# Department of Natural Resources
# SCI-MIC Project Requests for 2021

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## ADVANCING GENETIC ANALYSIS CAPACITY OF MICHIGAN DNR TO SUPPORT WILDLIFE DISEASE AND POPULATION MANAGEMENT

MANAGEMENT NEED AND APPLICATION: The Michigan Department of Natural Resources Wildlife Division proposes to purchase an Illumina MiniSeq Sequencing System (MiniSeq) to facilitate high-throughput genetic analyses for wildlife population health and management. This machine implements recent technological advances in genomic science and will allow for the expansion of capabilities currently available through the Wildlife Health Section. For example, this machine will allow us to address needs for large-scale surveys and will facilitate genomic sequencing approaches to better address host-pathogen interactions. This machine harnesses cutting-edge technology to allow for many animals to be analyzed at a single time, both driving down costs for personnel time and consumables while producing high-quality digitized data readily available for analysis.

Wildlife Disease Assessment

The DNR has received funding through the Michigan State University and Michigan DNR joint Wildlife Disease Initiative ($233,697) and the Fish and Wildlife Multi-state Conservation Grants Program ($143,000) for the development of a standardized, high-throughput genetic resource to inform white-tailed deer population and disease management. The end-product of this work will include a genomic panel designed specifically for wildlife managers to identify genetic variation in white-tailed deer relative to disease status. The panel will be faster, more universal, provide more information, and be less expensive than current methods being employed.

Once the panel is available, the DNR will be able to use the MiniSeq to gather genetic data to assess the susceptibility of deer to Chronic Wasting Disease (CWD), determine whether CWD or tuberculosis (Tb) positive deer are of local origin, resolve relationships among diseased animals, and determine how landscape features impact population connectivity and disease spread. These data could help inform decisions on several important management issues including: 1) delineation of deer management units to better align with disease presence and potential for spread in the local landscape, 2) identifying harvest regulations that could impact spread or prevalence of disease, 3) planning for long-term disease surveillance to align with the genetic potential for deer to harbor the disease without apparent symptoms, and 4) allocation of local population control augmentation efforts to maximize the potential to limit spread of disease.

Black Bear Population Monitoring

The Wildlife Division's black bear program is proposing a project to begin in FY2021 that could benefit from the MiniSeq for estimation of black bear populations in the Upper

Peninsula (UP). Most Michigan black bears are found in the UP, and they have important biological, social, and economic impacts. Hunting is the primary tool for management of bear populations in Michigan. A black bear population estimate is critical to ensure the DNR can make appropriate harvest quota recommendations and evaluate the effects of previous harvests on the UP-bear population. A sound population estimate helps ensure bear populations remain at levels that provide sustainable harvest, minimize nuisance issues, and maintain a positive public perception of bears.

The DNR's current bear population estimation technique relies on a statistical modeling framework called statistical catch-at-age analysis (SCAA), which provides detailed, annual estimates of the bear population in the UP and northern Lower Peninsula (NLP). The SCAA models combine harvest composition and effort data provided by hunters to model changes in the bear population over time, scaling the population abundance estimate with information from periodic independent population estimates. Past research has indicated that without an independent population estimate about every 5 years, the UP SCAA model would overestimate the bear population, which could affect the quota-setting process and potentially the bear population. Since 1990, the DNR has used a mark-recapture technique using the antibiotic tetracycline to estimate the UP-bear population. Due to recent changes in federal regulatory guidelines, the DNR can no longer conduct the tetracycline survey and is researching a replacement technique. The newly developed technique called close-kin mark-recapture (CKMR) shows promise, but the proposed methodology is dependent on a MiniSeq platform. The CKMR technique would allow the DNR to estimate the bear population in the UP based on genetic identification of parent-offspring pairs in the bear harvest. Using the CKMR technique could save the DNR at least 2,000 hours of staff time per survey year over the tetracycline survey and would provide estimates 1.5 years earlier than with the tetracycline survey. If successful, the DNR could also use the CKMR technique in the northern Lower Peninsula, replacing the current genetic mark-recapture survey and saving an additional 3,000 hours of staff time per survey year. In both cases, the DNR would use the CKMR-based population estimate as input for the SCAA models.

The MiniSeq platform would allow for the development of similar panels for other managed wildlife species as being done for deer and proposed for bear to assist the Department with high quality genetic data to inform management decisions.

Partners: The DNR is partnering with Iowa State University, University of Wisconsin-Milwaukee, Texas A&M University- Kingsville, and the USGS National Wildlife Health Center on the deer panel project and proposes to partner with Michigan Technological University and at least one additional partner on the bear CKMR project.

Partners: Safari Club International-MIC and MDNR.

Timeline and Budget: Purchase of the MiniSeq by 2023; total cost $49,500.00.

Targeted funding request from SCI-MIC for 2021: $6,000.

**Deer and Northern Hardwoods in Michigan**

MANAGEMENT NEED AND APPLICATION: White-tailed deer are arguably the most important terrestrial wildlife species to the economy of the Great Lakes region. About 700,000 hunters pursue deer in Michigan each year, spending an estimated 9.75 million hunting days and generating over $1 billion in revenue. In general, the hunting community equates high deer densities to an improved hunting experience, thus harvest season quotas and land management practices that reduce deer numbers attract considerable public criticism. However, high deer densities can have negative economic and ecological consequences. For example, deer have been implicated in the decline of desirable northern hardwood forests (like oak, yellow birch, and hemlock) in Michigan through browsing of tree seedlings and saplings. In some areas, herbivory by deer (and potentially snowshoe hare) undoubtedly have negative impacts on forest regeneration, which ultimately impacts future forest composition and deer habitat. However, the explanation for the decline of northern hardwood forests in many areas of Michigan is likely more complex than just deer herbivory. Other factors like past forest management (e.g., selection silviculture), forest insect and disease outbreaks, and a rapidly changing climate are also implicated in the decline.

Northern hardwood forests are one of the most valuable timber types in Michigan, both economically and for wildlife habitat. The Michigan Department of Natural Resources (MDNR) and forest products industry are interested in evaluating innovative silvicultural approaches to ensure desirable hardwood tree regeneration while minimizing deer browsing impacts. This project evaluates innovative silvicultural approaches to forest management that alter deer behavior in northern hardwood management areas to reduce browsing effects on tree regeneration. The premise is that these innovative prescriptions can be used to help mitigate deer herbivory impacts, improve seedbed quality, and provide competitive advantages for desirable tree species. The goal of the research is to identify cost-effective silvicultural techniques that allow regeneration of diverse northern hardwood forests in the presence of deer at densities that offer hunters reasonable opportunities for success.

Partners: Safari Club International-MIC, Michigan State University, MDNR.

Timeframe and budget: This project started in the summer of 2016, with the first phase of the deer portion scheduled to end in the spring of 2021 (4+ years). The initial budget for deer work approved by MDNR-Wildlife Division was $283,777, with equipment costs projected to exceed that budget. The forest monitoring component of the project started in summer of 2016 and is projected to run for 10 years (the time frame required to ensure that tree regeneration is free to grow). The budget for forest monitoring from MDNR-Forest Resources Division is >$600,000.

Targeted funding request from SCI-MIC for 2021: $3,000.

**Wolf Population Management Project**

MANAGEMENT NEED AND APPLICATION: The gray wolf has returned to its former range in the Upper Peninsula of Michigan (UP). Since 1989, the Department has monitored wolf population growth and range expansion. As Michigan's wolf population size increased and exceeded levels that required Federal and State agencies to protect the wolves under endangered species statutes, wildlife managers increasingly found themselves responding to wolf-related conflicts. This change in focus prompted the Department to update the state's wolf management plan. The Department revised the management plan in 2015 and is again in the process of updating the plan in 2020. As part of the wolf management plan revision, the Division will survey the public to assess their attitudes and beliefs regarding wolves and various management options. The social science data collected as a part of this study will provide critical input to the plan's revision.

As the wolf population increased, the Department developed a program of research to aid in monitoring their recovery and management. An important component of this work has been the capture and tagging of wolves with telemetry collars to determine their survival, cause-specific mortality, movements, and pack and territory size. Over 500 wolves have been captured and radio-collared to provide this valuable information. We have completed the transition from deploying VHF collars to GPS collars that transmit data through satellites. The GPS collars provide more frequent and more accurate locations without the need and expense of aerial relocation flights. At the end of 2020 we were monitoring 29 GPS collared wolves.

In 2020, due to the pandemic, our field work was limited. Despite a very short trapping period, we were able to put four new wolves on the air. We also collared six new wolves incidentally captured by coyote trappers in the fall.

The information collected from our collared wolves continues to be critical to our biennial wolf abundance surveys. Most importantly, the movement information and identification of pack territories allows us to interpret winter track survey data to estimate wolf abundance. Estimates of wolf abundance are the most important piece of information we collect on this population. The Division is currently developing a proposal to evaluate alternative abundance estimation techniques using occupancy modeling approaches. Any new abundance technique will still rely heavily on having collared wolves on the landscape.

Partners: Safari Club International-MIC and MDNR.

Timeframe and budget: Wolf population monitoring began in 1989 and work continues annually. Total annual costs are approximately $60,000 to over $100,000.

Targeted funding request from SCI-MIC for 2021: $4,000.

## Orphaned Cub Program

MANAGEMENT NEED AND APPLICATION: Bear cubs are typically born in January and are fully dependent on their mother until approximately 7 months-of-age. During this time of dependency, cubs sometimes become separated from their mothers and/or their mothers die leaving them orphaned. Sometimes these orphans are found by well-intentioned people and turned over to DNR. Removal of a few cubs annually from Michigan's bear population would have no effect on sustainability of bears, however; it has been repeatedly confirmed that euthanasia of orphaned cubs is not publicly accepted. Orphaned cubs less than approximately 4 to 6 months-of-age can be successfully placed with sows that have their own cubs. For this purpose, DNR maintains 6 to 8 radio-collared adult sows annually so they can serve as surrogate mothers for orphans.

Additionally, surrogate sows are used for training DNR staff in anesthetizing and handling bears, and they are incorporated into educational programs. For example, DNR has made available online curriculum for K-5 on the life history of Michigan bears and some of the information used for developing these materials originated from surrogate sows'. Occasionally, DNR allows stakeholders, reporters, and politicians to accompany biologists on winter den checks to replace radio-collars. This is done in an educational setting and provides positive public relations. Lastly, although the number of sows maintained annually is not enough for conducting rigorous research, data from den checks collected over many years provides supplemental information on habitat use and reproduction valuable for monitoring the bear population.

PARTNERS: SCI-MIC and MDNR

TIMELINE AND BUDGET: This is an annual project funded by MDNR.

Targeted funding request from SCI-MIC for 2021: $4,000.

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## NEW PROJECT FOR 2021:

## Deer Behavior and CWD

MANAGEMENT NEED AND APPLICATION: Effective CWD management strategies depend on understanding how disease spreads and grows on a landscape. While we have developed advanced models to estimate the spread and growth of CWD in Michigan, there is a critical need to inform the fundamental process that leads to disease transmission among deer. Transmission pathways for CWD are through direct (deer to deer) and indirect (environment to deer) contacts. This research is designed to quantify how the landscape, deer density, and artificial attractants, such as bait, influence where and to what extent deer congregate, actual physical contact among individuals, and the accumulation and persistence of deer feces; all factors in transmission of CWD.

Recent studies of CWD transmission pathways in white-tailed deer (Odocoileus virginianus) have focused on common patterns of within and between group interactions of radio-collared deer. These studies imply direct contacts by assuming that animals in close proximity in time and space have an opportunity to directly contact each other; however, direct contact is not observed and can vary from predictions. In theory, this information is useful, but practical use is limited because direct interactions among a few individuals may fail to represent potential interactions among all deer in a population. For example, interactions among unrelated deer can increase with increasing group size and at concentrated food sources. Indirect contacts are particularly important because unrelated deer are less likely to temporarily occupy the same areas and congregation behavior of unrelated deer varies seasonally. A better understanding of how deer ecology and social interactions facilitate direct and indirect contacts among deer is critical for understanding CWD transmission within populations.

Existing estimates of indirect contacts among deer are based on overlapping space-use by collared deer and do not account for important processes such as the differential shedding of infectious agents. Infectious CWD prions from cervids are shed in feces, saliva, urine, and blood and remain infectious in feces for up to 7 freeze-thaw cycles. Quantifying the accumulation and persistence of feces in different habitats would be informative for understanding the potential for disease transmission through indirect contact, particularly in the Midwest where deer frequently congregate in agricultural areas in late winter and early spring. Seasonal congregation of deer influences localized deer density and may lead to increased bioaccumulation of feces and potential for increased fecal prion seeding. While deer in northern forested regions congregate seasonally in “yards” for thermal cover and food resources, these factors are not limiting for deer from agricultural regions. Thus, we question whether predictable factors influence deer congregations, social behavior, and associations in agricultural regions of the Midwest.

Direct and indirect contact behavior among deer may be facilitated or disrupted by the presence of bait, which has been shown to alter the movement behavior of deer. In the presence of bait, deer significantly shift space use, potentially increasing opportunities for direct and indirect contact. Unfortunately, few studies have documented the temporal impacts of bait (i.e., how quickly deer behavior changes and for how long). While changes in deer movement patterns have been documented, little is known about how direct contact behaviors or the shedding of infectious agents differ in the presence of bait. Given the controversial nature of baiting deer in Michigan, a better understanding of potential deer behavioral changes related to bait is warranted.

A critical need for CWD management is to identify what factors influence aggregations of deer in agricultural regions and to quantify how those aggregations influence direct contacts (i.e., physical contact behavior) and bioaccumulation of feces at scales relevant for newly developed agent-based models for CWD. Understanding factors that influence congregations in agricultural regions and how deer interact under these circumstances would assist in epidemiological modeling for population management and disease control actions. This research would represent a critical advancement in

CWD knowledge, directly inform holes in existing disease modeling efforts, and have clear applications for CWD management.

PARTNERS: MDNR, MSU-Boone and Crockett Quantitative Wildlife Center

TIMELINE AND BUDGET: This project was initiated in winter 2021 and continues through 2022 with the possibility to extend through 2024. Total cost of this project is $204,000 plus in-kind services from MSU and DNR.

Targeted funding request from SCI-MIC for 2021: $6,000.