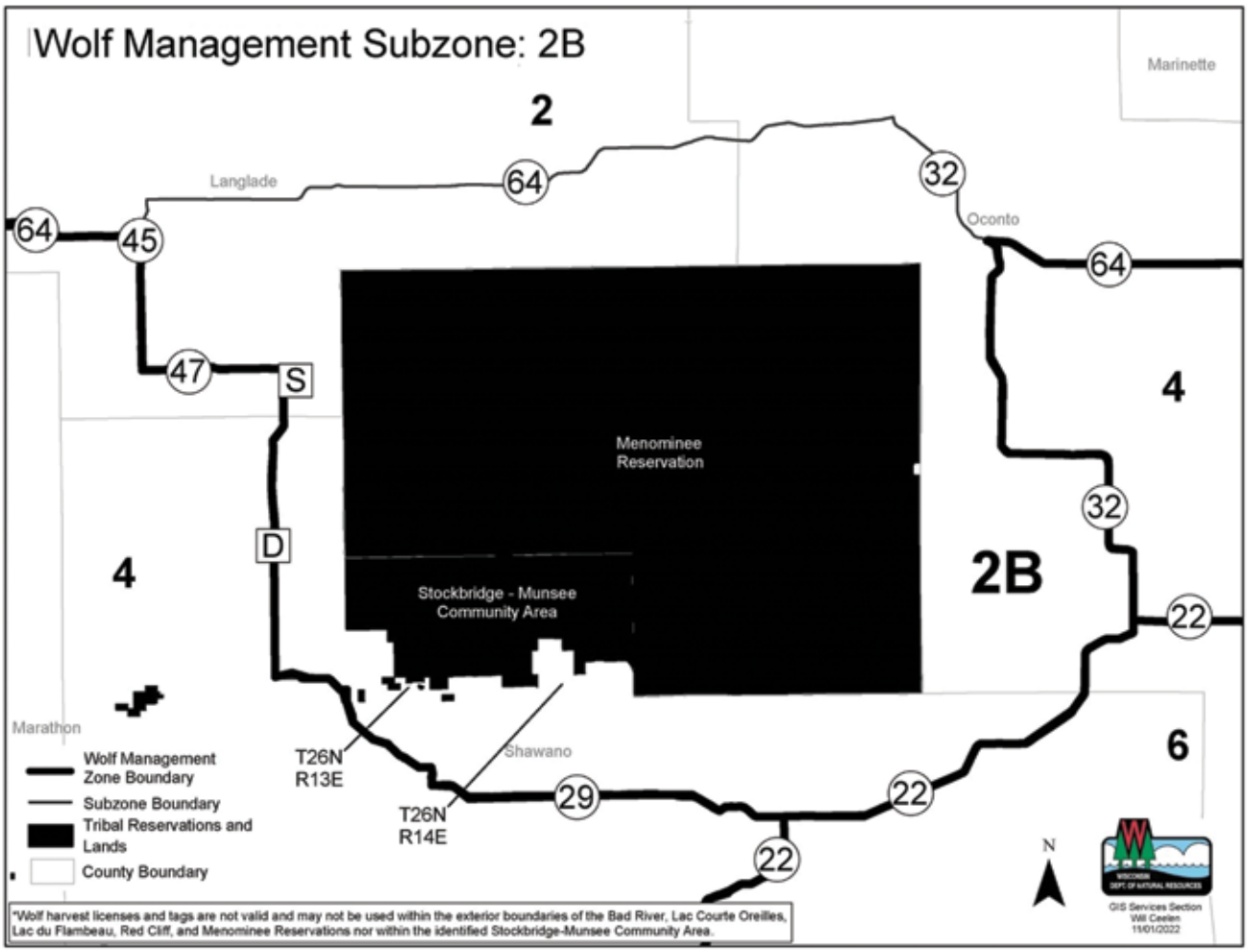


Figure A7. Boundaries of wolf management subzone 2B in Menominee, Langlade, Oconto, and Shawano Counties, Wisconsin.

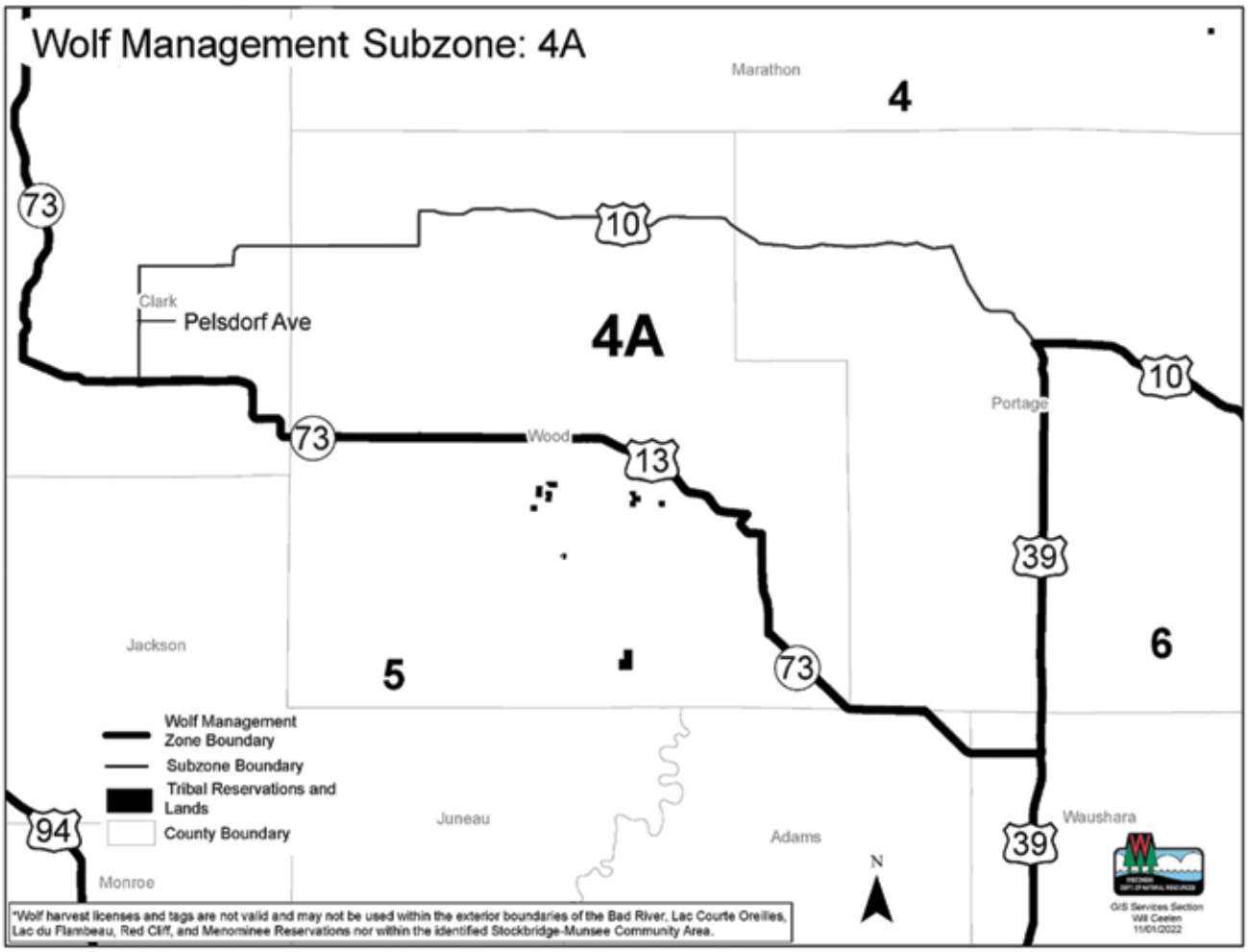


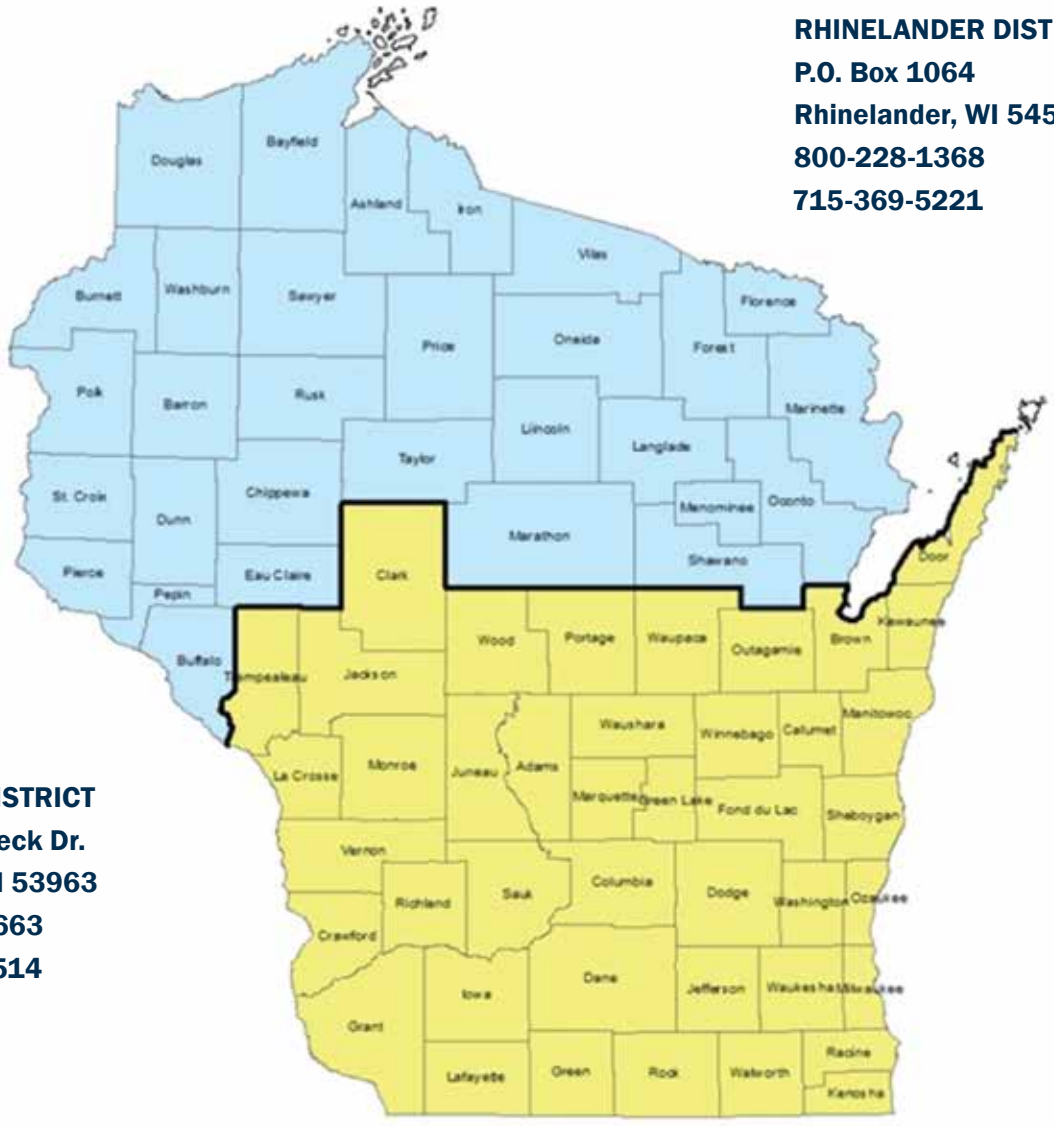
Figure A8. Boundaries of wolf management subzone 4A in Wood, Portage, Clark, Adams, and Waushara Counties, Wisconsin.

Appendix B. What To Do If You Suspect A Wolf Depredation Of A Domestic Animal

1. Immediately contact USDA-Wildlife Services (below) to investigate. Phone lines are monitored seven days a week, so it is important to leave a message if no one answers the phone.
2. Provide as much detail as possible.
3. Do not move or unnecessarily handle a carcass.
4. Preserve any evidence at the kill site by covering any carcass with a tarp or other covering to discourage scavengers and preserve any tracks, scat, blood or bone fragments.
5. Reduce any unnecessary human activity near the depredation site.

USDA-Wildlife Services Districts

RHINELANDER DISTRICT
P.O. Box 1064
Rhinelander, WI 54501
800-228-1368
715-369-5221



WAUPUN DISTRICT
1201 Storbeck Dr.
Waupun, WI 53963
800-433-0663
920-324-4514

Appendix C. Wisconsin Annual Wolf Damage Compensation Payment Summary 1985–2022

Also available online at https://p.widencdn.net/7o52me/WolfDamagePayments

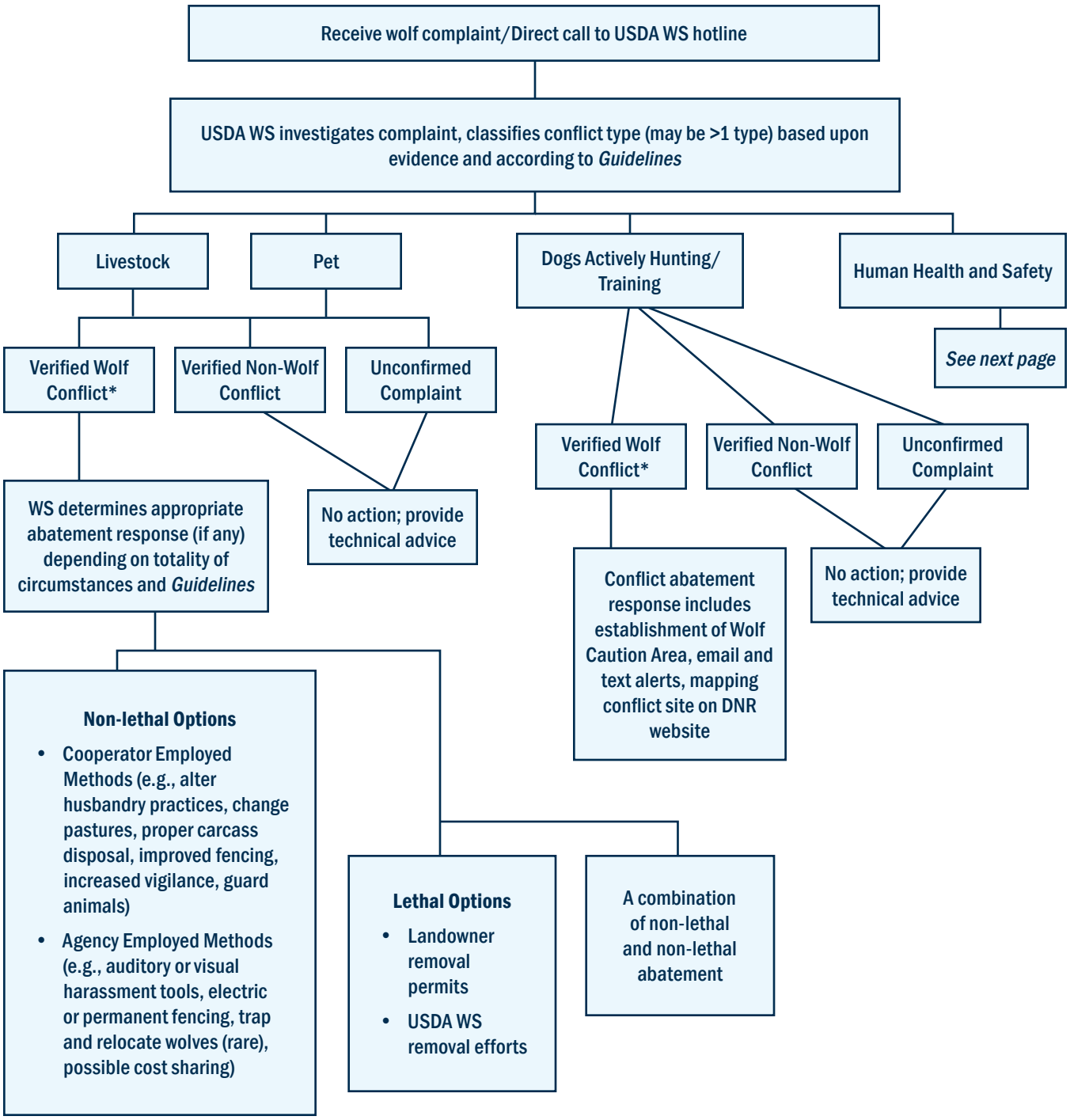
Wisconsin Annual Wolf Damage Payment Summary (rev.3/3/23)

Cal Year	Calves $	#	Missing Calves $	#	Cattle $	#	Cattle Vet $	#	Hunting Dogs $	#	Hunting Vet $	#	Pet Dogs $	#	Pet Vet $	#	Captive Deer $	#	Sheep $	#	Horse/ Donkey $	#	Llama $	#	Pig $	#	Goat $	#	Chickens $	#	Turkey $	#	Total $
85	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	200.00	2	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	200.00
86	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
87	0.00	0	0.00	0	0.00	0	0.00	0	2,500.00	1	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	2,500.00
88	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
89	400.00	1	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	400.00
90	0.00	0	0.00	0	0.00	0	0.00	0	2,500.00	1	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	2,500.00
91	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	187.55	2	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	851.00	115	1,038.55
92	80.00	1	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	300.00	1	0.00	0	0.00	0	304.00	10	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	684.00
93	0.00	0	0.00	0	0.00	0	0.00	0	1,000.00	1	0.00	0	0.00	0	0.00	0	0.00	0	600.00	6	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	1,600.00
94	900.00	2	0.00	0	0.00	0	0.00	0	5,000.00	2	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	225.00	25	6,125.00
95	1,500.00	6	0.00	0	0.00	0	9.75	1	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	1,509.75
96	2,040.00	8	0.00	0	0.00	0	0.00	0	9,500.00	4	175.45	2	0.00	0	203.37	1	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	11,918.82
97	3,600.00	9	0.00	0	0.00	0	0.00	0	8,250.00	5	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	11,850.00
98	2,198.00	5	0.00	0	0.00	0	0.00	0	6,200.00	6	225.82	2	0.00	0	716.34	2	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	9,340.16
99	13,471.82	26	5,724.00	12	0.00	0	0.00	0	8,750.00	5	201.65	1	500.00	1	162.00	1	55,250.00	29	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	220.00	44	0.00	0	84,279.47
00	3,030.00	7	475.00	1	0.00	0	0.00	0	1,350.00	1	0.00	0	750.00	2	0.00	0	13,000.00	3	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	25.00	4	0.00	0	18,630.00
01	2,308.96	4	12,694.08	21	0.00	0	0.00	0	28,150.00	13	378.20	1	0.00	0	71.00	1	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	3,731.90	66	120.00	8	47,454.14
02	7,125.00	11	0.00	0	3,500.00	1	429.00	2	22,000.00	11	151.60	1	500.00	1	238.00	3	8,100.00	5	2,453.50	27	10,000.00	2	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	54,497.10
03	6,950.00	12	1,450.00	2	2,400.00	2	0.00	0	12,550.00	7	332.21	1	0.00	0	1,549.68	3	1,200.00	1	1,425.00	11	2,250.00	1	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	30,106.89
04	32,093.33	49	32,146.62	53	7,250.00	5	0.00	0	24,500.00	11	1,868.18	3	1,900.00	3	2,858.47	3	5,300.00	6	2,025.00	15	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	109,941.60
05	19,509.00	30	1,900.00	3	9,175.00	5	64.50	1	28,750.00	14	1,628.95	3	5,300.00	4	527.95	2	0.00	0	750.00	3	4,750.00	3	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	72,355.40
06	34,897.33	41	7,450.00	6	9,450.00	5	129.00	1	51,000.00	21	4,081.30	6	4,000.00	3	2,471.89	6	0.00	0	970.00	6	0.00	0	0.00	0	0.00	0	0.00	0	350.00	50	0.00	0	114,799.52
07	18,745.00	25	6,990.00	9	1,000.00	1	0.00	0	26,500.00	11	908.95	2	5,735.00	3	1,128.93	4	0.00	0	1,400.00	6	6,500.00	2	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	68,907.88
08	22,684.46	26	28,950.00	21	18,000.00	13	0.00	0	52,500.00	22	100.50	1	2,200.00	2	2,567.52	5	3,500.00	1	150.00	1	0.00	0	3,500.00	1	600.00	1	0.00	0	0.00	0	0.00	0	134,752.48
09	27,442.43	37	2,550.00	4	0.00	0	46.00	1	47,500.00	19	4,665.64	6	4,450.00	4	2,814.28	5	0.00	0	360.00	2	1,500.00	3	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	91,328.35
10	28,936.50	38	28,050.00	28	27,325.00	18	0.00	0	44,651.00	19	1,779.65	4	8,730.00	6	6,146.36	11	55,000.00	6	1,225.00	6	0.00	0	0.00	0	0.00	0	150.00	1	0.00	0	0.00	0	201,993.51
11	42,457.00	54	190,702.00	257	22,231.00	15	414.82	2	42,000.00	17	3,348.41	5	1,250.00	2	401.20	2	20,000.00	2	8,850.00	43	2,000.00	1	500.00	1	0.00	0	1,975.00	11	0.00	0	0.00	0	336,129.43
12	27,926.00	40	95,519.20	115	6,919.00	9	0.00	0	16,500.00	7	0.00	0	1,000.00	1	87.11	1	150.00	1	135.00	1	0.00	0	0.00	0	0.00	0	900.00	2	0.00	0	0.00	0	149,136.31
13	20,332.00	26	52,362.00	*62	14,348.00	15	136.75	2	56,000.00	23	0.00	0	5,300.00	3	79.61	1	2,575.00	6	200.00	2	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	151,333.36
14	22,514.00	22	51,055.00	*41	6,885.00	4	0.00	0	50,000.00	20	5,827.32	5	1,000.00	2	1,503.53	3	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	138,784.85
15	23,315.00	31	73,771.00	98	25,307.00	15	188.84	1	55,000.00	22	3,224.70	3	8,800.00	6	1,113.69	2	8,325.00	4	0.00	0	1,200.00	1	0.00	0	0.00	0	0.00	0	150.00	10	110.00	2	200,505.23
16	11,905.00	28	51,590.00	117	8,650.00	9	0.00	0	99,400.00	41	5,367.91	6	4,800.00	6	476.43	2	0.00	0	14,008.00	20	1,000.00	2	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	197,197.34
17	11,700.00	29	37,426.00	79	2,700.00	3	0.00	0	39,400.00	17	6,701.13	6	2,500.00	1	1,573.10	1	0.00	0	600.00	4	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	102,600.23
18	20,578.50	26	49,163.00	56	3,310.00	4	429.25	2	45,000.00	18	16,683.65	11	2,500.00	1	1,344.80	1	0.00	0	0.00	0	5,500.00	3	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	144,509.20
19	16,382.10	23	70,262.58	103	5,975.00	5	1,435.36	4	56,800.00	23	4,287.23	4	1,700.00	2	3,046.47	3	9,500.00	1	11,810.00	56	0.00	0	4,000.00	2	200.00	1	4,350.00	9	0.00	0	0.00	0	189,748.74
20	38,091.08	37	84,772.82	111	14,855.96	10	371.11	1	72,500.00	29	5,161.44	6	8,100.00	4	2,538.91	4	0.00	0	4,175.00	16	12,300.00	5	0.00	0	0.00	0	0.00	0	1,200.00	60	0.00	0	244,066.32
21	22,645.26	30	38,657.67	*51	24,988.00	10	3,125.50	2	37,500.00	15	5,310.95	6	5,850.00	3	544.18	1	14,875.00	4	13,347.50	25	12,500.00	3	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	179,344.06
22	18,563.70	22	20,719.47	24	840.00	1	0.00	0	39,500.00	16	13,314.69	6	5,000.00	2	1,191.34	1	0.00	0	1,000.00	5	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	100,129.20
	504,321.47	706	944,380.44	1,250	215,108.96	150	6,779.88	20	992,751.00	422	85,913.08	93	82,165.00	63	35,356.16	69	196,775.00	69	65,988.00	267	59,500.00	26	8,000.00	4	800.00	2	7,375.00	23	5,676.90	234	1,306.00	150	3,212,196.89

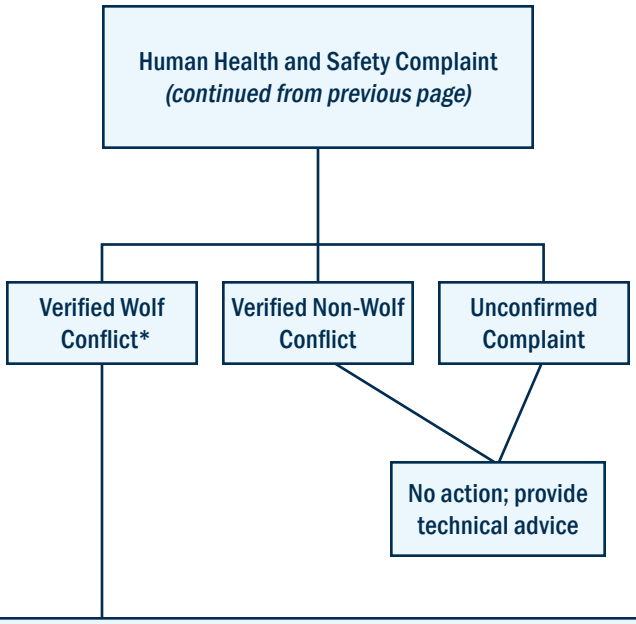
* Missing calves rule was in place limiting compensation to 5 missing calves for each verified depredation.

# Indicates the number of that species compensation was provided on.

Appendix D. Wolf Complaint Response Flow Chart for Typical Wolf-Related Conflict



*Under s. 29.888, Wis. Stats., individuals who experience verified death or injury caused by wolves to livestock, hunting dogs (except those being actively used in the hunting of wolves), or pets are eligible to apply for financial compensation.



Level 1 – Wolf Attack or Immediate Threat: A wolf has attacked or is displaying aggressive behavior towards a person. Lethal control should be implemented immediately.

- DNR will take the lead on Level 1 complaints. Refer to Guidelines for details on Wolf Incident Response plan including incident response protocols and coordination.

Level 2 – Demonstrable but Non-immediate Threat: A wolf constitutes a demonstrable but non-immediate threat to human safety. Lethal or non-lethal control may be implemented, depending on the situation. WS will consult with DNR (and any other agency/tribe as appropriate) to determine response.

Examples of Level 2 conflicts include:

- Wolf is sick or injured and unable to leave area where it poses a potential threat to health and safety.
- Wolf is in an urban area and unable to find an escape route.
- Wolf has entered unoccupied structures.
- Wolf shows signs of habituation to people and is reluctant to leave location but is not aggressive.
- Wolf is sick or injured but is not posing a safety risk, is able to move and could escape from the location.

Level 3 – Wolf Exhibiting Normal Behavior but in Frequent Close Proximity to People: A wolf is exhibiting normal non-threatening and non-habituated behavior but is in more frequent contact with people than deemed acceptable. Management action may or may not be warranted. WS will consult with DNR (and any other agency/tribe as appropriate) to determine response.

Examples of Level 3 conflicts include:

- Wolf hunting and killing wild prey near human occupied dwellings.
- Wolves in close proximity to human occupied dwellings.
- Wolves near humans in a wildland setting but not displaying aggressive behavior.