Movement Ecology of Gray Wolves in the Western Great Lakes Region

Alejandra Zubiria Perez, Department of Fisheries and Wildlife, Michigan State University, East Lansing, MI, USA, Shannon M. Barber-Meyer - Research Department, Pacific Whale Foundation, Wailuku, HI, USA, Dean E. Beyer, Jr. - Department of Fisheries and Wildlife, Michigan State University, East Lansing, MI, USA, John D. Erb - Forest Wildlife Populations and Research Group, Minnesota Department of Natural Resources, Grand Rapids, MN, USA, Kenneth F. Kellner - Department of Fisheries and Wildlife, Michigan State University, East Lansing, MI, USA, David M. MacFarland - Office of Applied Science, Wisconsin Department of Natural Resources, Rhinelander, WI, USA, Seth A. Moore - Grand Portage Band of Lake Superior Chippewa, Grand Portage, MN, USA, Brent R. Patterson - Ontario Ministry of Natural Resources and Forestry, Peterborough, ON, CA, Tyler R. Petroelje - Wildlife Division, Michigan Department of Natural Resources, Marquette, MI, USA, Jennifer L. Price Tack - Office of Applied Science, Wisconsin Department of Natural Resources, Rhinelander, WI, USA, Brian J. Roell - Wildlife Division, Michigan Department of Natural Resources, Marquette, MI, USA, Michael Schrage - Fond du Lac Resource Management Division, Cloquet, MN, USA, Morgan Swingen - 1854 Treaty Authority, Resource Management Division. Duluth, MN, USA, Merijn van den Bosch - Warner College of Natural Resources, Colorado State University, Fort Collins, CO, USA, Jerrold L. Belant - Department of Fisheries and Wildlife, Michigan State University, East Lansing, MI, USA

Gray wolf movements vary in response to demographics, life history, intraspecific dynamics, and prey, among other factors. We will present a synthesis of literature on wolf movement behavior in the Great Lakes Region which characterizes movement based on sex-age class, life history, residency status, and landscape characteristics. Our work evaluates how wolf movement behavior varies by sex-age class, which can influence an individual's role within its pack and its propensity to disperse. We will investigate how wolf movement varies based on seasonal life history events like mating and denning and extrinsic factors like prey availability and landscape characteristics. We will also evaluate how dispersal differs from resident movement and how wolf population abundance and pack dynamics influence dispersal rates. Finally, we will discuss limitations of current methods for evaluating wolf movement behavior and management implications of the dynamic nature of wolf movement.

Note: this presentation will be a chapter in the book titled "Gray Wolves in the Great Lakes Region of the United States: From Recovery to Coexistence".

Gray Wolf Tolerance of Human and Road Densities on and around the Fond du Lac Reservation

Grace Lavan, Fond du Lac Resource Management Division
Michael Schrage, Fond du Lac Resource Management Division.

The Fond du Lac Band of Lake Superior Chippewa's Resource Management Division has conducted research and monitoring of ma'iingan (gray wolf) populations on and around the Fond du Lac Reservation since 2016. Fuller et al.'s 1992 paper found that 88% of wolf packs and 81% of single wolves live in territories with human and road densities of <4 humans/km² and <0.70 km roads/km² and suggested these metrics define suitable wolf habitat. Our results indicate wolves in the area of the Fond du Lac Reservation can establish and successfully maintain territories in areas with human and road densities above the Fuller et al. (1992) thresholds. Overall, human density in wolf territories in our study area was 2.67 humans/km² greater and road density was 0.07 km roads/km² greater than the Fuller et al. (1992) thresholds for suitable wolf habitat. As wolf range and numbers have increased in the Great Lakes region there are fewer areas with densities less than 0.7 km roads/km² and 4 humans/km² for wolves to inhabit. Our results help demonstrate that wolves can successfully tolerate higher human population and road density than previously thought and has implications for what can be considered suitable wolf habitat in the Great Lakes region.

Differential provisioning roles, prey size, and prey abundance shape the dynamic feeding behavior of a social carnivore

Thomas Gable, University of Minnesota/Voyagers Wolf Project
Sean M. Johnson-Bice, University of Manitoba, Austin T. Homkes, University of Minnesota/Voyageurs Wolf Project, Joseph K. Bump, University of Minnesota/Voyageurs Wolf Project

The demands of raising dependent young can influence the feeding behaviors of social carnivores, especially for individuals that are primarily responsible for provisioning young. We investigated how the feeding and provisioning behavior of a social carnivore, gray wolves (*Canis lupus*), are connected and shaped by extrinsic and intrinsic factors, and whether and how these patterns changed throughout the pup-rearing season (April-August). We found breeding wolves had shorter handling times of prey, lower probability of returning to kills, and greater probability of returning to homesites after kills compared to subordinate individuals. However, the feeding and provisioning behaviors of breeding individuals changed considerably over the pup-rearing season. Further, wolves had longer handling times and returned to provision pups directly after kills less frequently as annual prey abundance decreased. These patterns indicate that adult wolves prioritize meeting their own energetic demands over those of their pups when prey abundance decreases. We suggest that differential provisioning of offspring based on prey abundance is a behavioral mechanism by which group size adjusts to available resources via changes in pup survival.

How can changes in the genetic health of wolf populations cascade to influence boreal forests?

Sarah Hoy, Michigan Technological University
John A. Vucetich, Michigan Technological University, Rolf O. Peterson, Michigan Technological University

Increasing evidence suggests that large predators can trigger trophic cascades which impact species across multiple trophic levels. Our goal was to advance our understanding of trophic cascades in two main ways. First, to understand how trophic cascades are shaped by changes in the genetic health of predator populations. Second, to better understand how predator-induced changes in levels of herbivory can affect both the growth, survival and chemical properties of plants (carbon and nitrogen content). We used long-term data from the Isle Royale ecosystem to assess how changes in the genetic health of the wolf population (associated with inbreeding) can cascade to impact the abundance and foraging behavior of their main prey, moose, and the trees that moose browse on. We found evidence suggesting that:

1) Declines in the genetic health of the wolf population (indicated by a genetic statistic, ancestry) reduced the rate that wolves preyed on moose (predation rate).

2) As predation rate declined, moose abundance increased and moose browsed more on coniferous trees, especially balsam fir.

3) As moose browsing pressure increased, we observed declines in the annual growth and survival of balsam fir saplings - which are likely to have important impacts on forest succession and the total biomass and species composition of this boreal forest.

4) As moose browsing pressure increased, we observed that fir foliage contained more nitrogen and less carbon. Preliminary data suggest these changes in nitrogen and carbon content are due to fir saplings chemically defending themselves to deter further browsing, by producing alkaloids which can be highly toxic to herbivores.

The broader significance of these results is indicated by recognizing that changes in forest biomass, species composition and the chemical properties of foliage are likely to influence carbon and nitrogen cycling. Therefore, our work highlights how genetically-mediated-trophic-cascades may affect large-scale ecosystem processes and the importance of conserving wolf populations at densities high enough to preserve their genetic health.

Genetic-morphologic investigation of Minnesota wolves: assessing the presence of distinct wolf types

Tyler Wheeldon, Ontario Ministry of Natural Resources, Brent Patterson, Ontario Ministry of Natural Resources, Shannon Barber-Meyer, Pacific Whale Foundation, John Erb, Minnesota Department of Natural Resources, Michelle Carstensen, Minnesota Department of Natural Resources

Reviews of genetic and morphologic data have supported the hypothesis that MN wolves derive from hybridization of gray wolves (lupus) and eastern wolves (lycaon), but there is disagreement concerning whether MN wolves comprise a single interbreeding population of hybrid ancestry or lupus and lycaon occur as distinct entities in MN with their hybrids. No published studies have attempted to relate genetic and morphologic data of MN wolves, but such has been suggested. Reports of temporal changes and longitudinal clines in morphology of MN wolves suggest dynamic historical and ongoing hybridization and indicate that individuals with greater morphologic affinity to each parental species co-occur with those of intermediate morphology. However, complementary genetic data are required to confirm whether these morphologic differences reflect the presence of distinct wolf types or variation within a single interbreeding population of hybrid ancestry. We sought to leverage additional information gained from combining genetic data, morphologic data, and spatial coordinates of individual wolves to determine if there is biologically meaningful population structure in MN wolves that is related to taxonomy. We genetically and morphologically characterized a sample of 408 MN wolves to investigate population structure and differences in genetics/morphology with respect to cluster assignment. We genotyped the sampled wolves at 14 autosomal microsatellite loci and recorded several body and skull measurements from them. We analyzed the genetic and morphologic data both separately and jointly using the program Geneland. The sampled MN wolves exhibited negligible population structure and no significant differences in genetics/morphology with respect to cluster assignment. Our data demonstrate that MN wolves comprise a single interbreeding population of hybrid ancestry that exhibits variable morphology, although lupus and lycaon may occur in MN as rare immigrants.

Born to Die: Pack and Population Level Estimates of Wolf Pup Survival and Recruitment in the Greater Voyageurs Ecosystem

Andrea Hynes, Northern Michigan University, Thomas D. Gable, Voyageurs Wolf Project
Austin T. Homkes, Voyageurs Wolf Project, Joseph K. Bump, University of Minnesota
John G. Bruggink, Northern Michigan University

Estimating wolf pup (*Canis lupus*) survival is challenging because wolf pups are difficult to monitor, especially in forested systems, and as a result our understanding of wolf pup survival is limited. We used a combination of litter counts and observations from remote cameras to estimate annual survival and recruitment of wolf pups at both the pack and population level in the Greater Voyageurs Ecosystem, Minnesota, USA, from 2019 to 2022. We estimated survival for 19 litters from 11 packs and recruitment for 49 litters from 22 packs. Mean annual pup survival during 2019–2022 was 0.27, and the mean annual recruitment rate was 1.41 pups per pack. Most wolf pups born during our study did not survive their first biological year. Annual wolf pup survival and recruitment rates were highly variable among years and packs, which is likely a result of resource availability and the ability of breeding animals to acquire sufficient prey to provision dependent pups. Wolf pup recruitment rates mirrored survival rates, indicating that recruitment is a good proxy for survival rates. We believe that new approaches and technology will provide compelling insight into the reproductive ecology of wolves.

Wolf search efficiency in northern Ontario: a time to event modelling approach

Brent R. Patterson, Ontario Ministry of Natural Resources, Ryan Holt – OMNR, Wildlife Research & Monitoring Section, Trent University, Peterborough, ON, Scott Moffatt, Morgan Anderson, Luke Vander Vennan and John Fryxell - Department of Integrative Biology, University of Guelph, Guelph, ON, Canada

With the potentially additive anthropogenic effects of deforestation, climate change, mining, and fossil fuel extraction, there may be rapidly changing predator-prey dynamics in Canada's boreal forest. Of particular concern is whether wolf predation is responsible for the retraction in the historical range of woodland caribou in Northern Ontario. Using time to event modelling, we determined how environmental heterogeneity in heavily forested sites of northern Ontario Canada, and animal movement behaviour, affected wolf kill success. We used Cox proportional hazard models to test several alternative hypotheses, including the wolf functional response, wolf pack characteristics, wolf satiation, landscape and other environmental features. In the context of a proportional hazards model, an increased relative killing efficiency corresponds with a decreased time between predation events. In a comparison of top models, the Predator Road Use hypothesis (defined by distance from road and wolf search velocity) had the most evidence. Wolves used linear features such as roads to quickly navigate their territory while targeting moose habitat near forest access roads. As the most efficient search trajectories occurred near roads, moose and woodland caribou were likely to be at significantly greater risk of predation in sites with high road densities.

Risk avoidance during dispersal: temporal and behavioral shifts in selection by non-resident eastern wolves (*Canis lycaon*)

Brent R. Patterson, Ontario Ministry of Natural Resources, Connor A. Thompson, John F. Benson, Tyler Wheeldon, Ontario Ministry of Natural Resources

Dispersal is important for connectivity and persistence of small, disjunct wildlife populations. However, in human-altered landscapes dispersing animals are often more likely than residents to use anthropogenic features that increase mortality risk. As such, quantifying spatial and temporal responses of dispersing animals to anthropogenic features will improve our understanding of the potential for small, isolated populations to expand in human-altered landscapes. The distribution of eastern wolves (Canis lycaon; a threatened species in Ontario, Canada) is limited to portions of eastern Canada within and adjacent to the population core in Algonquin Park. Recently, it was found that non-resident eastern wolves dispersing outside of Algonquin Park survive poorly, primarily due to high rates of human-caused mortality. We deployed Global Positioning System collars on 26 non-resident eastern wolves. We evaluated resource selection of dispersing individuals during different movement states to better understand their behavioral responses to anthropogenic landscape features during this critical, but risky period of their life history. Eastern wolves avoided areas with high building density during the day. However, during directed movements outside the winter period, eastern wolves selected areas closer to unpaved roads and areas with higher building densities at night. During winter, eastern wolves selected areas with high building densities at night while displaying tortuous movements. We demonstrate that harvested species may increase and relax avoidance of anthropogenic features at both daily and seasonal timescales. Failing to account for temporal and state-specific variation in resource selection patterns of dispersing animals may underestimate their ability to move through human-altered landscapes.

Wisconsin DNR Wolf Management Update

Randy Johnson, Wisconsin Department of Natural Resources

Wisconsin is home to a thriving gray wolf population and is part of the western Great Lakes regional metapopulation of wolves. In October 2023, a new state wolf management plan was approved after a nearly three-year long update process. This new plan recognizes that Wisconsin's wolf population is biologically recovered and turns management attention from species recovery to long-term sustainable management. In this talk, I will provide a population status update for the state of Wisconsin and discuss the state's new wolf management plan. I will highlight several key aspects of the plan and what it all means for the future of wolves in Wisconsin.

Michigan Wolf Program Update

Brian Roell, Michigan Department Natural Resources

Wolves (*Canis lupus*) have been part of the Great Lakes fauna since the melting of the last glacier and as such are native to the land area known as Michigan. By the time bounties were imposed in the 1800s, wolves were nearly extirpated from the Southern Lower Peninsula of Michigan. They were absent from the entire Lower Peninsula (LP) by roughly 1935, and by 1973 the Michigan wolf population was estimated at only six animals in the Upper Peninsula (UP). The wolf population in the UP of Michigan (excluding Isle Royale) showed mostly steady growth from 1989 to 2011. However, since 2011 the wolf population has remained stable ranging from 618 to 762 with overlapping 95% confidence limits, suggesting wolves may have reached their carrying capacity in the UP. A minimum of 762 estimated wolves occurred on the UP mainland during the winter of 2024. Currently, wolves can be found in every county of the UP; however, wolf density is variable. Although it is possible that wolves currently occur in the LP of Michigan, as of January 2024 no wolves are known to inhabit the Northern LP despite the availability some suitable habitat. Lastly, the only legal harvest of wolves in Michigan in recent years occurred in 2013 when wolves are briefly delisted by the United State Fish and Wildlife Service. Due to a February 2022 Federal Court order, wolves are once again protected under the Endangered Species Act, which does not allow for the public harvest wolves. Currently, wolves are listed as a protected game animal in Michigan.

Wolf Conflict Management in Minnesota

Duane (Pete) Sahr, USDA/APHIS/Wildlife Services

The USDA-Wildlife Services (WS) wolf conflict management program based in Grand Rapids, Minnesota uses a variety of methods to manage wolf conflicts with people, pets, and livestock. Wolves in Minnesota occasionally kill livestock (cattle, sheep, poultry and horses) and pets (primarily dogs), and more rarely pose a threat to human safety. WS investigates claims of wolf damage to livestock and pets in cooperation with the Minnesota DNR. Livestock verified as killed by wolves are eligible for compensation from the Minnesota Department of Agriculture. No compensation is paid for pets or livestock that are injured by wolves in Minnesota. If the loss or injury of livestock or pets is verified as caused by wolves, and there are opportunities for continued losses, WS may initiate wolf removal efforts near the depredation site to reduce the likelihood of further losses. WS also uses and recommends a variety of non-lethal methods to reduce wolf conflicts where appropriate. In addition to helping resolve individual wolf conflicts, the WS program provides technical assistance and recommendations for reducing wolf conflicts to livestock producers, resource managers and the public. The ability to provide site-specific assistance to reduce wolf conflicts has contributed positively to public acceptance of wolves and ultimately to wolf recovery in Minnesota.

Michigan Wolf Conflict Update

Brian Roell, Michigan Department of Natural Resources

Providing accurate update information on wolf (*Canis lupus*) conflicts is a critical part of managing this species. Although the wolf population offers benefits to Michigan visitors and residences, it also poses significant costs and concerns for some Michigan residents. These costs include losses of domestic animals (livestock and domestic dogs). Although depredation is currently lower in Michigan than in Minnesota or Wisconsin, wolf depredation of domestic animals is an important management issue in Michigan. There are more than 900 livestock farms occur in the Upper Peninsula and from 1998 through 2023, 326 wolf depredation events were verified on 107 of those farms. Since 1996 through 2023, wolves have killed or injured 159 dogs; approximately half (48%) of these incidents involved hounds used to hunt black bears (*Ursus americanus*), and about 72% involved hunting hounds (bear, rabbit/snowshoe hare (*Sylvilagus floridanus*, *Lepus americanus*), and bobcat (*Lynx rufus*)). The number of wolf-depredation events varies annually for both livestock and domestic pets and is often influenced by the activity of a single wolf pack. To date no wolf depredation has been documented in Lower Michigan.

Wolf Recovery in the Northeast

John Glowa, The Maine Wolf Coalition, Inc.

No less than twelve DNA verified wolves have been killed by hunters and trappers south of the St. Lawrence River since 1993. In 2019, The Maine Wolf Coalition, Inc. (MWC) verified an eastern wolf in Maine through its scat. In 2021, a Great Lakes gray wolf was shot and killed in central New York. The northeast U.S. and eastern Canada south of the St. Lawrence contain thousands of square miles of potentially suitable wolf habitat as well as abundant prey populations of moose, deer and beaver. Since 2019, MWC has been collecting canid scat and trail camera photos in an attempt to document the status of wolves in Maine. This is critical given the recent mandate for the U.S. Fish and Wildlife Service to develop a National Gray Wolf Recovery Plan and the state and federal governments' failure to try to document the status of wolves in the northeast. Complicating wolf recovery in the region is the fact that, unlike the Canadian government, the U.S. government does not recognize the eastern wolf as a species. The northeast is well within dispersal distance of both gray wolves and eastern wolves in the Great Lakes wolf range, with wolves as close as sixty miles from New York and seventy-five miles from Maine. Our presentation is an update of wolf recovery in the northeast including photos of dead wolves and living wolflike canids, potential wolf habitat, impediments and opportunities for wolf dispersal from Canada, a discussion of eastern wolves, and current efforts by wolf advocates on behalf of northeast wolf recovery.

Wolf-proof Fences for Dummies

Austin Homkes, Voyageurs Wolf Project, University of Minnesota, Thomas D. Gable, Voyageurs Wolf Project, University of Minnesota, Dakota Bird, USDA-APHIS Wildlife Services, John Hart, USDA-APHIS Wildlife Services, Jack Morawczynski, USDA-APHIS Wildlife Services
Eric M. Gese, USDA-APHIS Wildlife Services, Wesley Johnson, Producer, Robert Johnson, Producer, Savannah Johnson, Producer, Joseph K. Bump, Voyageurs Wolf Project, University

Raising livestock around wolves has led to wolf-human conflict for millennia. A 1500-acre cattle ranch in Northern Minnesota has been no exception, losing livestock annually to wolf depredations for nearly two decades. From 2020 to 2023, we constructed a fence designed to keep wolves off the ranch and end longstanding wolf-livestock conflict. Additionally, we fit wolves in wolf packs around the ranch with GPS collars to understand wolf movements in relation to the fence as well as identify if and how wolves got past the fence. The calving season of 2024 was the first in nearly two decades where not a single cow was lost to depredations and the second season not a single wolf was lethally removed from this ranch. However, this success was hard won, with many lessons learned through multiple years of troubleshooting. We describe lessons learned from failing and then succeeding in keeping GPS collared wolves off the cattle ranch and how other outfits might implement a similar solution to end wolf-livestock conflict.

Citizen-Science Study of Polar-bear Hunting Wolves

Jad Davenport, National Geographic/Churchill Wild

Gray wolves along the Kaskatama Coast in Manitoba, Canada, are the only wolves known to actively predate on polar bears. These wolves are unique in their relationship to North American bears. They share territory with all three North American bear species--black, brown and polar-- and are known to hunt both polar bears and black bears. Due to their inaccessibility to researchers (the wolves live in the heart of an uninhabited wilderness the size of California and are only accessible at a wilderness lodge that has a runway). Under sponsorship from Churchill Wild (lodge owners) I have launched a citizen-science field study using guests at the lodge as field observers. The citizen-scientists use snowmobiles, ATVs, trail cameras, UAV (unmanned aerial vehicles) and foot to track the Opoyastin Wolf Pack, record their activities, photograph and film the wolves, map kills and document findings. I would like to share our methods and study with the wolf community and connect with students and researchers interested in becoming involved.

Do wolves adjust their predation behavior when hunting deer fawns near human infrastructure?

Sean Johnson-Bice, University of Manitoba, Thomas D. Gable, University of Minnesota Twin Cities, 2003 Upper Bufurd Circles, St Paul, MN 55108, USA, Austin T. Homkes, University of Minnesota Twin Cities, 2003 Upper Bufurd Circles, St Paul, MN 55108, USA, Joseph K. Bump, University of Minnesota Twin Cities, 2003 Upper Bufurd Circles, St Paul, MN 55108, USA

Apex predators often adjust their hunting behavior near human communities, presumably to reduce their risk of encountering humans. These behavioral modifications generally include shifting their hunting behavior towards becoming more nocturnal and reducing their feeding time, the latter of which can lead to higher kill rates of prey due to consuming less biomass during the shorter feeding bouts. Here, we investigate patterns of wolf (Canis lupus) predation behavior on white-tailed deer (Odocoileus virginianus) fawns within and around rural communities in the Greater Voyageurs Ecosystem, northern Minnesota, where previous research has shown wolves disproportionately kill fawns near human infrastructure (i.e., buildings). We assessed whether (i) wolves killed a higher proportion of fawns during night near human infrastructure and (ii) whether wolf handling times were shorter when fawns were killed near human infrastructure, both of which would indicate shifts in predation behavior indicative of avoiding interactions with humans. Contrary to our hypotheses, we found no evidence that wolves adjusted their predation behavior when hunting deer fawns near human infrastructure: wolves killed a similar proportion of fawns at night (only 20–25% of kills) regardless of proximity to human infrastructure, and there was no evidence that wolves reduced their handling time of deer fawn carcasses – during night or day – near human infrastructure. These results remained consistent whether we examined proximity to or density of human buildings, and we observed similar overall patterns between subordinate and breeding individuals. Our results contrast with the prevailing canon that apex predators usually adjust their predation behavior near human communities, suggesting these behavioral shifts are likely more context-dependent than currently appreciated.

Wolves in the highly populated Netherlands - what could possibly go wrong?

Glenn Lelieveld, Averti Ecologie BV

Wolves were exterminated from the Netherlands in the early 19th century. However, since the fall of the Iron Curtain in the '90, wolves have made a spectacular comeback in Western Europe, including already 10 wolf packs in the Netherlands. This small country (43.000 km2) has a huge human population (on average 523 people per km2). Interactions between wolves and humans are frequent, and not always positive. In this presentation, Glenn Lelieveld will reflect on the comeback of wolves to the Netherlands out of his experience as the national coordinator for wolf monitoring.

Changing the Tolerance of the Intolerant: Does Large Carnivore Policy Matter?

Erik R. Olson, Department of Natural Resources, Northland College, Ashland, WI 54806, USA and Jamie Goethlich, Department of Forest and Wildlife Ecology, University of Wisconsin-Madison, Madison, WI 53706, USA

How people feel about large carnivores can be critical in determining the success of conservation efforts. In some cases, people's attitudes towards large carnivores are more influenced by policies dictating how people can interact with those species rather than the species themselves. Yet, the connections between policy and tolerance of large carnivores remain unclear. To better understand these connections, we surveyed residents of northern Wisconsin, USA, about wolves Canis lupus and wolf policies. We grouped survey respondents based on their general attitudes towards wolves and assessed whether respondents expected their tolerance of wolves to improve under different policy scenarios. Hunters, people with generally negative or ambivalent attitudes towards wolves, and people with wildlife conflict experience were more likely to expect their tolerance to improve under policy scenarios that allowed for the regulated killing of wolves under certain circumstances. However, we also observed important nuances in the relationship between tolerance of wolves and wolf policy. Large carnivore conservationists must balance conservation objectives with the preferences of local people. The fulcrum of this balance may shift over time as local preferences or species status change. Thus, monitoring local policy references may be just as important as carnivore population monitoring.

Wolves foraging on berries is likely a widespread behavior in southern boreal ecosystems

Isabella Evavold, Northern Michigan University, Thomas D. Gable; Department of Fisheries, Wildlife, and Conservation Biology, University of Minnesota, Austin T. Homkes; Department of Fisheries, Wildlife, and Conservation Biology, University of Minnesota, Joseph K. Bump; Department of Fisheries, Wildlife, and Conservation Biology, University of Minnesota

Wolves are opportunistic generalists that can respond quickly to new and unique food sources. Wolves in some ecosystems will consume berries and other fruits when they are abundant and available, however many aspects of this behavior remain unknown. In the Greater Voyageurs Ecosystem (GVE), Minnesota, USA, wolves consistently consume berries when available. We deployed remote cameras in blueberry patches to record wolves foraging on berries. We captured footage of wolves of all age-classes, social statuses, and sex foraging on blueberries alone or with other wolves. Our observations indicate berry consumption by wolves is a widespread behavior in the GVE. We hope our work spurs the examination of whether berry consumption is a widespread and ubiquitous behavior for wolves.

A case study on seasonal and population density effects on an intraspecific aggressive event in Gray Wolves in the central forest of Wisconsin

Danielle Deming, Wisconsin Department of Natural Resources, Randy Johnson, Wisconsin Department of Natural Resources

In carnivores, intraspecific mortality is rare, and even more so in gray wolves (*Canis lupus*). Intraspecific strife among wolves has been explained by a territorial defense as most wolf killing by other wolves has occurred along edges of wolf-pack territories or in adjacent territories. In addition, these conflict interactions coincided with breeding competition in the months leading up to and during breeding season (late fall-early winter). While there have been a few studies on intraspecific aggression among wolves, has been little examination on wolf consumption of other wolves. In the summer of 2024, a collared wolf died at Necedah National Wildlife Refuge in Wisconsin, and, after investigation, it determined that the wolf was killed by another wolf. The findings of this investigation suggest that population wedging, seasonality, and resource availability may be contributing factors to this unique intraspecific interaction.

Summer diets of Gray Wolf packs across several years in the Greater Voyageurs Ecosystem

Magdaline Baham, University of Minnesota/Voyageurs Wolf Project, Thomas D. Gable, University of Minnesota/Voyageurs Wolf Project, Austin T. Homkes, University of Minnesota/Voyageurs Wolf Project, Joseph K. Bump, University of Minnesota/Voyageurs Wolf Project

Wolf diets change seasonally in response to the availability of prey and other food sources. We collected 6,900 scats from 11 packs during 2015-2019 to understand the dynamics and shifts in wolf diets from April to October in the Greater Voyageurs Ecosystem, Minnesota, USA. Although the primary prey of wolves were deer and beavers, diets varied across packs and years. Wolves capitalized on pulses of prey and other food, suggesting that wolf diets are the result of changing availability of food as well as variation in foraging behaviors of individuals within packs.

How black bear hunting influences the time budgets and foraging behavior of gray wolves

Ian Smith, Voyageurs Wolf Project, University of Minnesota, Thomas D. Gable, Voyageurs Wolf Project, University of Minnesota, 2003 Upper Buford Circle, St. Paul, MN 55108, Austin T. Homkes, Voyageurs Wolf Project, University of Minnesota, 2003 Upper Buford Circle, St. Paul, MN 55108, Joseph K. Bump, Voyageurs Wolf Project, University of Minnesota, 2003 Upper Buford Circle, St. Paul, MN 55108

Wolves are opportunistic predators that utilize various food sources. We investigated how wolves in the Greater Voyageur Ecosystem (GVE), Minnesota, responded to food subsidies created by recreational black bear hunting from August to October. During 2018-2023, we searched clusters of GPS-locations from 36 collared wolves and found that nearly all wolves in the GVE spent time visiting bear bait piles. Further, wolf predation on and scavenging of black bears peaked in September, following the hunting season's opening day (September 1). Our results indicate that bear hunting influences the movement, time budgets, and foraging behavior of wolves seasonally.

Wolves on the Landscape. Investigating the Effects of Selective Predation on the Spread of CWD in Wisconsin

Michael Menon, Department of Forest & Wildlife Ecology University of Wisconsin-Madison, Tim Van Deelen, Department of Forest & Wildlife Ecology University of Wisconsin-Madison

The gray wolf, ma'iingan, plays an important role in the culture of the Ojibwe people. Stemming from a tribal interest to look beyond the spiritual role of the wolf, this research investigates whether wolves have an effect on the transmission and spread of chronic wasting disease (CWD) in Wisconsin's white-tailed deer. Prior studies that looked at the effects of selective predation by wolves on deer are largely based in theoretical models. There is a need for empirical data to buttress these models, and this study seeks to provide that data. Measuring the effects of direct predation (sampling wolf kill sites) and indirect predation pressure (observing deer carcass scavenging), we hope to answer the questions: How selective do wolves have to be to have an effect, what are those effects, and how these findings can aid in developing/supporting models to aid in wolf management decisions.

Spinoffs from a Long-Term Gray Wolf (Canis lupus) Study in the Superior National Forest

L. David Mech, U. S. Geological Survey

This study of wolves (*Canis lupus*) and white-tailed deer (*Odocoileus virginianus*) in the Superior National Forest (SNF) of northeastern Minnesota,1966-2022, produced much of the basic information about wolf ecology, behavior, and natural history known today. Based on aerial radio-tracking 778 wolves and 800 deer in a 2,060 km2 area, the research confirmed that wolf packs are families and established that packs maintain territories via scent-marking, howling, and direct defense. Pups of both sexes raised annually by each pack disperse when maturing, often hundreds of kilometers searching for mates and a space to raise their own offspring. Territory edges are used least and often overlap with neighbors. There, lethal interactions between packs occur, and prey survive longer. During summer, most wolves hunt individually for fawns, beavers (*Castor canadensis*), and moose (*Alces alces*) calves. In part of the area, wolves subsidized by deer preying enough on moose might have helped limit their population. In winter, packs hunt nomadically within their territories for deer, with low success, and disproportionately take female fawns, bucks, older adults, and/or those with disorders. The deer and wolf populations are affected by snow conditions, and in part of the area, several severe winters, maturing habitat, and a high wolf population resulted in a decades-long dearth of overwintering deer while in another part, deer maintained a 60+ year tradition of migrating up to 78 kilometers. Wolf mortality factors included several diseases and pathologies, starvation, prey injuries, intraspecific strife, poaching, vehicle strikes, and legal harvest (2012-2014 in Minnesota and open for dispersers to Ontario). Canine parvovirus (CPV) struck the wolf population in the late 1970s and affected its trajectory until about 1993, when the population gained enough resistance to begin increasing again.

Back to the Future: Achieving Wolf Co-existence in the Western Great Lakes Region

Peter David, Great Lakes Indian Fish and Wildlife Commission (Retired)

Wolf stewardship in Minnesota, Wisconsin and the Upper Peninsula of Michigan is transforming from a recovery phase to a co-existence phase. This transition reflects a profound shift in the human/wolf relationship in the region and necessitates concurrent modifications in management/stewardship goals and practices. Unfortunately, the Europeans who colonized this region and who still exert primary influence over contemporary wolf policy have historically been focused on wolf reduction or eradication. As a result, their history includes relatively few models of successful wolf co-existence to draw upon. This contrasts markedly with the history of the Ojibwe, who were the primary occupiers of current wolf range in the area at the time of colonization. The Ojibwe world view has long embraced wolf co-existence on both cultural and practical levels, offering an endemic example of successful coexistence to emulate. This presentation will briefly review the cultural underpinnings of the wolf/human relationship in Ojibwe and European cultures, both of which evolved long before the advent of the western science of Wildlife Ecology. It will highlight the primary components of the Ojibwe/wolf relationship which promote coexistence, and examine components commonly utilized in western management which could achieve similar outcomes. Finally, it will review how these contrasting historic approaches align with contemporary public opinion and ecological science.

Ma'iingan (Canis lupus) Conservation and the Remarkable Legacy of W813: A Multidisciplinary Approach from the Red Cliff Band of Lake Superior Chippewa

Genevieve Adamski, Red Cliff Band of Lake Superior Chippewa - Treaty Natural Resources Dept., Ron Nordin Jr., Red Cliff Treaty Natural Resources, 88455 Pike Rd. Bayfield, WI, USA

The Treaty Natural Resources Department for the Red Cliff Band of Lake Superior Chippewa has implemented a comprehensive ma'iingan monitoring project since 2010. This work is aimed at understanding and preserving the local ma'iingan families while mitigating conflicts with human activities. Our program employs a variety of techniques to gather crucial data on ma'iingan behavior, ecology, and interactions with other species.

During the presentation, we will discuss our wide variety of methodologies (GPS collaring, den checks, camera traps, howl surveys, and track surveys) used to better understand our local packs. As our department has a strong human dimension to our wildlife work, we regularly collaborate with community members to repair the relationships between humans and our wild neighbors.

Through this work, we have come to build a strong relationship with one wolf, W813, the matriarch of the Echo Valley Pack. She likely mothered over 40 pups over her 10-year tenure as our study partner. This remarkable wolf was estimated to be at least 12 years old before she was taken from us. We will also discuss her daughter's incredible dispersal journey and the on-going legacy of her pack. We are excited to share W813's accomplishments and life story to inspire the scientific community.

Red Cliff's ma'iingan monitoring project exemplifies a multidisciplinary approach to wildlife conservation and protection. Our department prioritizes cultural significance integrated with scientific methodologies to ensure the persistence of this valued relative in an increasingly human-dominated landscape.

Video of wolf predation on a foraging beaver: insight into how wolves influence beaver foraging?

Dani Freund, Trent University, Dr. Thomas Gable, University of Minnesota
Austin Homkes, University of Minnesota, Olivia Jensen, Sage Patchett, Dr. Joseph Bump, University of Minnesota

Knowledge of wolf (*Canis lupus*)-beaver (*Castor canadensis*) interactions has largely been derived from indirect observations due to the cryptic nature of wolves and the densely forested areas where they regularly kill beavers. In September 2023, we opportunistically recorded remote camera footage of a wolf killing an adult beaver, providing direct evidence of how wolves kill beavers. The camera also recorded beaver foraging activity before and after the kill, providing a unique opportunity to observe changes in foraging behavior of the surviving beavers at the pond in response to predation. Beaver foraging on the trail declined by 97% immediately following predation, potentially due to consumptive and/or non-consumptive effects of predation. Furthermore, we recorded vegetation along transects and active feeding trails to understand the influence that forage may have on where the wolf killed the beaver. The trail the attack occurred on was the longest at the pond, and had a significantly higher proportion of aspen (a preferred tree by beavers) than other trails on average. Preference for aspen may therefore have driven beavers to forage farther from the water and thus increased their risk of predation at this trail. Although we present just a single observation, to our knowledge, there is only one other documented observation in the literature of a wolf catching and killing a beaver. Our data therefore provide unique insight to difficult-to-observe predatory behavior.

Human-caused wolf mortality persists for years after discontinuation of hunting

Roman Oliynyk, Harvard University, Howling for Wolves

By the mid-twentieth century, wolves were nearly extinct in the lower 48 states, with a small number surviving in northern Minnesota. After wolves were placed on the endangered species list in 1973, the northern Minnesota wolf population increased and stabilized by the early 2000s. A wolf trophy hunt was introduced in 2012–2014 and then halted by a court order in December 2014. The Minnesota Department of Natural Resources collected wolf radiotelemetry data for the years 2004–2019. Statistical analysis showed that wolf mortality remained close to constant from 2004 until the initiation of the hunt, and that mortality doubled with the initiation of the first hunting and trapping season in 2012, remaining at a nearly constant elevated level through 2019. Notably, average annual wolf mortality increased from 21.7% before wolf hunting seasons (10.0% by human causes and 11.7% natural causes) to 43.4% (35.8% by human causes and 7.6% natural causes). The fine-grained statistical trend implies that human-caused mortality increased sharply during the hunting seasons, while natural mortality initially dropped. After the hunt's discontinuation, human-caused mortality remained higher than prior to the hunting seasons throughout the five years of the available after-hunt radiotelemetry data.

Poaching is dominant cause of gray wolf mortality and not reduced by federal protection.

Alejandra Zubiria Perez - Department of Fisheries and Wildlife, Michigan State University, East Lansing, MI, Shannon M. Barber-Meyer - Research Department, Pacific Whale Foundation, Wailuku, HI, Dean E. Beyer, Jr. - Department of Fisheries and Wildlife, Michigan State University, East Lansing, MI, John D. Erb - Forest Wildlife Populations and Research Group, Minnesota Department of Natural Resources, Grand Rapids, MN, Kenneth F. Kellner - Department of Fisheries and Wildlife, Michigan State University, East Lansing, MI, Seth A. Moore - Grand Portage Band of Lake Superior Chippewa, Grand Portage, MN, Tyler R. Petroelje - Wildlife Division, Michigan Department of Natural Resources, Marquette, MI, Jennifer L. Price Tack - Office of Applied Science, Wisconsin Department of Natural Resources, Rhinelander, WI, David Ruid - USDA/APHIS/Wildlife Services, Rhinelander, WI, Michael Schrage - Fond du Lac Resource Management Division, Cloquet, MN, Morgan Swingen - 1854 Treaty Authority, Resource Management Division. Duluth, MN, Steve K. Windels - Voyageurs National Park, National Park Service, MN, Jerrold L. Belant - Department of Fisheries and Wildlife, Michigan State University, East Lansing, MI

Human-caused gray wolf mortality can comprise two thirds of reported mortalities. Developing effective management policies depends on understanding factors affecting cause-specific mortality and the identification of risks to survival. We used GPS and mortality data representing 1,024 wolf-years from 547 wolves collected by state, tribal, and federal agencies in Minnesota, Wisconsin, and Michigan during 2012–2023 to assess annual wolf survival and cause-specific mortality in relation to sex-age class, residency status, and federal protection status. We found mean annual wolf survival for the region was 0.78 and was lower for wolves in Minnesota (0.69) compared to Wisconsin (0.86) and Michigan (0.84). Regional and state-specific annual survival was similar across years, between sex-age categories, and did not vary based on state or federal protection status, but survival probability for resident wolves was greater than for non-residents. Poaching represented 37% of all mortalities and peaked in mid-November. Mortality from legal kills, conspecific strife, vehicle strikes, and other natural causes comprised 15%, 13%, 10%, and 10% of total mortality, respectively. Cause-specific mortality risk did not vary by age class or sex except for vehicle collisions, where risk was less for females. As expected, risk of legal kill was greater during years without federal protection, but protection status did not influence mortality risk for other causes. Non-resident wolves were at greater risk of illegal kill, legal kill, conspecific strife, and overall mortality than resident wolves. Our findings suggest that wolf survival was not influenced by federal protection status but was influenced by wolf residency status and that poaching, which occurred primarily during deer-hunting season likely due to increased hunter presence on the landscape, was the leading cause of mortality for wolves in the region.

How the temporal dynamics of wolf predation during summer are shaped by resource pulses, prey availability, and pup-rearing demands

Thomas Gable, University of Minnesota/Voyagers Wolf Project

In many southern boreal ecosystems across North America, wolves rely on white-tailed deer and beavers during summer (April to October), yet relatively little is known about wolf predation behavior, or what drives changes in their predation behavior during this period. During 2015-2024, we studied the summer predation behavior of more than 50 wolves by searching >40,000 clusters of GPS-locations and identifying >1,900 kills. We used this dataset to estimate monthly kill rates and biomass acquisition rates of beavers and deer (both fawns and adults), and monthly ambushing rates on beavers to understand how these metrics of predation change from April to October. Our work demonstrates how the temporal dynamics of wolf predation in a southern boreal ecosystem are driven by prey availability, resource pulses, wolf cohesion, and the energetic demands of growing wolf pups—factors that coalesce not only to influence kill rates of wolves but also the ambushing behavior of wolves, particularly during periods of reduced deer availability. We also demonstrate striking individual variation in the predation behavior of wolves, both in terms of kill rates and ambushing rates, with breeding wolves generally be more adept hunters than subordinate wolves. By estimating kill rates, biomass acquisition rates, and the energetic requirements of wolves and their pups, we show how wolf predation behavior ultimately drives wolf population dynamics by driving population parameters such as pup survival and pack size.

Poster Abstracts

Germination rates of blueberries eaten by wolves in northern Minnesota, USA

Alex Gross, University of Minnesota/Voyageurs Wolf Project, Thomas D. Gable, University of Minnesota/Voyageurs Wolf Project, Austin T. Homkes, University of Minnesota/Voyageurs Wolf Project, Joseph K. Bump, University of Minnesota/Voyageurs Wolf Project, Kathy Winnett-Murray, Hope College, K. Greg Murray, Hope College

In southern boreal ecosystems like the Greater Voyageurs Ecosystem in Minnesota, USA, blueberries (Vaccinium spp.) can be an important seasonal food source for wolves from July-August. We conducted comparative germination trials using blueberry seeds from wolf scats and control seeds to see if germination rates differ for seeds that passed through the digestive systems of wolves. We found that seeds that had been consumed by wolves and then passed had higher germination rates and germinated quicker than control seeds. Our findings illustrate another way in which wolves are connected to larger ecological processes in boreal ecosystems.

Wildlife Science Center Internship

Andrew R. Linder, Wildlife Science Center, Northland College, Jayden Janusiak, Wildlife Science Center, Northland College, Peggy Callahan, Wildlife Science Center

The Wildlife Science Center (WSC) offers an unparalleled opportunity for aspiring wildlife professionals to immerse themselves in hands-on learning and gain essential experience in the field. Focused on education, conservation, training, and research, the WSC internship provides an invaluable platform for students to develop a profound understanding of wildlife management and research. Interns at WSC engage directly with a diverse array of species, including over 100 wolves, cougars, black bears, elk, bobcats, reptiles, and birds of prey. This immersive experience includes not only the daily care and management of these animals but also active participation in ongoing research and conservation efforts. Interns are involved in critical tasks such as safely conducting wildlife captures, performing health checkups, and contributing to field research. WSC places a particular emphasis on wolves, offering interns the unique opportunity to work closely with various wolf species, including gray wolves from across North America, endangered red wolves, and Mexican gray wolves. This specialized focus allows interns to develop expertise in the care and study of these complex animals while contributing to public education and awareness about wildlife conservation. Overall, the WSC internship equips students with practical skills and deepens their understanding of wildlife management, making it an exceptional foundation for a career in natural resources.

Characteristics of gray wolf (*Canis lupus*) dispersal in northern Minnesota

Livia Coletta, Northern Michigan University, Thomas Gable, Voyageurs Wolf Project, University of Minnesota, 2003 Upper Buford Circle, St. Paul, MN 55108, Austin Homkes, Voyageurs Wolf Project, University of Minnesota, 2003 Upper Buford Circle, St. Paul, MN 55108, Sean Johnson-Bice, University of Manitoba, Department of Biological Sciences, 50 Sifton Rd, Winnipeg, Manitoba R3T 2N2, Canada, Joseph Bump, University of Minnesota, University of Minnesota, 2003 Upper Buford Circle, St. Paul, MN 55108, John Bruggink, Northern Michigan University, Biology Department, 1401 Presque Isle Avenue, Marquette, MI 49855

Wolf dispersal is generally thought to be stimulated by restricted food access via intraspecific competition with dominant pack members. Thus, we predict that dispersals should occur when food availability is most constrained within a pack. We examined dispersal data from >50 GPS-collared wolves since 2012 to determine when wolves typically disperse from the Greater Voyageurs Ecosystem, Minnesota. Dispersal occurred most frequently in early spring, late summer and early fall. Our results correspond with prioritization of provisioning dependent pups in spring, and the scarcity of prey availability in late summer and early fall.

Wolf Pup Survival in Northeastern Minnesota

Sammi Shimota, 1854 Treaty Authority, Morgan Swingen, 1854 Treaty Authority, Mike Schrage, Fond du Lac Resource Management Division

The 1854 Treaty Authority has monitored wolf pup survival in northeastern Minnesota since 2017 using expandable radio-collars and supplementing with other monitoring methods (e.g. PIT tags, trail cameras). Expandable collars work well but are often chewed off (presumably by littermates) before fully expanding. In 2023 we used a new bitter apple spray treatment on the collars to prevent litter mates from chewing on them. From 2017-2023 we have monitored 52 individual wolf pups from seven different wolf packs using a combination of methods. Using the Kaplan-Meier estimator, we have estimated average wolf pup survival rates to 6 months (0.768) and 1 year (0.585) of age. Causes of mortality can be difficult to determine but have included health-related reasons in young (<4-month-old) pups, and human-related causes in older juveniles (4-12 months).

One man's trash: impacts of anthropogenic food subsidies on foraging behavior of gray wolves

Sophie Heny, University of Minnesota/Voyageurs Wolf Project, Thomas Gable, University of Minnesota/Voyageurs Wolf Project, Austin T. Homkes, University of Minnesota/Voyageurs Wolf Project, Joseph K. Bump, University of Minnesota/Voyageurs Wolf Project

Gray wolves are generalist predators and in human-modified landscapes often meet their energetic requirements by capitalizing on natural and anthropogenic foods. We studied the foraging ecology of 37 GPS-collared wolves during summer in the Greater Voyageurs Ecosystem (GVE) Minnesota, by searching 26,928 clusters of GPS locations from April-October of 2019-2023. Our results indicate humans provide substantial food for wolves during summer months, a time when prey is less available and wolves have more variable diets. Our work shows that human food sources play an important role in the foraging ecology of wolves even in areas of low human population density.

How wolves alter forests by killing beavers

Thomas Gable, University of Minnesota/Voyageurs Wolf Project, Sean M. Johnson-Bice, University of Manitoba, Austin T. Homkes, University of Minnesota/Voyageurs Wolf Project John Fieberg, University of Minnesota, Joseph K. Bump, University of Minnesota/Voyageurs Wolf Project

Using visually-appealing graphic design, we illustrate how wolves indirectly alter the trajectory of forests by constraining the distance that beavers, a central place forager and prolific ecosystem engineer, forage from water. Specifically, we show that wolves wait in ambush and kill beavers on longer feeding trails than would be expected based on the spatio-temporal availability of beavers. This pattern is driven by temporal dynamics of beaver foraging: beavers make more foraging trips and spend more time on land per trip on longer feeding trails that extend farther from water. As a result, beavers are more vulnerable on longer feeding trails than shorter ones. Wolf predation appears to be a selective evolutionary pressure propelled by consumptive and non-consumptive mechanisms that constrain the distance from water beavers forage, which in turn limits the area of forest around wetlands, lakes and rivers beavers alter through foraging. Thus, wolves appear intricately linked to boreal forest dynamics by shaping beaver foraging behaviour, a form of natural disturbance that alters the successional and ecological states of forests.