2015 Joint Annual Meeting:
Minnesota & Wisconsin State Chapters of The Wildlife Society

February 17th-19th, 2015
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Presentation & Poster Abstracts

Table of contents:

Plenary Session

Benjamin Zuckerberg
Assistant Professor, UW-Madison Dept. of Forest & Wildlife Ecology

Dr. Zuckerberg's lab focuses on advancing the field of climate change ecology by studying how forces of climate and land use change impact wildlife populations from local to national scales. The evidence that wildlife populations are responding to modern climate change is now overwhelming. Climate change transcends political and jurisdictional boundaries and adds significant uncertainty to the conservation and management of our national resources. Dr. Zuckerberg will discuss the observed and predicted trends in climate within an ecological context, identify the ecological and evolutionary impacts of climate change on wildlife populations and communities, and present research on how climate change vulnerability assessment is an increasingly important tool for modern conservation.

Peter Donovan
Co-founder, Soil Carbon Coalition

The Soil Carbon Coalition's goal is to advance the practice and spread awareness of the opportunity to turn atmospheric carbon into soil organic material. His principal project is the Soil Carbon Challenge, which measures how fast land managers can turn atmospheric carbon into water-holding, fertility-enhancing soil organic material. He will explain the carbon cycle - why it is the mother of all ecosystem services, why and how water follows carbon, and how our management, policy, and decisions are influential elements of this most powerful and creative planetary force. Peter's presentation will be phenomenally interesting, thought-provoking, challenging, and deeply inspiring.

Judith D. Schwartz
Freelance Writer

A longtime freelance writer from southern Vermont, Judith's work has appeared in various venues across the publishing spectrum. She is the author of several books, including Cows Save the Planet and Other Improbable Ways of Restoring Soil to Heal the Earth. Drawing on the work of thinkers and doers, renegade scientists, and institutional whistleblowers from around the world, Judith will challenge conventional thinking about global warming during her talk. Much of the carbon dioxide that burdens the atmosphere is not the result of fuel emissions, but from agriculture; returning carbon to the soil not only reduces carbon levels but also enhances soil fertility. The solution to our carbon and global warming issues lies beneath the ground we walk on, and the proper management of soil could solve a long list of environmental problems.

W. Richard Teague, Ph.D.
Associate Resident Director & Prof., Texas A&M AgriLife Research

Dr. Teague's primary focus is to conduct a ranch-scale, multi-county assessment that addresses three related objectives in the context of the Climate Change Mitigation and Adaptation: (1) Determine the extent that grazing strategies influence key ecosystem services (especially soil and vegetation carbon sequestration), soil fertility and stability, water quality, net primary and secondary production, and the economic viability of working ranches that contribute to the retention of open space and rural community health in the Southern Plains of the USA, (2) Determine the extent that different grazing management strategies can be used by livestock producers to mitigate and adapt to alternative climate change scenarios, and (3) Evaluate the long-term economic consequences of using alternative-grazing management strategies to achieve rangeland restoration and production goals. Dr. Teague will cover how ranchers successfully managed their predominantly livestock-based businesses to facilitate wildlife habitat and management in addition to soil carbon and biodiversity consequences of using different livestock grazing strategies.

Special Session: Elk Restoration & Management in the Midwest

Potential for elk restoration in the 1854 and 1837 Ceded Territories of Minnesota

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Prior to the middle 1800s omashkoozoog (elk) ranged widely across Minnesota including parts of what became the 1854 and 1837 Ceded Territories of Minnesota. These were lands ceded by the Ojibwe to the United States Government for settlement. In exchange the Ojibwe retained the rights to hunt, fish and gather there. Before elk were extirpated from eastern Minnesota, evidence indicates they were routinely hunted by the Ojibwe people.

The Fond du Lac Band has partnered with the University of Minnesota to explore the feasibility of restoring elk to their ceded territories in Minnesota. The FDL Band sees elk restoration as both returning a native species and preparing for eventual climate change. Suitable elk habitat is most likely to be found on landscapes where timber harvest is a priority, agriculture is limited and the ownership is primarily public. Social acceptance is expected to be a critical factor in order for elk restoration to be successful. The Band and the UM intend to apply for funding to study habitat suitability for elk and public attitudes towards elk restoration in 2015.

History, status and management of elk in Northwest Minnesota

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Minnesota's native elk were extirpated in the early years of the 20th century due to overhunting and developmental pressures. Interest in elk reintroduction resulted in the herd that would become the Grygla herd, with a range in eastern Marshall and northwestern Beltrami Counties. Over the last 25 years, two additional elk populations have become established naturally in Kittson County in the northwest corner of the State from probable sources in Manitoba.

The elk range in NW Minnesota is part of the Aspen Parklands, and is a mosaic of public lands interspersed with private, largely agricultural lands. It is a transition between more heavily forested areas to the east and prairies/agricultural lands to the west. Elk populations in this area have been largely limited by depredation conflicts with private landowners. Elk management has been geared toward maintaining Aspen Parklands habitats while minimizing depredation complaints. Habitat maintenance activities focus on disturbance (prescribed fire, timber harvest, shearing and mowing) to maintain aspen and brushland covertypes, along with foodplots to minimize depredation. Population management (via public hunting) has focused on keeping herds within limits established in the management plan. Citizen input into management processes has increased in recent years in an effort to increase landowner tolerance for elk, with the elk plan re-visited at 5 year intervals.

History and Current Management of Elk in Michigan

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Jennifer Kleitch, Michigan Department of Natural Resources, Gaylord, MI 49735

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The history and current management of elk in Michigan is a blend of ecological, social, and economic challenges for managers. Elk lived in Michigan during the pre-European period, yet were extirpated by the late 1800s. Reintroduction attempts around 1918 resulted in today's herd that exists in a relatively small area of the northern lower peninsula. Abundance was estimated to be 300-400 animals in 1939 and 900-1,000 in 1958. Crop damage, reforestation problems, and concerns of competition with white-tailed deer emerged, but elk viewing grew, and local guides established outings for tourists. Active population management using hunting was first used in 1964 and 1965. Abundance declined as intended, but hunting was not reauthorized in 1966, and the population continued to decline. Factors included habitat degradation, increased human activity in the elk range, and increased poaching. By 1975, the population was estimated at 200 animals, prompting development of Michigan's first elk management plan. Habitat enhancements, increased law enforcement, and education helped the population rebound in the 70s and 80s with a population goal set at 600-800 animals in a 1600 km2 area. Annual hunting was resumed in 1984, management plans were revised in 1984 and 2012, and new population goals of 500-900 animals in 1200 km2 established. Management for low numbers occurs when significant disease, forest regeneration, and crop damages issues are present; for higher numbers if none of these issues are significant. Challenges today include forest regeneration, crop damage and increasing human use of the core elk range.

Elk Restoration and Management in Ontario, Canada

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After several previous failed attempts to restore elk, the Government of Ontario announced an elk restoration initiative in 1997. From 1998 to 2001, 460 elk were translocated from Elk Island National Park, Alberta, to four release areas in Ontario; Bancroft/North Hastings (BNH), Nipissing/French River (NFR), Lake Huron/North Shore (LHNS), and Lake of the Woods (LOW). Elk in two of the release areas (BNH and LHNS) are doing well, with high rates of population increase, while those in the other two areas (NFR and LOW) have experienced slower growth, likely related to poor recruitment rates during some years. During 1998-2005, overall mortality of 443 collared elk was 49%, ranging from a low of 19% in the LHNS region to a high of 85% in the NFR region. Predation by wolves and possibly black bears was the most important cause of mortality (25%), whereas death within 1month of release due to injuries sustained during translocation and/or post-capture myopathy was the cause of death for 20% of all elk, followed by accidents, including vehicle collision, injury and drowning (19%), emaciation (9%), illegal hunting (9%), and meningeal worm (2%). An additional 17% of collared elk died of unknown causes. A provincial Elk Management Plan was implemented in 2010. A September elk hunt was initiated in the BNH area during 2011 in response to the dramatic population increase to keep elk within the population objective (400 to 600 elk in the core area) and to manage the population where elk/human conflicts occur within the area.

Try, Try Again! The Wisconsin experience in elk reintroduction

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In 1995, 25 wild elk were donated to the State of Wisconsin from the State of Michigan, and were released as an experimental herd. Since that time, the elk herd has been intensively monitored and researched, revealing a great deal about their ecology. However, due to a variety of impacts that include predation, changes in timber management, habitat issues, and others, the herd has not grown at the anticipated rate. As a result, additional efforts are being taken to increase the herd, assist them in dispersing to better habitat, and to establish an elk herd at a second location in the state. This effort originated and is made possible because of a strong grassroots efforts and high public support. I'll highlight the many aspects of this effort, both successes and failures, and future plans to ensure the Wisconsin elk reintroduction effort succeeds.

Special Session: Wild Rice Management in Minnesota & Wisconsin

Lessons Learned: 40 Years of Wild Rice Management in the Brainerd Lakes Area

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Wild rice is very important for waterfowl and other wetland wildlife, providing both food and habitat. Minnesota Department of Natural Resources (MN DNR) Wildlife staff in the Brainerd work area have been managing wild rice waters to benefit wildlife for decades. Back in 1975, three lakes were managed for rice. Today 50 wild rice lakes are routinely managed. Wild rice management can be complex, and each lake can have unique challenges. This presentation will share lessons learned in 40 years of rice management, and share case studies from lakes where management was successful.

Inching Towards Ecological and Cultural Recovery: Lessons in Manoomin Restoration from Lac Vieux Desert

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It would be difficult to find a more socially challenging location to attempt manoomin (wild rice) restoration than Lac Vieux Desert (LVD), the headwater of the Wisconsin River and a lake which straddles the Wisconsin/Michigan border. The rice beds historically found on Lac Vieux Desert once provided for generations of non-human and human beings, including members of the Lac Vieux Desert Band of Ojibwe, who requested that lands on this lake be included in their reservation so they would have access to this critical subsistence resource. However LVD's rice beds had largely disappeared by the 1950's in response to dam-induced changes in the lake's hydrology. In the late 1990's, a multi-agency effort began to restore some of the historic abundance of rice on LVD. This effort included incorporating an experimental, 10-year condition in the license issued to the dam owner by the Federal Energy Regulatory Commission which reduced the maximum operating depth of the lake by 10". It was hoped this change would provide an area of suitable growing depths on Rice Bay, which once held the largest beds on the lake. This presentation will summarize some of the social, ecological and legal challenges faced in the effort; document how the rice bed – and its users - responded to the experimental condition; review some of the lessons learned in the process; and discuss the yet-to-be determined ultimate outcome of this ecological and cultural restoration effort.

Identifying Mechanisms of Change within a Northeastern Minnesota Wild Rice Lake: Applied Management Techniques, Trials, and Triumphs

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Big Rice Lake, a 2072 acre Designated Wildlife Management Lake within the Superior National Forest in northeastern Minnesota, is an important wild rice lake for resident and migratory waterfowl. Presently, Big Rice Lake is utilized by wild rice harvesters, waterfowl hunters, and other recreationists. Recent recorded trends show that wild rice abundance has declined within the past 10 years while pickerelweed has steadily increased. The specific causes for these changes are not well understood, and the shift to pickerelweed dominance is likely not the result of a single culprit but rather a combination of variables that have contributed to gradual changes within the basin. Lake management goals are to increase the presence and abundance of wild rice and decrease pickerelweed through various methods. Active management to reduce pickerelweed presence throughout the lake has occurred intermittently for the past 20 years and regularly for the past 4 years. Management has included water level manipulations, winter snowplowing, summer shearing via airboat, and

hand pulling. Some techniques are more efficient and successful than others at reducing pickerelweed, and additional techniques are being employed to encourage wild rice to recolonize in vacated pickerelweed plots. Through consistent and methodical management we hope to better understand the changes occurring so that through management we may be able to mitigate some of those changes to ensure Big Rice Lake will remain an important wild rice and wildlife resource in the future.

Restoring Wild Rice on Clam Lake through Common Carp Management

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Clam Lake, located in Burnett Co. (northwest Wisconsin), is historically the largest wild rice producing waterbody in the state according to harvest data supplied by the Great Lake Indian Fish and Wildlife Commission. In 2007 the lake experienced a dramatic decline in the density and distribution of its wild rice beds. In 2009, the St. Croix Tribe in cooperation with the WI DNR and Clam Lakes Protection and Rehabilitation District began a study/restoration project on Clam Lake to determine the reason for the decline and mitigate the effects.

After considering multiple factors, the group focused on common carp (*Cyprinius carpio*) as the limiting factor. Aging samples and an exclosure study in which wild rice would only grow in a protected and seeded setting confirmed this theory.

In 2010, we began a project to quantify the carp population and assess removal efforts using mark and recapture method. This data was compared to threshold values developed by University of Minnesota researchers. A judas fish technique was used to enhance removal efforts. Carp removals, along with wild rice seeding and barriers are being used to accomplish restoration goals.

This project is ongoing, but we have seen a positive response from the aquatic plant community and an increase in wild rice distribution. A portion of the lake that was barricaded has been restored and seed from this area is being used in seeding efforts.

Twin Lakes: Monitoring Mining Impacts to Wild Rice

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Sandy and Little Sandy lakes (Twin Lakes) historically contained good wild rice crops utilized by harvesters. Wild rice production generally declined through the 1970s and 1980s, with little rice found in the lakes during a 1987 survey. The lakes are located downstream of the U.S. Steel Minntac iron ore operation tailings basin, which was constructed beginning in 1966. The resulting changes to water quantity and/or water quality in the system may have impacted wild rice in the Twin Lakes. Under an agreement between the Bois Forte Band of Chippewa and U.S. Steel, a monitoring program was completed in 2010-2014 to document conditions at the lakes. Project activities included water depth recording, inlet and outlet field surveys, water sampling, vegetation surveys, and aerial surveys. A primary focus of the monitoring was water quality. A Minnesota water quality standard of 10 mg/L sulfate exists for waters used for the production of wild rice. Monthly (May-October) water sampling at the inlet to the lakes indicated an average sulfate concentration of 483 mg/L in 2010 before a seep collection system was operational at the tailings basin. After seep collection began, average annual sulfate concentrations at the inlet ranged from 207-357 mg/L in 2011-2014. Water levels also remained elevated in the lakes which may be a contributing factor to wild rice success. Surveys completed each year showed sparse wild rice plants growing in the lakes.

Special Session: Applying LiDAR Technology to Wildlife Management & Research

Measuring Vegetation Structure via LiDAR Data: LiDAR Basics, Data Availability, and Applications in Forest and Wildlife Management

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Light Detection and Ranging (aka, LiDAR) is a relatively novel technology that provides three-dimensional measurements of vegetation structure at unprecedented levels of accuracy and precision. Over the last thirty years research has demonstrated the efficacy of LiDAR data for providing multi-scale measurements of vegetation structure across large spatial extents. Continual maturation of LiDAR technology, coupled with increased data availability, has facilitated its application in support of both forest and wildlife management. This presentation will include a detailed overview of LiDAR technology, a brief summary of how LiDAR data have been employed to measure vegetation structure across multiple spatial scales, as well as an overview of data availability. Several examples demonstrating the application of LiDAR in support of both forest and wildlife management will also be discussed.

Applications of LiDAR Data to Wildlife Habitat Modeling

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Identifying species-specific habitat associations is a common goal of wildlife research that provides information critical for landscape management and wildlife monitoring. Many wildlife species depend on specific structural attributes. LiDAR data provides high-resolution information on three-dimensional physiographic and vegetative structure over large spatial extents, making it a useful tool for measuring structural variables that can be incorporated into single- or multi-species habitat models. Potential applications of LiDAR data to wildlife-habitat modeling are numerous and include habitat mapping, predicting presence or use, and correlating landscape structural metrics to habitat quality. Because of the continuous nature of LiDAR data, it is particularly well-suited for characterizing wildlife-habitat relationships across a range of spatial scales. Furthermore, LiDAR-derived metrics can be summarized over entire management units, providing a useful resource for managers. In this talk, we provide an overview of how LiDAR data can be used for wildlife-habitat analysis, highlighting recent examples from the literature that demonstrate the benefits of incorporating LiDAR data into wildlife-habitat models. Applications for forest wildlife species will be emphasized.

LiDAR and Hierarchical Statistics Improve Abundance Estimates of Karner Blue Butterflies

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The Karner blue butterfly (*Lycaeides melissa samuelis*) is a Federally endangered species. The species occupies remnant savanna/barrens vegetation communities and other open landscapes, such as rights-of-ways, airports and military bases. Wild lupine (*Lupinus perennis*) is the obligate host plant for Karner blue butterfly larvae. Understanding the relationship between Karners and their habitat is important to manage and monitor them.

Pollard's random-walk technique and conventional distance sampling are two common methods to monitor Karner blue butterflies. While Pollard's random-walk can provide population abundance indices, it does not address imperfect detection and cannot yield estimates of true abundance. Conventional distance sampling surveys address incomplete detection rates of observers and yield defensible estimates of abundance. However, conventional distance sampling does not yield spatially-explicit abundance estimated beyond the transect scale. Effectively assessing species-habitat relationships requires defensible, spatially-explicit, population estimates and the associated habitat conditions. Hierarchical distance sampling allows researchers to simultaneously identify (1) factors influencing the probability of detection and (2) those influencing the abundance of a species. Previously, obtaining the landscape-scale habitat data needed for hierarchical distance sampling would have required extensive fieldwork. Fortunately, many biologically meaningful vegetation measurements can be obtained remotely using LiDAR data. For 2014, we evaluated the efficacy of three survey analysis methods: line-transect based Pollard walks, conventional distance sampling and hierarchical distance sampling on the Necedah National Wildlife Refuge. We found hierarchical distance sampling and LiDAR-based habitat data improved the rigor of karner blue butterfly population estimates and provided information valuable for habitat management and restoration decisions.

Use of LiDAR Data to Quantify Forest Structure for American Marten Habitat Assessment in Minnesota

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As part of a broad study of marten (*Martes americana*) ecology in Minnesota, we collected vegetation data in plots centered on natal and maternal dens and rest sites used by radio-collared martens from 2008-2014. Vegetation metrics measured included mean DBH and basal area by tree species and type (conifer versus deciduous), % canopy cover, canopy structure, understory cover density, sapling density, snag and stump density and volume, number of exposed root masses and slash piles, and volume of course woody debris. In spring 2014, we contracted a LiDAR flight (8 pulses per meter) over a 25 square mile area at the southwest corner of our current marten study area in northeast Minnesota. We used LP360 (qcoherent), an ArcGIS integrated software extension, to 'clean' the raw data, classify the ground and various vegetation layers, and build new digital elevation, surface, and canopy height models. Using boundaries of ground-based vegetation plots, we clipped out matching LiDAR data using LP360. Using Fusion (U.S. Forest Service), ArcMap (ESRI), and R, we will evaluate or develop LIDAR metrics as predictive models of forest structural attributes important to martens. We will also evaluate the influence of LIDAR resolution on our ability to predict each forest metric by sub-sampling the 8 point-per-meter data as well as using previously-collected 1 pulse per meter data.

Using LiDAR in Wetland Restoration and Management

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In order to restore and manage artificial wetlands, a land manager needs local knowledge, specialized equipment, technical skills, and many other tools to conduct a project successfully. With the recent availability of LiDAR data in some areas, this process has become easier and more efficient. In 2005, Outagamie County, Wisconsin, obtained LiDAR data to create two foot contour maps of the entire county for use in flood mapping.

This data was made available for use, free of charge, to any interested parties. The Wisconsin DNR owns and manages over 11,000 acres of land in Outagamie County, of which over 3000 acres is currently managed year-round as shallow flowages for wetland dependent species. This presentation will focus on how the WDNR is planning to use LiDAR data to manage its current wetland infrastructure in Outagamie County as well as how the data is being used to plan for future wetland creation opportunities.

Using LiDAR Data to Interpret Behavior-Specific Habitat Use of Moose

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Interpreting animal habitat use with LiDAR data would increase precision of management planning, and would make it possible to evaluate potential habitat quality across large areas. We evaluated a data set of moose locations that were collected at 20 minute intervals throughout the year, which essentially meant that we had a continuous record of movements and habitat use. We identified inactive behaviors (bedding) and active behaviors (foraging) in this data set, and measured canopy cover and other characteristics in the field at 155 bed sites. We processed the statewide LiDAR data set with Fusion at these bed sites. Canopy cover estimated with LiDAR in a 5, 8, and 10 m radius around each bed site was correlated with measured canopy cover ($R^2 \geq 0.67$) at bed sites. In initial analyses LiDAR based estimates of vegetation height was not highly correlated with temperature dependent use of different stands by moose for bedding. Night bed site locations tended to have lower vegetation height than day bed site locations in both cold and hot temperatures. With a 5 m radius around a bed site, the proportion of all returns > 5 m was affected by time of day and by temperature class (ANOVA, $P < 0.001$ and $P < 0.05$, respectively). Further analysis on more bed site locations should enable us to make a generalized description of characteristics of typical moose bed sites and foraging areas, including temperature dependent range of variation in bed site characteristics.

Expanded Wood Duck Banding Effort in Minnesota

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Minnesota is one of the top wood duck harvest areas in North America; wood ducks typically are 2nd or 3rd most abundant in the State's annual duck harvest. Several changes to wood duck seasons have recently occurred in Minnesota, including an increase in daily bag limit from 2 birds/day (1968-2010) to 3 birds/day starting (2011-present) and an earlier waterfowl hunting season opening date starting in 2011. Wood ducks are early migrants, and the earlier opener, in combination with the 3-bird bag limit, may increase harvest on the birds within the state. Consequently, there is increased interest in potential changes in the annual survival and harvest rates of wood ducks. To attain CV < 0.10 on harvest rates, 200-300 individuals from age-sex cohorts including: AHY-F, HY-F, and HY-M must be banded. To attain this CV for AHY-M wood ducks, annual samples of approximately 950 must be banded. These sample goals have not been met recently. In 2013, 1 full time duck banding crew was added to increase the banded sample of wood ducks; in 2014 3 additional crews were added in south-central Minnesota. In 2014, 1883 wood ducks were banded in south and central Minnesota; statewide we were able to meet sample goals for some, but not all cohorts. Herein, we present preliminary summaries of harvest data for wood ducks banded in Minnesota during 2014.

Distribution, Migration Chronology, and Survival Rates of Eastern Population Sandhill Cranes

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The Eastern Population (EP) of greater sandhill cranes (*Grus canadensis tabida*; hereafter, cranes) is rapidly expanding in size and geographic range. The core of their breeding range is in Wisconsin, Michigan, and southern Ontario, Canada. Little information exists regarding the geographic extent of breeding, migration, and wintering ranges of EP cranes, or migration chronology and use of staging areas. In addition, there are no published estimates of survival rates for EP sandhill cranes. To address these information needs we trapped and deployed solar Global Positioning System (GPS) Platform Transmitting Terminals (PTTs) on 29 sandhill cranes from December 2009 through September 2011. This study explores EP sandhill crane distribution during the breeding season and winter, migratory routes, and migration chronology and also estimates survival rates. EP cranes settled on summer areas beginning mid-March in Minnesota (11%), Wisconsin (36%), Michigan (29%), and Ontario (21%). On average, PTT-tagged cranes arrived at their winter terminus beginning mid-December in Indiana (29%), Kentucky (11%), Tennessee (79%), Georgia (11%), and Florida (32%). Twenty-three marked cranes returned to their summer area's calculated mean center after a second spring migration. The average linear distance between individual estimated mean activity centers for a summer area was 1.34 km (range: 0.01 – 7.82 km). EP cranes used fall and spring migration routes similar to those previously documented. Annual survival rates (from October through September) were estimated at 0.921 (2010-2011; SE = 0.058) and 0.913 (2011-2012; SE = 0.087) using the known fates platform in Program MARK.

Aerial surveys of breeding sandhill cranes in Minnesota

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Sandhill crane (*Grus canadensis*, hereafter crane) numbers have been increasing in Minnesota since the 1970s. Following the inception of a crane hunting season in northwest Minnesota in 2010, we initiated a survey to estimate the size of the crane population during the breeding season in that portion of the state (11,812 km^2). Estimates were obtained in 2012, 2013, and 2014. We were interested if these methods would work elsewhere, thus in 2014 we conducted a pilot survey to estimate the number of cranes in a portion of east-central Minnesota (16,392 km^2).

We used a GIS to construct a grid-based sampling frame consisting of 4-km^2 plots in each area, which were stratified based on the amount of potential crane nesting habitat. We selected a spatially balanced sample of 115 plots in each year/area and surveyed each sample plot once during May using a DNR helicopter. We counted and classified all crane observations in each plot based on their social status (individuals, pairs, groups) and evidence of breeding status (e.g., nest, colts, territorial behavior).

We estimated there were 7,260, 5,550, and 2,280 cranes in Aspen Parkland survey area in northwest Minnesota during 2012, 2013, and 2014. Survey timing and spring phenology were critical; for example, nonbreeding groups of cranes were not present in this area during the 2014 survey. We estimated 1,920 cranes in east-central Minnesota survey area in 2014. We will discuss survey results, interpretation, and future plans to monitor breeding sandhill cranes in Minnesota.

Spatial Ecology of Sandhill Crane Populations in Minnesota

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Minnesota is one of the few states to contain two distinct breeding populations of sandhill cranes, the Mid-Continent Population (MCP) and the Eastern Population (EP). Historically, these two breeding populations were separated spatially in Minnesota, but it now appears they may overlap. The population size of EP cranes has increased significantly in the past 15-20 years and EP cranes have expanded their breeding range in Minnesota during that period. Management options in Minnesota are currently limited because the boundary between MCP and EP cranes is not clearly delineated. Furthermore, additional information concerning how and where cranes depredate crops and how cranes use habitat at local and landscape scales is required to effectively manage sandhill cranes in Minnesota. We captured 6 sandhill cranes during 2014 in the zone between the historical breeding range boundaries. We fitted captured cranes with cellular-based GPS transmitter to monitor their locations throughout the year. We will use this information to assess current range boundaries, migration chronology, and habitat use. Four of the captured cranes from 2014 used traditional migration routes for EP cranes whereas one bird used a previously undocumented migration pathway to the MCP wintering area. We will present preliminary movement data from our first field season and describe future analysis methods for high-resolution, high-frequency movement data.

Predators

Enhanced competition limits recovery of American martens in Wisconsin

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Reintroductions and translocations are increasingly important tools for the conservation and recovery of carnivores. The American marten is a state endangered mammal in Wisconsin and has been subject to multiple reintroduction attempts. Marten recovery has been slow, yet the limiting mechanisms remain unknown. We hypothesized that competition with fishers is the ultimate mechanism regulating Wisconsin martens and used stable isotope analyses and dynamic occupancy models to assess niche overlap and competitive coexistence between the two species. Martens fell 99.99% within the isotopic niche of fishers and exhibited no partitioning of space, time, or resources with their primary competitor. Moreover, martens and fishers aggregated in space and time with mean occupancy probabilities of 0.37 and 0.86, respectively. We propose that enhanced competition via niche overlap has had negative fitness consequences for reintroduced martens and limited their recovery in the state. We are further testing our hypothesis through the genetic analysis of 79 non-invasively collected samples to estimate marten abundance, survivorship, and recruitment via mark-recapture and parentage analyses. Ultimately, this project is elucidating the mechanisms limiting marten recovery in Wisconsin and may provide a better understanding of reintroduction biology for recovering carnivore populations overall.

The role of risk perceptions in public tolerance of grey wolves in Wisconsin

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Successfully conserving large carnivore species in increasingly human-dominated landscapes requires effective management of human-wildlife conflicts whether they be actual or perceived. In Wisconsin, grey wolves (*Canis lupus*) provide an example of how, despite the relatively low potential for negative encounters, perceived risks to human safety and to pets can influence social tolerance for conservation measures. In the spring of 2014, we

conducted a mail survey to document Wisconsin resident's attitudes toward wolves and their management in the state. Our results suggest that there are significant differences in risk perceptions based on participation in deer hunting and proximity to wolf range, particularly in relation to experience with wolves. For hunters, more frequent experience with wolves increased perceived risks; however, among non-hunters, experience had a minimal effect on risk perceptions. Among wolf range residents, more frequent experience with wolves increased levels of fear, but among non-range residents, experience with wolves decreased levels of fear. These findings illustrate the need to adapt outreach and education efforts to account for the discrepancy between the actual risk and the high levels of perceived risk from wolves in the state.

Using Satellite Collar Data to Determine Wolf Den Location and Attendance in Northern Minnesota

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Population estimates of gray wolves (*Canis lupus*) conducted by the Minnesota Department of Natural Resources require radio-collaring wolves in packs across wolf range to determine territory and pack sizes. Lotek Iridium GPS collars were fitted on wolves beginning in 2012 which enabled monitoring of wolf movements and mortality without depending on aerial locations. Pilot availability and flight safety limits the number and timing of data points available from Very High Frequency (VHF) and deployed Store-on-board (SOB) collars, making real-time monitoring of activity and movement difficult. Iridium technology has allowed us to closely track wolf movements in the spring in an attempt to determine denning time and location. Activity of both male and female wolves centered on a single site in the spring suggests denning. We have located 7 actual and potential natal den sites using Iridium GPS collared wolf data since spring of 2013. Trail cameras were deployed at all sites and basic den attributes were described. Additional information on parturition date, length of den attendance, and movement patterns around den was obtained by further examining data from Iridium GPS collars as well as recovered SOB collars deployed prior to 2012.

Losing the predator-prey space race leads to extirpation of woodland caribou from Pukaskwa National Park

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Persistence for woodland caribou (*Rangifer tarandus*) in Pukaskwa National Park (PNP, Ontario, Canada; 1878 km^2) was tied to females finding safe calving areas on offshore islands with a water barrier created by Lake

Superior. During 1975−1988, PNP caribou fluctuated around a carrying capacity of 24, but after 1988, the population declined to 5 individuals by 2009. Caribou are now likely extirpated from PNP, even in the absence of any local or increased anthropogenic disturbance since the protected area was created in 1978. As moose (*Alces alces*) in the region declined concurrently, their relative density remained higher along the Lake Superior coastal strip than inland, reverse of the situation during 1975−1988; moose especially held to the coast during heavy snow years. Wolves (*Canis lupus*) accordingly shifted more of their hunting effort to the coast, likely encountering both moose and caribou with increasing search efficiency. These behaviours are described as a predator-prey 'space race' that wolves eventually won.

Beaver lodge site selection in large lake environments

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In contrast to the classic beaver pond system, beavers in large lake systems typically do not maintain a dam but construct lodges along the lakeshore. Beavers likely select lodge sites based on forage availability as well as abiotic factors such as the amount of wind and wave action (fetch), substrate type, and water depth sufficient to ensure safe underwater access to the winter food caches. In some managed lakes, beavers also must contend with decreasing water levels during the main period of lodge occupancy (winter). Beavers are keystone species whose foraging and construction activities can dramatically affect vegetation communities (both terrestrial and aquatic), nutrient loading, and the abundance of coarse woody debris in the vicinity of their lodge. Thus understanding how and where beavers build lodges is important to understanding spatial patterns in beaver-affected processes.

We analyzed field-based and remotely-sensed data from 54 beaver lodges from two managed lakes in Voyageurs National Park to identify factors affecting beaver lodge site selection in large lakes at the macro- and microhabitat scales. At the macrohabitat scale, beavers selected for deeper water at entrance and for clay/mud substrates, and selected against deeper water at 10m from entrance and increased fetch. At the microhabitat scale, we found similar water-level and substrate effects, but also a slight decrease in selection for vegetation indicating abiotic factors may be a more important driver than vegetation at this scale. Beavers showed stronger selection for deeper water in the lake that experienced a large overwinter water level drawdown. Our results have implications for predicting beaver habitat suitability in large lakes that are common throughout the Canadian Shield, and understanding the ecological effects of artificial water level management.

Loss of Habitat & Wildlife

The Loss of Wildlands at the National and Minnesota Scales Since European Settlement

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The disappearance of wildlands in the lower 48 states particularly pristine, unmodified wildlands has been drastic. Since 1650 unspoiled wildlands have declined by 92% or 1.8 billion acres. Since 1900 these wild places have decreased by nearly 800 million acres or 83%.

For Minnesota, the loss of our wildland heritage has been no less alarming. Since pre-settlement Minnesota's original wildlands have waned from 51 million acres to 3 million acres today; a 95% loss.

Within 20 years, assuming current rates of loss continue, up to 99% of our original wild heritage could be gone indefinitely. When viewed in the context of wildland acres per person, pristine wildlands have declined from 383 wildland acres per person pre-European settlement to .5 acres per person today; a 99.9% decline.

This paper attempts to capture the magnitude of loss at the national and Minnesota scales, during five time periods; pre-settlement, 1900, 1964, current day and 2030. The role of disturbance factors of logging, agriculture, mining, grazing, energy development, motorized recreation, urban and rural residential sprawl and invasive species are evaluated for each time period.

The primary objectives of this presentation are:

1. Heighten awareness to resource planners, decision makers, legislators, the public and land management boards that when planning landscape altering projects, environmental effects on wildlands be viewed in a larger context of trends that are or have occurred at the local, regional, state and national levels.

2. Put forward recommendations for land management agencies, NGO's, and local and state policy makers.

Mercury Levels in Birds of Prey Captured at Hawk Ridge, Minnesota.

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The goal of this study is to create a baseline dataset of mercury levels in raptors. While mercury levels are widely studied in birds, there is relatively little known about mercury levels in wild birds of prey. Breast feathers were analyzed for mercury content from eight species of raptors banded at Hawk Ridge, MN. Sharp-shinned Hawks (*Accipiter striatus*) averaged 3.26 ppm (n = 392), Merlins (*Falco columbarius*) 2.15 ppm (n=137), Northern Harrier (*Circus cyaneus*) 1.48 ppm (n = 30), Peregrine Falcons (*Falco peregrinus*) 1.44 ppm (n = 8), Northern Goshawks (*Accipiter gentilis*) 1.24 ppm (n = 222), Cooper's Hawk (*Accipiter cooperii*) 1.11 ppm (n = 11), Long-eared Owl (*Asio otus*) 0.68 ppm (n = 88), and American Kestrel (*Falco sparverius*) 0.61 ppm (n = 71). Analysis of variance results show that after-hatch-year birds had significantly higher Hg levels ($p<0.05$) than hatch-year birds for all species except for Cooper's Hawk, Long-eared Owl and Peregrine Falcon. Based on known effects of mercury levels on American Kestrels, these results suggest that some individuals migrating through central flyways may be at risk to detrimental effects of mercury.

Waterfowl die-offs to trematodiasis in Minnesota: Understanding the distribution, abundance, and parasite prevalence of the invasive faucet snail host and their parasites.

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Faucet snails (*Bithynia tentaculata*) are an aquatic invasive species from Europe that are host to several trematodes (*Cyathocotyle bushiensis, Sphaeridiotrema* spp., and *Leyogonimus polyoon*) that cause waterfowl die-offs in the Midwest. Since 2002, trematodiasis has killed 135,000 waterfowl in the Midwest, primarily Lesser scaup (Aythya affinis) and American coots (*Fulicula americana*). More than 10,000 scaup have died at Lake Winnibigoshish in Minnesota since 2007, when trematodiasis was first detected. We studied 13 water bodies known to be infested with faucet snails in inland Minnesota, including 6 lakes, 2 rivers, and 5 ponds, during 2011-2013. We examined the seasonal distribution, abundance, and parasite prevalence and intensity of faucet snails within these water bodies to better understand waterfowl exposure to trematodes. We collected benthic samples and microhabitat data at each sampling location, including substrate, depth, and water chemistry variables. Waterfowl die-offs occurred at Lake Winnibigoshish and Bowstring Lake during spring and fall migration, although the magnitude of the die-offs during our study was less than the initial die-offs at Lake Winnibigoshish in the fall of 2007. Snail occurrence and abundance varied seasonally within a water body, as did parasite prevalence and infection intensity, indicating that the risk of exposure to parasites varies spatially and temporally. Our findings indicate that if management options become evident in the future, they could be focused in areas of greater infection risk.

The influence of hunting season and snowfall on lead exposure of wild Bald Eagles (*Haliaeetus leucocephalus*) in the Upper Mississippi River Valley

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Spent upland ammunition is now the preeminent source of lead poisoning in eagles. Recent studies linking spent upland ammunition to lead poisoning in raptors has informed a growing trend to ban lead in all hunting ammunition. While availability of lead is caused by humans, a mixture of natural and anthropogenic factors influence uptake of lead in an avian population. The availability of lead in carcasses scavenged by raptors has been broadly associated with hunting season and snowfall has been proposed as mitigating exposure. Our analysis of blood lead levels (BLL) is the first from a large population (n=55) of free flying Bald Eagles (*Haliaeetus leucocephalus*) east of the Rocky Mountains in North America. We captured Bald Eagles overwintering in the Upper Mississippi River Valley, and blood analysis revealed 31% of individuals as recently exposed to lead - about half the exposure level found in local clinical data from eagles admitted to recovery centers or found dead on the landscape. Our analysis also reveals that the availability of firearm harvested white-tailed deer (*Odocoileus virginianus*) remains and snowfall are the primary factors influencing Bald Eagle lead exposure in the Upper Mississippi River Valley. The negative association we found between snowfall and lead exposure can inform more accurate collection and interpretation of data on BLL in scavenging eagles.

The New Wisconsin Institute for Wildlife at UW-Stevens Point

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In 2014, UW-Stevens Point established the Douglas R. Stephens Endowed Chair in Wildlife. The Chair is responsible for teaching and developing the "Wisconsin Institute for Wildlife (WIW)." The current mission of the WIW is "engaging students, professionals, and the public for sustainable wildlife management." Scott Hygnstrom became the Chair and Director of the WIW in September 2014 and spent the first three months networking with students, faculty, administrators, agency personnel, and leaders of conservation organizations in an effort to identify needs and opportunities for collaborative efforts to promote wildlife and wildlife habitat. A steering committee was formed to assist with strategic planning. Priority areas include eco-literacy, conservation, leadership skills, and professional development. Extension programs include a website, workshop series (leadership, chemical immobilization, resident Canada goose management, urban wildlife management, R programming, structured decision-making), colloquium series (wolves, waterfowl, herpetofauna), alumni receptions, nature festivals, and fund-raising events (Guys on Ice, Tim Badore, Joel Sartore). The WIW now is the home of the Internet Center for Wildlife Damage Management, National Wildlife Control Training Program, and Prevention and Control of Wildlife Damage. Current research interests include elk reintroduction, white-tailed deer monitoring, snake hibernacula, and wild rice. Teaching efforts include courses in wildlife damage management, wildlife techniques, outdoor skills, and boreal forest ecology, as well as development of internships, teaching assistants, and a conservation corps. The wildlife faculty at UW-Stevens Point feel the sky is the limit for the WIW and any assistance that you can provide to help build it will be appreciated.

Conservation Partners Legacy Grant Program

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The Conservation Partners Legacy Grant (CPL) Program began with the approval of the Legacy Amendment and is funded through the Outdoor Heritage Fund recommended to the legislature by the Lessard-Sams Outdoor Heritage Council. The CPL Program provides competitive matching grants from $5,000-$400,000 to nonprofits and government entities for habitat projects that restore, protect, or enhance forests, prairies, or wetlands for fish, game and wildlife in Minnesota. Work can be done on lands under public ownership, lands under a permanent conservation easement and in public waters. The CPL Program now has 3 grant cycles; the Traditional Grant Cycle, the ongoing Expedited Conservation Project (ECP) Grant Cycle (for frequently funded, standard-practice habitat projects), and the new Metro Grant Cycle (for projects occurring in the 7 county metro area and within the city limits of Duluth, Rochester or St. Cloud). CPL is a great way to get funds for on-the-ground habitat projects.

An Information Exchange on Wildlife in Fire-dependent Ecosystems of the Northern Lake States

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In the northern Lake States, a recent gap analysis of peer-reviewed literature has shown that our knowledge of the interactions among disturbances, vegetation, and wildlife in fire-dependent ecosystems is generally lacking. Some wildlife species may themselves be considered fire-dependent if their regional distribution and abundances were historically (or currently) linked with fire-dependent ecosystems. In 2013, the Lake States Fire Science Consortium (LSFSC) began an effort to develop lists of fire-dependent wildlife species and identified 46 bird species, 15 mammal species, and 13 reptile species that are associated with 20 fire-dependent ecosystem types in Michigan, Wisconsin, and Minnesota. To investigate how these species are prioritized for management in this region, their conservation status, game status, and other designations were noted. Results indicate that 22 fire-dependent wildlife species are State Threatened or Endangered, 14 are game species, and 6 have been identified as surrogate species by the U.S. Fish and Wildlife Service. Additionally, efforts were made to investigate what peer-reviewed literature exists for different fire-dependent wildlife species; it is apparent that current gaps in fire literature are uneven across taxa and are more pronounced for reptiles in the region. Moving forward, the LSFSC hopes to communicate with professionals who are doing inventory, monitoring, and research in an effort to initiate an information exchange on these species. Such an exchange would seek to enhance the understanding of natural disturbances, vegetation, and wildlife and the integration of this knowledge into restoration and conservation efforts.

Changing the culture of hunter recruitment and retention: Can we become effective?

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One recently completed survey of state agencies concluded that $30 million dollars are spent every year on over 400 programs recruiting, retaining and reactivating (R3) hunters. These programs are targeted primarily at the children and grandchildren of active hunters. The number of Americans participating in hunting has declined by 10% since 1984 and appears to be on course to continue the descent. Perhaps most surprising is that agencies responsible for implementing these R3 programs have done so without quantifiable benchmarks, goals, or control groups. We examine some potential reasons these programs have not resulted in slowing the decline in hunting participation and propose implementing a novel system of training adults to hunt for food. Pilot projects in Wisconsin and Minnesota have shown that training adults to hunt adds new hunters and expands the hunting and conservation culture in a natural path. Pilots have shown that this recruitment method is effective when applied to a motivated customer base. We propose creating benchmarks, control groups, and estimated return on investment to evaluate program expansion. We recommend that agencies implement this R3 tool and expand

this trial to gather more empirical data for evaluating the potential for adult R3 to slow the decline in hunter numbers over the long term.

Minnesota and Wisconsin's vanishing prairie butterflies: recent federal listing and efforts to save them

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This past October, the Dakota skipper (*Hesperia dacotae*) and Poweshiek skipperling (*Oarisma poweshiek*) were listed as threatened and endangered, respectively, under the US Endangered Species Act. Both species specialize in tall grass and mesic prairie, and were once prevalent in the Midwest. With the loss and fragmentation of prairie habitat, the range of these butterflies has been greatly restricted in recent decades. Alarmingly, both species have vanished from many of the protected sites in which they occurred even a decade ago. The Minnesota Zoo, Minnesota DNR, US Fish and Wildlife Service and numerous other partners are working to understand the reasons for the butterflies' recent declines and taking steps to prevent their extinction. Current efforts include captive rearing, genetics research, pesticide residue analysis, field surveys, and public outreach.

Wisconsin's Deer Management Assistance Program

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In May 2014 the WI Department of Natural Resources (DNR) opened enrollment for Wisconsin land managers and private landowners to participate in the Deer Management Assistance Program (DMAP). DMAP is a new program in Wisconsin that intends to promote sound land stewardship practices, provide outreach and educational information to landowners about wildlife habitat management practices, provide a means for site-specific deer management, and build relationships between DNR, landowners, and hunters. The Wisconsin DMAP framework includes 3 application levels with associated fees and minimum acreage requirements. Applications received from April 29 – May 30, 2014 were considered for program participation in 2014. The DNR received 114 applications during that time, involving nearly 300 landowners and 44,000 acres. Ninety-two percent of applications indicated they wanted to improve the wildlife habitat on their property, 61 percent wanted to increase the number of deer using the property, and 47 percent wanted to improve relations. Wildlife Management and Forestry staff conducted site visits and wrote management plans with habitat improvement recommendations to all eligible cooperators (n = 73). DNR also issued antlerless harvest tags at a reduced price to eligible landowners whose habitat would benefit from harvesting additional deer. In 2015, the DNR will expand DMAP to include public lands. Additionally, DMAP cooperators will be invited to attend local workshops and field days to expand learning opportunities and program involvement. The program was well received in the first year and there is a waiting list for DMAP enrollment in 2015.

Annual Winter Variation and Condition-Dependent Dispersal of Yearling Male White-tailed Deer in Wisconsin

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Dispersal influences many ecological processes, such as disease spread, range expansion, population dynamics, and gene flow. For intensively managed wildlife populations, like Wisconsin's white-tailed deer (*Odocoileus virginianus*), understanding the factors that influence dispersal behavior is crucial for effective management. Only a proportion of yearling males from any population disperse, and the composition of that subset appears to

be non-random. To sustain the energetic demands associated with dispersal movements, a threshold body condition may be required for successful dispersal. Our research occurred during 2011-2014 in 2 study areas within the northern (forested) and eastcentral (farmland) regions of Wisconsin. We selected these areas because of contrasting ecological contexts—highly fragmented private land with milder winters versus heavily forested public land with more severe winters. Preliminary dispersal rates for the farmland study area (n=176 radio-collared yearling males) consistently fell around 55%. However, dispersal rates in the northern site (n=137 radio-collared yearling males) revealed high annual variation (21-58%) related to annual fluctuation in winter severity. Our results display a compelling association between winter severity and dispersal probability, suggesting that high phenotypic quality may be a critical prerequisite for successful dispersal. Condition-dependent dispersal carries profound consequences for spatial flux in population dynamics, where a change in average body condition could alter connectivity between populations and, consequently, gene flow. We will further investigate condition-dependent dispersal on an individual basis by analyzing how morphological measurements, antler characteristics, and landscape metrics influence dispersal probability and distance.

Trends in overwinter survival of white-tailed deer in Wisconsin

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Understanding factors that influence overwinter survival of white-tailed deer (*Odocoileus virginianus*) is important in many Upper Great Lakes states that occasionally experience severe winter conditions. Through the twentieth century, deer have adapted and flourished in these environments, however, changes in forestry and agricultural practices, deer densities, and predator densities can alter overwinter survival and subsequently population dynamics. Our objectives were to investigate correlations in survival rates and winter conditions across two study areas from 2011 – 2014. We used known fate information from 860 radiocollared deer to estimate annual survival rates based on piecewise constant hazard models, and modeled log hazards as a function of winter snow depth and temperature covariates. We extended these models to account for competing risks and estimated cause-specific mortality rates. We documented substantial variation in annual overwinter conditions during the course of our study. Snow depth and temperature covariates sufficiently explained variation in overwinter survival, which differed between each study area and deer age groups. Although overwinter survival is only one factor among many that impact deer population dynamics, results from our research can be used to improve informed decision making in regards to deer harvest management strategies.

Using genetics to evaluate the conservation status of the American badger in Wisconsin

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Despite their iconic status in Wisconsin, the American badger (*Taxidea taxus*) is one of the most elusive and poorly understood carnivores in North America. It is currently listed as a Species with Information Needs in Wisconsin, because a lack of data on distribution, abundance, and population trends has made it difficult to designate appropriate strategies for conservation and management. In this study, we combined citizen science and genetic techniques to make an informed, objective assessment of the conservation status of badgers in Wisconsin. We used 12 microsatellite loci to consider 3 specific questions relevant to badger conservation: 1) Do badgers exhibit high genetic variation in Wisconsin?; 2) Are there any landscape features within Wisconsin that restrict or promote movement?; and 3) Are Wisconsin badgers unique compared to other badgers throughout their range? Sighting data compiled from public reports indicated that badgers were distributed widely throughout the state, and genetic data indicated high levels of genetic variation. Genetic analyses indicated that agriculture strongly influenced gene flow in Wisconsin, by facilitating movements through low-quality habitat. Finally, badgers in Wisconsin are genetically distinct from badger populations elsewhere across their range, isolated at the northern edge of their range by landscape features (Lake Michigan and the Mississippi River) and low density populations to the south. Overall, our data indicate that Wisconsin contains a genetically diverse and unique population of badgers that is continuously distributed across the state with no clear barriers to movement.

Use of human-derived foods by northern Wisconsin black bears

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American black bears (*Ursus americanus*) show great plasticity in their foraging, and can become quickly habituated to novel diet items, including human-derived ones. In Wisconsin, black bears are a harvestable species for which baiting is a common approach. Baits are deployed before and during the hunting season, providing a potential novel, widely available, and calorically-rich food source throughout summer and fall. The degree to which bears rely on this resource and its effect on individual condition and population dynamics remains largely unknown. To quantify the relative importance of human-derived foods, we are examining assimilated diet with stable isotope analysis (δ13C and δ15N) on tissues collected from hunter-harvested bears. We sampled hair, blood, and bone from harvested bears at registration stations in north-central Wisconsin (n=189) from 2011-2013. Using isotopic mixing models parameterized with potential diet items from the same area, we estimated proportional contributions of broad dietary groups. Male and adult black bears were, on average, enriched in both δ13C and δ15N, indicating a greater consumption of both bear bait and animal matter. Hair (summer-early fall diet) was also enriched in δ13C compared to blood (fall diet), suggesting bait consumption by bears decreased during the fall hunting season. We also compared individual differences between tissue types to further examine temporal patterns of age and sex class resource use. Overall our results demonstrate that bait is a significant resource for northern Wisconsin bears.

Managing Wetlands in the Anthropocene – The Age of Man

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The influence of humans on their environment has been ongoing for millennia. It has accelerated over the last two centuries with impacts coming at an ever increasing pace in recent decades. The wetland landscape has been affected by loss and degradation due to watershed modification, invasive species and climate change. As these changes continue wetland managers need to freshen their approach with better defined objectives, a better understanding of wetland wildlife needs, and a stronger commitment to active management.

Managing Prairie Wetlands in a Climate Change Future

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Although climate change models for the remainder of this century are fraught with uncertainty the most likely trends for MN and WI are a warmer, wetter environment. In addition, there is a greater likelihood of more extreme singular precipitation events. The MN DNR gathered input from natural resource professionals within the agency in 2011 to prepare for management implications from climate change. Most felt remaining wetlands affected by climate change are more likely to be degraded by increased watershed flows and invasive species, including both plants and animals. Prairie wetland ecosystems developed under extreme hydrological changes ranging from multi-year droughts to sustained precipitation. The resiliency of these ecosystems was historically supported by wetland complexes that included basins of varying water regimes surrounded by permanent cover. Using this natural resiliency as a model the respondents suggested that building climate change resiliency will require actively managing for varying water regimes within a wetland habitat complex and controlling invasive species.

Assessing the Value of Sediment Removal in Wetland Restoration

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The typical prairie pothole wetland restoration project conducted on public or private lands usually involves plugging or filling drainage ditches and/or breaking tile lines to restore natural hydrological cycles to drained wetland basins. However, some managers have noticed that not only are these degraded basins drained by ditches or tile, the physical integrity of the basin has been further compromised by many inches and in some cases several feet of washed-in sediment from the surrounding uplands. Native seed banks are buried, excess nutrients (N & P) are present, and soil characteristics at the surface are changed (organic matter, density, etc.). Thus, to fully restore these drained wetlands, many restoration projects have involved sediment removal in wetlands but these efforts have not always been well documented or monitored. The practice is costly and there

are considerable uncertainties about if and when it is an appropriate tool to use alongside the typical ditch fill and tile removal tools used to restore drained wetland basins. One thing managers want to know is whether or not removing the sediment will minimize or delay colonization by invasive plants such as reed canary grass and hybrid cattail. In an attempt to resolve these questions, the Service has turned to adaptive management (AM). As of December 2014, 105 wetland basins are part of the Wetland Sediment Project, with basins located in 4 Minnesota Wetland Management Districts (WMD), the Minnesota Private Lands Office (MNPLO) work area in central Minnesota, and the Iowa WMD. This presentation will summarize results of the AM project to date, provide several examples of sedimentation and post-restoration plant response, and show the need for additional collaborators in this project.

A tale of three turtles: conservation and genetics of wetland chelonians in the Upper Midwest

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Turtles (order Chelonia) are considered to be one of the most highly threatened vertebrate groups. Some North American turtle species have experienced severe declines in recent decades, while others have remained relatively stable. To better understand the reasons behind these species-specific trends and inform long-term management of genetic diversity and adaptive potential in these species, we collected demographic and genetic data for the endangered Blanding's turtle as well as two more common, the painted turtle and the snapping turtle, across 22 sites in Wisconsin and 1 site in Minnesota. Our results indicate differential responses to changes in the landscape among the three species. Blanding's turtles in particular show evidence of population decline (skewed sex ratios and reduced genetic diversity) associated with areas of greater road density, likely due to long terrestrial nesting migrations undertaken by females of this species. Each species demonstrates an individualistic pattern of spatial genetic variability as well. Blanding's turtles throughout the region can be divided into several genetically distinct populations, some of which correspond to natural features (e.g. the lower Wisconsin River) while others correspond to isolated populations embedded within human-dominated landscapes. The other two species follow an isolation-by-distance pattern, with snapping turtles exhibiting greater resistance to gene flow in human-altered landscapes than painted turtles. These results indicate that maintaining genetically diverse turtle populations for long-term viability will require mitigation of upland threats and barriers to gene flow (especially in more terrestrial species) in addition to the preservation of wetland habitats.

Testing Multiple Methods for Wildlife Habitat Restoration on inland Lakeshores: The Crystal Lakeshore Restoration Project

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Humans are inclined to construct human dwellings in and around lakeshores. The direct effect is the removal of native plants and alteration of vegetation structure which displaces native wildlife, and increases runoff of sediments and nutrients into lakes. To counter these negative impacts, lakeshore restoration projects have occurred in the past decade in Vilas County, WI. We evaluated different restoration practices to identify the most cost-effective measures that would yield the most benefit for property owners interested in the practice.

Private and public nurseries can be a good source for native plant species for lakeshore habitat restoration projects. Here we investigate establishment and survival of trees and shrubs using three treatments: 1) planting of private nursery bare root stock, 2) planting of WDNR nursery bare root stock and 3) "natural recovery" (no plants added, rely on native seed bank). In addition, we compared the three treatments with or without irrigation and herbivore abatement using fencing.

Our results reveal a significant increase in total number of saplings for all treatments three years post-restoration within the irrigation and fenced area. We conclude that wildlife habitat restoration projects can be more successful when proper irrigation and herbivore abatement is installed and maintained.

Recovery of a Native Pollinator in a Disturbance-Based Landscape: The Karner Blue in Wisconsin

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The holdouts of disturbance-based barrens and savanna communities across the Great Lakes are facing growing threats in the face of changing climate, competition from invasive species, and loss of critical habitat elements necessary for species persistence. The open grassland complexes of Wisconsin generate habitat for the native pollinator, the Karner blue butterfly (*Lycaedies melissa samuelis*), along with over 50 other species of concern. These habitat pockets provide rare opportunities to observe and learn from species interactions within an imperiled ecological community. Recovery of the Karner blue in Wisconsin is a focus of the Wisconsin Department of Natural Resources and U.S. Fish and Wildlife Service, where annual monitoring of populations and habitat is conducted across ~80,000 acres of state properties. The scale of monitoring and management and the need for more advanced techniques has led to the development of enhanced ecological tools that classify potential habitat sites, categorize habitat quality, and forecast the distribution and density of butterfly populations, allowing for fine-scale evaluation of landscape areas. Research involving the interactions of American bison (*Bison bison*) disturbance and Lepidopterans has produced unique observations of the Karner blue and host plant Wild blue lupine (*Lupinus perennis*), as well as other Lepidopterans including the Eastern Tailed Blue (*Cupido comyntas*), fritillaries (*Heliconiinae* spp.), sulfurs (*Pieridae* spp.), and satyrs (*Satyrinae* spp.). These management and research efforts have improved our understanding of the Karner blue and its habitat thresholds, enhancing and focusing management to better facilitate recovery.

Recent Declines in Gray Jays on Christmas Bird Counts in Northern Wisconsin

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Gray Jays (*Perisoreus canadensis*), are resident, boreal birds of northern Wisconsin, typically associated with Black Spruce (*Picea mariana*) bogs. Gray Jays cache perishable food items for over-winter consumption, and are therefore dependent on cold weather and the antibacterial and antifungal properties of the Black Spruce trees in which they store their food for cache-preservation. Warming climate trends and loss of Black Spruce habitat may adversely affect Gray Jay populations. In recent years, there have been anecdotal reports of declines on Gray Jays in northern Wisconsin. Here we investigate trends in Gray Jay abundance in Northern Wisconsin

using Christmas Bird Count data. After compiling data from five suitable locations across northern Wisconsin, we examined temporal trends in the relative abundance of Gray Jays by fitting joinpoint regressions (segmented line regressions) to the data. Our resulting models were able to confirm a current decline in Gray Jays abundance at all five locations (including locations where Gray Jay abundance had previously been increasing). All locations appear to have started their downward trends during the early 1990s. With a decline in Gray Jay abundance having been confirmed, further research may be able to determine if the decline can be directly linked to climate-driven habitat loss, or more direct human influences such as logging or habitat fragmentation.

Population Viability Analyses to Evaluate Post-delisting Management of the Kirtland's Warbler

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The Kirtland's Warbler (*Setophaga kirtlandii*) is an endangered migratory songbird that breeds primarily in Michigan and winters in the Bahamian Archipelago. The species is an extreme habitat specialist on the breeding grounds, showing a strong preference for large, dense patches of young jack pine (*Pinus banksiana*) and well-drained sandy soils. Due to aggressive and collaborative management actions the species has recovered from ca. 200 breeding males in 1971 to over 1,800 breeding males today, and is now a candidate for federal delisting. We are conducting population viability analyses to evaluate potential management strategies for this species after delisting and to infer how climate change might impact future management decisions. We developed a population dynamics model that integrates components of the full annual cycle using spatially-explicit breeding habitat suitability and empirically-derived links between precipitation on the wintering grounds and demographic parameters. We assessed the performance of candidate models based on their ability to reproduce the observed population trend between 1979 and 2013. We then used the most accurate models to estimate extinction vulnerability under current management and environmental conditions, and assessed the impact of future management scenarios that included reductions in amount of high suitability habitat and reduced control of Brown-headed Cowbirds (*Molothrus ater*). We will use the baseline model to investigate population-level impacts of climate change. Taking a full annual cycle approach linked to habitat conditions will help managers evaluate the trade-offs of different management scenarios, while also incorporating the uncertainties and variability of environmental factors to ensure long-term viability.

Patterns in diurnal airspace use by migratory landbirds along an ecological barrier

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Conditions during landbird migration periods affect populations and survival, yet a disproportionate number of studies and conservation and management efforts focus on terrestrial stoppage and staging areas. The aerial environment through which migrants move is also subjected to anthropogenic impacts with potential impacts on avian migratory movement and survival. During autumn migration, the northern coastline of Lake Superior acts as an ecological barrier for many landbirds migrating out of the boreal forests of Canada and Alaska. We assessed the diurnal movements of birds throughout autumn migration, 2008-2010, within the coastal region of Lake Superior. Several raptor species showed patterns in airspace associated with topographic features such as proximity to the coastline and presence of ridgelines. Funneling movement, commonly used to describe the concentration of raptors along a migratory diversion line, occurred only for Bald and Golden Eagles. This suggests a "leaky" migration funnel for most migratory raptors. Passerines migrating during the late-season showed more spatial and temporal structure in airspace distribution than raptors, including funneling and an association with airspace near the coast. We conclude that a) the diurnal use of airspace by migratory landbirds is patterned in space and time, b) autumn count sites situated along ecological barriers substantially underestimate the number of raptors due to 'leakage' out of these concentration areas, and c) the structure of diurnal passerine movements in airspace has been overlooked. The heavy and patterned use of airspace associated with anthropogenic development (e.g., buildings, towers, turbines) by migratory landbirds necessitates management and conservation attention.

There and Back Again: Migratory Behaviors of Golden-winged Warblers Discovered Using Geolocators

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Golden-winged warblers (*Vermivora chrysoptera*) are a neotropical migrant songbird that have experienced severe population declines across portions of their range. Demographic studies report relatively high nest success throughout the breeding distribution, suggesting that differences in observed population trends are influenced by juvenile survival (i.e., survival once young birds leave the nest), adult survival on population-specific wintering sites, or survival during migration. To assess the potential influence of migratory and wintering ground factors on golden-winged warbler population trends, we set out to document migratory connectivity in golden-winged warblers and identify wintering sites and migratory routes using light-level geolocators. In 2013, we deployed geolocators on territorial, male golden-winged warblers in both Minnesota and Tennessee and recaptured them upon their return to breeding areas in the spring of 2014. We present preliminary findings from those efforts including effects of geolocators on return rates, body condition, and arrival date. We describe the wintering locations and migratory routes of geolocator-marked golden-winged warblers from each of these populations. We also present evidence for evacuation migration, a previously unknown, facultative migratory strategy we observed in golden-winged warblers as a response to a large tornadic storm system during 2014. Finally, we describe a timeline for expanding our pilot efforts across the golden-winged warbler breeding distribution.

Factors Affecting Avian Nest Detection Probability and Guidance for Future Nest Study Design

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Locating avian nests is necessary for research and assessing management activities that target nest density, abundance, success, parasitism, depredation, and many other aspects of population demographics. However, some nests may go undetected and this could influence estimates thereby negatively impacting management decisions. Our objective was to quantify the factors that influence nest detection with a controlled, manipulative experiment. We placed 160 artificial nests with dummy eggs along two transects (~1500*40ft). We tested the ability of 8 observers to locate nests along these transects. We modeled their data as capture-recapture and considered the following variables as potentially impacting nest detection using AICc: individual observer differences, experience, nest density, distance of nest from transect center, height of nest, % visual obstruction from vegetation, and the transect location itself. The model that considered individual observer differences was the only model with AICc weight (AICc weight = 1.0). Individual observers only found between 73-123 nests (mean = 108.8, mean bias of more than 32%) and detection probabilities ranged from 45.6-76.9%. Modeling the data as capture-recapture data provided an adjusted nest abundance estimate of 155 (SE = 0.2) which was only 3.1% less than the truth. We considered the impacts of random subsets of varying numbers of observers on nest abundance estimates. Random groups of as few as 2 observers provided estimates within 12% of the truth. Random groups of 3 or more were always within 10% of the truth. Using 2 or more observers in a capture-recapture context greatly improves nest abundance estimates.

Sharp-tailed Grouse Occupancy-Habitat Relationships Differ at Multiple Spatial Scales

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Sharp-tailed Grouse (*Tympanuchus phasianellus*) have exhibited significant long-term population declines in Wisconsin and primarily occupy highly fragmented landscapes in the northwestern portion of the state where patch connectivity and gene flow are thought to be limited. As part of a multi-year study to assess the distribution and long-term population viability of prairie grouse in Wisconsin, we conducted occupancy surveys in the Northwest Sands ecological landscape from 31 March-23 May 2014. We surveyed 8 stations on each of

117 roadside routes 2-3 times (2.87 ± 0.03) during 3 consecutive 18-day sampling periods and quantified the effects of habitat characteristics on local (400 m from survey stations) and landscape-level (5 km from survey routes) occupancy rates. Sharptails were extremely rare across the sampled region (average $\psi = 0.02 \pm 0.03$), but were more prevalent at the local scale (average $\theta = 0.08 \pm 0.04$; average $\theta' = 0.34 \pm 0.16$). At the landscape-scale, sharptails were more likely to occupy routes containing a large proportion of open habitat and dispersed forest patches. In contrast, local occupancy rates were most strongly associated with distance to established wildlife management areas and proximity of open patches. Our results highlight the importance of research and management at multiple spatial scales given that occupancy-habitat relationships may not be consistent across local and landscape levels.

Assessing Visual Obstruction Estimates in a Controlled Setting: Similarities and Differences between Observers and Photo Processing Software

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Visual obstruction estimates (VOE) are a frequent measure used for assessing bird nesting habitat. Common methods include the Robel pole and Nudd's board. Recent field work suggests digital imagery and image processing may reduce observer bias in VOE. However, few attempts appear to have been made to determine the overall accuracy of VOE from digital imagery processed by humans or software. We assessed the effectiveness of humans and a software program (GIMP) to interpret photos of obstructed objects in a controlled lab setting. Specifically, we controlled the % obstruction, complexity of obstruction, and whether the target object was shaded. Results showed there is no significant difference ($\alpha = 0.05$) between true obstruction values and either the average of human observers ($n = 69$) or GIMP estimates. Both the average of human observers and GIMP estimates were within 2% of true obstruction values and this did not differ by level of complexity or shading. The average of human observers was as good as GIMP, but human processing of digital photos was faster than GIMP with our methods. However, most studies will not have access to 69 volunteers to process each photo. Therefore, we took 30 random subsamples of 1-10 human observers' responses to determine the percentage of estimates with 95% CIs that included the truth (an indication of the number of humans required to match the accuracy of GIMP). On average, individuals scored only 56%, groups of 2-3 between 71-78%, groups of 4-5 between 84-88%, and groups of 6-10 between 91-95%.

Factors Affecting Greater Prairie-Chicken Nest Daily Survival Rates on Two Wildlife Areas: Preliminary Results

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The Greater Prairie-Chicken (GPCH) population has declined at the state-level in Wisconsin for decades. Two of the last strongholds are the Buena Vista (BV) and Paul Olson (PO) Wildlife Areas in Central Wisconsin. The overall objective of our research is to determine the factors impacting GPCH nest daily survival rates (DSR) and juvenile survival as these are critical to sustaining or increasing GPCH populations at these wildlife areas. Here, we provide preliminary DSR estimates for both BV and PO as well as identify the critical variables associated with higher DSR. We used radio-collared hens to locate 18 nests in BV and 9 nests in PO. Nests were monitored with telemetry and thermal data loggers until they failed or succeeded. We used an information-theoretic approach (AICc) with the DSR option in Program MARK to consider models with one or more of the following variables: wildlife area, patch size, distance to woodland, and visual obstruction of the nest site. The top model considered DSR a function of visual obstruction of the nest site (AICc weight = 0.64) and the overall importance value of visual obstruction of the nest site was 0.88. Average DSR for the top model was 0.95 (SE = 0.01) for both wildlife areas. The average visual obstruction was 97.24% (SE = 1.91) and 92.14% (SE = 2.12) at successful and unsuccessful nests, respectively. These preliminary results suggest management efforts to increase visual obstruction of nests at both wildlife areas will benefit nest outcomes for GPCH in Central Wisconsin.

Modeling Detectability in Bird Surveys: A New, Extensive Simulation

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Bird surveys are commonly used to assess species' population status and assess biodiversity. Birds vary in their detectability, however, and not accounting for detectability results in biased estimates of abundance. Several survey methods have been developed to estimate probability of detection as well as abundance, but all require collecting additional data during surveys, and estimates are not always comparable among methods. We constructed a model including 3 components of detectability: spatial arrangement of birds, availability (the probability that a bird vocalizes during a survey), and perceptibility (the probability that a bird is observed, given that it is available). We modeled each component of detection, including variation due to environment, bird behavior, and human presence. The model was parameterized with species-specific biological and environmental information, and perceptibility information from previous field experiments using recorded bird songs. Five survey methods (index to relative abundance, distance sampling, time of detection, double observer, and replicated counts) were used to analyze simulated counts. Estimated abundance from each survey method was then compared to the true abundance. We simulated surveys using the Black-Throated Blue Warbler (*Setophaga caerulescens*) as an example. We examined 4 combinations of 2 scenarios: stable population versus declining population, and a broad, range-wide survey versus a targeted survey on a subset of high-density sites. Results varied by analysis method. By extending this model to simulate surveys under a wide range of conditions, we expect to provide guidelines for choosing an effective survey method.

Assessing Climate Change Vulnerability throughout the Annual Cycle for Migratory Birds of the Upper Midwest and Great Lakes Region

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Climate vulnerability assessments (CVAs) assess risk and are increasingly used as a tool to inform state wildlife plans. Ideally, risk should be assessed throughout an animal's full annual cycle, but migratory animals move across vast regions and are difficult to track. Consequently, the challenge of conducting full annual cycle CVAs has not been well addressed. We conducted a full annual cycle CVA for 46 migratory birds breeding in the Upper Midwest and Great Lakes region (UMGL), including: background risk, climate exposure × climate sensitivity, adaptive capacity to climate change, and indirect effects of climate change. We incorporated climate variables throughout each species' annual cycle using available data when possible to determine migratory connectivity to link the UMGL region to relevant non-breeding regions. We ranked nine species as "highly vulnerable" and two as "low vulnerability." In general, vulnerability was driven by poor adaptive capacity to climate change, specifically high breeding site fidelity. We found that temperature increases on UMGL breeding grounds will have a larger effect on vulnerability compared to most non-breeding locations. In contrast, moisture changes (i.e. drying) in Mexican and Caribbean non-breeding regions will have a greater effect on vulnerability compared to anywhere else. We also identified nine species vulnerable to temperature and/or moisture change throughout their annual cycle. All but one of which are considered species of conservation concern in UMGL. Finally, we provided possible applications to adaptive management, including: priority species, priority habitat types, regions within the non-breeding range for potential conservation partnerships, and research gaps.

Birds and Climate Change

National Audubon Society. 2014. Audubon's Birds and Climate Change Report: A Primer for Practitioners. National Audubon Society, New York. Contributors:

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The National Audubon Society has completed a continental analysis of how North America's birds may respond to future climate change. Using extensive citizen science data from the Christmas Bird Count and the Breeding Bird Survey, and detailed climate layers, we developed models that characterize the relationship between the distribution of each species and climate. Then, we used our models to forecast species distributions to future time periods based on climate estimates described by the Intergovernmental Panel on Climate Change (IPCC). This core set of analyses will serve as the backbone for informing bird conservation in North America by addressing the impacts of climate change on birds. Specifically, Audubon's Conservation Science Team has created three products: Modeled Climatic Suitability Maps, Climate Sensitivity Lists, and Climate Prioritizations. The presentation describes how these tools were developed and how they can be useful in guiding bird conservation.

Climate Change Surpasses Land Use Change in the Contracting Range Boundary of Snowshoe Hares

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Habitat fragmentation and climate change are recognized as two predominant threats to wildlife populations. Populations at the southern range boundary of a species distribution offer a unique opportunity to study the effects of both these stressors, because they are likely most sensitive to a changing climate and habitat is often patchy. Snowshoe hares (*Lepus americanus*) exist at their southern range limit in Wisconsin and detailed historical information needed to track the response of this boundary to environmental change is available from historical surveys. We performed snow-tracking surveys at 148 historical hare locations and 64 additional sites throughout central Wisconsin to determine hare presence. We detected snowshoe hares at only 29 historical sites, and 22 additional sites, and observed an average shift north of 29.5 km since 1980. We found that historical snowshoe hare presence was best explained by the distribution of forest cover, while patterns of extinction between time periods was primarily driven by a reduction in snow cover duration. In this respect, the distribution of snowshoe hares in Wisconsin has tracked the shifting paradigm of wildlife conservation. The historical range retraction was primarily driven by habitat, at that time when habitat loss was the most recognized threat by research biologists. More recently, however, as climate change has moved into the conservation spotlight, the range of snowshoe hares in Wisconsin has become increasingly limited by snow cover. Projections of future range show that snow cover loss will likely continue to drive this species' range shift into the future.

Too Little, Too Late: Human Overpopulation and Climate Disruption

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Humanity faces a "perfect storm" of ecological challenges that are converging and threatening societal collapse within the coming decade. Foremost among the driving factors are human overpopulation and climate disruption. With a global population of more than 7 billion and atmospheric concentrations of carbon dioxide

about 400 parts per million, humans have created an unprecedented planetary emergency on Earth. Every one of our current environmental problems is accelerating as population continues to grow toward an estimated 9 billion by 2050. Climate disruption caused by global warming due to greenhouse gas emissions generated by our industrial civilization is rapidly approaching an irreversible planetary tipping point. Much of our ecological knowledge and habitat conservation is rapidly becoming obsolete because ecosystems are changing and functioning at different rates and scales than historic baselines. Despite early warnings over the past 50 years, we continue ecocidal behavior and perpetuate unsustainable economic growth on our finite planet. Now political stalemate and budgetary bankruptcy are becoming major barriers to the policy and structural changes necessary to avert disaster. Future prospects appear bleak for wild life and wild places that so many natural resource professionals have dedicated their lives and careers to making a difference for future generations.

Potential Climate-Driven Shifts in Mammalian Species Composition in Great Lakes National Parks

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Climate change is projected to cause a ~3°C increase in mean temperatures and 5-10% increase in annual rainfall in the upper Great Lakes region. This will affect the distributions of both plant and animal species and their presence in the region. Our overall project goal was to identify trajectories in plant and animal species' distributions that might occur under various climate change scenarios to understand how these changes might affect natural resource management and visitor experience in 7 forested National Park units in northern MN, WI, and MI. We evaluated the geographic distributions of mammal species currently present in and around the parks to determine which species may remain, move into, or move out of these park units over the next 85 years. Given future climate scenarios, 11% of the 61 current mammalian species will no longer exist in any of the seven park units, 18% will move out of some units, 48% will remain in all units currently occupied, and 23% will move into additional park units. We also identified 7 additional mammalian species that currently do not exist in any of the park units that will move into one or more of the parks. We are currently working with NPS personnel to develop interpretive materials and decision support tools that address potential impacts of climate change on all NPS units in the western Great Lakes Region.

Monitoring the distribution and seasonal movements of reintroduced elk (Cervus elaphus) in habitats created by clear cutting in boreal forest

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Abstract: Identifying the diet and the determinants of the distribution of grazing herbivores is a common problem facing rangeland managers. Monitoring the distribution and movements of reintroduced elk populations is part of Ontariowide efforts to understand elk diet in new environments where food patches are very often not natural grasslands. We show that the abundance and diversity of forage species in cutover patches in the Kenora area is higher than what is found in typical grasslands foraged by elk elsewhere, while the temporal window for foraging is narrowed by forest succession. Elk spatial distribution in this area varies as a function of foraging patch quality and direct and indirect effects of other large herbivores. This study may offer advice to resource managers on how to create through timber management a diversity of forest age classes that can provide better habitat for elk and an increase in a forest-dwelling elk population.

Calving Characteristics of the Reintroduced Clam Lake, WI Elk Herd

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Intensive radio telemetry collaring and monitoring of the wild Clam Lake, Wisconsin elk population, specifically neonatal calves, has illuminated unique characteristics and relationships such as calf capture weights, survival, sex ratios, conception date and natality rates of cows.

Our observations show that September yearling cows likely do not breed and none sustain pregnancy. 33% of 2 year olds, 90% of 3-14 year olds and 46% of 15-17 year old cows give birth. There is no evidence of 18+ year olds giving birth (2000-2013). Pregnancy-specific Protein B (PSPB) tests of 62 cows support these observations. By determining the ages of neonatal captured calves (Johnson 1952) the median birth date is between May 25-31, ranging from May 13-June 21. With a 250 day gestation period the median conception date is estimated as September 17-22, ranging from September 5 to October 16. Mean weight varies, ranging from 15.1kg to 16.8kg (2005-2013), possibly influenced by spring green up date and winter severity. Male calf survivorship has ranged from 25% to 86% with a mean of 54% (n=125) while female survivorship has been 9% to 100%, mean of 56% (n=95) between 2000 and 2013.

The impacts of these factors may explain why the population growth from 1995-1996 through 2004-2005 was 21% then from 2004-2005 through 2013-2014 growth has slowed to 7% annually. Understanding this data is important for future management goals and decisions.

Cause-specific mortality of moose calves in northeastern Minnesota, 2013 and 2014

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Low and variable recruitment can have a strong influence on large mammal population dynamics. The northeastern Minnesota moose (*Alces americanus*) population has been exhibiting a downward trend from 2006 to 2014. Neonate and seasonal survival rates and specific causes of mortality have been largely unknown. In 2013 and 2014, we tracked 73 and 70 adult female moose, respectively, fitted with global positioning system (GPS) collars, looking for long distance calving movements followed by localization. In 2013, a helicopter-assisted capture crew fitted expandable GPS collars on 49 neonates from 31 dams (58% twinning rate). In 2014, after switching to ground captures, we fitted GPS collars on 25 neonates from 19 dams (32% twinning rate). We investigated calf mortalities and determined proximate causes of mortality on site. Causes of death included natural and capture-induced abandonment by dams, predation by bears and wolves, drowning, disease, and injury inflicted by the dam. After censoring capture-related mortalities and slipped collars, we observed 50% calf mortality by 40 days of age in 2013 and 2014. Expandable band functioning has precluded recruitment estimates, but in 2013 survival to 9 months of age was 26%. Predation accounted for 88% and 83% of natural mortalities in 2013 and 2014, respectively, with wolf-kills outnumbering bear-kills ≥4:1. Identifying specific causes of mortality and understanding their relations to various landscape and other extrinsic factors should yield insight into mechanisms contributing to the declining moose population in northeastern Minnesota and serve as a basis for an ecologically sound management response.

Moose Habitat Restoration Techniques in Northeastern Minnesota

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Moose foraging habitat is created by shearing, forest harvest, prescribed burns, windstorms and forest fires. We measured 87 moose habitat restoration sites in spring (winter browse) and fall (summer browse) of 2014. Browse use and availability were measured at each site. We collected data on 13 common species eaten by moose in Minnesota. A typical site contained 7 of these 13 species. Species richness decreased with stand size at spring ($r = -0.53$) and fall sites ($r = -0.42$). At sites measured in spring 2014, species richness increased ($r = 0.36$) with stand age, while richness did not change with stand age at sites measured in fall 2014. Aspen (25%), beaked hazel (22%), and paper birch (12%) were the most abundant species available. These species were browsed less than their availability, but they were browsed most heavily in absolute terms and are important forage species. Conversely, red-osier dogwood, mountain ash and maple species are less common, but were browsed at high percentages when available. Much less browsing was observed in summer, potentially masked

by leaf replacement early in the season. Availability of aquatic vegetation may also reduce browsing on upland forage sites during the summer months.

Determining an Effective Approach for Capturing Moose Neonates and Minimizing Capture-related Abandonment in Northeastern Minnesota

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Enhancing our understanding of moose (*Alces americanus*) calf survival, cause-specific mortality, and impacts on population performance requires: 1) capturing and Global Positioning System (GPS)-collaring moose neonates, 2) closely monitoring their movements and survival, and 3) rapid investigation of mortalities. Unexpectedly, our 2013 capture operations (helicopter assisted) resulted in 7 of 31 (23%) dams abandoning 9 of 49 (18%) calves; twins (8 versus 1 singleton) appeared more predisposed to abandonment. Hourly location data of GPS-collared neonates and dams indicated that capture-related abandonment involved movement behavior which was highly variable and complex. During the 1-6-hour interval postcapture, abandoning and nonabandoning dams were similar distances from their calves, but by the 13-18-hour interval, nonabandoning dams were returning to their calves, whereas abandoning dams were moving farther away. However, most of the abandoning dams made periodic returns to their calves before ultimately abandoning them. During spring 2014, we employed 2 all-ground (no helicopter assistance) calf capture approaches (1st and 2nd phase). Most important, during the 2nd phase we reduced our capture team from 3-4 to 2 members and we limited handling to fitting the expandable GPS collars and determining sex, which typically required ≤ 60 seconds. This was associated with a dramatic reduction in capture-related abandonment compared to the 1st phase and to 2013.

"Surrogate" Species: Wrong Word, Bad Idea?

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Several Federal and State natural resource agencies have adopted the term "surrogate species" in their conservation planning. In some instances, "surrogate" is used appropriately; for example, a certain fish species might adequately reflect the water quality of a stream. A measurement of the population status of that fish indeed could be a suitable "substitute" or surrogate for a suite of water-quality metrics. More often, it seems, the term "surrogate species" is used to mean a single species that can somehow represent a larger group of species. This approach is taken because of the difficulty of conservation planning for the multitude of species that exist in most any area. A more appropriate term might be "indicator species," "umbrella species," or "flagship species." But these terms have distinct meanings, and conflating them under "surrogate species" is of questionable value. I discuss the strengths and weaknesses of these other concepts and propose that the term "surrogate species" be abandoned in favor of more accurate, specific, and meaningful terms.

Upland Sandpiper: A Flagship for Jack Pine Barrens Restoration in the Lake States?

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Fire-dependent ecosystems have been altered across much of North America and their restoration has the potential to affect many wildlife species, including those of conservation priority such as the Upland Sandpiper (UPSA, *Bartramia longicauda*). In the Upper Midwest, jack pine (*Pinus banskiana*) barrens were once common in the region and are now a focus of restoration by state, federal, and non-government agencies. Given its association with openlands, including barrens, we determined the location of UPSA-occupied habitat across multiple states and in Michigan to illustrate its relationship with specific ecoregions, soils, and land covers while considering what role the species may have as a flagship for barrens restoration. With the exception of Michigan, UPSA-occupied blocks in all states studied had higher proportions of agricultural land (pasture/hayland, cultivated crops). In Michigan, 66% of long-term occupied blocks were found in the northern Lower Peninsula, and most often consisted of anthropogenic grasslands providing stable habitat on higher-quality soils. In contrast, short-term occupied blocks had a greater proportion of dynamic, natural herbaceous openlands that were often located on poorer, xeric soils associated with jack pine ecosystems. Openlands with no UPSA breeding evidence was characterized by intensive agriculture (row crops). Our data suggest that in Michigan and elsewhere in the Upper Midwest, UPSA would be a novel flagship species for the conservation of anthropogenic grasslands and the restoration of jack pine barrens.

Home is Where the Estimation Is

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"Home range" is a standard concept in animal ecology and behavior but few people do more than plot outlines of the areas animal use. Nonetheless, analyses of home ranges have the potential to provide tremendous insight into the lives of the animals that we study. Using data for black bears (*Ursus americanus*) and fishers (*Pekania pennanti*), I calculated utilization distributions for resting animals and foraging animals, comparing the distributions of these 2 categories of activity across space. I also calculated utilization distribution for energy spent resting and foraging. These approaches highlight the diversity of insights that home range analyses can provide.

Evaluating grazing effects on a native prairie – The Bjornson WMA Grazing experiment

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Native grasslands have evolved into a disturbance dependent ecosystem, adapted to benefit and maintain their health and diversity by periodic burning or grazing disturbances. Vegetative species composition and structure are managed with grazing by targeting timing, duration and stocking rates. However, grazing can have both positive and negative effects. The hoof action of cattle can reinvigorate soil and increase productivity, while the disturbance to vegetation can change species composition and favor warm or cool season species, depending upon the timing and duration of the grazing event. Because some plants are increased by grazing, while others are decreased, caution needs to be used when planning sites and dates for grazing. In early June 2011, I erected three 400-ft^2 cattle exclosures, and paired them with three 400-ft^2 control areas within a 120-acre fenced portion of the Bjornson Wildlife Management Area (WMA) to examine the effects of grazing. The exclosures and controls were picked non-randomly to ensure that there were large numbers of small white lady slippers (*Cypripedium candidum*) within both exclosures and control areas. The 120-acre area of the WMA was grazed with 60 cow calf pairs from June 15 to July 15, 2011. I evaluated the effects of grazing on erosion, number of white lady slipper blooms, vegetation changes, and exotic species abundance. Care must be taken when grazing on native prairie areas to insure objectives are met, while minimizing adverse effects to native plants and soils.

Grassland birds demonstrate delayed response to large-scale, experimental tree-removal

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The control of woody vegetation is necessary to maintain open grassland habitat for grassland-obligate birds, many of which are sensitive to habitat edges and patch size. In many situations, manual removal is the only effective way to remove well-established tree groves. Few experimental studies examined the efficacy of manual tree-removal treatments in improving habitat for target species.

We conducted a study of large-scale tree-removal from 2005 – 2011 on 14 grassland sites. Beginning in the fall of 2006, we removed shrubs, scattered trees, and woodlots from six sites (trees and shrubs accounted for 7–21% of ground cover on sites before removal) with cutting and burning treatments. We conducted 20 vegetation surveys and avian point count surveys annually on each site for one year before and six years after tree-removal. Tree-removal treatments were effective at removing larger woody vegetation (> 6 m in height), but shrubs were not effectively reduced. Treatment sites also demonstrated a temporary reduction in above-ground dead grass litter in 2007 and 2008, likely the result of prescribed fire treatments intended to reduce tree-regrowth after initial cutting.

Avian response to treatment varied. Grassland birds were slow to respond, and most species and groups of grassland birds declined on treated sites for several years before eventually demonstrating a significant, positive response to treatment. Waterfowl and wetland bird counts were generally positively affected by treatment. Abundance of woodland birds, particularly those that nest in cavities, was immediately reduced on treated sites.

Snapshot Wisconsin: A statewide trail camera project to monitor wildlife

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Snapshot Wisconsin is a new, year-around, statewide effort to monitor Wisconsin's wildlife with a network of trail cameras. The goals of the project are to improve the spatial and temporal resolution of wildlife monitoring to help inform management decisions, and to include citizens, including educators and their students, in that process. We expect to recruit thousands of volunteers to place and monitor > 3,000 trail cameras in a grid across Wisconsin. *Snapshot Wisconsin* is just beginning, and we will recruit the first volunteers in 2015. In addition to background on the project, we will talk about the results of our 79 camera pilot study, how trail camera pictures are used currently, and our ideas on how trail camera data will be used for wildlife monitoring in the future.

The State of Minnesota and Wisconsin Forest Habitats: a strategic summary from the Forest Inventory and Analysis (FIA) program

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Minnesota and Wisconsin forests provide habitats for numerous species of amphibians, reptiles, birds, and mammals. Quantity and quality of habitat is affected by extent, composition, and structure of forests. These characteristics are quantified by Forest Inventory and Analysis (FIA), a research program within the USDA Forest Service. A wealth of habitat-related forest data and information are available in the FIA database, online estimation and mapping tools such as FIDO, and EVALIDator, FIA state reports, and special studies. We present an overview of Wisconsin and Minnesota forest extent, composition, and structure, with emphasis on both early and late successional stages, and from historical, current, and future perspectives.

The Wisconsin Young Forest Partnership: Establishing a Landscape-scale Young Forest Habitat Conservation approach across Wisconsin's Forest Ownerships

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In 2011, the Wisconsin Department of Natural Resources partnered with the Wildlife Management Institute, Ruffed Grouse Society, and American Bird Conservancy to form a six county young forest pilot project area in North-central Wisconsin. The goal was to work with landowners who were not actively managing their property and had no management plan. We would help them begin to actively manage early successional habitat, especially aspen and tag alder, to benefit American Woodcock (*Scolopax minor*), Golden-winged Warblers (*Vermivora chrysoptera*), and other wildlife species. The success of this effort resulted in the formation of the Wisconsin Young Forest Partnership (WYFP). The WYFP represents a formal agreement between a dozen partners including non-profit organizations, industry representatives, and state, county, and Federal natural resource agencies. A full-time Habitat Outreach Coordinator has been hired by WYFP to lead private forest landowners through the habitat improvement process from beginning to end. The WYFP goal is to establish a landscape-scale conservation program that can deliver young forest habitat on suitable lands across Wisconsin, regardless of ownership. Our objectives are to create young forest habitat for high conservation priority wildlife species, increase active forest management on private lands, support local economies by promoting a healthy timber industry, and improve outdoor recreation opportunities to view and pursue wildlife. These activities are being promoted within a framework of supporting diverse forest landscapes and creation of young forest in appropriate locations as defined by conservation opportunity areas and best management practices (BMPs) for focal wildlife species.

Prairie Conservation and the Prairie Plan 2015: How are we doing so far?

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Minnesota Prairie Conservation Plan Implementation Team

The Minnesota Prairie Conservation Plan (MPCP) was developed in 2009/10 to take full advantage of the 2008 Legacy Amendment to the state constitution. 2015 is a good benchmark to review the progress and accomplishments. This talk will discuss how conservation activities in western Minnesota have accelerated since this funding was implemented. The talk will show the increase in public lands acquisitions, increased management capacity, and development of partnerships to further the goals of the MPCP.

Building a Midwest Grassland Network to Support Implementation of State and Regional Conservation Plans

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Grassland bird populations are decreasing faster than any other group of breeding birds in North America, with especially pronounced declines occurring in the Midwest. Throughout the region, many organizations have developed plans to address the problem, including state agencies, Joint Ventures, Landscape Conservation

Cooperatives, and single-species partnerships. The Migratory Bird Program of the US Fish and Wildlife Service is leading a new effort to create a network of grassland landscapes in the Midwest to support implementation of these state and regional conservation plans. The Midwest Grassland Network will: 1) integrate spatial information about land cover, grassland birds, and conservation focus areas into a regional grassland bird conservation map; 2) evaluate strategic options for promoting grassland landscapes; and 3) highlight innovative partnerships that have succeeded in conserving or restoring grassland bird habitat. This presentation will introduce a range of options for customizing a Midwest grassland bird conservation map in order to advance the work of Landscape Conservation Cooperatives, Climate Science Centers, and other key audiences. In particular, we seek input on placing habitat and bird conservation values in the context of co-occurring services, conservation opportunity, and risk of grassland conversion. A common system for delineating, categorizing, and prioritizing grassland bird habitat will equip bird conservationists to coordinate activities and forge productive partnerships with other grassland stakeholders. In the face of ongoing agricultural intensification and land-use change, such alliances are vital to achieving habitat gains at the scale needed to stem long-term population declines.

LiDAR Analysis of Snowshoe Hare Habitat in Northeastern Minnesota

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Snowshoes hares serve as an important food source for many meso- and large carnivore in North America's northern forests. Because of this role as a key prey species, cost-effective methods of predicting snowshoe hare occupancy and density would be helpful tools for researchers who study a wide variety of carnivores in this region. Working toward this goal, we used LiDAR data collected in Northeast Minnesota in 2011 to analyze the relationships between forest characteristics and snowshoe hare pellet count data gathered from 2010 to 2013. LiDAR-derived average values for forest stand height, vegetation density, and canopy cover in 100 m buffers around survey coordinates were calculated using ArcGIS and Geospatial Modeling Environment. Linear regression of each of these variables on pellet counts demonstrated individually significant ($p < .05$) relationships between the variables, though explanatory power was low for all variables ($R2 < .1$). Multiple regression models that included both height and density factors marginally improved explanatory power, with a model that included average stand height and understory vegetation density explaining the most variance of any model tested (adjusted R2 = ~.11). Though the simple preliminary analyses we conducted showed low explanatory power, the statistical significance of all factors tested indicates that further analysis could yield more useful results. Later iterations of these analyses using a larger pellet count data set, additional cover type variables, and more advanced statistical tools will likely improve the quality of these results and their utility for researchers and wildlife management officials.

Wisconsin Breeding Bird Atlas II: Beginning 2015

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In 2015, we begin collecting bird observations for Wisconsin Breeding Bird Atlas II – a 5-year, statewide effort to document breeding bird distribution and abundance in the state. Atlases collect important information for conservation planning while engaging the public in wildlife conservation. During the first Wisconsin Breeding Bird Atlas (1995–2000), over 1,600 field observers confirmed breeding for 226 species and we expect to exceed those numbers. Data will be collected via an online portal to www.eBird.org, which should provide an easy and intuitive framework for submitting observations. Although the majority of observations will likely come from experienced birders covering the priority atlas blocks, we encourage everyone to submit any observations of breeding birds across Wisconsin from 2015–2019. Visit http://wsobirds.org/atlas to sign up and learn more.

Exogenous 17β-Estradiol Disrupts Gonadal Differentiation in Freshwater Turtles Exhibiting Temperature-Dependent Sex Determination

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The red-eared slider turtle (*Trachemys scripta*), the painted turtle (*Chrysemys picta*), and the snapping turtle (*Chelydra serpentina*) all exhibit temperature-dependent sex determination (TSD), where incubation temperature determines the sex of the individual. Previous studies have used exogenous estrogens to sex-reverse individuals when incubated under male-producing temperatures to examine the pathway and role of estrogens during sex determination. It remains unclear, however, if exogenous estrogen is mimicking a natural event in sex determination, or if it is overriding the endogenous sex determination pathway. In the current study, *T. scripta*, *C. picta*, and *C. serpentina* eggs incubated at a female-producing temperature (30°C) were treated with either an ethanol control, one dose of 15 µg of 17β-estradiol at embryonic stage 14, or a second dose of 15 µg of 17β-estradiol 7 days later. Eggs were incubated until embryonic stage 26 and adrenal-kidney-gonad complexes were dissected. Gross morphology of the gonads were examined and sexed when possible. Verification of gonad and sex was verified through histology. In *T. scripta* and *C. picta*, gonads treated with 17β-estradiol were barely visible to absent whereas, gonads in *C. serpentina* were unaffected by 17β-estradiol. These results indicate that exogenous estrogens applied at the beginning of the temperature sensitive period may disrupt the normal process of gonadal differentiation in 2 of the 3 species, and may be altering the natural sex-determination pathway instead of mimicking the native pathway. These findings provide an avenue for investigating the temporal and functional aspects of estrogen sensitive components in the sex determination cascade.

Pilot Study: Migration Patterns, Habitat Use, Food Habits, and Harvest Characteristics of Long-Tailed Ducks Wintering on Lake Michigan

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Recent aerial surveys indicate that Lake Michigan supports a sizeable wintering population of long-tailed ducks (*Clangula hyemalis*). Over 18,000 long-tailed ducks (LTDUs) were tallied along 2,400 km of transects during a December 2013 survey. Long-tailed ducks rank high in priority with the Sea Duck Joint Venture and have been a focal species in a large-scale sea duck telemetry project to address information needs concerning population delineation, migration, and ecology of sea ducks wintering in the Atlantic and Great Lakes regions. While a large effort has been placed on radiomarking LTDUs during 2007-2013 on the Atlantic coast and Lake Ontario, the effort has not yet included the Lake Michigan population. We are conducting a pilot study to demonstrate the efficacy of capturing LTDU's in offshore waters of Lake Michigan in support of an anticipated Master's study to determine temporal and spatial patterns of migration, breeding ground affiliations, and site fidelity of long-tailed ducks wintering on Lake Michigan. Mist-netting and night-lighting techniques will be employed to

capture the birds during winter 2014-2015. Additional components of the study are expected to include evaluations of food habits, harvest characteristics, and relations to avian botulism and wind energy concerns.

The influence of hunting season and snowfall on lead exposure of wild Bald Eagles (Haliaeetus leucocephalus) in the Upper Mississippi River Valley

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Spent upland ammunition is now the preeminent source of lead poisoning in eagles. Recent studies linking spent upland ammunition to lead poisoning in raptors has informed a growing trend to ban lead in all hunting ammunition. While availability of lead is caused by humans, a mixture of natural and anthropogenic factors influence uptake of lead in an avian population. The availability of lead in carcasses scavenged by raptors has been broadly associated with hunting season and snowfall has been proposed as mitigating exposure. Our analysis of blood lead levels (BLL) is the first from a large population (n=55) of free flying Bald Eagles (*Haliaeetus leucocephalus*) east of the Rocky Mountains in North America. We captured Bald Eagles overwintering in the Upper Mississippi River Valley, and blood analysis revealed 31% of individuals as recently exposed to lead - about half the exposure level found in local clinical data from eagles admitted to recovery centers or found dead on the landscape. Our analysis also reveals that the availability of firearm harvested white-tailed deer (*Odocoileus virginianus*) remains and snowfall are the primary factors influencing Bald Eagle lead exposure in the Upper Mississippi River Valley. The negative association we found between snowfall and lead exposure can inform more accurate collection and interpretation of data on BLL in scavenging eagles.

An Alternative Design to Sample Breeding Birds for a State Atlas

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For Minnesota's first state atlas, we designed a means to systematically sample all of the 2,353 townships (9.65 x 9.65 km) with at least 50% land throughout the state. Within each township, the northeast quadrant (typically 4.83 x 4.83 km) was randomly selected as the priority block for detection of breeding bird activity. Within each priority block, we compiled data layers for roads from the 2008 Minnesota DOT data base and land cover types from the 2001 National Land Cover Data. Non-major roads (e.g., no Interstate or State Highways) were buffered within 45 m and these buffers searched by an automated GIS procedure for appropriate land cover types. Each priority block was sampled with three 10-minute, unlimited-distance point counts; generally sampled between 0500 and 1000 and within the safe nesting dates for breeding bird species in Minnesota. The first point was a randomly-selected point, the second in the predominant land cover type, and the third point in the second most common land cover type of the township. From 2009 to 2013 we successfully sampled 6,993 points in all but 5 of the 2,353 townships in Minnesota. We observed a total of 219 species and 195,475 individual birds over the five-year period. These data will allow a systematic, re-sampling of the Minnesota breeding bird atlas in future years with standard effort and an equal distribution across the state. These data allow for estimates of population size, habitat distribution, and the development of probability distribution maps for species breeding in the state.

Are Ruffed Grouse in Southeast Minnesota and Northern Iowa an Isolated Population?

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Ruffed grouse (*Bonasa umbellus*) and their closely-related European counterpart the hazel grouse (*B. bonasia*) are notoriously poor dispersers. Gullion (1984) stated that it is rare for a ruffed grouse to travel >8 km from where it was hatched, and that more than half live within 1.6 km of their natal site. Leopold (1931) found that ruffed grouse were present on islands in Michigan in the Great Lakes if the island was <0.5 km from the mainland and absent if the island was >1.6 km from the mainland. Ammann and Palmer (1958) found that ruffed grouse released over open water in Michigan flew an average of 0.275 km and a maximum of "much less than a mile" before ending up in the water. Aberg et al. (1995) found that hazel grouse were absent from woodlands in agricultural settings that were >0.1 km from contiguous forest, and from suitable habitat in forested landscapes if that habitat were >2 km form other suitable habitat. Gullion (1984) placed the limits of ruffed grouse dispersion across unsuitable habitat at 0.4 km (0.25 miles) over open water and 0.8 km (0.5 miles) over open land.

Recently we published a paper on the effect of Twin Cities urbanization on regional breeding bird distributions (North and Faber, in press) in which we statistically tested for differences in abundance in urban, suburban and exurban zones for 38 species for which there was a visual indication of an adverse effect from urbanization on their distribution based on results in the Minnesota Breeding Bird Atlas. Although the ruffed grouse showed strong visual evidence for an adverse effect, a chi-square goodness of fit test did not return a significant result (X^2=2.7, n=75 survey blocks, n.s.). We attributed this to the possibility that ruffed grouse were responding to urbanization at a greater geographic scale than we tested for, and we raised a concern that the Twin Cities metro

area is a barrier to ruffed grouse gene low and population exchange between southeast Minnesota and northern populations, except for a narrow corridor of habitat in Washington County along the St. Croix River. The question then becomes, "Is the Mississippi River a barrier to population exchange between Wisconsin and southeastern Minnesota?" Aerial photography indicates that the main channel width of the Mississippi River is typically 0.20-0.30 km from the St. Croix River to Lake Pepin; 1.5-3.7 km Lake Pepin at narrow points; 0.25-0.35 km from Lake Pepin to Winona; and 0.33-0.50 km from Winona to the Iowa border. While these distances may be traversable by ruffed grouse, the terrestrial habitat on either side may not be suitable grouse habitat, and where these distances allow for island hopping, the floodplain islands may also not be suitable habitat. We recommend that ruffed grouse dispersal between southeast Minnesota and Wisconsin be studied by a combination of banding and radio-telemetry. This would inform wildlife managers as to what extent southeastern Minnesota ruffed grouse should be considered a separate population that perhaps needs unique management and harvest regulations. The updating of the Wisconsin Breeding Bird Atlas, which is in progress, could also inform us of distributional differences on each side of the river.

Moose Modify Bedsites in Response to High Temperatures

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Moose respond to ambient temperatures above the upper critical temperature of their thermoneutral zone via physiological and behavioral mechanisms that enable them to dissipate excess heat. Here we describe two cases where GPS-collared moose modified summer bed sites as a potential thermoregulatory response to high temperatures. In the first case on July 18-20, 2011, ambient temperatures averaged 8°C above the upper critical temperature of moose over 3 days, where the most extreme conditions reached 32°C (89°F) and 96% relative humidity. The moose physically cleared litter and duff to expose 3 m2 of mineral soil under closed canopy balsam fir based on field observations of the bed site immediately after the event. The moose spent 63% of the 3-day event bedded, with ≤11 individual bedding events in the same bed site. A second case on July 5, 2013 occurred during similar weather (max temp 29°C [84°F]; max relative humidity 70%). A different moose cleared and used a bed site for one 10-hour continuous period. Though observed in other ungulates, these are the first documented cases of moose modifying their bed sites in response to high temperatures. This behavior may only occur in hot temperatures with high humidity as 174 moose bed sites from across a range of lower temperatures did not show bed site modification.

Brokering Relationships Between Non-Farming Landowners And Livestock Producers to Increase Grasslands in the Upper Midwest

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The Grazing Broker project uses market drivers as a tool to preserve grasslands on private land. The Southwest Wisconsin Grassland and Stream Conservation Area is a 500,000 acre region of high quality public and privately owned grasslands in the Driftless area. Conservation partners have nurtured this grassland using traditional tools such as land and easement purchases, set-aside programs, landowner education, and cost-sharing of conservation practices. The Grazing Broker project brings together sustainable livestock producers and non-farming landowners together for mutually beneficial pasture lease partnerships. Pasture raised meat and dairy products are in high demand among consumers, but grassland for grazing livestock is often unavailable to farmers wishing to access this market. Non-farming landowners control an estimated 60% of agricultural land in the Upper Midwest. These landowners have diverse goals for their land investment, and given the option, may choose to maintain the environmental benefits of grasslands while generating a rental income. The Grazing Broker is modeled after the private consulting forester, brokering relationships between the landowner and the 'resource harvester,' in this case, livestock producers harvesting forage. The broker works to create partnerships to manage the grassland for its conservation value as well as to produce an income for both parties. The broker shepherds the relationship, developing a grazing plan, connecting both landowner and producer with resources to develop fencing and other infrastructure, and providing assistance with lease agreements. Our ultimate goal is to create a model for replicating this service throughout the region.

Habitats and Landscapes Associated with Bird Species in Lowland Conifer Forests of Northern Minnesota

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Concern over the persistence of lowland conifer forests in hemiboreal regions is increasing due to potential effects of climate change and increased harvest levels. These forests support many breeding bird species and effectively extend the range limits of several boreal species into hemiboreal and even temperate regions. These species are of concern, as shifting patterns in forest composition will likely affect their populations, especially at the southern boundaries of their ranges. It is important to understand the details of these species' breeding habitats to effectively manage appropriate habitat. We have modeled and mapped habitat suitability for seven species of birds that breed in the lowland conifer forests of the Agassiz Lowland Ecological Subsection in northern Minnesota: Connecticut Warbler (*Oporornis agilis*), Yellow-bellied Flycatcher (*Empidonax flaviventris*), Boreal Chickadee (*Poecile hudsonicus*), Ruby-crowned Kinglet (*Regulus calendula*), Yellow-rumped Warbler (*Setophaga coronata*), Palm Warbler (*Setophaga palmarum*), and Golden-crowned Kinglet (*Regulus satrapa*). A priori sets of 16 to 23 potential environmental variables, including both stand-level attributes and landscape metrics, were developed and used to calibrate individual species models. We found significant selection for specific forest and landscape characteristics by each of these species, with the best models including between one and nine variables. Habitat suitability maps were developed from these models. In addition, we present a map that combines suitability scores of five of these species, which can be used by managers to help identify particularly important forests for conservation.

Protecting Rare Plant Communities through Deer Management at Apostle Islands National Lakeshore

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White-tailed deer management within the park is complex. The park's 21 islands have a diverse deer history. A few islands were not historically impacted by browsing and contain rare forest communities dominated by Canada yew (*Taxus canadensis*), a species nearly extirpated on the mainland. Deer hunting is allowed within the park's enabling legislation and deer management is coordinated with the WDNR and local tribes. A Wildlife Management Plan and EA for Harvestable Species was completed in 2007 and updated in 2014. Consistent with the plan, the park has been implementing culling activity on Sand (2,949 acres, 11.9 km^2) and York (321 acres, 1.3 km^2) Islands where deer densities may have reached a peak of approximately 13 km^2 and 19 km^2, respectively and impacts to Canada yew were significant. Various techniques have been used including: recreational hunting, Tribal harvest, clover traps, and culling by National Park Service staff, volunteers, and APHIS-Wildlife Services. This paper will discuss the park's approach to this difficult and complex natural resource issue, lessons learned, and current results.

Evaluating Snow-Track Surveys for Monitoring Co-Occurring Furbearers in Wisconsin

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Effective monitoring tools are critical for developing wildlife management programs. This is especially true for harvested and cryptic species such as furbearers, which are often monitored through indirect population indices that implicitly assume a linear relationship with true population size or density. Here, we use an existing track survey dataset to evaluate the utility of occupancy models for monitoring furbearers in northern Wisconsin. We developed models of bobcat (Lynx rufus), coyote (Canis latrans), fisher (*Martes pennanti*), fox (*Urocyon cinereoargenteus* & *Vulpes vulpes*), marten (*Martes americana*), river otter (*Lontra canadensis*), and snowshoe hare (*Lepus americanus*) relative abundance during the winter seasons of 2004 – 2014. We used two implementations of occupancy models to derive annual estimates of relative abundance that could be compared to results from the existing monitoring framework, and used these annual estimates to model population trends. Results indicated the best model was species-specific. We found no evidence of significant changes in relative abundance for any species. Although our results suggest that abundance indices derived from occupancy models did not generally outperform those derived from existing monitoring procedures, improved data collection procedures may increase the utility of occupancy models for monitoring wildlife populations trends for numerous species of furbearers in Wisconsin.

Breedng Bird Trends in Minnesota National Forests – 1995-2014

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We sampled breeding bird populations in > 300 forest stands annually from 1995-2014 in the Chippewa and Superior National Forests (NFs) of northern Minnesota. Methodology included 10-minute, unlimited distance point counts gathered in a randomly, stratified design in proportion to the available forest cover types. We tested trends for 73 species. Over 70 % of species tested in both forests were either stable or increasing, while seven species in the Chippewa NF and twelve species in the Superior NF significantly declined. Only two species, Connecticut Warbler (*Oporornis agilis*) and Chipping Sparrow (*Spizella passerina*), had significant declining trends in both NFs. With the two NFs combined in a regional analysis, 17 species increased and eight species had declining trends. These trends are likely related with changes in forest cover, climate change, and many other interacting factors. Besides calculating trends, these data can be used for habitat and landscape modeling that are essential for effective conservation and management of these species.

Using LiDAR to understand water conveyances more accurately within SLICE Lake watersheds in Minnesota

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Researching hydro-connectivity within the SLICE watersheds has shown that corrections need to be made to show actual water conveyances that aren't captured in current data. Using LiDAR data, creating a topographic position index (TPI) is useful to analyze hydro-connectivity among surface waters. TPI is a focal statistical tool that ultimately helps accentuate, thus visualize depressions and probable areas of concentrated flow in a landscape (e.g., ditches, intermittent streams, and connections present only in high water conditions). The composition of water conveyances and hydro-connectivity across a landscape is important information that can be used to identify how and when aquatic habitats are connected, estimate nutrient and pollutant loads to lakes, and predict distributions and movements/invasions by native and non-native species. TPI's are extraordinarily useful for identifying ditches, depressions, and areas of concentrated flow, as well as various "digital dams" that prevent the correct analysis of water flow throughout a landscape. Digital dams are actual on-the-ground features captured during LiDAR data collection (e.g., roads, bridges, fish barriers, and actual water control structures). The most prevalent examples of digital dams in Minnesota are roads and driveways which appear as digital dams, whereas in reality, culverts actually pass water under these roads and driveways. Once digital dams are removed we then have most accurate representation of hydro-connectivity and water conveyances available with current technology.

Determinants of livestock depredation events in Manyara Ranch Conservancy, Northern Tanzania

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Manyara Ranch Conservancy is a multi-use conservation area that combines wildlife conservation and livestock keeping. Mitigating livestock depredation is important to lion conservation to prevent retaliatory killings. To understand the factors that lead to livestock depredation by lions, trail cameras were set up on Manyara Ranch Conservancy comparing captured images of wildlife and domestic livestock between areas of known livestock kill sites and non-depredation sites. The three factors hypothesized to detect livestock depredation sites were livestock density, wild prey density, and proximity to a water source. Logistic regression tests were used to measure the likelihood of an area being high risk for livestock depredation with respect to livestock density, wild prey density, and proximity to water sources. The results of this study can be used to make regulations and provide cautionary warning to pastoralists bringing their livestock near water sources to help limit livestock.

Breeding Bird-Habitat Associations of the Red Lake Peatlands, Minnesota, USA.

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Potential changes due to logging, insect infestations and global climate change in lowland conifer forests in Minnesota are unclear. Lowland conifer forests including Black Spruce (*Picea mariana*), Tamarack (*Larix laricina*) and White Cedar (*Thuja occidentalis*) tree species are home to many species of breeding birds, some of which have experienced population declines in Minnesota. During the 2013 and 2014 breeding seasons, we sampled 65 lowland conifer stands located in the Agassiz Lowlands Ecological Subsection of the Red Lake Peatland, Minnesota, USA. Primary variables of interest were site index (stagnant to productive), stand age (young to old) and stand size. Each stand was sampled with two 10-minute, unlimited-distance point counts; generally sampled between 0445 and 1000 and within the safe nesting dates for breeding bird species in Minnesota. Each stand was sampled five times each; three in 2013 and twice in 2014. We detected a total of 109 species, totaling 10,913 individuals. Most common species for unlimited distance counts were Nashville Warbler (*Vermivora ruficapilla*), White-throated Sparrow (*Zonotrichia albicollis*), Myrtle Warbler (*Setophaga coronata coronate*), Hermit Thrush (*Catharus guttatus*) and Yellow-bellied Flycatcher (*Empidonax flaviventris*), respectively. We used linear regression to determine habitat relationships for species breeding in lowland conifer forests. In addition, we analyzed species based on 5 habitat classes that are characterized by age and site index. The identification of stand-level habitat characteristics that influence breeding success will be important to managers and researchers in efforts to conserve habitat for species facing population declines.

Variation in Turtle Capture Rates over Summer Months in Clay County, Minnesota

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Nearly 1,000 painted turtles (*Chrysemys picta bellii*) have been live-trapped during our long-term study in Clay County, Minnesota, to study growth rates, survival, population characteristics, and movements. Captured turtles were weighed, sexed, measured, marked by scute notches (and PIT tags starting in 2006), and released on the shoreline of the slough of capture. From 2001-2010, we live-trapped 2 sloughs that were <1 km apart and roughly 3 ha and 6 ha in size. From 2011-2014, a third slough (<0.4 ha) was trapped approximately halfway between the 2 original sloughs. Since 2007, turtle capture rates have declined, possibly due to changes in water depth and/or land use or behavioral differences as turtles learned to escape traps. Our purpose here is to examine capture rates yearly from 2001-2014 over the course of our trapping seasons (usually mid-May to mid-Sept) to determine if this has varied year-to-year or by sex and to make future adjustments in our trapping schemes. After analyzing over 4,000 captures, June most often had the highest capture rate (including recaptures) for both adult males and females. July sometimes had the highest rate or was very close to that of

June. In 2001 and 2006, total captures (including recaptures) were very high, over 500 and nearly 700, respectively. Captures for 2001 were very high for all months from June-August, and, in 2006, captures were high for all months May-August. Juvenile captures were spread more evenly over the months, indicating peaks for adults in June/July were probably associated with breeding season.

Effects of Mown Paths on Small Mammal Movements in Clay County, Minnesota

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Small mammals, with their relatively small home ranges, can be greatly affected by habitat fragmentation. We conducted our study in a grassland habitat near Rollag, MN, to investigate the impact of mown paths on small mammal movements. We live-trapped small mammals from 02 July to 06 August 2014 on 3, 7x7 grids, with 5m between trap stations. On 2 grids, a pre-existing mown path, 15.5m wide, ran down the middle of the grids. The third grid was continuous habitat with no pre-existing mown path. On 29 July 2014, a new path of the same dimensions was mown down the middle of this grid, and trapping was resumed. Five species were captured: meadow voles (MV) (*Microtus pennsylvanicus*) (n=80), thirteen-lined ground squirrels (TLGS) (*Spermophilus tridecemlineatus*) (n=23), and 1 each of eastern chipmunk (*Tamias striatus*), short-tailed shrew (*Blarina brevicauda*), and masked shrew (*Sorex cinereus*). Of these, only 31 MV and 14 TLGS were captured more than once, with 29 and 14, respectively, caught at more than 1 trap station. Of these captured >1 time, only 6 MV and 8 TLGS were noted to cross over the pre-existing mown trails. On the grid with the newly mown trail, the entire population of small mammals was disrupted with no animals crossing the newly mown trail. In fact, most of the marked animals trapped just prior to the mowing seemed to move off the grid entirely. We concluded that mown paths, especially newly mown paths, can greatly affect small mammal movements in a negative manner.

Semi-aquatic mammal populations in the St Louis EPA designated Area of Concern

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The St Louis River Estuary was designated as an Area of Concern in the Great Lakes Water Quality Agreement of 1987. The estuary enters Lake Superior at the dense urban complex of Duluth, Minnesota and Superior, Wisconsin and has historically experienced physical modification, industrial pollution and chemical spills. Degraded wildlife habitat and wildlife populations were included among the Beneficial Use Impairments to be addressed, and while several remediation projects have been completed, there is no clear picture of the recovery of semi-aquatic mammals in the area.

Using a combination of remote cameras and aerial surveys, we are quantifying semi-aquatic mammal populations throughout the estuary as well as in two unimpaired reference sites; Boulder Lake Reservoir in eastern Minnesota and the St Croix River near Danbury in northwestern Wisconsin. Data collection began in November 2014, focusing on the occurrence of mink (*Neovison vison*), river otter (*Lontra canadensis*), beaver (*Castor canadensis*) and muskrat (*Ondatra zibethicus*) in these systems with varying degrees of anthropogenic influence. These data will be used in an occupancy modeling framework to assess differences in abundance between the estuary and unimpaired sites and to determine habitat relationships for these species, including water quality, documented historic disturbances, and reclamation activities. Additionally, our work will provide a means of validating current aerial survey methods for semi-aquatic mammals in this region by comparing aerial survey results to intensive field monitoring.

Diet and body condition of fisher in northern Wisconsin

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As opportunistic foragers, the diet of fisher (*Martes pennanti*) shows great variation across geographic range and season, as well as by age and sex classes. The diet of fishers have been explored in parts of their range, principally based on scat and gut analyses; however, in Wisconsin the foraging ecology of fisher and its effect on body condition remain largely unknown. As traditional diet reconstruction methods can be subject to biases of digestibility, we aimed to quantify assimilated diet of fisher with stable isotope analyses (δ13C and δ15N). We sampled hair and blood from whole fisher carcasses trapped in northern Wisconsin (n=54) during the 2013 season. We also collected omentum fat to index body condition. We conducted preliminary analyses on the relationship between diet and individual potentially relevant covariates. Ultimately we will relate geographic variables to diet and body condition in an effort to better understand this species basic biology and regional population trends.

Refining the Beaver Tooth Aging Method

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The most common and accurate technique to age beavers (*Castor canadensis*), the Van Nostrand and Stephenson (1964) method, is by examining the closure of the basal cavity and counting cementum annuli in the molariform teeth. There is some subjectivity inherent in this method, however, and inter-observer bias has yet to

be quantified. Our objectives were to: 1) compare the accuracy of beavers aged via tooth examination vs. known age from multiple captures; 2) examine inter-observer bias and the effect of observer experience on accuracy; and 3) explore relationships between morphological tooth measurements and age. Out of 14 known-age beavers from trapping (< 5 years of age), tooth examination correctly estimated for 10 (71%) beavers. Of the four incorrectly aged, all estimates were within a year of the correct age. Cementum area/tooth area was the single best predictor of beaver age (range: 2.5-18 years). The model correctly predicted the ages (±1.5 years) of 40 out of 48 (83%) beavers. The model also placed 8 out of 48 (17%) beavers in the correct half-year age class and 15 out of 48 (31%) in the correct year age class. Analyses for inter-observer and experience bias are ongoing at the time of this abstract.

Ring-Necked Pheasants Latency to Cover and Vigilance in Response to Predator Call

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Latency to cover and vigilance are common behaviors implemented by animals to help increase their survival rates from predators (Javurkova et al. 2010 and Ivins and Smith 1983). For many species, this could mean the difference between life and death; ring-necked pheasants (*Phasianus colchicus*) are no different. Five samples from different blocks at the Poynette Game Farm in Wisconsin were taken to demonstrate how ring-necked pheasants would react to a red-tailed hawk (*Buteo jamaicensis*) call. We hypothesize that female pheasants will have an increase in display of vigilance and latency to cover versus the male population when hearing the red-tailed hawk call. Data was collected on October 17th and 18th 2014. Each sample was video recorded; later data was categorized and analyzed from the footage. For every sample, behavioral categories (1-4), 1-no reaction to 4-most reaction; which includes running and flying, were issued to each pheasant to see which sex would display more latency to cover and vigilance. Our results didn't support a difference in the type of response of males or females to the red-tailed hawk call. Further studies to test how ring-necked pheasants detect predators, and also studies to determine the effects of different predators would be useful in understanding their behaviors, and if there is a difference between males and females. This would then help ring-necked pheasant game farms as well as hunters become more effective in management and harvest rates.

Seasonal Food Habits of Bobcat (*Lynx rufus*) in Central Wisconsin

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Bobcats (*Lynx rufus*) are an ecologically and economically important furbearer species in the state of Wisconsin. A statewide harvest for bobcats is scheduled to open in 2014/15. During the winters of 2006 and 2008, the stomachs of 275 harvested bobcats were analyzed for their contents. Their winter diet was dominated

by white-tailed deer (*Odocoileus virginianus*; 62.9% occurrence), followed by rabbits and hares (*Sylvilagus* and *Lepus* spp.; 24.4%), squirrels (*Sciuridae*; 7.6%), and small mammals (*Microtus* spp, *Myodes* spp., *Peromyscus* spp., and *Tamiascirus* spp.; 6.2%). The dominance of deer in their diet might be incidental scavenging of hunter-wounded deer rather than direct predation. During the summer of 2011, 56 scat were collected using scat detecting dogs. The samples, from 4 areas of central Wisconsin, provided an opportunity to verify the importance of deer in the bobcat diet. Following genetic analysis to confirm species identity, bone fragments and hair were extracted from fecal samples and analyzed to determine content. The most common prey items were small mammals (59.6% occurrence), followed by muskrat (*Ontantra zibethicus*; 40.4%). Deer was detected in a smaller percentage of scats (30.7%). Although the diets are different between seasons ($P<0.001$), it is impossible to determine if the differences are the result of over-representation of deer in the winter sample, a seasonal change in food habits (winter vs. summer), or changes in sampling locations (northern vs. central Wisconsin). Regardless, the continued importance of deer in summer scat samples suggests the impact of bobcat on deer populations may be substantial.

Effects of Three Land Management Regimes on Small Mammal Abundance at Grand Forks Air Force Base, North Dakota

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We determined small mammal abundance in three differently managed habitats (restored prairie, old field, and hay field) at Grand Forks Air Force Base, ND, during summer 2014. After 9,000 trap nights, four species were captured: meadow vole (*Microtus pennsylvanicus*), *Peromyscus* spp., *Sorex* spp., and ermine (*Mustela erminea*). Relative density of small mammals (number of individuals captured per 100 trap nights) was highest in the restored prairie and lowest in the hay field. A Robel pole was used to determine vegetation height and density at the three sites. The restored prairie had the highest mean vegetation height and density (6.53 dm), whereas the hay field had the lowest (1.45 dm). Determining small mammal abundance in a variety of managed habitats at Grand Forks Air Force Base contributes to better management of natural resources and provides baseline data for future small mammal studies on the base.

Nitrate Pollution of Groundwater in the State of Wisconsin: Analyzing Land Use Contributions and Modeling Distribution via Indicator Kriging

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Nitrate pollution represents a major risk to groundwater quality across the state of Wisconsin. As the state's infrastructure continues to develop, it is important to understand the origins of nitrate pollution as well as its distribution. Dividing monitoring between various state and federal departments, as well as a random distribution of measurement points, nitrate pollution is not well understood on a statewide level. Combining well measurements from the United States Geological Survey (USGS), Environmental Protection Agency (EPA), United States Department of Agriculture (USDA), the Wisconsin Department of Natural Resources (WI DNR), average nitrate levels were determined for 359 locations from 2007 to 2014. This point data was then analyzed within a GIS environment. Measurements were classified as safe or hazardous based on the EPA's standard of 10 mg/L nitrate as nitrogen. Utilizing the National Landcover Database via the USGS, land use within 5 km of each well was measured using buffers. Statistical analysis was used to investigate land use differences surrounding safe and hazardous sites. Analyses were also carried out on different types of land use

surrounding sites deemed hazardous. Furthermore, applying the known nitrate levels at 359 points, indicator kriging was used to model nitrate levels continuously across the entire state.

Population Structure of Painted Turtles Captured at Different Traps within and between Three Sloughs in Clay County, Minnesota

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In our long-term study (2001-2014), nearly 1,000 painted turtles (*Chrysemys picta bellii*) have been live-trapped on floating/basking traps in Clay County, Minnesota, to study growth rates, survival, population characteristics, and movements. Captured turtles were weighed, sexed, measured, marked by scute notches (and PIT tags starting in 2006), and released on the shoreline of the slough of capture. From 2001-2010, we live-trapped 2 sloughs that were <1 km apart and roughly 3 ha and 6 ha in size. From 2011-2014, a third slough (<0.4 ha) was trapped approximately halfway between the 2 original sloughs. The purpose of this poster is to characterize the overall turtle population structure within each slough for each year from 2006-2014 (when PIT tags were used) and compare that with the population structure of turtles caught at individual traps within that slough. Our intent is to determine if turtles are segregating (or clustering) by sex and/or age (size) on different traps (with differing water depths, distances from shore, amount of sun/shade, etc.) within each slough or if the population structure of turtles captured at different traps reflect the overall composition of that slough. We analyzed over 2,700 captures and found, in general, that turtles were not clustering by sex on particular traps, and sex ratios of turtles trapped at a particular trap usually reflected overall sex ratios for that slough. Turtles of both sexes seemed to be trapped more often in traps in shallow water (<1m-2m) than in deeper water. Analyses for turtle size are ongoing.

Determining the Current Abundance of Franklin's Ground Squirrel in Northern Wisconsin

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In conjunction with the WI DNR, we are looking for populations of Franklin's Ground Squirrels (*Poliocitellus* [*Spermophilus*] *franklinii*) in areas of northern Wisconsin. Franklin's Ground Squirrels are species of special concern in the state. They are tallgrass prairie specialists and have a complex history in the northern part of Wisconsin. Historically, forests were unsuitable for the squirrels, but the 19th and 20th century deforestation enabled colonization. Currently, we are looking for relict populations on a landscape that contains regenerating forest. We are using mailer surveys to inform targeted trapping for 2015. Questionnaires will be sent out to landowners in Douglas and Bayfield Counties, with more intensive surveying near the Brule River State Forest and nearby State Natural Areas, as one population has been confirmed there. The mailer survey asks landowners to indicate whether they have seen the squirrel and describe the vegetative cover and land-use type of their properties. Once mailed questionnaires are returned, ArcGIS will be used to create a map containing points of interest to survey for summer 2015.

Population genetic structure of wolves (*Canis lupus*) in Minnesota

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In the mid-1970s, the wolf (*Canis lupus*) population in northern Minnesota was estimated at only a few hundred wolves. The number of wolves in the state increased to around 3,000 individuals by 2005, with a slight decrease in more recent years, according to population surveys conducted by the Minnesota Department of Natural Resources. After removing the Great Lakes Distinct Population segment of wolves from federal protection in 2012, a wolf harvest season was initiated in Minnesota. Management via hunter harvest can be an effective tool for population management, though uncertainty remains in the exact effects of harvest on wolves. Recent research in other wolf populations suggests that responses to harvest-related mortality include increased litter sizes, increased migration, decreased territoriality, smaller pack sizes, and increased pack dissolution. One method of analyzing these responses is to determine the amount and geographic distribution of genetic variation in the population. Muscle tissue samples were collected from wolves harvested during the 2012-2013 wolf season (n = 413) and analyzed to determine the population genetic structure of Minnesota wolves. The average allelic richness, a measure of genetic variability, among 22 microsatellite loci was 12.82 (range 6.62-21.30). The expected heterozygosity was 0.814±0.021, while the observed heterozygosity was 0.641±0.044, suggesting a significant amount of population structure. STRUCTURE analysis identified two genetically distinct subpopulations within the state (FST = 0.0252), indicating low but significant population differentiation with individuals in the northeast clustering separately from those toward the southern and western edge of wolf range in the state.

Comparing Unmanned Aerial Vehicles (UAVs) and Manned Helicopter Surveys for Moose (Alces alces) in the Boreal Forest of the Lake Superior Watershed

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Advances in technology may have opened doors for wildlife monitoring through Unmanned Aerial Vehicles (UAVs). The lower cost and innate ability to record observations through cameras may allow UAVs to compete against the traditionally used helicopters in aerial surveys of moose (*Alces alces*). This study compares the use of UAVs and helicopters in line transect surveys of moose in the Grand Portage Indian Reserve (GPIR) in northeastern Minnesota. A mathematical spatial model will also be used to compare an ideal UAV to helicopters in both line transect and block surveys over a virtual landscape and moose population. Expected results are a close comparison between the aircraft types that could lead to a transition to potentially cost effective UAVs.

Urban Turkeys: Use of a Random, Stratified Survey of Homeowners in the Fargo (ND)-Moorhead (MN) Area to Estimate Turkey Distributions and Numbers, Human-Turkey Interactions, and Public Opinion on Turkeys

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Our original study started in 2003 using mailed surveys to homeowners to estimate the wild turkey (*Meleagris gallopavo*) population in the Red River Valley (RRV) in the Fargo/Moorhead area. In 2004, urban human-turkey interactions were monitored as well, adding a new survey in 2005 to assess public opinion on wild turkey management options. Surveys from 2003-2012 showed a thriving turkey population. For at least 4 years before 2012, we mailed approximately 200 surveys per year, mostly to people who had been on our mailing list for a number of years (originally taken from the tax rolls of homeowners in the area). Many of these people responded to our surveys for repeated years and were accustomed to receiving yearly surveys and generally had a positive opinion of turkeys. In 2014, we wanted to compare survey results between our "tried-and-true" repeat survey responders and a new, random, stratified sample taken from all homeowners in Fargo, West Fargo, Moorhead, Dilworth and 4 smaller, associated suburbs. In March 2014, we mailed 360 surveys to our "new" people in the proportions that reflected the total homeowner numbers from that particular city/suburb and 56 surveys to our repeat responders. As expected, repeat responders had a higher return rate (37/56=66%) compared to "new" responders which ranged from 19%-23% for the 4 larger cities. We got no responses from the 4 smaller suburbs. More repeat responders had a positive attitude toward turkeys (26/37=70%) than did new responders (35/70=50%). Our poster will give more survey results.

Population Genetics of Moose in Northeastern Minnesota

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Moose, *Alces alces*, are at the southern edge of their geographic distribution in Minnesota. Many moose populations at the southern edge of their range have declined in the last decade. For example, the moose population in northeastern Minnesota has declined by approximately 50% over the last 8 years. Concern over the population decline in Minnesota has led to several research projects on different aspects of moose biology and management. One of these projects was to investigate genetic variability and population genetic structure of the current moose population. We evaluated 16 microsatellite loci from moose in several regions of Minnesota, including Voyageurs National Park and the northwestern and northeastern portions of the state. Samples were collected by the DNR from hunter harvested (n=117), sick (n=6), and GPS collared (n=132) moose. Results of analyses from the Bayesian clustering algorithm STRUCTURE indicated that moose throughout Minnesota are part of a single panmictic population. Average allelic richness was 4.69 (range 1.35-10.78), average expected

heterozygosity (He) was 0.552 (s.d. 0.200), and average observed heterozygosity (Ho) was 0.489 (s.d. 0.207). Similarity in He and Ho values also indicates a lack of genetic structure. These measurements provide baseline data for comparison to future measures of genetic variability in Minnesota moose.

Factors Determining Giant Liver Fluke Infection in White-tailed Deer and Moose

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The giant liver fluke, *Fascioloides magna*, is a common parasite of white-tailed deer in the Great Lakes region. Although innocuous in deer, the giant liver fluke may increase mortality in moose. As overlap of deer and moose range increases, a higher prevalence of giant liver fluke infection in moose is expected. Deer pellets were collected across northeastern Minnesota and examined for fluke infection. Of individuals sampled, 31% had giant liver fluke infections with an average infection intensity of 264 eggs/gram dry weight feces (N=589). In addition, lymnaeid snail intermediate hosts were found at 41% of locations (N=22). Locations with lymnaeid snails had a lower pH (6.5 compared to 6.8) and higher prevalence of aquatic macrophytes (100% compared to 77%). Lymnaeid snails were found less often in areas with high proportions of developed/urban cover types, despite these areas having similar amounts of aquatic habitat. Further, there were no habitat differences in buffered areas around infected and uninfected deer pellets. We suggest that snail distribution and habitat characteristics are the primary factors leading to giant liver fluke infection in deer and moose. Understanding these snail characteristics will aid in management efforts for both species in the region.

Using Automated Acoustic Recording Devices in Avian Research: An Assessment of the Wildlife Acoustics, Inc. Song Meter

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Automated acoustic recording devices have recently become popular as an economical means of monitoring bird populations and conducting ecological investigations. With this recent popularization, questions arise regarding the utility of these recording systems when compared to human observers in the field. We investigated the utility of the most common acoustic recording device, the Song Meter SM2 (Wildlife Acoustics, Inc) for conducting point-count surveys for sub-Arctic breeding birds during the summer of 2014. We expected that human observers would have a greater detection rate than song meters because the recording devices can only detect vocalizing birds, while field observers can also detect non-vocalizing birds. Alternatively, recording devices may yield higher detection rates due to the ability of the recording interpreter to rewind the sound files and re-listen to periods of high bird activity. Our objectives for the study included evaluating 1) how bird detection rates differ between a trained field observer and an acoustic recorder, 2) whether and the degree to which detection varies by species, survey conditions, time of the season, and habitat type, and 3) how detectability varies with distance of birds from the recording device for sub-Arctic breeding

birds in relatively open tundra landscapes. We will present preliminary results from our field study on the Seward Peninsula of Alaska.

Estimates of Ruffed Grouse Detection Probability from Point Counts

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Drumming surveys are commonly used by managers as a method of monitoring ruffed grouse abundance. We conducted drumming surveys for ruffed grouse using the time-of-detection method at the University of Wisconsin - Stevens Point's Treehaven property near Tomahawk, WI. We surveyed 57 unique locations on each of three days and encountered 35-66 individuals per day. Each point count consisted of four 2.5min intervals for a total of ten minutes. We used an information-theoretic approach (AICc) with the Huggins Closed Capture option in Program MARK to consider the influence of the following variables on ruffed grouse detection: time of day, observer effect due to previous detection, cloud cover, wind speed, and distance. The same models were considered for each data set (3 separate days of sampling). While the top model varied among data sets, detection estimates were similar within model sets and the top model detection estimates for each 2.5min interval only ranged between 0.62 (SE = 0.04) and 0.64 (SE = 0.04) across all three data sets. Thus, we estimate that over 97% of the grouse at each survey location were encountered during the ten minute survey period. Our results suggest that a ten minute time-of-detection survey can be highly effective for estimating ruffed grouse numbers. Moreover, our results suggest over 85% of ruffed grouse should be detected after a point count of only five minutes. Five minute point counts would allow additional sites to be surveyed each day with only a slight decrease in the number of encountered grouse.