



**SUMMARY OF
SUSTAINABLE FORESTRY
AND
OTHER RESEARCH
Fiscal Year 2014**

MICHIGAN DEPARTMENT OF NATURAL RESOURCES MISSION STATEMENT

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Background

The State of Michigan, under the Department of Natural Resources (DNR), supports research and development projects that contribute to the management of Michigan's forest lands in such a way as to sustain those resources and associated values for future generations. This report is an annual summary of those projects for the DNR's 2014 fiscal year (October 1, 2013 through September 30, 2014).

The DNR is committed to the continuous improvement of forest management in the state on all forest lands, but specifically state forest lands. Forest management in the state is guided by a hierarchy of plans: the *Forest Action Plan* (currently called the Forest Resource Assessment and Strategy (2010-2020)); the *State Forest Management Plan, 2008 (2008-2018)*; and three *regional state forest management plans (2013-2023)*. The state and regional plans apply to state forest lands, and the Forest Action Plan applies to all forest land in the state.

Research is one of several integral components of a sound forest management program and is one of two critical components of adaptive management (the other being effectiveness monitoring). Together, effectiveness monitoring and research (also referred to as validation monitoring) reach their maximum utility, which is diminished if one is done in the absence of the other. Research or validation monitoring is used to identify and validate or verify the assumptions and causal pathways underlying a conceptual model of how we believe a system or part of a system works. It is critically important that the results of research are integrated back into the forest management process or system through the development of tools, techniques, best management practices, guidelines and policy.

Policy Context

Almost all of the state forest land in Michigan is certified under two different sustainable forestry program standards: the Sustainable Forestry Initiative (SFI) and the Forest Stewardship Council (FSC). Implementation of these standards in terms of forest management is interpreted and directed by a suite of 20 work instructions. Work Instruction 5.1 speaks to coordinated natural resource management related research (http://www.michigan.gov/documents/5_133216_7.1.pdf).

The work instruction requires that the DNR, through the division research coordinators, produce a research summary report, report internal and external research funding for the SFI Annual Report and a review of research and implementation needs and opportunities. This research summary report represents partial fulfillment of this work instruction requirement.

Research Summary

To meet the requirements of certification, the required summary focuses on the research that occurs within forested landscapes considering one or more elements of forested ecosystems and or associated social and economic systems. Because of research's close association with effectiveness monitoring, the forested landscape research is considered within the monitoring framework for sustainable forests: that is, the criteria and indicator framework of the Montreal Process (<http://www.montrealprocess.org/>). However, since the suite of indicators is more of a moving target than the criteria under which they fall, the research projects are categorized only using the seven criteria. Projects that are related to more than one criterion are listed under the primary criterion with the other linkages being identified.

Research Administration within DNR

Research is administered and supported differently in each of the DNR divisions; however, each division has a research coordinator as a point-of-contact. The Wildlife Division (WD) and Fisheries Division (FD) administer all research activities through their respective research sections. These divisions also have a significant portion of their research efforts funded by a variety of federal grants that have annual reporting requirements. Forest Resources Division (FRD) and Parks and Recreation Division (PRD) do

not have dedicated research sections, and consequently the administration and support of research occurs through each program area.

Research that supports sustainable forestry occurs through a variety of mechanisms. The DNR supports a large number of research projects contracted or partnered with several universities within the state and some beyond its borders. The DNR also supports a Partnership for Ecosystem Research and Management (PERM) program with Michigan State University (MSU). The DNR also employs its own research and monitoring staff in FRD, WD and FD.

Research programs and projects are providing useful information to support improvements in our operations and business practices, and each division uses a different array of means to communicate those research findings to staff. Division in-service trainings, specialist meetings and ongoing field and program communications are examples of the means used to convey research information to DNR personnel.

For more information about specific research programs or projects, interested parties should contact the research coordinator for the appropriate division. The research coordinator for each division is listed below with their respective contact information.

Scott Jones, Forest Certification Specialist, FRD, 517-284-5873, Joness38@michigan.gov

Ron Murray, Forest Health Unit Supervisor, FRD, 517-284-5886, murrayr@michigan.gov

Steve Beyer, Research Coordinator; WD, 517-243-5179, Beyers1@michigan.gov

Gary Whelan, Research Program Manager, FD, 517-5840, whelang@michigan.gov

Alicia Ihnken, Research Coordinator, PRD, 517-284-6129, ihnkena@michigan.gov

Research Related to Sustainable Forestry – Currently On-Going

Criteria Framework for Sustainable Forestry and Associated Research:

1. Criterion One: Conservation of Biological Diversity

Landscape Diversity:

Conduct Forest Inventory and Assessment (FIA) Re-measurements

Primary Contact: Scott Pugh, US Forest Service, Houghton, MI spugh@fs.fed.us, 906-482-6303 x 17

DNR financial support: \$87,998.00

Study Area: Forested Landscapes nationwide including Michigan

Time Frame: Long-Term, On-going.

Web Site: <http://www.fia.fs.fed.us>

Abstract: The FIA program has been the Nation's continual forest census since 1930. We collect and analyze data collected from permanent sample plots to enable reporting information on the status and trends of America's forests: how much forest exists, where it exists, who owns it, how it is changing, and also how the trees and other forest vegetation are growing, how much has died or been removed and how the harvested trees have been used in recent years. This information can be used in many ways, such as in evaluating wildlife habitat conditions, assessing sustainability of current ecosystem management practices, monitoring forest health, supporting planning and decision making activities undertaken by public and private enterprises and predicting the effects of climate change. The FIA program combines this information with related data on insects, diseases and other types of forest damage to assess the current health and potential risks to forests. These data are also used to project how forests are likely to appear in 10 to 50 years under various scenarios to evaluate whether current forest management practices are sustainable in the long run

and to assess whether current policies will enable our grandchildren and their grandchildren to enjoy America's forests as we do today. Although this is a national program, the results can be and are summarized for regions and individual states.

The data from this program can also be used to inform the species diversity indicators and Criterion Two: Maintenance of Productive Capacity and Forest Ecosystems.

Development of a GIS-Based Inventory System for the Michigan State Forest – Michigan Forest Inventory (MiFI)

Primary Contact: Jason Stephens, DNR FRD, stephensj@michigan.gov, 989-732-3541 ext 5010
DNR Financial Support: \$736,039.00

Study Area:

Time Frame: Long-Term, On-going.

Abstract: This project is moving the former inventory system – Integrated Forest Mapping Assessment and Prescription (IFMAP) - to a new operating platform and reinventing the system to provide greater utility while simplifying input and output methodologies. The MiFI system will provide a more user-friendly environment for both power and casual users, thus enhancing the utility of the system overall for collecting, storing, processing, and providing data and information to inform resource management decisions.

Critical Silvicultural Research Conducted by PERM Research Forester on Sustainable Regeneration of Northern Hardwood Stands Following Impacts By Invasive Species That Threaten Forest Productivity and Wildlife Habitat

Primary Contact: Dr. Mike Walters, MSU, walte245@msu.edu, 517-884-4892

DNR Financial Support: \$35,000.00

Two Study Areas: 1) near Levering on private lands; 2) site on State Forest lands near Goodhart

Time Frame: A 5-year project is just drawing to a close in 2016.

Abstract: Dr. Walters initiated the research project funded by the FRD in FY11 to investigate the effects of EAB motivated harvesting on regeneration in northern hardwood stands in the NLP—essentially, what comes back, with or without management intervention after ash dies or is removed in northern hardwood stands. The project is located on two sites; one site near Levering on private lands, and one site on state forest lands near Goodhart. Deliverables include data collection and analysis for both sites. The goals of the project are to improve forest structure and the composition of regeneration in ash-heavy northern hardwood stands following EAB-motivated harvests for sustainable timber production in the face of high deer browse pressure. Specifically, the project aims to identify:

- Techniques to steer composition of regeneration away from ash-heavy regeneration and toward a more diverse species mix.
- Factors that can be manipulated using silvicultural techniques to influence natural regeneration composition and density in northern hardwood stands in light of widespread regeneration failures.
- Deer- vs. non-deer causes for differences in regeneration composition and density in northern hardwood stands.
- Information on the performance and success of under-planted hardwood and conifer seedlings, including those that may do better under global warming scenarios, or in the face of deer browse pressure.

The project will be completed over a 5-year period, in 2016 (FY16), although funding is required only for the first 4 years during collection of field data. Final analysis of the data and preparation of research synopses will be completed in year 5 (2016). Deliverables for FY15 include two extension-style bulletins for field foresters on the following topics:

- “Does gap size influence mortality of residual trees at gaps edges?”
- “Can we plant species with more southern distributions into northern hardwood stands: being proactive about climate change”

Develop and Implement a Computerized Timber Sale Treatment Tracking System

Primary Contact: Doug Heym, Timber Sale Spec., DNR, FRD, heymd@michigan.gov, 517-284-5867

DNR Financial Support: \$562.00

Study Area: State forest land statewide

Time Frame: Ongoing

Abstract: We are currently developing our timber sale computer program (VMS) to work with our forest wide inventory system (MiFI) to better track forest treatments over time. This will help to better monitor our sustainable forest management. We are researching and then implementing a method whereby treatments are tracked from when they are first proposed to when they are fully implemented. After an area of state forest land is inventoried, areas are designated for treatment. These areas go through a review process and a final treatment boundary and prescription is approved. Field work begins, the boundary is designated on the ground, the area is mapped using GPS points and the inventory system is updated. The pre-contract paperwork is developed into a timber sale contract proposal. When the proposal is approved, the system is again updated with the final boundary and the approval status. VMS tracks work as the timber sale progresses. When units of the contract are completed, VMS updates the inventory system. MiFI is then used to schedule and track any other activities needed to complete the treatment.

Over time, and at any point in time, the system will better reflect the condition of the forest. This is complicated technology to sort through and implement, but the final product will be a model for any land management organization.

Status and Trends of Inland Lakes: Methods Development, Program Oversight, and Ecological Assessment

Primary Contact: Kevin Wehrly, DNR FD, Institute of Fisheries Research, Ann Arbor, Michigan;

wehrlyk@michigan.gov, 734-663-3554 x 12055

DNR Financial Support: \$26,210 Total (25% Game and Fish funds)

Study Area: Statewide

Time Frame: Ongoing

Abstract: The DNR FD initiated the statewide SSTP for inland lakes during the spring of 2002. The division-wide SSTP uses standardized sampling methods in an effort to collect and evaluate data from a statewide perspective. These data include fisheries information from electrofishing, standardized netting, habitat measurements and water quality sampling that will be used to monitor statewide status and trends of inland lake aquatic resources, develop models on key influences and evaluate fisheries and land management activities.

Status and Trends of Fish Populations and Community Structure in Michigan Streams

Primary Contact: Todd Wills, DNR FD, Lake St. Clair Fisheries Research Station, Mt. Clemens,

Michigan; willst@michigan.gov, 586-465-4771

DNR Financial Support: \$15,596 (25% Game and Fish funds)

Study Area: Statewide

Time Frame: Ongoing

Abstract: The FD of the DNR initiated the statewide SSTP for streams during the spring of 2002. The division-wide SSTP uses standardized sampling methods in an effort to collect and evaluate data from a statewide perspective. These data include fisheries information from electrofishing, habitat measurements and water quality sampling that will be used to monitor statewide status and trends of streams, develop models on key influences and evaluate fisheries and land management activities.

Evaluation of Returns of Salmonids to Weirs in Michigan's Waters of the Great Lakes

Primary Contacts: Randy Claramunt, DNR FD, Charlevoix Fisheries Station, Charlevoix, MI & Jory Jones, DNR FD, Traverse City, MI; claramuntr@michigan.gov and jonasi@michigan.gov; 231-547-2914 x 224 & 231-922-5280.

DNR Financial Support: \$24,254 (25% Game and Fish Funds)

Study Area: Selected tributaries and weirs to lakes Michigan and Huron

Time Frame: Ongoing

Abstract: This project provides annual information on returns of adult stocked and wild salmon and trout to selected Michigan rivers that is used in many Great Lakes management and research efforts. Additionally, biological data on age, growth, condition and fish health are also collected at these sites. Since many of these fish are of wild origin, usually from the watershed on which our weirs are located, the information generated from these locations provides baseline data on the effects of fisheries, land and forest practices on recruitment processes for these species.

Statewide Coded-wire Tagging and Tag Recovery Program

Primary Contact: David Clapp, DNR FD, Charlevoix Fisheries Research Station, Charlevoix, Michigan; clappd@michigan.gov, 231-547-2914 x 237

DNR Financial Support: \$98,667 (25% Game and Fish Funds)

Study Area: Statewide

Time Frame: Ongoing

Abstract: This is a support project for all research and assessment projects that use coded-wire tags; the specific results and benefits will vary by study. Coded-wire tags have been used in all Great Lakes to evaluate wild fish production, salmonid stocking methods (e.g., net pens vs. direct stocking), as well as hatchery practices and how these practices influence salmon growth and survival. Coded-wire tag marking has also been an important component of fish restoration projects; e.g., in the case of lake sturgeon marking related to the state lake sturgeon rehabilitation strategy. This study provides information annually that is used to evaluate a broad range of resource issues from the effects of land and forest management practices on wild fish production to better ways to increase salmonid survival following stocking and the feeding ecology and seasonal distribution of Great Lakes fish populations, many of which are dependent on inland streams for recruitment.

Species Diversity:

Lake Sturgeon Population Status in the Cheboygan River Watershed Lakes, Michigan

Primary Contact: Edward Baker, DNR FD, Marquette Fisheries Research Station, Marquette, Michigan; bakere1@michigan.gov, 906-249-1611 x 309

DNR Financial Support: \$4,050 (25% Game and Fish Funds)

Study Area: Cheboygan River Watershed

Time Frame: Ongoing

Abstract: This project is focused on Burt, Mullett and Black Lakes in the Cheboygan River watershed which support one of the largest concentrations of lake sturgeon *Acipenser fulvescens* in Michigan. The population in Black Lake is the largest of the three lakes and still supports a small harvest fishery and spawns in the Black River in state forest land. Due to the population's size and the large body of knowledge available on the population's demography, spawning behavior, recruitment dynamics and genetics, this population will figure prominently in Michigan's state-wide

sturgeon recovery plans. However, this population has been reduced numerically. In contrast, lake sturgeon harvest in Burt and Mullett Lakes has been prohibited since 2000, and there is little known of the status of lake sturgeon in these two lakes which also use rivers in state forest lands for recruitment. Data is being generated by this study on key life history components of lake sturgeon in Black Lake, along with the initial status of the populations in Burt and Mullett Lakes. This study would help DNR FD in undertaking meaningful management actions directed at restoring lake sturgeon throughout our state and is providing insights on the effects of forest management practices on this state listed threatened species.

Sturgeon Rehabilitation Plan

Primary Contacts: Edward Baker, DNR FD, Marquette Fisheries Research Station, Marquette, MI & Kim Scribner, MSU, East Lansing, MI; bakere1@michigan.gov & scribne3@msu.edu, 906-249-1611 x 309 and 517-353-3288.

DNR Financial Support: \$306,208 (25% Game and Fish Funds)

Study Area: Statewide

Time Frame: Ongoing

Abstract: This study supports Michigan's lake sturgeon rehabilitation activities, as documented in the DNR *Lake Sturgeon Recovery Plan* and the existing 2005 *Michigan's Wildlife Action Plan* (currently in revision), and in Great Lakes fish community objectives (see www.glfc.org). Lake sturgeon require intact river habitat with clean spawning substrate for spawning, both of which can be affected by forest and land management practices. The study has a number of components including stream rearing of lake sturgeon at multiple restoration sites; developing information on the effects of fish culture practices on egg survival and larval lake sturgeon growth and survival; quantifying environmental covariates (temperature and discharge both related to forest and land management practices) and their effects on larval recruitment; developing information on effects of stream habitat and the species composition and abundance of predators and alternative prey on lake sturgeon larval survival; and determining stage-specific survival of natural and hatchery age-0 and older juvenile lake sturgeon. All of this information is being used to rehabilitate existing lake sturgeon populations and to provide insights on how land use and forest practices affect the habitat of this state-listed species on a statewide basis.

Refinement of the Aquatic Portion of Michigan's Wildlife Action Plan and Development of Tools to Support the Plan

Primary Contact: Kevin Wehrly, DNR FD, Institute of Fisheries Research, Ann Arbor, MI; wehrlyk@michigan.gov, 734-663-3554 x 12055

DNR Financial Support: \$197,192 (25% Game and Fish Fund)

Study Area: Statewide

Time Frame: Ongoing

Abstract: This project is developing and will provide implementation tools for the aquatic portion of the *Michigan's Wildlife Action Plan* (MWAP). This plan will assist the DNR in managing a broad range of aquatic resources and species of greatest conservation need. The products of this project include identifying high priority conservation areas, assessing ecosystem health and identifying key human disturbance factors that are components required by USFWS and MWAP. Additionally, the project is developing the needed GIS spatial framework, databases and decision support tools for carrying out required actions in the plan. Since most of the plan is focused on inland systems, understanding and effectively mitigating the effects of land use and forest management practices will be key components for the successful management of these limited aquatic resources that are critical components of the biodiversity of our forests.

Role of Predators, Winter Weather, and Habitat on White-tailed Deer Fawn Survival in Michigan

Primary Contact: Dr. Dean Beyer, DNR Wildlife Division (WD), Northern Michigan University, Marquette, Michigan; beyerd@michigan.gov, (906) 227-1627

DNR Financial Support: \$242,600 in FY14, \$1,042,800 total

Study Area: Western Upper Peninsula

Time Frame: 10/1/2011-9/30/2017

Abstract: This research project is designed to investigate the role of predators, winter weather, and habitat on white-tailed deer condition and survival across a gradient of ecological conditions (snowfall zones) in the UP. Results from this project will help us understand the interactions among various factors that may limit deer abundance. Specific study components include: 1) estimating pregnancy rates and condition of white-tailed deer; 2) estimating survival and cause-specific mortality of white-tailed deer fawns and does; 3) estimating proportion of fawn mortality attributable to black bear, coyote, bobcat, and wolf predation; and 4) comparing vegetation characteristics at fawn birth sites and kill sites with predator habitat use.

Knowledge of limiting factors is the foundation of wildlife management. This study will provide information on the importance and interactions among several factors that may limit deer abundance. Results from this work are intended to help us formulate appropriate harvest and management recommendations for both deer and predators. Results will also help us address increasing public concerns regarding the impact of predators on deer.

Adaptive Management of Sharp-Tailed Grouse in the Eastern Upper Peninsula of Michigan

Primary Contact: Dr. Dave Luukkonen, DNR WD, East Lansing, MI; luukkonend@michigan.gov, 517-641-4903

DNR Financial Support: \$17,000 in FY14, \$102,200 total

Study Area: Eastern Upper Peninsula.

Time Frame: 10/19/2011-9/30/2014

Abstract: This research aligns directly with the adaptive management principle of the DNR-WD strategic plan and outcomes will explicitly address goals for population and habitat management for a featured species. Wildlife managers will be able to better use existing monitoring data to evaluate sustainability of sharp-tailed grouse in eastern Upper Peninsula under alternative harvest and habitat management scenarios. Sharp-tailed grouse hunting has only recently again become legal and there is an opportunity to use new survey methodologies in an explicit manner to help direct future hunting regulations. The question of how much open land to maintain is an ongoing debate within land management agencies and better understanding habitat needs of sharp-tailed grouse may help refine this debate for the eastern Upper Peninsula. There will likely be future opportunities to conduct habitat management for sharp-tailed grouse and other open land species on private and public lands, so outcomes of an adaptive approach can help justify future grant requests by identifying activities most likely to sustain sharp-tailed grouse. Agency accountability and credibility could be increased by developing this approach in a transparent environment that is inclusive of stakeholders within and outside agencies sharing jurisdiction.

Factors Influencing Snowshoe Hare Occupancy and Abundance

Primary Contact: Dr. Dwayne Etter, DNR WD, E. Lansing, MI; etterd@michigan.gov, 517-641-4903

DNR Financial Support: \$90,193 in FY14, \$176,352 total

Study Area: Northern Lower and Upper Peninsulas

Time Frame: 10/1/2011-9/30/2014

Abstract: Snowshoe hares are an important ecological and cultural species in Michigan.

Ecologically, hares are prey for numerous meso-carnivores (e.g., bobcat, fisher, marten, coyote) and raptors. Culturally, hares are part of Michigan's hunting heritage. A broad-scale habitat assessment corresponding to the late 1990s and early 2000s indicated that hare habitat quality in Michigan's

Upper Peninsula ranged from poor to marginal with only small, isolated areas of higher quality habitat. Additionally, small-game hunter surveys indicated that snowshoe hare harvest and presumably abundance has declined statewide over the past few decades. The decline in snowshoe hare harvest and presumably abundance is likely associated with multiple factors in Michigan including changes to forest management practices, carnivore abundance and spatial distribution, land use patterns, and/or climate. Because of the ecological and cultural importance of this species in Michigan, there is a need to better understand how these factors influence the abundance of hare and occupancy of particular habitats.

Improving the Effectiveness of Wolf Management Approaches in Michigan

Primary Contact: Dr. Pat Lederle, DNR WD, Lansing, MI; lederlep@michigan.gov, 517-243-0700

DNR Financial Support: \$42,943 in FY14, \$168,012 total

Study Area: Upper Peninsula

Time Frame: 1/15/2012-9/30/2015

Abstract: Until recently, wolf management in Michigan was restricted to recovery efforts. Today, managers must contend with range expansion and post-recovery issues including policy changes (e.g., federal delisting, compensation schemes, regulated hunting seasons); public responses to policy change (e.g., lawsuits, ballot initiatives, media coverage, poaching); and balancing preferences, tolerance, and behaviors of traditional and non-traditional wildlife stakeholders both within and outside Michigan. Previous studies have characterized management stakes, stakeholders, and associated attitudes and preferences about wolf management in Michigan. Others have explored the role of hunters as wolf stewards and the relationship between wolf tolerance and compensation. These studies have provided critical information on the human dimensions of wolf management, particularly about stakeholders' fear, experience, and knowledge about wolves and wolf management. Additional social science research needs identified by previous work, the 2007 Michigan Wolf Management Roundtable, and the 2008 Michigan Wolf Management Plan, as being essential to accompany ecological, social, and regulatory changes include: (1) investigate social factors critical to wolf management, especially hunting (e.g., risk perception, value orientations, media coverage); (2) designing, implementing, and evaluating tools to educate key stakeholders about, reconcile competing stakeholder opinions for, and reduce stakeholder conflict vis à vis wolves and wolf management (e.g., hunting, compensation schemes); and (3) evaluating and improving perceived legitimacy of institutional arrangements for wolf management. Current events in Michigan (e.g., the potential for changing management authorities and regulations) provide an ideal time to address gaps in understanding and provide new insight for improving the current and future effectiveness of wolf management in Michigan. Findings from this project will inform other current DNR wildlife management priority areas, including human-wildlife conflict, urban deer management, and policy evaluation.

Statistical Catch-at-Age Assessment of Michigan Black Bear Population Dynamics

Primary Contact: Sarah Mayhew, DNR WD, E. Lansing, MI; mayhews@michigan.gov, 517-336-5036

DNR Financial Support: \$30,211 in FY14, \$102,200 total.

Study Area: Northern Lower and Upper Peninsulas

Time Frame: 10/1/2011-9/30-2015

Abstract: The DNR has adopted black bear management goals to maximize recreational opportunities for hunters while maintaining a stable bear population. To accomplish this goal, the DNR uses a quota system to allocate hunting licenses. To make science-based management decisions, managers must have estimates of population abundance and change over time. The DNR has used capture-mark-recapture (CMR) surveys to estimate black bear abundance in the state, but costs and staffing requirements prevent the DNR from conducting these surveys annually. Statistical catch-at-age (SCAA) models provide an objective statistical approach to obtain annual estimates of black bear population abundances, recruitment, and mortality rates using long-term sex and age-at-

harvest data sets and a wealth of auxiliary information that the DNR already has and continues to collect for minimal cost.

Analytical Support Refining Black Bear Abundance Estimates in the Northern Lower Peninsula and Addressing Action Items in Michigan's Bear Management Plan.

Primary Contact: Dr. Dwayne Etter, DNR WD, E. Lansing, MI; etterd@michigan.gov, 517-641-4903
DNR Financial Support: \$92,584 in FY14, \$183,438 total. Study Area: Northern Lower and Upper Peninsulas Time Frame: 9/13/2013-9/30/2015

Abstract:

The goal of Michigan's Bear Management Plan (BMP) is to maintain a sustainable bear population that is within social carrying capacity (MDNR 2009). Bears occur across Michigan's Northern Lower Peninsula (NLP), however, their distribution is not uniform; higher bear densities are likely in areas of preferred habitat (Carter et al. 2010). The distribution and density of bears across the landscape are important to managers because Bear Management Units (BMUs) are established to effectively distribute hunters and harvest. Additionally, social attitudes towards bears (both positive and negative) may be influenced by localized bear densities.

The DNR presently estimates abundance of bears across the area of the NLP open to bear hunting using a genetic capture-mark-recapture estimator (CMR; Dreher et al. 2007, Etter and Mayhew 2008). These estimates are produced every few years and are used to evaluate desired population trends and establish annual harvest quotas. While this approach may be effective for achieving broad-scale management objectives, finer resolution estimates of abundance would assist in determining if present BMU boundaries are achieving desired management goals and could be used to address localized bear management issues including evaluating social attitudes towards bears.

Landscape level estimates are also used as an initial population size for a simulated population model that is used in turn to establish annual bear harvest quotas. Although recent trends in estimates and model projections indicate a substantial decline in bear abundance in the NLP, (>20% since 2003) harvest levels remain high even as hunter effort has been reduced (>50% decrease in available licenses since 2008). Additional estimates of bear abundance and model input parameters (i.e., survival and recruitment) would assist in evaluating the impacts of annual harvest on abundance of bears in the NLP.

Data Collection and Analysis to Generate Localized Deer Abundance Estimates and Recommended Future Protocols

Primary Contact: Dr. Brent Rudolph, DNR WD, East Lansing, MI; rudolphb@michigan.gov (517) 641-4903

DNR Financial Support: \$56,338 in FY14, \$250,417 total.

Study Area: southcentral Michigan

Time Frame: 5/01/2014-9/30/2018

Abstract: Monitoring efforts to support decision making for deer management typically occur at county or regional scales. Numerous factors that influence deer management (e.g., hunting access or intensity, land use and cover, predation rates) vary at a much finer scale, but uniformly monitoring such conditions and associated population responses is not generally feasible or necessary. However, events that significantly impact populations or generate substantial public concern periodically create a need to assess deer abundance or population dynamics at a finer scale. This scale mismatch may disrupt an agency's ability to effectively manage social and ecological process and require organizations to evaluate new monitoring frameworks (Cumming et al. 2006). In particular, the Michigan Surveillance and Response Plan for Chronic Wasting Disease (CWD) requires localized deer abundance estimates to be generated following any documented outbreak of CWD. Furthermore, an increased frequency of outbreaks of Epizootic Hemorrhagic Disease (EHD) in Michigan is attracting substantial concern among deer hunters and other wildlife enthusiasts in

affected areas. A particularly significant EHD outbreak in 2012 created considerable public alarm, but may provide a unique and timely opportunity to assess new monitoring frameworks capable of addressing this management dilemma.

EHD is an acute, infectious, viral disease that is often fatal in Michigan. It was first identified as a viral disease in 1955 following investigations into the death of several hundred white-tailed deer in both New Jersey and Michigan (Shope et al. 1960). Since the initial 1955 outbreak, additional die-offs in Michigan attributed to EHD occurred in 1974, 2006, 2008, 2009, 2010, 2011, 2012, and 2013. Most die-offs occurred in isolated areas and resulted in estimates of no more than a few thousand deer dying. However, in 2012, EHD was confirmed in 30 counties and mortalities were reported in 21 other counties where confirmatory laboratory testing of samples was not able to be conducted. In total, EHD was the suspected cause of death in nearly 15,000 reported deer mortalities. To date, these outbreaks do not appear to have had an effect on regional populations. Because of its high mortality rate in Michigan, however, EHD outbreaks are likely producing highly contrasting localized deer abundance. Hunters and other wildlife enthusiasts in affected areas may observe reduced densities of deer for years to come, and these occurrences may influence stakeholder satisfaction. With the greater frequency of EHD outbreaks, such stakeholder experiences are becoming increasingly common.

Monitoring Mast Occurrence and Production Using Citizen Scientists to Inform Wildlife Management in Michigan

Primary Contact: Sarah Mayhew, DNR WD, East Lansing, MI; mayhews@michigan.gov, (517) 336-5036

DNR Financial Support: \$63,720 in FY14, \$123,763 total

Study Area: southcentral Michigan

Time Frame: 5/01/2014-9/30/2018

Abstract: Hard and soft mast is a critical component of habitat for many wildlife species in Michigan. For example, wild turkeys, bears, and white-tailed deer are known to rely on acorns to build fat reserves for the winter months (e.g., Ostfeld et al. 1996, Ryan et al. 2004). Bear damage complaints generally increase when summer crops of soft mast fail (Howe et al. 2010) and bear hunter success may be inversely correlated with mast production (Malcolm and Van Deelen 2010, Bridges et al. 2011, S. Mayhew, DNR pers. comm.). Additionally, the productivity of several important furbearers is likely linked to mast production through the population status of small mammal prey species that are known to positively respond to increases in mast production (e.g., Ostfeld et al. 1996, McShea 2000). Knowledge of the ecological factors that may drive mast occurrence, production, and timing in Michigan are needed to improve current population dynamics models for game species used to for management by DNR WD.

Mast occurrence and production are highly variable both spatially and temporally. Hence, direct observation through continuous monitoring is needed to incorporate mast dynamics into DNR population models. For this monitoring to be financially feasible for the WD, however, requires a large volunteer workforce. The goal of our proposed research is to evaluate the feasibility and accuracy of using citizen scientists to help collect information on mast production that can be used to inform DNR WD on population and harvest management decisions. We propose conducting a feasibility study in the northern Lower Peninsula of Michigan.

Analytical Support Refining Wolf Survival Estimates in the Upper Peninsula and Addressing Action Items in Michigan's Wolf Management Plan

Primary Contact: Dr. Dean Beyer, DNR Wildlife Division, Northern Michigan University, Marquette, Michigan; beyerd@michigan.gov, (906) 227-1627

DNR Financial Support: \$51,220 in FY14, \$135,333 total

Study Area: Upper Peninsula

Time Frame: 6/01/2014-9/30/2016

Abstract: On January 27, 2012, the U.S. Fish and Wildlife Service (USFWS) removed gray wolves (*Canis lupus*) in the Great Lakes region from the federal list of threatened and endangered species, transferring management authority to the states. Regional wolf populations exceed recovery criteria and there is stakeholder interest in managing wolf abundance to reduce wolf-human conflicts and/or allowing a harvest to manage conflicts or provide recreational opportunities. However, proposals for a public wolf harvest in Michigan are controversial. Because the USFWS removed wolves from the list of federally endangered species only a short time ago, some stakeholders are concerned that any harvest of wolves might cause populations to decline, resulting in reinstatement of federal protection of wolves. Decision-makers will request predictions on the effect of various harvest scenarios on Michigan's wolf population. Biologists can use a population modeling approach to develop these predictions. However, population modeling requires inputs of wolf population vital rates. Important inputs needed include estimates of survival rate, mortality factors, and dispersal dynamics. Biologists commonly estimate these rates and factors by monitoring the fates of radio-collared individuals. In Michigan, over 350 wolves were radio-collared and monitored from 1992-2010. These data are more than adequate for developing estimates of survival rate, determining mortality factors, and estimating dispersal. Although preliminary analyses of these data are available, the management need warrants analyses that are more detailed. In addition, biologists need to understand causes of mortality and dispersal dynamics in order to consider their relative effects and determine which factors management might be able to manipulate to cause desired changes in wolf populations.

Genetic Diversity:

Support for Research on Seedling, Nursery and Tree Development Projects

Primary Contact: Dave Neumann, DNR FRD; neumannd@michigan.gov, 517-284-5887

DNR Financial Support: \$6,000.00

Study Area: Brighton State Forest Nursery

Time Frame: 10/2013 – 9/2014

Abstract: Cooperative research and technical assistance related to nursery improvement and seed orchard management from MSU's Forestry Department. Work in 2014 included continued jack pine seed collection from the best performing families in provenance test sites for use in establishing the next improved jack pine seed orchard. The DNR plans to begin replacement of its current jack pine seed orchard located at the Brighton Tree Improvement Center in a few years. Other work in 2014 included technical assistance in designing the next jack pine seed orchard and evaluation of options for establishing a red pine seed orchard and/or red pine seed production areas out in the forest in the future.

2. Criterion Two: Maintenance of Productive Capacity of Forest Ecosystems

Seasonal Deer Migration Affects the Distribution of Nutrients in Forest Ecosystem

Primary Contact: Christopher Webster, Ecosystem Science Center, School of Forest Resources and Environmental Science, Michigan Technological University; cwebster@mtu.edu, (906) 487-3618

DNR Financial Support: None

Study Area: Ontonagon & Gogebic Counties – Porcupine Mountains Wilderness State Park

Time Frame: 2010 – Present

Abstract: Twenty five pellet plots were sampled during the 2014 season providing nine years of continuous sampling of three hemlock stands within Porcupine Mountains Wilderness State Park (PMWSP). These three stands are part of a larger study encompassing 39 stands distributed across the western Upper Peninsula of Michigan. Based on the pellet survey, deer use was higher in 2013 than 2012, but lower than the peak levels observed during the winter of 2008. Use was strongly related to stand area. The greatest use occurred in our largest sample stand. No winter deer activity has been recorded in our smallest sample stand. Our results from the broader data set suggest that deer use the same areas within stands through time. The level of overall use during any given winter is strongly influenced by the timing and depth of snow accumulation.

3. **Criterion Three: Maintenance of Forest Ecosystem Health and Vitality**

Development of a Statewide Beech Bark Disease Monitoring & Impact Analysis Plot Network

Primary Contact: Dr. Deborah G. McCullough, Michigan State University, Dept. of Entomology and Dept. of Forestry, East Lansing, MI; mccullo6@msu.edu, 517-355-7445

DNR Financial Support: None. Conducted partially on state land.

Study Area: State forest lands on the leading edge of the Beech Bark Disease advancing front in both the UP and LP.

Time Frame: Ongoing.

Abstract: This project studies the spread of the disease and analyzes the impacts of this highly destructive disease of American Beech. Beech is a significant species in many northern hardwood stands in Michigan. From the data and information developed, maps of the current areas impacted by the disease are prepared and modified annually. Pathways and rates of spread are analyzed to give forest managers information on which to base forest management decisions. Since there is no practical control for this disease under forest conditions, having the latest management information and the most up-to-date knowledge of pathways and impacts is critical to managing forests to sustain productive sites and avoid unacceptable losses to the disease, as well as unacceptable regeneration. Information from this research is conveyed to DNR FRD as it is developed.

Oak Wilt Sample Analysis for Delimitation of Infected Areas

Primary Contacts: Dr. Ray Hammerschmidt, MSU, East Lansing, MI & Dr. Dana Richter, Michigan Technological University (MTU), Houghton, MI; hammers1@msu.edu, 517- 355-2308, drichte@mtu.edu, 906-487-2149

DNR Financial Support: None. Use of state forest land and data.

Study Area: State and private forest lands statewide

Time Frame: Ongoing

Abstract: Laboratory culturing of samples of oak wood that is thought to be infested with oak wilt is the only concrete way to tell conclusively that this is in fact the case. Confirming the cause of oak mortality is critical to treating oak wilt as several other diseases cause mortality that looks much like oak wilt. These studies make it possible to differentiate causal agents and thus map more accurately the occurrence of oak wilt vs. other diseases that kill oak and are easily confused with oak wilt. Having definitive identification of the causes of oak mortality is critical to sustainable forest management, as treatments for the various causes differ and what works for one has no impact on the others. Forest managers need to know what they are fighting to adopt the correct response. These studies are developing ways to detect oak wilt more efficiently, direct suppression efforts and resources more precisely, and manage oak forests more effectively to maintain the species and keep sites productive.

Continuing Emerald Ash Borer Research on DNR Lands in 2014

Primary Contact: Dr. Deborah G. McCullough, Michigan State University, Dept. of Entomology and Dept. of Forestry, East Lansing, MI; mccullo6@msu.edu, 517-355-7445

DNR Financial Support: None

Study Area: DNR lands in Southeast Michigan

Time Frame: 2002 – Present

Abstract: (see supplemental reading for more information) Since its discovery in 2002 in Detroit, Michigan, emerald ash borer (EAB) (*Agrilus planipennis* Fairmaire) has been found in 21 additional states and 2 Canadian provinces as of April 2014. This EAB research began shortly after EAB was identified in 2002. Results from this study have contributed substantially to the understanding of EAB biology, and its economic and ecological impacts. Our goals in 2014 are to: (1) document survival rates of white ash in forested areas in the core of the EAB infestation (e.g., areas where EAB has been present for several years); (2) identify traits associated with unexpectedly high white ash survival or, conversely, very low white ash survival; and (3) evaluate two EAB trap/lure combinations. There are certainly areas in the EAB core where all or nearly all white ash trees have been killed. Two recent papers in scientific journals have reported 99% mortality of green ash, black ash and white ash trees in plots located in forested sites in southeast MI and northwest OH. We are aware, however, of numerous stands where a high proportion of the overstory white ash remain alive and appear relatively healthy, despite several years of EAB presence. Our previous studies, conducted in forests, plantations and the laboratory, have shown the ash resistance or vulnerability to EAB varies among species. Green ash and black ash are highly preferred hosts, while blue ash is quite resistant to EAB. White ash, the most widely distributed native ash and the species with the highest timber value, falls in the middle; i.e., it is an intermediate host for EAB. We will combine field surveys to document condition of white ash and other overstory trees, trapping to assess presence and relative abundance of EAB, and GIS analyses to determine if there are characteristics consistently associated with high (or low) survival of white ash trees.

A Project to Study the Biology and Methods of Reducing the Rate of Spread of the Emerald Ash Borer in Newly Established or Low Density Forested Sites

Primary Contact: Dr. Deborah G. McCullough, Michigan State University, Dept. of Entomology and Dept. of Forestry, East Lansing, MI; mccullo6@msu.edu, 517-355-7445

DNR Financial Support: None. Conducted partially on state land

Study Area: Research data from the SLAM Project (2009-2012)

Time Frame: 2014

Abstract: Emerald ash borer, *Agrilus planipennis* Fairmaire, has become the most destructive forest insect to invade North America. Unfortunately, tactics to manage *A. planipennis* are limited and difficult to evaluate, primarily because of the difficulty of detecting and delineating new infestations. Here we use data from a unique resource, the SLAM pilot project, to assess whether treating a small proportion of trees with a highly effective systemic insecticide or girdling ash (*Fraxinus* spp.) trees to serve as *A. planipennis* population sinks can result in detectable effects on *A. planipennis* population growth or ash mortality. Components of the SLAM pilot project included an extensive inventory of ash abundance across a heterogeneous area encompassing >390 km², 587 ash trees treated with a highly effective systemic insecticide, and 2,658 ash trees girdled from 2009 to 2012. Fixed radius plots were established to monitor the condition of >1000 untreated ash trees throughout the area from 2010-2012. Despite only a very small proportion of ash trees in the project area being treated with insecticide or girdled, both tactics led to detectable reductions of *A. planipennis* densities and protected ash trees in areas surrounding the treatments. Number of trees treated with insecticide yielded a detectable reduction in larval abundance in subsequent years. In contrast, the area of phloem in treated trees had no discernable effect on *A. planipennis* population growth, indicating the number of treated trees was more important than the size of treated trees. Significant interactions among girdled trees, larval density, and the local abundance of ash phloem indicate girdling trees has a positive, but complex potential as a management tactic.

Emerald Ash Borer Parasitoid Rearing

Primary Contact: Nick Barc, USDA Animal & Plant Health Inspection Service;
nicholas.barc@usda.aphis.gov, 810-844-2711

DNR Financial Support: None.

Study Area: Currently conducted partially on state land in the central and southern LP of MI
Time Frame: Ongoing

Abstract: The project is learning and developing new methods of rearing and handling these parasites to reproduce them in large quantities and distribute them to field locations across the impacted states for control of EAB. While production of large quantities of EAB parasites is an ultimate goal. Considerable research has to be done to determine how to do it and develop the methods that work better and yield more efficient results. They then follow up on the releases to monitor the success/failure rate. They do this in cooperation with Dr. Leah Bauer, USDAFS-NRS.

Emerald Ash Borer Parasite Release on State Forest Lands

Primary Contact: Dr. Leah Baurer, USDA Forest Service, Northern Research Station, MSU Depts of Entomology, Agriculture, & Natural Resources, 480 Wilson Rd., East Lansing, MI 48824;
lbauer@fs.fed.us, 517-884-8059

DNR Financial Support: None. Conducted partially on state land.

Study Area: EAB-infested sites in Michigan

Time Frame: Ongoing

Abstract: (taken from a report on:

http://www.nrs.fs.fed.us/disturbance/invasive_species/eab/control_management/biological_control/)

“Over the years, regulatory agencies have determined EAB eradication efforts ineffective and quarantine compliance incomplete. Land managers are now seeking sustainable methods such as biological and microbial control for managing EAB populations. Since 2002, we have been working to develop an EAB biological control program in the U.S., which includes research in the U.S. and China.

Our EAB natural enemy research started in 2002 in parts of southeast Michigan where EAB populations were sampled for natural enemies commonly associated with wood-boring insects: predaceous and parasitic insects, insect-pathogenic fungi, and woodpeckers. By 2004, we had expanded this study to include a total of 17 EAB-infested areas of southeast Michigan.

In China, EAB outbreaks were previously reported in native and North American ash species, including *F. americana* and *F. pennsylvanica*, planted in Heilongjiang and Shandong provinces. More recent EAB outbreaks were reported in the Tianjin in plantings of *F. velutina*, an ash species endemic to the southwestern U.S. and northern Mexico. To locate research sites in China, we sampled ash trees in 2003 for EAB and natural enemies in the provinces or cities of Heilongjiang, Jilin, Liaoning, Hebei, Tianjin and Shandong. During this initial survey, and in a subsequent study in 2004, *Spathius agrili* and two parasitoid species previously unknown to science were found attacking EAB at field sites in China.

In summer and fall 2007, we released *O. agrili* and *T. planipennisi* each at two research sites, and APHIS released *S. agrili* at three different sites. In 2008, additional research sites were set up in central Michigan, and two each in Indiana and Ohio. In 2009, study sites were set up in Maryland and Illinois.

Establishment of EAB Parasitoids. Early in the spring of 2008, we successfully recovered *O. agrili* from one of our 2007 release sites and APHIS recovered *S. agrili* at one of their sites. In 2009, in collaboration with scientists from Michigan State University, University of Massachusetts, USDA ARS and USDA APHIS, both *T. planipennisi* and *O. agrili* were recovered and presumed established at

three of our Michigan research sites; successful recovery of *S. agrili* at these sites cannot be confirmed until adults emerge from cocoons and are identified. Long-term monitoring of these sites continues along with other releases as parasitoids become available.

To centralize and increase the efficiency of EAB parasitoid rearings, APHIS and FS are working together to develop an EAB Biological Control Program. APHIS recently completed construction of a parasitoid mass-rearing laboratory in Brighton, MI. Once new personnel are hired, we will begin training them to rear EAB, *F. uhdei* in the greenhouse, *O. agrili* and *T. planipennisi*.”

Portable Field-Based Application of Non-Destructive Technologies for Rapid, Early Detection of Emerald Ash Borer

Primary Contact: : Dr. Sophan (Steve) Chhin; Asst Prof, MSU, Dept of Forestry, Natural Resources Bldg, 480 Wilson Road, Room 126, East Lansing, MI; chin@msu.edu

DNR Financial Support: None. Conducted partially on state land.

Study Area: Two LP plots (Lapeer State Game Area) were re-sampled in August, 2014

Time Frame: The portion of the project conducted on state land was initiated in summer 2013 and all analyses and report writing is expected to be completed by summer 2016.

Abstract: Field sampling on state land was initiated in summer 2013 and all field sampling was completed in summer of 2014. Field sampling took place in the Lower Peninsula in the summer of 2013. Two Lower Peninsula plots (Lapeer State Game Area) were re-sampled in August, 2014. Field sampling for the Upper Peninsula took place in the summer of 2014. Sample processing was the focus of fall 2014. In spring 2015, the project has moved mainly to data analysis. The general objective of the proposed project is to promote the application of three key non-destructive technologies that will allow rapid, early detection of emerald ash borer (EAB).

Acoustic Tomography: This non-destructive technology allows for early detection of insect feeding activity and pattern detection of compromised wood integrity (e.g., insect galleries) based on the measurement of sound velocity through the wood. Multiple sensor probes were inserted in each sample tree into the sapwood of the stem with minimal impact on the tree.

Infrared Thermal Imaging: This non-destructive technology allows for early detection of plant stress by measuring changes in heat production of the stem, crown foliage, and surrounding soils of each plot tree.

Near Infrared Spectroscopy (NIR): NIR reflectance spectra are known to provide early detection of physiological stress levels in plants induced by plant pests. Foliage, branch segments, bark surface, phloem, sapwood tissue and soil samples were collected for NIR analysis in the laboratory at MSU.

The key expected outcome is that the three technologies will be successfully trained to discriminate between stands affected by EAB and healthy stands and therefore promote forest sustainability. The key benefit is that outlier areas of EAB will be classified along a gradient of potential susceptibility to EAB. This will allow more efficient use of financial resources to target quarantine efforts in areas forecasted to be most impacted by EAB.

Trapping of Exotic Forest Pests

Primary Contacts: Dr. Deb McCullough & Sara Tanis, MSU, East Lansing, MI; mccullo6@msu.edu, 517-355-7445

DNR Financial Support: None. Conducted partially on state land.

Study Area: Michigan's Upper and Lower Peninsulas

Time Frame: 2013-2014

Abstract: Our goal was to survey sites at relatively high risk for exotic forest pest introductions. We were especially interested in woodborers and bark beetles, which could potentially cause widespread damage if they became established. To choose sites, we developed risk maps for Michigan's Upper and Lower Peninsulas using GIS technology. Variables used for the risk maps included forest cover type, number and origin of state park visitors, sawmill and campground locations, and linear corridors such as railroads, highways and rivers. Spatial data sets and point data were overlaid to identify sites at risk for specific forest pests. For example, a state park surrounded by maple-dominated forest would be considered a high risk site, if the park attracts visitors from within or near locations where Asian long horned beetle (ALB) is present. Using these maps, we selected 32 sites across Michigan's Upper and Lower Peninsulas to survey.

In all, 285 traps were monitored in hardwood and conifer sites, and specimens were collected and identified. ALB traps were also deployed. Despite collection and identification of thousands of beetles, no ALBs have been found to date.

Design and Develop Specialized Equipment for Forest Fire Fighting

Primary Contact: Dan Munn, DNR FRD; munnd@michigan.gov, 989-275-5211

DNR Financial Support: \$154,148.00

Study Area: Roscommon Equipment Center and DNR forest lands

Time Frame: Ongoing since March 2007

Abstract: An example of the type of project that is developed entirely from scratch is DNR's flamethrower's ability to project burning matter while creating a high intensity sustained heat some distance away from the wildland firefighter is beneficial to reach remote pockets of fuels regardless of whether those fuels are wetland fuels or sparse vegetation that are intended to be consumed during a prescribed burn. Again, this work involves considerable engineering, mechanical, and machining knowledge, skill, and ingenuity.

Forest Fuels and Vegetation in Wildfire-Regenerated Jack Pine Forests: Informing Ecological Forestry in the Lake States Region

Primary Contact: Jessica R. Miesel, MSU, E. Lansing, MI; jrmiesel@gmail.com

DNR Financial Support: None. Conducted partially on state forest land.

Study Area: Wildfire sites with natural jack pine regeneration on state and federal land in NLP

Time Frame: Fieldwork has been completed. Data analysis is in progress. DNR sites are no longer actively being used for this project.

Abstract: Managing forests according to ecological principles requires an understanding of disturbance effects and stand development processes characteristic of a given ecosystem. In ecosystems dominated by jack pine (*Pinus banksiana* Lamb.) in northern Michigan, stand-replacing wildfires historically created extensive areas of young, even-aged jack pine stands that provided breeding habitat for the Endangered Kirtland's warbler (*Setophaga kirtlandii* Baird). Kirtland's warbler (KW) habitat is currently managed intensively as jack pine plantations, but the success of KW recovery efforts has increased interest in managing jack pine ecosystems for a broader suite of ecological components. This project was part of a larger investigation focused on understanding the natural range of variability in jack pine forest structure and composition. Our goal was to quantify forest fuel loads and to evaluate tree species composition in young (2-4 years post-fire, pre-KW occupancy) and mature (22-38 years post-fire, post-KW occupancy) wildfire-regenerated jack pine stands in Michigan. This project provides information that helps to improve current understanding of

structural and compositional heterogeneity in jack pine ecosystems following wildfire in the northern lower peninsula of Michigan. Data from this project will be relevant for ecological forest management decisions that aim to incorporate natural stand characteristics into habitat treatments, both during preparation for establishing new plantations and for creating more natural patterns in mature, post-KW occupancy plantations.

Understanding Habitat, Breeding Ecology, and Diseases of Feral Swine in Michigan in Inform Effective Management

Primary Contact: Dr. Dwayne Etter, DNR WD, E. Lansing, MI; etterd@michigan.gov, 517-641-4903
DNR Financial Support: \$95,270 in FY14, \$541,629 total

Study Area: central Michigan

Time Frame: 12/01/2013-9/30/2018

Abstract: Feral swine (*Sus scrofa*), specifically the Russian boar breed, pose significant threats to habitat, wildlife, human health, and the agricultural industry in Michigan. Free-ranging feral swine occur in 76 of 83 Michigan counties as of 2012. The occurrence of feral swine is projected to negatively affect the billion-dollar wildlife value (USFWS and US Department of Commerce 2006) and \$300 million domestic swine industry in Michigan. Additionally, feral swine affect agricultural crop production with potential ramifications that extend to the entire agricultural industry. Furthermore, researchers are just beginning to understand the indirect impacts of feral swine on naturally occurring plant and animal communities.

Feral swine are opportunistic omnivores known to consume almost any organic material including vegetation, invertebrates, and vertebrates (Schley and Roper 2003). Feral swine affect plants and animals through direct consumption and by habitat modification and degradation, competition, and invasive species propagation. For example, feral swine can negatively affect forest regeneration through consumption of vegetation and seeds (particularly during low mast periods; Sanguinetti and Kitzberger 2010) and secondarily through soil disturbance and stream bank erosion associated with rooting behavior (Hone 1995). In addition, feral swine compete directly with wildlife for food and water resources (Ilse and Hellgren 1995, Laurance 1997) and can prey on some wildlife species. Direct predation on wildlife is poorly documented in the scientific literature, but ground nesting birds and altricial young are likely susceptible to feral swine predation (Tolleseon et al. 2003). The scale of ecological damage caused by feral swine has not yet been spatially delineated nor economically assessed for Michigan. An understanding of feral swine space use and activity budgets is needed to help assess and predict risks to plant and animal communities and to help prioritize targeted management actions. Unfortunately, little is known about feral swine ecology in northern climates that can be used to better inform control strategies in Michigan.

Feral swine are reservoirs and potentially amplifiers for >30 viral (i.e. pseudorabies, hog cholera, and foot-and-mouth disease [FMD]) and bacterial (i.e. bovine tuberculosis and brucellosis; e.g., Aranaz et al. 2004) diseases and at least 37 known parasites that can affect humans, livestock, and wildlife (Forrester 1991, Davidson and Nettles 1997, Samuel et al. 2001, Williams and Barker 2001, Hutton et al. 2006, Wyckoff et al. 2009). These factors, along with the tendency for feral swine to move throughout landscapes, coupled with their low susceptibility to capture, make it difficult or impossible to eradicate swine diseases. The presence of feral swine in Michigan threatens to compromise the disease-free status of the domestic livestock herds and complicates eradication of bovine tuberculosis (bTB) in free-ranging deer. bTB is established in portions of Michigan's deer herd and feral swine are a primary reservoir of bTB in many countries around the world. If Michigan's feral swine population became infected with bTB, it could have substantial negative consequences for the cattle industry. Additionally, over the past 17 years, the US has spent about \$200-250 million to achieve a pseudorabies free status for the domestic livestock herd (Hutton et al. 2006). Feral swine have also been implicated in three outbreaks of swine brucellosis in domestic herds (Feral Swine Subcommittee on Brucellosis and Pseudorabies 2005). Presently, pseudorabies has been reported

in 11 states and brucellosis documented in 14 states where feral swine are found (USDA-APHIS 2005). In Michigan, preliminary testing by the DNR of 133 feral swine samples indicated ~10% were positive for pseudorabies; toxoplasmosis has also been confirmed. Feral swine can also transmit some common zoonotic diseases to humans such as leptospirosis, salmonellosis, and trichinosis (Tegt et al. 2011). Collectively, the potential of feral swine as a disease reservoir and vector makes disease monitoring and control a top priority for Michigan's agricultural community.

Feral swine are possibly the most prolific large mammal on earth reaching sexual maturity at a young age, capable of farrowing several times a year, have large litters, and high natural survival. In good habitat, population growth and subsequent colonization through dispersal can occur rapidly resulting in irruptive population growth (Waithman et al. 1999, Bieber and Ruf 2005). Natural predators have little impact on feral swine populations (Sweeney et al. 2003); and in good habitat feral swine can endure extremely high rates of hunting harvest with little impact on the overall population (Barrett and Pine 1990). Thus, if Michigan has any chance to locally control and potentially eradicate feral swine, action must be taken swiftly using all available control techniques.

Feral swine trapping in Michigan has been implemented by USDA Wildlife Services, with support from the Michigan Department of Agriculture (MDA), to control localized populations. However, little is known about the effectiveness of these trapping efforts to reduce or eradicate local populations. Additionally, there is an absence of spatial ecology information (i.e., dispersal capabilities, daily movements, seasonal movements, proximity to domestic swine, and feeding behavior) that can be used to inform stakeholders about risk, educate landowners, and ultimately better inform population management strategies, including lethal removal. The goal of this project is to quantify feral swine space and resource use, disease status and potential for disease transmission, and develop and evaluate effective lethal removal techniques and strategies.

4. Criterion Four: Conservation and Maintenance of Soil and Water Resources

Effects of Sediment Traps on Michigan River Channels

Primary Contact: Todd Wills, DNR FD, Lake St. Clair Research Station, Mt. Clemens, MI;
willst@michigan.gov, 586-465-4771

DNR Financial Support: \$2,836 (25% Game and Fish Funds)

Study Area: Statewide

Time Frame: Completion in FY2014

Abstract: Sediment traps are commonly used as a mitigation measure to influence sediment transport dynamics in stream systems and evaluated their effectiveness in this role. The data from this study show that excavation of sediment traps generally had only small effects on mean channel depth and substrate in the streams studied, with changes occurring both upstream and downstream of the trap. The lateral position of the channels examined remained constant, indicating little side cutting had occurred. Changes in channel area remain variable and appear as likely to occur at transects proximal to the sediment traps as at transects located further upstream or downstream. These results suggest that sediment trap maintenance has not achieved the desired goals of increased down-cutting and exposure of coarse substrates downstream of the sediment traps studied.

Protecting Instream Habitat by Development and Support of a Water Withdrawal Decision-Support Tool in Michigan

Primary Contact: Troy Zorn, DNR FD, Marquette Fisheries Research Station, Marquette, MI; zornt@michigan.gov, 906-249-1611 ext. 308

DNR Financial Support: \$ 78,622 (25% Game and Fish Funds)

Study Area: Statewide

Time Frame: Ongoing

Abstract: Land use practices are well known to influence water yields to stream systems that in turn directly influence fish habitat. Michigan's Water Withdrawal Assessment Tool (WWAT); <http://www.miwwat.org/> is designed to estimate the likely ecological impact of a proposed water withdrawal and potentially land use on nearby streams and rivers. The foundation of the WWAT is the Michigan Rivers Inventory Project that produced statewide models of landscapes, river habitats, and fish distributions; an initial ecological rivers segment classification; a statewide model of potential groundwater influx to rivers; a regional classification of riparian ecosystems; and a method for regional assessment of stream condition. This project continues the refinement and improvement of this key regulatory tool.

Influence of Lotic and Nearshore Habitats on Fish Populations in Great Lakes and Inland Lake Ecosystems, with Emphasis on Walleye

Primary Contact: Troy Zorn, DNR FD, Marquette Fisheries Research Station, Marquette, MI; zornt@michigan.gov, 906-249-1611 ext. 308

DNR Financial Support: \$ 2,722.00 (25% Game and Fish Funds)

Study Area: Bays De Noc

Time Frame: Completed in FY2014

Abstract: This study provided insights into the extent of natural reproduction of walleye in the Michigan waters of Green Bay via marking stocked fish with oxytetracycline (OTC) and described their contribution to walleye year classes; and assessed the relative influence of river spawning habitat, estuary conditions, juvenile-adult growth habitat, and supplemental stocking on spawning runs of walleye (and estimates of percent natural reproduction) in various river-influenced systems in Michigan. These data have implications for assessing the effects of land management practices on a key sportfish species.

Assessment of Nearshore Fish Communities in Northern Lake Michigan

Primary Contact: Troy Zorn, DNR FD, Marquette Fisheries Research Station, Marquette, MI; zornt@michigan.gov, 906-249-1611 ext. 308

DNR Financial Support: \$97,167.00 (25% Game and Fish Funds)

Study Area: Northern Lake Michigan

Time Frame: Ongoing

Abstract: Inshore areas of the Great Lakes can be affected by riparian land and fisheries management actions and many of the species found in these areas use tributary streams for recruitment which exposes them to the effects of land use actions. This study is providing key information on the population trends in Bays de Noc fish populations that include adult abundance, year class strength, sex and age structure of walleye and yellow perch in northern Lake Michigan. Additionally, the study is developing a database on fish community composition for under-sampled nearshore areas of northern Lake Michigan. These data provide a key baseline to evaluate current and future fisheries, land use, and forest management actions.

5. Criterion Five: Maintenance of Forest Contribution to Global Carbon Cycles

Michigan Gradient Study on Nitrogen Gradients to Understand the Mechanisms Controlling Carbon and Nitrogen Cycling in the Face of Chronic Nitrogen Deposition and the Long-term Consequences of Nitrogen Saturation

Primary Contact: Dr. Andrew Burton, MTU, Houghton, MI; ajburton@mtu.edu, 906-487-3470

DNR Financial Support: None. Use of state forest land and state data.

Two Study Areas: 1) Primarily in the SE 1/4 NW 1/4 NW 1/4 Sec 33 T52N R36W, but a small portion is in the SW 1/4 NE 1/4 NW 1/4 Sec 33 T52N R36W; 2) In the SW 1/4 NE 1/4 Sec 1 T36N R5W, with a small part of one research plot in the SE 1/4 NE 1/4 Sec 1 T36N R5W.

Time Frame: Ongoing

Abstract: As the Earth's climate changes over the next century, ecosystems in the Northern Hemisphere will be exposed to elevated rates of atmospheric nitrogen (N) deposition, which could theoretically strengthen the terrestrial carbon sink (C) in this region. However, the degree to which anthropogenic N deposition could foster greater forest productivity and C storage remains uncertain. Ecologists at the University of Michigan, Michigan Technological University, and the University of Idaho have conducted a long-term, regional, field experiment located in Michigan. To simulate rates of elevated atmospheric N deposition, four sugar maple (*Acer saccharum*)-dominated northern hardwood study sites have received annual additions of 3 g NO₃--N/m² over the past 21 years. All four study sites rapidly approached N saturation, evidenced by substantial leaching of both inorganic and organic N. Although simulated atmospheric N deposition increased, net primary productivity over the 21-year experiment, soil respiration and litter decay, have significantly declined; these responses have rapidly increased C storage in the organic horizons and surface mineral soil. Greater C in these pools results from a decline in lignolytic microbial activity and a corresponding change in microbial community composition. Given these responses, we hypothesize that: i) simulated atmospheric N deposition will continue to accelerate tree growth, tree mortality, and coarse woody debris production, further increasing C storage in woody biomass and soil organic matter, ii) surface soil C will continue to accumulate at a faster rate under experimental atmospheric N deposition; iii) warmer temperatures will accelerate net primary productivity across the climatic gradient encompassed by the study sites; and, iv) climate warming will eventually interact with simulated atmospheric N deposition to differentially increase ecosystem C storage among sites. A series of established core long-term measurements (some stretching back to 1988) enable us to test these long-term hypotheses and to understand how elevated N deposition and climatic variation might affect forest composition and productivity in the long-term.

Downscaling Climate Predictions for Michigan & the Great Lakes

Primary Contact: Christopher Hoving, DNR WD, Lansing, MI; hovingc@michigan.gov, 517-284-6192

DNR Financial Support: \$2,613 in FY14, \$326,936 in total (all federal GLRI funds).

Study Area: Statewide, work conducted in offices and labs

Time Frame: 9/1/2010-1/1/20104

Abstract: This research project is designed to provide downscaled climate data to fish and wildlife managers in Michigan and to provide insight into the effects climate change will have on water levels of the Great Lakes. Climate in Michigan is warming, and global models predict warming will continue. However, global models do not capture local climate variation, such as lake effect. Nor do global models provide managers with measures of the certainty or uncertainty of predictions. Global models provide averages and poorly capture the intensity and frequency of extreme events, which affect natural systems as much or more than changes in average temperature or precipitation. Finally, future water levels on the Great Lakes is a critical unknown in conserving coastal wetlands, which are critical habitat for fish and wildlife. Future water levels will also impact coastal communities, infrastructure, and international trade.

Climate predictions that incorporate local conditions, uncertainty, extreme events, and lake level dynamics are a critical step in managing fish and wildlife to prepare for a changing climate. Predictions that incorporate local weather patterns, such as lake effect, will allow managers and decision-makers to visualize how the climate has changed and will continue to change. Changes in lake-effect snow are a good example of the utility of downscaled predictions. Lake-effect snow continued to increase as lake ice decreases. At some level of warming that increase will cease, and then reverse, as ever more lake effect precipitation falls as rain. The timing of the change will occur differently along Lake Michigan than Lake Superior, and the timing of the change has important implications to wildlife affected by snow, such as deer, moose, wolves, bobcats, and pine marten. Important fisheries in Michigan are affected directly by temperature, but also indirectly via snowfall, ice cover, and algae growth. Downscaled data will also help foresters model forest growth and health, as required in forest certification. Although focused on Great Lakes ecosystems, downscaling and lake level research will be used by a broad segment of society, including public health and transportation decision-makers.

Development of Management Scenarios for Lake and Stream Habitat and Fisheries Under Current and Future Land-use and Climate Conditions

Primary Contact: Kevin Wehrly, DNR FD, Institute of Fisheries Research, Ann Arbor, MI; wehrlyk@michigan.gov, 734-663-3554 ext 12055

DNR Financial Support: \$137,492.00 (25% Game and Fish Funds)

Study Area: Statewide

Time Frame: Completed in FY2014

Abstract: This project assessed habitat conditions for all lakes and streams statewide under current land-use and climate conditions and provided insights on how current habitat conditions influence sport fish populations and fish community structure in lakes and streams. Boosted regression tree models were developed that predicted abundance and growth of fish species in 6,500 lakes. Nutrient loading models and a new temperature model were developed for use in predicting habitat changes in lakes. Recently developed predictions from 14 downscaled climate data were obtained and summarized for all lakes and stream reach catchments in Michigan. Changes in thermal regime and fish species suitability were estimated for all lakes greater than or equal to 10 acres. Maps identifying lakes vulnerable to species changes were developed for 14 different climate scenarios for mid-century and late century time steps. These data are key baseline and predictive information for the effects of land use and forest practice changes on fisheries resources.

6. Criterion Six: Maintenance and Enhancement of Long-term Multiple Socio-economic Benefits to Meet the Needs of Societies

Comprehensive Analysis and Improvement of Michigan Statewide Angler Survey Data

Primary Contact: Zheming Su, DNR FD, Institute of Fisheries Research, Ann Arbor, MI; suz@michigan.gov, Phone: 734-663-3554 x 12355

DNR Financial Support: \$52,764.00 (25% Game and Fish Funds)

Study Area: Statewide

Time Frame: Ongoing

Abstract: This study examines and improves the catch and effort estimates generated by the Statewide Angler Survey Program by developing methods that will improve the spatial and temporal efficiency of estimates and data use and conceptual and quantitative models that describe fishery dynamics and aid in management decision-making. These data provide key baseline harvest and economic benefits across the state that is required to properly evaluate fisheries management and land use practices.

Michigan Statewide Angler Survey Program

Primary Contacts: Tracy Kolb, DNR FD, & Zhenming Su, DNR FD, Ins. Fish. Res, Lansing, MI;

kolbt@michigan.gov & suz@michigan.gov, 517-284-5828 & 734-663-3554 x12355

DNR Financial Support: \$1,489,279.00 (25% Game and Fish Funds)

Study Area: Statewide

Time Frame: Ongoing

Abstract: The most fundamental requirements for sound management of recreational fisheries are knowledge of the response of fish stocks to fishing and of the contributions of various fish stocks to the fisheries. This knowledge can be obtained only if there is a long-term record of fishing effort, catch, and catch composition available for analysis. This project is designed to obtain a continuous record of sport fishing effort, catch and harvest, catch and harvest rates and catch composition for important Great Lakes, tributary and inland fisheries of the State of Michigan using consistent protocols and data collection and analysis methods. These data provide key baseline harvest and economic benefits across the state that is required to properly evaluate fisheries management and land use practices.

Charter Boat Catch and Effort from the Michigan Waters of the Great Lakes

Primary Contact: Donna Wesander, DNR FD, Charlevoix Fish Res Station, Charlevoix, MI;

wesanderd@michigan.gov, 231-547-2914 ext 223

DNR Financial Support: \$89,405 (25% Game and Fish Funds)

Study Area: Statewide – Great Lakes

Time Frame: Ongoing

Abstract: Fisheries biologists cannot effectively manage sport fish in the Great Lakes without knowledge of the relationship between fish stocks and the fisheries that exploit them. Additionally, some of these stocks are dependent for recruitment on inland streams that can be affected by forest and land management practices. Charter angling is one type of fishery on the Great Lakes. The Michigan charter industry consists of approximately 530 businesses operating 570 boats that catch and harvest a measurable amount of sport fish from the Great Lakes. Charter catch and effort data are generated continuously by this project for a broad range of purposes including wild fish production. Fisheries trends from this group of users provides key insights on how well wild fish are recruiting to our fisheries and these fish can be traced back to inland streams along the land practices that influence them.

A Statewide Survey of Michigan's Licensed Anglers

Primary Contact: Dr. Frank Lupi, MSU, East Lansing, MI; lupi@msu.edu, 517-432-3883

DNR Financial Support: \$66,909.00 (25% Game and Fish Funds)

Study Area: Statewide

Time Frame: Ongoing

Abstract: This project provides additional fishing effort, catch and catch composition to supplement the direct census information from other surveys through a mail survey of licensed anglers. This study provides information about anglers and their fishing behavior and the ability to track the behaviors over time to assess the status and trends of angling behavior in Michigan. These data provide key baseline harvest and economic benefits across the state that is required to properly evaluate fisheries management and land use practices.

Partners in Ecosystem Research and Management: Social, Economic, and Policy Aspects of Wildlife Management –Faculty Support

Primary Contact: Dr. Brent Rudolph, DNR WD, E. Lnsng MI; rudolphb@michigan.gov, 517-641-4903

DNR Financial Support: \$217,074

Study Area: Statewide

Time Frame: FY14

Abstract: The DNR WD continues to be a national leader in supporting social science relevant to applied wildlife management. More important than the generation of knowledge is the integrated consideration of social science along with biological science when directing wildlife management programs and providing technical advice to policy makers. Topics requiring particular attention in this regard include human dimensions of wildlife health; hunter recruitment and retention; antecedents to and consequences of varying levels of public trust and confidence in the WD; human-wildlife interactions; how individuals and communities develop capacity for living with wildlife; application of systems thinking to natural resource policy; and decision-making processes.

Dr. Shawn Riley Support – Dr. Shawn Riley possesses considerable experience, expertise, and a history of consulting with agency staff on improving capacity to make effective decisions informed by these broad perspectives. This project will provide support for professional development for WD staff, program evaluation, and diffusion of techniques to integrate human dimensions of into programs, improve public trust and confidence in the agency, and maintain relevance of application of the public trust doctrine to wildlife management.

Dr. Frank Lupi Support – Dr. Frank Lupi possesses considerable expertise to advise and consult with WD on data collection, study design, and application of findings regarding the economic aspects of wildlife management.

Dr. Dan Kramer Support – Dr. Dan Kramer possesses considerable expertise to advise and consult with WD on data collection, study design, and application of findings regarding the social, economic, and policy aspects of wildlife management, particularly regarding conservation of biodiversity and changing land use.

Boone and Crockett Chair Graduate Student Fellowship

Primary Contact: Dr. Brent Rudolph, DNR WD, E. LnsG MI; rudolphb@michigan.gov, 517-641-4903

DNR Financial Support: \$30,000

Study Area: Statewide

Time Frame: FY14

Abstract: The DNR WD has collaborated with the Boone and Crockett Chair of Wildlife Conservation to provide a graduate student fellowship to support a research project to address unmet WD research priorities. The current project involves a regional analysis of deer-vehicle collision (DVC) occurrence in the Midwest region. This work is examining broad-scale factors that influence the likelihood of DVC in Illinois, Iowa, Michigan, and Wisconsin. Results from this research will be used to inform strategies for reducing DVCs and examine whether factors that influence the rate of DVCs can be accounted for in order to use standard available data in each state to generate an index to deer abundance at the regional, state or county scale. The WD will support the graduate fellowship associated with this research project for the entire FY 2014.

Geographic Analysis of Age-Period-Cohort Dimensions in Michigan Hunter Participation

Primary Contact: Dr. Brent Rudolph, DNR WD, E. LnsG MI; rudolphb@michigan.gov, 517-641-4903

DNR Financial Support: \$14,148 in FY14, \$64,230 total

Study Area: Statewide

Time Frame: 7/01/2014-9/30/2016

Abstract: Michigan's hunting population is declining with important implications for wildlife and forest management, conservation funding, restoration efforts, social relationships with nature, and social and cultural ways of life. For recruitment and retention efforts to respond to this decline, it is vital that wildlife planners, policy-makers, and managers understand the nuanced social, cultural, and demographic issues behind it. Moreover, adaptations to smaller future numbers of hunters and different types of hunters (i.e. older) will be necessary. Planners need a solid projection of how the future hunting population will change with a realistic accounting of what to expect under different

scenarios. The proposed project focuses on picking apart the demographic issues related to recent hunting decline by estimating the independent effects of age, period, and cohort on hunting participation rates.

Age has long been recognized as an important variable affecting hunting participation. The true effects of age, however, are complicated by the fact that they are easily confounded by period changes that occur over time and differences among birth cohorts. Cohort effects play a vital role in shaping hunter participation (Winkler and Warnke 2012, Chase 2012, Frawley 2006), but again they are difficult to disentangle from age and period effects. Frawley's (2006) report suggests that cohort effects are affecting participation among Michigan's small game hunters and provides some indication that more recent cohorts are not hunting deer at younger ages to the same extent that prior cohorts did. The age-period-cohort (APC) analysis proposed here would go further to statistically test the independent effects of age, period, and cohort in explaining recent hunter decline, do this by single year of age to specify important cohort groups, and incorporate results into a proven model for projecting the future hunting population.

Moreover, APC patterns likely vary across space with environmental, social, and cultural contexts. In order to better direct recruitment/retention efforts, it is vital to understand differences in how these patterns work between more urban and more rural areas of the state and from north to south. For instance, if geographic analysis indicates that the Detroit Metro Area is experiencing particular declines among the heavy-hunting Baby Boom generation, then this could be a cohort within a particular geography that deserves special attention in retention efforts. Are more rural areas continuing to recruit newer cohorts into hunting at the same rates as past generations? To what extent are cohort effects driving participation declines in rural vs. urban areas?

It is important to independently estimate age, period, and cohort because each has different implications for recruitment and retention efforts. Age can be addressed to some extent by improving accessibility. Period changes can be analyzed for relationships with policy changes, deer population changes, weather, economic change, and other factors to better understand how these factors contribute to hunting participation across all age and cohort groups. Cohort effects require further social analysis of how and why different cohorts develop differential likelihoods to hunt. But social analyses of cohort effects need to be closely integrated with demographic analysis to inform study design (i.e. which cohorts should be sampled and grouped together for analysis and from what parts of the state); to analyze survey results (modeling for cohort effects, independently of age and period); and so that social findings can inform assumptions that are integrated into demographic hunter population projection scenarios.

Facilitating Urban-Suburban Deer Management in Michigan: Social, Spatial and Population Considerations

Primary Contact: Dr. Brent Rudolph, DNR WD, E. Lnsq MI; rudolphb@michigan.gov, 517-641-4903

DNR Financial Support: \$154,983 in FY14, \$583,202 total

Study Area: southeastern Michigan

Time Frame: 10/18/2011-9/30/2016

Abstract: The number of urban and suburban communities consulting with WD staff or requesting direct assistance for addressing conflicts with deer has increased in recent years, and this trend is expected to continue. It is unclear whether the rising concerns are a consequence of increasing frequency and intensity of conflicts between deer and human populations in these settings or if tolerance for impacts of deer is decreasing. As a result, there is a need for the WD to gain an understanding of factors affecting tolerance levels – ranging from how different segments of the public perceive impacts to characteristics of the composition and use of the landscape by deer – and to discover new ways of achieving societal goals through deer management at geographic scales to which management might be effectively applied. A comprehensive analysis is needed to compare

characteristics of communities that are and are not experiencing conflicts. Our goal is to provide WD staff with better knowledge and understanding of causal factors in Michigan's urban-suburban deer problems, increase WD capacity for assisting communities resolve deer issues, and to help the WD anticipate the most effective locations and means to prevent or resolve problems within the scope of influence and authority of the division.

An Evaluation of Moving to a Learning Organization in the Wildlife Division: Measuring Collaboration, Trust, Performance and Effectiveness of Decisions

Primary Contact: Dr. Pat Lederle, DNR WD, Lansing, MI lederlep@michigan.gov, 517-243-0700

DNR Financial Support: \$87,007 in FY14, \$436,389 total

Study Area: Statewide

Time Frame: 11/1/2011-9/30/2016

Abstract:

The DNR WD *Strategic Plan for 2010-2015* sets ambitious objectives for becoming an adaptive (thus learning) organization with improved performance arising from, among other activities, collaborative governance, and greater accountability to the WD's external stakeholders. Although some of the objectives laid on in the strategic plan – especially the biologically oriented objectives related to habitat and wildlife populations – are straightforward to measure, other objectives relevant to becoming a learning organization are less tangible or easy to measure. To evaluate progress in achieving the desired outcomes of the strategic planning effort relevant to becoming a more adaptive and learning organization, research is needed to clarify measures of success (such as greater trust in the division among stakeholders and more sustainable, effective decisions), collect baseline information, and measure progress.

Increasingly, organizations strive to keep up with environmental changes and philosophies of continuous improvement. A key mechanism for dealing with these issues is to optimize the use of human resources and strengthen collaborative relationships with external stakeholders. In wildlife management, this undertaking has to be accomplished within a “messy world” with constantly changing environments and a high level of uncertainty. In the face of uncertainty, trust (we assume trust to include credibility) in the agency on the part of stakeholders becomes crucial to moving forward with decisions, yet systems that accelerate learning must be in place to keep pace with change in physical and social-economic environments. Organizational learning – that is, being adaptive – is a major determinant of sustainably high organizational performance. To thrive, organizations need to learn and change at an increasingly rapid rate. Improving service delivery and effectiveness calls for continual evaluation of the current state of the organization and consideration of future possibilities. A principal way any organization learns and changes is through rigorous assessment, monitoring, and evaluation.

Assessing the Viability of Game Meat Sharing as A Strategy to Increase Support for Hunting and Wildlife Conservation

Primary Contact: Dr. Brent Rudolph, DNR WD, E. Lnsng MI; rudolphb@michigan.gov, 517-641-4903

DNR Financial Support: \$47,744 in FY14, \$53,335 total

Study Area: Statewide

Time Frame: 7/01/2014-9/30/2015

Abstract: Hunters are key stakeholders in state wildlife conservation. Hunting is a valuable part of Michigan heritage and tradition, engaging Michiganders with wildlife, and connecting them to nature and to one another. Large societal transformations (e.g., increasing affluence and urbanization) are decoupling humans from nature (Heberlein and Ericsson 2005). If declining attitudes and support for hunting are to be countered, and participation increased, insights are needed about how to enhance the relevance, legitimacy, and value of hunting to society (Peterson 2004). Evidence exists that sharing and consumption of game meat may function in several ways as a “coupler” that links humans and natural systems (Ljung et al. 2012). Yet, specific knowledge is lacking about how social

networks operate in distribution and sharing of game meat, what effect game meat sharing has on societal views of legitimacy and relevancy of hunting, and whether support for hunting (and more broadly, nature) may be derived from experiences associated with meat sharing and consumption. An estimated 15 million pounds of venison are harvested annually in Michigan, providing > 60 million quarter pound servings of venison (>6 servings per Michigan resident annually, if distributed equally). The extent to which this meat is shared and any positive impacts associated with this sharing are unstudied benefits of wildlife management. Knowledge and insights regarding game meat sharing's social impact are expected to enable the DNR to facilitate partnerships that will increase the reach and impact of game meat in promoting positive attitudes towards and support for hunting.

7. Criterion Seven: Legal, Institutional and Economic Framework for Forest Conservation and Sustainable Management

Currently, there is no ongoing research in relation to this criterion.

Recently Completed Research Related to Sustainable Forestry

Development of Databases, Classification Systems, and Fisheries Management Tools for Inland Lakes of Michigan

Primary Contact: Kevin Wehrly, DNR FD, Institute of Fisheries Research, Ann Arbor, Michigan; wehrlyk@michigan.gov, 734-663-3554 x 12055

DNR Financial Support: \$11,420.00

Study Area: Statewide

Time Frame: Completed in FY2014

Abstract: The State of Michigan has more than 11,000 lakes that are 5 acres or larger, and adequate information is only available for 730 lakes that are “significant public waters”. The mission of FD to protect and enhance fish environments, habitat, populations and other forms of aquatic life requires us to manage all waters to promote the optimum use of lake resources for the benefit of the people of Michigan. The lack of information from the majority of lakes (93%) in the state has hindered our ability to develop adequate fisheries resource sampling designs, to interpret and extrapolate local knowledge regionally or statewide, to develop strategic plans for protecting, enhancing and restoring ecological function and processes for all lakes in Michigan and to evaluate the effects of forest and other land use practices on our lake systems. The study developed a set of inland lake databases and classification systems to provide information and tools for assessing and managing inland lakes in Michigan by: 1) assembling available information on inland lakes into a centralized and standardized database, including water quality, biological community, lake morphology and shoreline development descriptors; 2) delineating buffer, and local and network lake catchment boundaries for all lakes that are five acres or larger; 3) synthesizing natural landscape descriptors for the local and network catchments, including land cover, surficial geology, soil permeability, slope and climate; 4) synthesizing landscape human disturbance descriptors for the buffer and local and network catchment spatial zones, such as agricultural and urban land uses, population, imperviousness, nutrient loading, point source pollution and road density; 5) calculating lake network descriptors, such as lake network position, linkages with river network and groundwater and zoogeographic zone; 6) developing models for predicting parameters that are essential for assessing conditions in lakes where field data are not available; 7) developing a lake classification framework based on variables that are not influenced by human activities; 8) developing lake fisheries classifications based on the suitability for targeted sport fish species; and 9) assessing lake health status based on landscape human disturbances. These data provide a baseline for assessing future fisheries and forest management practices.

Walleye Dynamics in Michigan's Inland Waterway: the Burt-Mullett-Pickerel-Crooked Lake System

Primary Contact: Dr. Daniel Hayes, MSU, E. Lansing, MI; hayesdan@msu.edu, 517-432-3781

DNR Financial Support: \$102,556.00 (25% Game and Fish Funds)

Study Area: Cheboygan River system

Time Frame: Completed in FY2014

Abstract: Forest practices have the potential to directly affect the quality of aquatic habitat for key fish species. This project quantified the timing and rates of movement among lakes in the large Cheboygan River system, in order to better understand potential source-sink dynamics of walleye in these lakes. The study identified important spawning locations within Mullett Lake and provided insights into dynamics of larval and early juvenile walleye, with an emphasis on determining factors potentially limiting their growth and survival which has application to other lakes in Michigan. The last major element was an analysis of the diet of post-YOY walleye in all of the lakes within the Inland Waterway, comparing food web structure among these lakes, and the potential shift in food webs as the limnology of these lakes change over time partly in response to land use changes.

Design, Develop and Build Prototype and Operational Equipment Units for Mechanized Forest Fire Fighting

Primary Contact: Dan Munn, DNR FRD; munnd@michigan.gov, 989-275-5211

DNR Financial Support: \$716,290.00

Study Area: DNR Forest Fire Experiment Station and DNR forest lands

Time Frame: Completed on May 23, 2014

Abstract: Research done under this project involved design and development of customized firefighting equipment involving considerable engineering, mechanical, and machining knowledge, skill, and ingenuity to meet needs for wildland firefighting equipment. This equipment is not available commercially and is often developed entirely from scratch to meet a need (see the project below). At other times, the equipment development requires building customized parts to link two existing units. In 2014, a primary project was to build, fit and install a Michigan Fireline Plow onto a U.S. Forest Service D4K2 Crawler-Tractor. Project was successful and was tested at the Forest Fire Experiment Station in Roscommon Michigan prior to a USFS representative collecting it from the DNR. This firefighting unit is currently in service at the USFS Mio Michigan location.