Maine Golden Eagle Study

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Project proposal submitted to the Maine Department of Inland Fisheries and Wildlife (MDIFW)

Abstract:

Golden eagles are of conservation concern in North America as populations are at best stable and may be declining or being held beneath carrying capacity (Millsap et al. 2022, Slabe et al. 2022). The eastern population is genetically distinct and is of concern throughout its range due to its small size, vulnerability to human threats, and considerable knowledge gaps (Katzner et al. 2012, 2020, Doyle et al. 2016). This population is listed as vulnerable or endangered in several states and provinces. In Maine, golden eagles are listed as endangered within the Maine Endangered Species Act and a Species of Greatest Conservation Need within the Maine Wildlife Action Plan (SGCN Priority 2). Breeding birds were extirpated from the state in 1997, but Maine serves as a migratory corridor and hosts a wintering population. Further, eagles telemetered for other studies have been noted near eyries during summer, suggesting that existing eyries have the potential to host breeding eagles in the future. However, the extent of use during summer and distribution and habitat use throughout the year remains largely unknown. This study will expand public outreach efforts and gather camera trap and telemetry data to better understand golden eagle presence, distribution, habitat use, and movement patterns in Maine throughout the year. In doing so, we will directly benefit eastern golden eagle populations at state and range-wide scales, with the goal being to improve the conservation of golden eagles in Maine and support similar efforts focused on the eastern population. This proposal incorporates priorities identified by the Eastern Golden Eagle Working Group and highlights research, outreach, and survey needs of a species that is listed as a Regional and Priority 2 Species of Greatest Conservation Need in the Maine State Wildlife Action Plan. The primary objectives are to 1) increase public awareness and participation in the conservation of golden eagles in Maine, and 2) address knowledge gaps and apply results to direct specific conservation and management actions.

Photo courtesy of Albert Ladd

Background:

Golden eagle breeding populations in eastern North America have experienced long-term declines over the past century (Bednarz et al. 1990). Although once breeding throughout the northeastern US, the current population now only breeds in Quebec, Labrador, and Ontario. Historically, little has been known regarding the size and distribution of the golden eagle population in eastern North America. However, in northern New England, breeding populations of golden eagles were more closely monitored, and their declines were relatively well-documented (Morneau et al. 2015). Maine hosted a breeding pair until the late 1990s (1984 – 1996, Todd 2000), New York supported multiple territorial breeding pairs until the late 1970s, and most of the remainder of New England also once supported breeding pairs. In Maine, 12 historical eyries were known and one of those was the earliest documented golden eagle nest site in North America (W.R. Spofford pers. com., Palmer 1988). This oldest eyrie in Piscataquis County was the last to host a pair and fledged the last young eaglet in 1983. The last territorial adult disappeared from the site after 1997. The decline of the species' breeding population has largely been attributed to their affinity for water birds and subsequent bioaccumulation of DDT (Todd 2000). Importantly, the historical nesting sites in Maine continue to hold promise for reoccupation by the current population. Notably, two female golden eagles telemetered in Virginia and Alabama and spent some time in the last decade exploring Maine's eyries. Thus, efforts to understand eagle presence near eyries during the breeding season and efforts to protect, maintain, or improve their suitability are of value.

Obtaining additional information regarding the wintering and migratory population is also important. Eastern golden eagles are predominantly migratory and overwinter across a wide range from Southern Quebec to Alabama with most occurring in areas of the Appalachian Mountains and other mountainous regions (Katzner et al. 2012, 2020). The best source of information regarding the size of the eastern population was based on migration count data (Dennhardt et al. 2017), because migratory birds tend to concentrate along ridge lines that support updrafts, including those in Maine (Fig. 1). However, once eagles reach their wintering grounds they are not easily observed (Katzner et al. 2012) and thus traditional survey methods are of little use. Camera trapping and telemetry in the mid-Appalachians and southward have been the primary source of information on habitat use and distribution (Miller et al. 2017, Duerr et al. 2019, McCabe et al. 2021). Nonetheless, there remains limited information on regional population size, density, habitat use, and distribution during winter in the far northeast (ME, VT, NH, northern NY, [Katzner et al. 2012, Miller et al. under review]).

Further, across the range, there is a lack of understanding of eagle flight behavior during winter which might put them at risk of collision with wind turbines. In contrast to migration, wintering birds may be more at risk for collisions with wind turbines (Miller et al. 2017) because flight altitudes tend to be lower and because eagles engage in known risky behaviors including interactions with other eagles and hunting. They are known to winter along ridgelines that are also suitable for wind turbines and given the expected build-out over the next 20 years, there is a potential for negative interactions. Understanding these knowledge gaps is critical to conserving this species in Maine.

Justification and Conservation Actions:

Our current understanding of golden eagle presence in Maine is deficient. Estimates are primarily based on eBird, migration count sites, and migration surveys at proposed wind facilities, all of which likely underestimate the size of Maine's wintering golden eagle population. This is because golden eagles exhibit "secretive" habits and will frequently perch in the dense forest where they are difficult to see, even by experienced birders and observers (EGEWG unpublished data). For example, golden eagles have been recorded on camera traps in large numbers (> 9 individuals recorded on 3 cameras placed within 10 km of one another in two weeks) in Arkansas. Yet over 4 days during that same time, an expert eBirder and golden eagle researcher who was in the same area did not see a single bird away from the camera trap (M.J. Lanzone and T.A. Miller, pers. com.). Similar observations have occurred in other areas of the eastern US, including Alabama, North Carolina, Virginia, West Virginia, and Pennsylvania.

Through efforts outlined in this proposal, we seek to work towards documenting the presence of Golden Eagles throughout the annual cycle to inform our knowledge of their annual distribution in Maine. This may include collecting and organizing incidental observations, but we also intend to bolster efforts using camera traps because this is the most effective method of detecting and identifying golden eagles. The accurate identification of golden eagles at known locations will not only improve our understanding of their distribution in the state but will also increase public awareness of their presence through outreach and community science initiatives. Further, data from camera traps can also have the potential to be used to estimate the density/abundance of a population (Nakashima et al. 2018, Luo et al. 2020, Stien et al. 2022), a key gap in our knowledge of the species.

Bait sites used for camera trapping serve a dual purpose because they can also be used for trapping golden eagles for telemetry studies. Thus, we intend to identify camera trap partners, appropriate sites, and establish camera monitoring in the first year to facilitate capture of 3 golden eagles. Our initial goal will be to affix three eagles with GPS transmitters in the second year of the project. Data collected from telemetry will not only be used to understand the distribution but also to understand habitat use and selection.

Photo courtesy of Laura Zamifrescu

The successful implementation of this proposed two-year project will set the foundation for achieving the overall program goal of capturing and affixing transmitters to 8 – 10 golden eagles. Transmitter movement data, in additional to camera trap, eBird, MDIFW occurrence records, will help inform our understanding of distribution and presence, habitat use, winter home range, movement patterns, and risks of wind development in terms of topography, airspace, and temporal contexts to inform environmental review (MDIFW ETSC database, wind development pre-construction, project design [e.g., turbine placement and selection], construction, and mitigation). The analysis of occurrence, movement, and other relevant data layers (e.g., land cover, topographic features) can be used to create spatially explicit resource selection function (RSF) models. RSF models can predict airspace use of Golden Eagles and estimate collision risk. Spatial risk distribution invaluable in land use planning of wind development to limit risks to Golden Eagles. The work proposed here will provide the first steps towards achieving these insights.

Initial project efforts will contribute to improving the conservation and management of golden eagles in the state. For example, the use of specific areas by golden eagles could inform best practices for forest management and recreational use (Miller et al. 2014). Further, with transmitter movement data and potential future operation of year-round camera traps (at some sites with high winter use), we hope to document the use of areas near historical eyries. Documentation of golden eagle occupancy in regions associated with historical breeding sites will help support efforts to protect and manage these locations to maintain or improve suitability for the potential recolonization by breeding pairs. Management may include connecting and maintaining a dialogue with landowners, collaborating with the rock-climbing community, providing forest management recommendations, and participating in any environmental review or development projects that may impact the area.

An additional benefit of capturing eagles is that it provides an opportunity to collect blood and feather samples to understand the levels of environmental contaminants. Lead exposure is an important issue facing golden eagles at an individual and population level (Slabe et al. 2022), with evidence for these effects on bald eagles also documented at the state level (Call 2020, Hanley et al. 2022). While outreach in other regions has occurred (e.g., Schulz 2020), an understanding of how best to educate and inform hunters of the benefits of nonlead ammunition in the eastern US and Canada are still being explored. The extent of exposure to lead has not been investigated in the eastern golden eagle population in Maine and evidence would serve to bolster the strength of outreach narratives.

Golden eagles that are captured will also help inform critical knowledge gaps in the understanding of highly pathogenic avian influenza (HPAI) in wild birds, (Erica Miller, University of Pennsylvania, pers. comm.). The outbreak of this disease strain has impacted wild aquatic birds, domestic poultry, and their predators including raptors. Therefore, we intend to test all captured eagles for HPAI and follow protocols to limit the spread of the disease among captured birds and researchers.

Phase 1 Goal: Increase public awareness and participation in Maine's conservation of golden eagles.

Objective 1.1: Encourage and improve the frequency and accuracy of golden eagle sighting reports from partners and community scientists.

Strategy: Develop updated outreach materials and messaging to improve the identification of golden eagles and encourage community scientists and other partners to report golden eagle sightings (either incidental or through camera trapping).

Objective 1.2: Promote and increase awareness of the community science golden eagle camera trapping effort.

Strategy: Develop outreach and messaging materials to encourage participation in the community science camera trapping program.

Phase 2 Goal: Address knowledge gaps of golden eagles in Maine to direct specific conservation actions.

Objective 2.1: Improve documentation and understanding of golden eagle occurrences and movements in Maine to inform conservation actions.

Strategy 1: A golden eagle field coordinator (part-time position) based in western Maine, will participate as well as bolster the involvement of community scientists, hunters, available and interested state staff (e.g., MDIFW, MDOT, Warden Service), and partner agencies to help maintain 5 - 10 camera trap study areas near historical eyries (when possible), recently confirmed sightings, or high-use regions previously documented through telemetry or other means.

Strategy 2: During the initial efforts of the project outlined in this proposal, capture three golden eagles, and attach telemetry devices, with the intention of continuing capture and telemetry efforts based on success and available funding.

Strategy 3: Document distribution and presence of golden eagles in Maine by summarizing camera trap, eBird, MDIFW records, telemetry, and other available sources of information.

Objective 2.3. Collect information on eastern golden eagle exposure to environmental contaminants and disease.

Strategy: Sample and analyze the blood and feathers of captured individuals to identify potential contaminant exposure, including lead, mercury, and potentially per and polyfluoroalkyls (PFAS). Collect mouth swabs and cloacal swabs to test for highly parthenogenic avian influenza and possibly other pathogens.

Methods:

Phase 1 Goal: Increase public awareness and participation in Maine's conservation of golden eagles.

Photo courtesy of Garth McElroy

In collaboration with MDIFW information and outreach staff, we will develop messaging (e.g., website, social media posts, blogs) to improve identification of golden eagles, increase awareness of MDIFW's interest in the observation of the species, improve participation in camera trapping, as well as inform the public of the benefit of nonlead ammunition for golden and bald eagles as part of the community science camera trapping protocol.

Phase 2 Goal: Address knowledge gaps of golden eagles in Maine to inform conservation actions.

<u>Presence and distribution:</u>
With the assistance of an MDIFW golden eagle field coordinator we will partner with 5 to 10 camera trap participants. This may include MDIFW Regional Biologists, landowners, community scientists, and partnering Departments (e.g., potentially MDOT, Warden Service) and other agencies. The goal will be for partners to follow camera trap protocol for the first two years of the project. Potential locations for sites include areas with recent confirmed sightings, locations in the vicinity of historical eyries, or areas where eagles were documented previously through telemetry.

A road-kill deer or other carcasses (lead-free) will be used as bait. Sites will be selected in consultation with CSG prior to the trapping period. Camera trap data will be collected following the Eastern Golden Eagle Working Group's camera trapping protocol and updated guidance from CSG specific to Maine. When sites are visited, SD cards will be changed, and images will be transferred to a hard drive and uploaded to a cloud backup. Where possible, we will use cell-enabled cameras that upload images to the manufacturer's website. For these sites, we will monitor scavengers, bait, and battery levels remotely and visit sites only when the bait needs refreshing or batteries need to be changed.

Camera traps will be active throughout the year following two monitoring approaches. During the winter, from January 1 to mid- to late February bait will be maintained throughout the period. If goldens are not detected after two weeks of site operation (camera trap present with bait maintained), the camera will be moved to another site and maintained with bait. This

process will continue during the winter in the hopes of finding suitable locations for detecting golden eagles. The winter period is after most southbound migrants have passed and before most northbound migrants begin passing through Maine, ensuring that the individuals captured on camera traps are wintering in Maine. Sites will be visited as needed (generally weekly) to refresh bait.

At sites where goldens were consistently present between January through February or at sites near historical nesting eyries, camera traps may be run from April - December, replenishing carcasses once per month. We expect that carcasses will last <1 week depending on the number of scavengers and the presence of large scavengers such as coyotes. By only replenishing once per month, we expect that the bait will only attract eagles that are in the vicinity and not lead to long-term occupancy by migrants and subsequent short-stopping during migration. If after two months, no golden eagles are detected a new camera trap site will be selected and maintained.

At the end of each month throughout the year, data will be uploaded to a desktop Camelot Project (https://camelotproject.org/) or web-based analysis system (e.g., Wildlife Insights) reviewed, and processed. We will document the presence of golden eagles at each site and include that information in our distribution map. Additionally, we will count the number of visits (i.e., images with eagles).

All camera trap data collected in the state, eBird reports, MDIFW reports (e.g., emails reports, ETSC, Maine Bird Atlas), telemetry data, and regional ornithological journals will be reviewed. When a golden eagle(s) was detected at a camera trap, in an eBird report, or noted in the literature, the location will be noted at the finest scale possible, as well as the date, the number of eagles observed, and the source of the data (i.e., camera trap, eBird, etc.). All historic and contemporary data will be added to the same database and the results mapped. Data will be shared in a format that best meets the needs of MDIFW.

Habitat use, winter home range, and movement patterns:
Sites with golden eagles may be visited for the capture of individuals during January – February. Once captured, the age and sex of each bird will be noted, morphometric measurements taken, and a band and telemetry unit (< 50 g) will be attached.

The telemetry units we plan to deploy will be manufactured by Cellular Tracking Technologies, LLC (CTT). We plan to use ES-400 GSM/GPS transmitters. The form and function of these devices can be custom designed for eagles. The manufacturer indicates that the ES-400 features an internal antenna, precision GPS, 3-axis accelerometer, geofence capability, multiple duty cycles, Over-The-Air programming, ActivityIndex™, and advanced solar recharging. Additional details on these units are at https://celltracktech.com/pages/es400. The units weigh <50 g and together with the harness will weigh <3% of an eagle's body weight. The units are expected to last 3 years; however, we have many units on Eagles that have continue to operate for >5 years.

The ES-400 telemetry devices collect a suite of information at each relocation, and even between relocations. At each relocation, we anticipate collecting GPS data (latitude, longitude,

time, date, altitude above sea level (in m), speed (knots), heading (deg), bearing (deg), and data on fix quality - # of satellites, 2D vs 3D, and horizontal and vertical dilution of precision. GPS data will be set to "flight mode", so that data are collected at 15-minute intervals when the bird is not moving, but 1-10 second intervals when the bird is in flight. These data are essential to understanding the fine-scale responses of eagles to human development, including changes in flight behavior (Bergen et al. 2022).

Beyond the GPS, we will also collect accelerometry data on each bird. Accelerometry data are collected many times per second, thus much more frequently than each relocation. There are two modes by which these data can be collected, and we anticipate discussing these options with MDIFW to identify which data collection approach fits their needs best. At its simplest, accelerometry data can be aggregated onboard the telemetry device to provide an "activity index", which can be useful in identifying both periods of activity and potential fatality events.

Data collected by the telemetry units will be automatically downloaded each night from the CTT server and added to the Conservation Science Global custom-designed SQL Server Database that houses telemetry data from > 1000 birds including > 400 golden eagles.

This initial data from 3 golden eagles will contribute to the goal of capturing and affixing transmitters on 8 – 10 individuals. This sample size will facilitate the analysis of occurrence, movement, and other relevant data layers (e.g., land cover, topographic features) to create spatially explicit resource selection function (RSF) models. Th RSF model can predict airspace use of Golden Eagles and estimate collision risk in the context of wind development. Understanding the spatial risk distribution can inform land use planning of wind development to limit risks to Golden Eagles.

<u>Contaminants and disease</u>:
We will also collect blood and feather samples for contaminants (lead and mercury) and blood samples for pathogen analysis, DNA sex determination, and a DNA archive. Blood samples will be sent to Dr. Todd Katzner at USGS in Boise, Idaho. The Katzner Lab manages and processes a large collection of blood and feather samples. Blood samples will be sent from the Katzner Lab to Michigan State University Veterinary Diagnostics Lab for heavy metal analysis. HPAI samples will be sent directly from CSG to Colorado State University Veterinary Lab. Should PFAS analysis be conducted, we will send samples to Biodiversity Research Institute for analysis. Results will be summarized and included in our final report.

Photo courtesy of Avian Haven

Proposed Timeline:

Project Year	Month	Activity
Year 1 (November '23 - August '24)	November 2023	Contract awarded
	December 2023	Purchase supplies (8 cameras, 3 telemetry units, etc.)
		Start identifying camera trap partners and sites
	November - December 2023	Continue to id partners and sites, develop, and disseminate outreach materials
	January - February 2024	Run cameras traps, continue outreach efforts
		Evaluate photos, summarize occurrence and distribution data
	April - August 2024	Run cameras traps at high use/eyrie sites
Year 2 (September '24 - November '25)	September 2024 - Dec 2024	Continue running camera traps at high use/eyrie, camera trap partner communication, outreach
	January - February 2025	Run camera traps, trapping and affixing transmitters, partner collaboration and outreach
	April - November 2025	Run camera traps at high use/eyrie sites, trapping if transmitters are available, develop, and submit proposal for continuation of project. Submit project deliverables.

Qualifications and responsibilities:

Tricia A. Miller, Ph.D., is a Senior Research Wildlife Biologist and Executive Director of Conservation Science Global (CSG). She has been studying the eastern population of Golden Eagles since 2005, completing her dissertation on the ecology of the eastern population. She has extensive experience trapping and tagging Golden Eagles during winter, having trapped >70 across the eastern US. She has >50 published manuscripts and was a co-author on the Golden Eagle account on Birds of the World. She is also a founding member of the Eastern Golden Eagle Working Group. Miller will lead all aspects of the work conducted by CSG, including trapping, ordering telemetry units, data analysis, and supervision of CSG staff. Additionally, she will assist E. Call as needed.

Melissa Braham, is the Director of Data Science and Analytics and manages all SQL databases at CSG. She has more than a decade of experience working with databases, telemetry data, and GIS. For this project, she will manage all aspects of telemetry data collection including entering individual eagles into the database and reviewing and inspecting telemetry data for errors. She will also produce any maps required for this project.

Steve Runyon, is a Computer Technician at CSG and is in charge of maintaining all technical aspects of CSGs SQL Server databases. He assists Braham and Miller as needed for any IT needs (e.g., coding, AI needs, etc.) and ensures that all databases are running and properly backing up, among other things. He will do the same for this project.

Michael Lanzone will be a contracted eagle trapper on this project. He and Miller will work together to trap and tag eagles for this project. Lanzone has >30 years of experience trapping raptors, is a founding member of the Eastern Golden Eagle Working Group, has studied the eastern population of Golden Eagles since 2005, and has trapped, tagged, and banded >100 Golden Eagles.

Erynn Call, Ph.D., is the Raptor Specialist with MDIFW and has focused on the conservation of Maine's raptors for 10 years. She has coordinated community science programs to monitor breeding peregrine falcons as well as extended the focus of her dissertation into a monitoring program to understand river-associated avian assemblages including Osprey and Bald Eagles. She is a member of the Eastern Golden Eagle Working Group and the Atlantic Flyway Council Raptor Committee. Dr. Call will be responsible for overseeing the review and funding logistics of this proposal, supervising, and assisting the Maine Field Coordinator, and developing and disseminating outreach materials. She also will assist CSG with trapping.

Evan Jackson will be the Maine Field Coordinator and work closely with Dr. Call to correspond, coordinate, and recruit community scientists and other partners in establishing, maintaining, and monitoring camera trap sites, maintain camera traps himself, as well as tracking other confirmed Golden Eagle observations throughout the state. Jackson serves in the position of Lecturer 1 within the Department of Biology at the University of Maine, Farmington, and has also been responsible for conducting surveys and data entry and management as part of the Maine Peregrine Program since 2019.

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