M.L. 2016 Project Abstract
For the Period Ending June 30, 2019

PROJECT TITLE: Statewide Monitoring Network for Changing Habitats in Minnesota
PROJECT MANAGER: Hannah Texler
AFFILIATION: Minnesota DNR – Minnesota Biological Survey
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FUNDING SOURCE: Environment and Natural Resources Trust Fund
LEGAL CITATION: M.L. 2016, Chp. 186, Sec. 2, Subd. 03d

APPROPRIATION AMOUNT: $ 500,000
AMOUNT SPENT: $ 500,000
AMOUNT REMAINING: $0

Sound bite of Project Outcomes and Results

We developed the new Ecological Monitoring Network and established the first 125 plots that will be used to monitor change in native vegetation across the state. We also resampled 88 relevé vegetation plots and found significant changes in prairies and forests over the last 20 to 40 years.

Overall Project Outcome and Results

This project developed a network for monitoring change in the condition of prairies, forests, and wetlands across Minnesota to inform land protection and management in the face of rapid environmental change. The first activity was the development of long-term monitoring plots for the newly established Ecological Monitoring Network (EMN). We established 125 permanently marked plots on public and private lands, and collected data on native vegetation, soils, and other aspects of the environment. To address pollinators in monitoring plots, bee specialists visited six plots and hand-netted over 75 bees. The 125 plots represented a broad spectrum of quality. We recorded 885 vascular plant species, which represents 44% of the total number of species in Minnesota. The plot with the highest diversity was a tamarack swamp with 112 species. Over half (52%) of the plots contained at least one non-native plant species. Upland and wetland prairies were the plant communities with the most non-native species. In future years, we plan to install another 475 plots, and then to resample all plots every 6 years. Data analyses will include summaries of how native prairies, forests, and wetlands change over time, and how those changes are related to habitat patch size, past management, and other factors.

This project also included historic vegetation sampling to measure past changes in native vegetation by using relevé vegetation plots originally sampled 20-40 years ago.   We sampled 80 relevés in prairies and forests in State Parks and Scientific and Natural Areas in east-central Minnesota, and sampled the first eight of 80 relevés to be sampled in 2019 on the North Shore of Lake Superior. We began analyses of the 80 relevé plots from southeastern and east-central Minnesota.   Results indicate that we can detect significant changes in vegetation using the relevé resampling technique. For example, we found that prairies that have had fire management had fewer non-native invasive species, less cover by vines, and higher native species diversity than those that have not had fire management. However, we did detect increasing frequency of non-native invasive species such as smooth brome and common buckthorn, as well as increasing frequency of native vines, over time on all plots. Further analyses will be completed and the results disseminated in 2020.

Project Results Use and Dissemination

A web page for this project was created and can be accessed here:
https://www.dnr.state.mn.us/mbs/ecologicalmonitoring/index.html
The project goals, objectives, most recent brochure, and field methods, including a link to the Standard Operating Procedures (DNR Biological Report Number 121), can be found on this web site.

Reports summarizing data collected in each plot were sent to the respective landowner or land manager for that plot following each field season.

Email updates regarding the project's progress were shared with DNR Oversight and Project Teams following 2017 and 2018 field seasons.

PowerPoint presentations were developed and presented at a number of venues, including the Minnesota Biological Survey annual meeting, the Minnesota Native Plant Society, The Nature Conservancy, and the University of Minnesota's Conservation Science Symposium.

Date of Report: August 16, 2019

Final Report

Date of Work Plan Approval: July 5, 2016

Project Completion Date: June 30, 2019

PROJECT TITLE: Statewide Monitoring Network for Changing Habitats in Minnesota

Project Manager: Hannah Texler

Organization: MN DNR – MN Biological Survey

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Location: Statewide.

Total ENRTF Project Budget:	**ENRTF Appropriation:**	**$500,000**
	Amount Spent:	**$500,000**
	Balance:	**$0**

Legal Citation: M.L. 2016, Chp. 186, Sec. 2, Subd. 03d

Appropriation Language:
$500,000 the second year is from the trust fund to the commissioner of natural resources to develop a consolidated statewide network of permanent habitat monitoring sites in prairies, forests, and wetlands to help guide and prioritize habitat protection and management decisions in response to environmental change. The design and testing methodologies of monitoring plots must address the status of pollinators and pollination. This appropriation is available until June 30, 2019, by which time the project must be completed and final products delivered.

PROJECT TITLE: A Statewide Monitoring Network for Minnesota's Changing Habitats

II. PROJECT STATEMENT:
This project will develop a statewide network for monitoring change in the condition of prairies, forests, wetlands, and other terrestrial habitats.

Minnesota's diverse terrestrial habitats provide recreation, timber, water filtration, habitat for wildlife and pollinators, flood protection, carbon storage, and other valuable services. Many habitats have changed noticeably in recent decades from changes in land and water use, invasive species, changing climate, and other environmental changes. We do not have a complete or current picture of how environmental change is affecting the full range of habitats across the state, from local biological hotspots to widespread forest types that sustain economies. The monitoring network will deliver timely information on habitat condition and trends to resource managers, conservation programs, local governments, researchers, and citizens. This information will guide habitat management, conservation, and research across Minnesota.

- The monitoring network will focus on answering questions needed for habitat management and conservation.
- During the 3-year project period we will develop the monitoring network design and sampling methods, and collect field data on at least 90 pilot monitoring sites.
- Researchers will collect data on vegetation structure and composition at each monitoring site, along with other important indicators of habitat health, including pollinator populations, soil and hydrological samples, and wildlife habitat metrics.
- The monitoring of plots will include the design and testing of methodologies to address the status of pollinators and pollination (specific methods to be developed in year 1; field testing of methodologies to occur in years 2 and 3; progress and outcomes to be reported in each activity status update).
- Some monitoring sites will include resurveys of historic vegetation plots to acquire information on trends in habitat change since the 1980s and 1990s.
- The final statewide network will have about 1,000 to 1,500 monitoring sites, distributed across all terrestrial habitats and all regions of Minnesota; initial sampling of all 1,000 to 1,500 sites is estimated to be complete in 6 to 10 field seasons after this 3-year project, and sites will be resurveyed in the future at regular intervals.

The statewide monitoring network will fill data gaps and add to data collected by existing regional or habitat-specific monitoring and biological inventory efforts (e.g., Sustaining Lakes in a Changing Environment, Wetland Status and Trend Monitoring, Minnesota Wetland Condition Assessment, State Wildlife Action Plan Prairie Monitoring, U.S. Forest Service Forest Inventory and Analysis, DNR Cooperative Stand Assessment). Bridging these efforts with systematic statewide information will place existing habitat monitoring and research into statewide context, provide fundamental baseline data, and improve data collection. This will increase the value of all monitoring and research and expand the scope of information for natural resource planning and management.

The Minnesota DNR's Minnesota Biological Survey will coordinate the initial development and pilot testing of the monitoring network in collaboration with other DNR programs, other government agencies, conservation organizations, local government units, tribes, and university researchers. During this project period, partners will:

- agree on key management and conservation questions to be addressed;
- identify baseline data to record on vegetation, pollinator and pollination status , soils, hydrology, , wildlife habitat metrics, and other fundamental indicators of habitat health and change;

- establish a process for selecting target habitats, locations of monitoring sites, and field survey methods;
- develop standard methods for collecting data;
- field test data collection methods on a minimum of 90 pilot monitoring plots;
- evaluate data collected for effectiveness in addressing management and conservation questions;
- assess habitat change over the past 20-30 years by comparing new and old data at sites with historic vegetation plots;
- develop a central database for long-term storage and broad access to data;
- develop data standards to ensure data quality; and
- create a website for access to project methods, results of analyses, interpretive products, and other information.

Important goals of this 3-year project are the development of a rigorous network design and sampling methods and a framework for collaboration among multiple partners. Rigorous initial design and pilot testing are critical for effective data collection across all 1,000 to 1,500 monitoring sites statewide in future field seasons.

III. OVERALL PROJECT STATUS UPDATES:

Amendment Request (06/30/2016)
An amendment is requested to correct an error in calculating DNR Direct & Necessary. Correcting the error reduced the total Direct and Necessary charges. All dollars made available by this correction were moved to Biometrician contracts within the Professional/Technical/Service Contracts budget.

Amendment Approved: [07/05/2016]

Activity Status as of December 31, 2016:
We issued an RFP and awarded a 15-month contract beginning on October 10th to Western Ecosystems Technology, Inc. for statistical consultation. We hired a Project Coordinator who began work on November 14th, and began to establish Position Descriptions for two Resource Specialists. A DNR Oversight Team was established and had its first meeting on September 9th. A Project Team was established and will have its first meeting on January 11th -12th. Meetings were held with many potential partners and collaborators to inform them about this project, seek ideas and expertise, and discuss future collaboration. A monitoring panel was held for Minnesota Biological Survey staff to provide information about setting up ecological monitoring projects and to seek their input. Minnesota Biological Survey plant ecologists collected data from seven relevé plots in six different native plant communities that had been originally sampled 20 to 30 years previously. We compiled a spreadsheet with information about the 189 relevés in our database that were flagged as resampled; we will be analyzing the data this winter. All of this work was done using DNR internal funding sources. We will be utilizing funding provided for this project in the near future.

Activity Status as of March 31, 2017:
We finalized Position Descriptions for the two Resource Specialists and advertised the positions nationwide. We received 100 applicants, which are currently being reviewed. The DNR Oversight Team met on February 9th and February 24th to review work to date, help craft objectives, and ensure that other DNR division perspectives and goals were incorporated into the project. The Project Team met for two 2-day meetings, using a structured decision making process and the guidance of WEST, our statistical consultants, to work through details of goals, objectives, and attributes to be monitored. At the second meeting, we had leaders of the three existing state-wide Minnesota long-term vegetation monitoring projects (Forest Inventory and Analysis (FIA), Long-Term Grassland Monitoring, and Status and Trends of Wetlands) give presentations and answer questions to ensure we are collaborating and not duplicating efforts. A two-page draft Problem Statement, Goals, and Objectives

was completed after the second Project Team meeting. We will be using random sampling of uncultivated vegetation throughout the state. We are currently working with WEST to develop rules for the sampling frame we will use to choose our plot locations, and are developing our field sampling protocol. We have been working with bee and Lepidoptera specialists in the MBS program to develop methods for pollinator surveys in a portion of our sampling sites. We anticipate beginning field sampling in late spring or early summer.

Activity Status as of September 30, 2017:
Two Natural Resource Specialists were hired in late June to collect and enter data for this project. A folder for this project was established on a DNR shared drive so that DNR partners could access documents and spreadsheets related to the project. We revised and finalized our Project Statement, Goals and Objectives Document, developed rules for our sampling frame, and developed draft field sampling protocols. The protocols were described in a detailed manual titled "Draft Standard Operating Procedures for Developing a Minnesota Ecological Monitoring Network," which was posted on the DNR shared drive. WEST generated a sample frame of 20,000 random points across the state. We eliminated points that fell within cultivated areas, lakes, impervious surfaces, and mined areas using GIS, and then reviewed the remaining points in consecutive order to select 90 potential plot locations that met our criteria for native vegetation. We obtained permits from public landowners and permission from private landowners to place plots in selected locations. Data were collected from 48 randomly selected plots between July 5 and September 18. We also collected data from two non-randomly selected sites with new groundwater monitoring wells in partnership with DNR hydrologists. MBS zoologists collected data on bat activity levels and species richness in one plot as a small pilot to determine if this will work in the future, and an MBS entomologist made plans to visit one or more plots in the fall to experiment with moth and butterfly surveys. A Project Update report was developed and distributed to project team members, partners, and all DNR Ecological and Water Resources staff in June.

Activity Status as of March 31, 2018**:**
We expanded the historic vegetation sampling part of the project during this period. We developed criteria for choosing sites on Scientific and Natural Areas and State Parks with input from SNA and Parks staff. An RFP was issued in March to hire a contractor to resample 80 relevés during the 2018 field season.   The long-term monitoring plot portion of this project was renamed "Minnesota's Ecological Monitoring Network." An Access database was created, and the data from the 48 plots visited in 2017 were entered into the database. The data collected from each individual plot were compiled into reports and sent to each landowner/manager. Data summaries from the season showed that 63% of the plots fell within MBS Sites of Biodiversity Significance, and 40% fell within native plant community polygons mapped by the DNR. A total of 665 species were recorded, ranging from 10 species in one plot to 92 species in the most diverse. Sixty-seven percent of the plots contained at least one non-native invasive species; prairie plots had the most invasives. A Project Update brochure was developed and distributed to owners/managers of lands where plots were completed. A new web page was created in April and can be accessed here: www.mndnr.gov/ecomonitoring

Amendment Request (04/16/2018):
Overall, Activity 1 is complete and came in well under budget in most categories. We want to direct remaining balances from Activity 1 to Activity 2. Activity 2 is field work and the central focus of this project, we intend to add more personnel to field sampling as result of these budget amendments. More personnel in the field will also require an increased travel budget. Also, based on travel expenditures thus far in the project, travel expenses were likely under-estimated at the start. Thus, some of the Activity 1 remaining budgets will be moved to Travel expenses. Details are as follows:
1. Move $36,154 from Activity 1 Personnel to Activity 2 Personnel.
   a. Reason: Activity 1 Personnel costs came in well below budget. Activity 1 is complete now and we want to redirect this money to Activity 2 Personnel to cover additional field crews assigned to this project during the 2018 field season.
2. Move $51,250 from Activity 1 TBD contracts to Activity 2 personnel.

a. The project will not require as much money for IT contracts and we would like to direct some of this budget to contracts for more field work.
3. Move $31,477 from Activity 1 Biometrician Contracts to Activity 2 Travel.
   a. Reason: Activity 1 Biometrician costs came in well below budget. Activity 1 is complete now and we want to redirect this money to Travel to cover additional field crews assigned to this project during the 2018 field season.
4. Move $6,811 from Activity 1 Direct & Necessary to Activity 2 Direct & Necessary.
   a. Reason: Activity 1 is complete and won't incur additional Direct & Necessary charges. Per the amendments above more project activity will occur in Activity 2 and therefore Activity 2 will be billed more for Direct & Necessary.
5. Professional/Technical/Service Contracts: add language to allow for contracts with biologists (TBD) for field survey/monitoring.

Amendment Approved: [**04/18/2018**]

Activity Status as of September 30, 2018**:**
For the historic vegetation sampling project, we selected 80 releve locations that had been sampled between 20 and 50 years ago for resampling. They were located in Scientific and Natural Areas or State Parks in east-central and southeast Minnesota. Plant community types and locations were based on statistical analyses and input from SNA and State Parks staff. The 80 releve plots were all in Fire-Dependent Forest, Mesic Hardwood Forest, or Upland Prairie Ecological Systems. Through a contract with the environmental consulting company Ecological Strategies, new releve plot data were collected in locations as close to historic sites as possible and permanently marked with buried magnets and tree tags. For the Ecological Monitoring Network, the field protocols were adjusted to make data collection more efficient, and three Seasonal Monitoring Botanists were hired to help collect and enter data. Vegetation data were collected from 68 plots between May and September, including 59 new plots and nine that had been sampled in 2017. The latter will help us to understand year to year variation. The 68 plots were located throughout the state in 34 counties, with 45 occurring on public land and 23 on private land. Six plots were also visited by bee specialists, who used hand-netting to collect more than 75 bees. Five plots were visited by a moth and butterfly specialist, who used various methods to sample moth and butterfly species. All collected bee, butterfly, and moth specimens will be processed and identified in the coming months.

Activity Status as of February 27, 2019:
For the historic vegetation sampling project, half of the data from the 80 releves sampled in 2018 have been entered into the statewide releve database, and a report summarizing field methods and lessons learned by the contractor was completed. For the Ecological Monitoring Network, summaries of the data from the 107 plots sampled in the first two years of this project were completed. A total of 885 vascular plant species were recorded, which is 44% of the total number of species in the state. Over half (52%) of the plots contained at least one non-native plant species, and the most frequent non-native species was Kentucky bluegrass. Upland and wetland prairies were the plant communities with the most non-native species, followed by mesic hardwood forests in southeastern Minnesota. The 107 plots represented a broad spectrum of quality, from high quality, diverse communities, to more disturbed communities with lower diversity, such as young aspen-dominated forests, disturbed prairies dominated by non-native brome grass, and cattail marshes. All data were entered into the Access database, and potential plot locations for the 2019 field season were selected from the GRTS random sample set. Reports summarizing data collected in each plot were sent to the respective landowner or land manager for that plot.   PowerPoint presentations were given to The Nature Conservancy and as part of the University of Minnesota's Conservation Science Symposium.

Amendment Request (02/27/2019)
An amendment is requested to transfer $20,000 into the Equipment/Tools/Supplies budget item in order to purchase tools for an additional field office for this project. A total of $10,000 was moved from the Personnel

Activity 3 budget because other funding sources have helped pay for a portion of the Project Coordinator's salary, and $10,000 was moved from the Travel Activity 2 budget because of an overestimate in the amount needed for the 2018 field season.

Amendment Approved by LCCMR 3/8/2019

Activity Status as of 07/18/2019:
There was an accounting error in the previous budget update that double counted a biometrician contract invoice, leaving us with $27,150 more than we realized in the Biometrician Contracts Activity 3 category.

Amendment Request (07/18/2019)
1. Regarding the error listed above in the 07/18/2019 Activity Status, we addressed the error but are requesting an amendment to move $20,000 to Personnel Activity 2 and $7,150 to Personnel Activity 3, to cover personnel costs that were higher than anticipated.
2. A retroactive amendment is requested for the transfer of $5,000 within Contracts from Biometrician Contracts to TBD Contracts with Biologists. We let a contract that was within our overall Contract budget to collect mosses and lichens from our plots, but neglected to seek approval beforehand for this amendment.
3. An amendment is requested for the transfer of $881 from Equipment/Tools/Supplies to Personnel. Our equipment costs came in under budget, and this helps to address personnel costs that were higher than anticipated.

Amendment Approved by LCCMR 7/30/2019

Activity Status as of 08/16/2019:
EMN final budget close-out amendments:
1. Increase Activity 2 Personnel by $6,846. New Activity 2 Personnel Budget = $296,431.
    a. Move $4,648 from Activity 3 Personnel. New Activity 3 Budget = 40,502.
    b. Move $2,198 from Activity 2 Contracts, Biologists. New Activity 2 Contracts, Biologists = see 2a below.
2. Increase Activity 2 Equipment/Tools/Supplies by $1,014. New Activity 2 E/T/S Budget = $33,533
    a. Move $631 from Activity 2 Contracts, Biologists. New Activity 2 Contract, Biologists budget = $2171
    b. Move $382 from Activity 2 Travel Expenses. New Activity 2 Travel Expenses budget = $54,845
3. Increase Activity 2 Direct & Necessary by $950. New Activity 2 Direct & Necessary = $21,006

Move $950 from Activity 3 Direct & Necessary. New Activity 3 Direct and Necessary budget = $3,381

Overall Project Outcomes and Results:
This project developed a network for monitoring change in the condition of prairies, forests, and wetlands across Minnesota to inform land protection and management in the face of rapid environmental change. The first activity was the development of long-term monitoring plots for the newly established Ecological Monitoring Network (EMN). We established 125 permanently marked plots on public and private lands, and collected data on native vegetation, soils, and other aspects of the environment. To address pollinators in monitoring plots, bee specialists visited six plots and hand-netted over 75 bees.

The 125 plots represented a broad spectrum of quality. We recorded 885 vascular plant species, which represents 44% of the total number of species in Minnesota. The plot with the highest diversity was a tamarack swamp with 112 species. Over half (52%) of the plots contained at least one non-native plant species. Upland and wetland prairies were the plant communities with the most non-native species. In future years, we plan to

install another 475 plots, and then to resample all plots every 6 years. Data analyses will include summaries of how native prairies, forests, and wetlands change over time, and how those changes are related to habitat patch size, past management, and other factors.

This project also included historic vegetation sampling to measure past changes in native vegetation by using relevé vegetation plots originally sampled 20-40 years ago.   We sampled 80 relevés in prairies and forests in State Parks and Scientific and Natural Areas in east-central Minnesota, and sampled the first eight of 80 relevés to be sampled in 2019 on the North Shore of Lake Superior.

We began analyses of the 80 relevé plots from southeastern and east-central Minnesota.   Results indicate that we can detect significant changes in vegetation using the relevé resampling technique. For example, we found that prairies that have had fire management had fewer non-native invasive species, less cover by vines, and higher native species diversity than those that have not had fire management. However, we did detect increasing frequency of non-native invasive species such as smooth brome and common buckthorn, as well as increasing frequency of native vines, over time on all plots. Further analyses will be completed and the results disseminated in 2020.

IV. PROJECT ACTIVITIES AND OUTCOMES:

ACTIVITY 1: Design statewide monitoring network and develop methods

The project team (coordinator, biometrician, collaborators) will design a statewide network of permanent monitoring sites. Sites will be selected across prairie, forest, and wetland habitats. Sites with historic vegetation plots will be included in the network to gain preliminary information on trends in habitat change. Methods for collecting field data will be developed and published. The project team will analyze data at the end of each field season and refine methods as necessary.

The project team will use professional planners and facilitators to develop a framework for designing the monitoring network and collaboration. Internal DNR collaboration will include the Divisions of Ecological & Water Resources, Forestry, Fish & Wildlife, Parks & Trails, and Operation Services. External partners will be solicited from the Minnesota Pollution Control Agency, The Nature Conservancy, University of Minnesota, U.S. Forest Service, U.S. Fish & Wildlife Service, tribes, and other local government and private organizations. The project team and collaborators will:

- define the questions addressed by monitoring;
- design statewide sampling methods; and
- select strategies for disseminating data and information.

The project team will work with IT professionals to develop a monitoring database, using existing vegetation databases to minimize costs, and a project website.

Methods and associated manuals and forms will be reviewed and revised periodically throughout the 3-year project. Field data collection manuals and forms will be published and made accessible.

Summary Budget Information for Activity 1:	**ENRTF Budget:**	**$ 33,280**
	Amount Spent:	**$ 33,280**
	Balance:	**$0**

Outcome	Completion Date
1. Statewide network of permanent habitat monitoring sites published	1/2017
2. Field data collection manuals and forms published	5/2017
3. Habitat Monitoring Database and Monitoring Network website developed	9/2017
4. Field data collection manuals and forms revised and republished following pilot studies	6/2019

Activity Status as of December 31, 2016**:**
Activities completed in this six-month period focused on writing a project definition, forming teams, developing partners, hiring a Project Coordinator, initiating a contract with a statistician, meeting with natural resource specialists who are conducting other long-term monitoring projects, and initiating collaboration with DNR and MPCA experts in hydrology, climate, wildlife habitat, and pollinators.

Project Definition
A draft Project Definition was completed to establish an organizational framework and timeline for the project. The organizational framework established Ann Pierce as Executive Sponsor, Bruce Carlson as Managing Sponsor, and Hannah Texler as Project Manager. A facilitator to help with meetings was secured.

Hiring and Contracting
An RFP was issued for a biometrician consultant who will advise the project from October 10, 2016 through December 31, 2017. The contract was awarded to Western EcoSystems Technology, Inc. (abbreviated WEST). Jennifer Stucker is the WEST manager for this project. Jennifer has participated in several planning meetings and gave a presentation on "Statistical Considerations in Planning a Monitoring Project" as part of our October 18th monitoring panel.

A new Research Scientist position was created for a Project Coordinator for this project. Erika Rowe was hired for this position and began work on November 14th, with 60% of her time devoted to this project and 40% to other MBS work.

Initial work was begun to establish two Natural Resource Specialist positions to do most of the field data collection and data entry; it is expected that these positions will be hired near the beginning of April.

Establishing Project Teams
The DNR Oversight Team was formed to ensure strong collaboration with other DNR divisions. Team members include staff from Ecological and Water Resources, the Office of Management and Budget Services, Fish and Wildlife, Parks and Trails, and Forestry. The team met on September 9th and discussed the project, gave input into project objectives, and compiled a list of priority external and internal partners. The team directed the Project Manager to the 2016 article "A road map for designing and implementing a biological monitoring program" by Reynolds et al, which subsequently formed the basis for moving forward with project design.

The Project Team was formed and given the charge of refining project objectives and developing the sampling protocol. The team is composed of 13 DNR staff – 10 from the MBS program, one from Parks and Trails, one from Fish and Wildlife, and one from Forestry. The team will meet on January 11-12 and will use a structured decision making process to refine the project objectives.

An advisory group consisting of DNR as well as external natural resource experts is being formed to provide technical advice and to review proposed objectives and methods developed by the Project Team.

<u>Meetings with DNR Collaborators and Experts</u>
A monitoring panel consisting of five presentations was presented to MBS staff on October 18th to introduce them to this project, present information about designing and implementing biological monitoring programs, and solicit input and ideas for this project.

Many meetings with natural resource experts in a variety of related fields have been held to seek input and partners, to learn about related monitoring efforts, and to learn from the experiences of others who have established long-term monitoring projects.

We presented an overview of the project to the Commissioner's Advisory Committee on Natural Heritage, and solicited input and feedback from them.

<u>Releve Resampling</u>
Minnesota Biological Survey plant ecologists collected data from seven resampled relevés in six different native plant communities during the 2016 field season. Objectives included exploring issues related to finding older plots, and adding to our dataset of resampled relevés. We compiled a spreadsheet with information about the 189 relevés in our database that were flagged as revisited. We will be examining this dataset this winter to determine what kinds of changes took place in these plots between sampling periods in order to inform future relevé resampling.

All of this work was done using internal DNR funding sources.

Activity Status as of March 31, 2017**:**
We finalized Position Descriptions for the two Resource Specialists and advertised the positions nationwide. We received 100 applicants, which are currently being reviewed. The DNR Oversight Team met on February 9th and February 24th to review work to date, help craft objectives, and ensure that other DNR division perspectives and goals were incorporated into the project. The Project Team met for two 2-day meetings, using a structured decision making process and the guidance of WEST, our statistical consultants, to work through details of goals, objectives, and attributes to be monitored. At the second meeting, we had leaders of the three existing state-wide Minnesota long-term vegetation monitoring projects (Forest Inventory and Analysis (FIA), Long-Term Grassland Monitoring, and Status and Trends of Wetlands) give presentations and answer questions to ensure we are collaborating and not duplicating efforts. A two-page draft Problem Statement, Goals, and Objectives was completed after the second Project Team meeting. We will be using random sampling of uncultivated vegetation throughout the state. We are currently working with WEST to develop rules for the sampling frame we will use to choose our plot locations, and are developing our field sampling protocol. We have been working with bee and Lepidoptera specialists in the MBS program to develop methods for pollinator surveys in a portion of our sampling sites. We anticipate beginning field sampling in late spring or early summer.

Activity Status as of September 30, 2017:
Two Natural Resource Specialists, Laura Bosacker and Nathan Dahlberg, were hired in late June to collect and enter data for this project.

The Project Statement, Goals and Objectives document was finalized in April following input from DNR Oversight and Project teams and WEST statistical consultants. Draft field sampling protocols were developed based on consultations with other agencies who have done similar long-term vegetation monitoring projects. These protocols were presented to two external groups for review and input. The first was a group of University of Minnesota ecologists. The second was held in Duluth and included ecologists from the University of Minnesota NRRI, The Nature Conservancy, and Superior National Forest. The field protocols were finalized following this input, and summarized in a document called "Draft Standard Operating Procedures for Developing a Minnesota Ecological Monitoring Network," which was posted on the shared DNR I drive. They were modeled after protocols developed by the National Park Service.

Activity Status as of March 31, 2018**:**
We expanded the historic vegetation sampling part of the project during this period. Funding was obtained from the Scientific and Natural Areas (SNA) and the Parks and Trails Division to resample historic releve plots in SNAs and State Parks in southeastern and east-central Minnesota. We developed criteria for choosing sites with input from SNA and Parks staff, and began analyzing historic releve data with the help of our contract statisticians. An RFP was issued in March to hire a contractor to resample 80 releves during the 2018 field season.

The long-term monitoring plot portion of this project was renamed "Minnesota's Ecological Monitoring Network." An Access database was created for data entry. The data collected from each individual plot were compiled into reports and sent to each landowner/manager. The Project Team and the DNR Oversight Team met together to review results of the 2017 field season and help inform next steps.

Activity Status as of September 30, 2018**:**
For the Minnesota's Ecological Monitoring Network (EMN) portion of this project, the field protocols were adjusted to make the data collection more efficient, and the Draft Standard Operating Procedures manual was revised to reflect these changes. In spring 2018, Laura Bosacker left the program, and three Seasonal Monitoring Botanists were hired to help us collect and enter data from the plots.

For the historic vegetation sampling portion of the project, we worked with our statisticians as well as our partners in the Scientific and Natural Areas program and Parks and Trails division to select 80 releves that had been sampled between 20 and 50 years ago to resample. We chose releves from just three ecological systems to limit variability between plots and maximize the likelihood of obtaining useful data. The 80 selected releve sites were all in Scientific and Natural Areas or State Parks, in the Mesic Hardwood, Fire-Dependent Forest and Woodland, or Upland Prairie Ecological Systems. They were located in the Oak Savanna, Paleozoic Plateau, and Hardwood Hills Ecological Sections of east-central and southeast Minnesota. A contract was signed with Ecological Strategies, an environmental consulting firm, to visit the sites and collect current releve data.

Activity Status as of February 27, 2019:
No activity in this period.

Final Report Summary:
For the new long-term monitoring plot portion of this project, this activity involved the development of goals and objectives, the design and refinement of sampling protocols and the development of methods for disseminating the data and information. We began with extensive research into existing long-term monitoring projects through a literature review and consultation with many plant ecologists with monitoring expertise. We hired Erika Rowe as the Project Coordinator in November 2016. We then formed two multi-division DNR teams: 1) the Oversight Team, which ensured strong collaboration within the agency, and 2) the Project Team, which helped us develop objectives and sampling protocols. We contracted with Western EcoSystems Technology (WEST) to provide statistical advice and analyses. We used a structured decision making process to systematically develop our goals and objectives, and these led to the development of our draft field protocols. All of this information is available on our website:
https://www.dnr.state.mn.us/mbs/ecologicalmonitoring/index.html

Our goals and objectives were based in part on our decision to include native vegetation of varying quality, from high to low, and our interest in ensuring that we were collecting scientifically rigorous, unbiased data. We presented our draft protocols to experts outside the DNR, including ecologists from the University of Minnesota, Superior National Forest, and The Nature Conservancy, as well as members of the Commissioner's Advisory Committee on Natural Heritage. Our field protocols were finalized following this input, and posted on a DNR shared drive. We named the project Minnesota's Ecological Monitoring Network (EMN), reflecting the goal of

establishing both a network of plots and a network of people who would collect long-term ecological data from the plots. We developed an Access database for data entry for this project. Following the first field season of data collection, we revised our field protocols to make data collection more efficient.

For the historic vegetation sampling part of this project, we began by resampling seven releve vegetation plots in six different plant communities to explore issues related to finding older plots. We then compiled data from all 189 releves in our database that had been resampled at various times. WEST consultants used the resampled releve data for Mesic Hardwood Forests and Upland Prairies in nonmetric multidimensional scaling ordination analyses that helped inform our plans for this project's releve resampling. They found that phenological stage was not responsible for change between sampling periods, meaning resampling plots at the same time as original samples were taken is not important, and they also found that the number of plots available for analyses were sufficient to detect patterns and causes of change. We secured funding from the Parks and Trails Division and the Scientific and Natural Areas Program to resample releves in Parks and SNAs in 2018 and 2019, and developed methods of plot selection to maximize the usefulness of the information we would gain from this effort. For 2018, we selected 80 releves in east-central and southeast Minnesota that had been sampled between 20 and 40 years ago to resample, including Mesic Hardwood Forest, Upland Prairie, and Fire-Dependent Forest and Woodland ecological systems. We selected spatially balanced points stratified by ecological system, site, and whether prescribed burning had taken place. For 2019, we selected 80 releves sampled between 20 and 40 years ago on the North Shore of Lake Superior in Mesic Hardwood Forest, Fire-Dependent Forest and Woodland, Wet Forest, Rock Outcrop, and Lakeshore ecological systems. We selected spatially balanced points stratified by ecological class and site. We also developed guidelines for finding and permanently marking historic releve locations, and protocols for data collection beyond the basic releve methods, including Invasive Earthworm Assessments, tree diameters at breast height (DBH) for all trees larger than 10 cm DBH, basal area estimates using a prism, and standardized photo documentation. For the North Shore releves, we added a Lake Superior Shoreline Plant Communities Addendum form designed to record data specific to rock outcrop and lake shore plant communities.

ACTIVITY 2: Conduct pilot studies
The project coordinator will oversee pilot studies to test and refine methods. Data will be collected at a minimum of 90 monitoring sites. Forest locations will include sites within the project area of the LCCMR ML2016 recommended project, *Enhancing Forest Inventory using Multiple Remote Sensing Technologies*. Data collected will be entered into the Habitat Monitoring Database at the end of each field season. Field data collection during pilot studies will take place during the 2017 and 2018 field seasons.

Summary Budget Information for Activity 2:	ENRTF Budget:	~~$ 402,389~~
		$ 407,988
	Amount Spent:	$ 407,988
	Balance:	$0

Outcome	Completion Date
1. Data collected at ≥30 prairie monitoring sites	9/2018
2. Data collected at ≥30 forest monitoring sites	9/2018
3. Data collected at ≥30 wetland monitoring sites	9/2018
4. Data entered into the Habitat Monitoring Database	1/2019

Activity Status as of December 31, 2016**:**
No activity in this period.

Activity Status as of March 31, 2017**:**
No activity in this period.

Activity Status as of September 30, 2017:
To determine plot locations, a sample frame of 20,000 random points were generated across the state using a generalized random-tessellation stratified (GRTS) design. Those points that fell within cultivated areas, lakes, impervious surfaces, and mining areas were eliminated, and the remainder of the points were reviewed in consecutive order to select plots that met our criteria for native vegetation until 90 potential plot locations, including wet forests, upland forests, open wetlands, and grasslands, were selected. Permission and permits were then obtained from private and public landowners to place plots in selected locations.

Data were collected from 48 plots between July 5 and September 18. The goal of 90 plots was not reached because hiring delays led to a shortened field season, and the field protocols took longer than expected. Completed plots included 14 in upland forests, 9 in wet forests, 9 in open wetlands, 2 in wet prairies, and 14 in upland grasslands. Most of the data collection was done by the Project Coordinator and two Natural Resource Specialists, but they were joined by a botanist on contract for one month, and by twelve DNR ecologists from the Minnesota Biological Survey and other programs at various times. Plots were placed in 28 counties and encompassed 11 ecological systems. Fourteen were in upland forest, nine in wet forest, nine in open wetlands, two in wet prairie, and 14 in upland grassland. Forty-two were on public lands, ranging from federal to state to watershed-district and county-owned lands. Six were on private lands, including one on land owned by The Nature Conservancy. Two plots were located within the *Enhancing Forest Inventory using Multiple Remote Sensing Technologies* LCCMR project area.

Data collected in the plots included species and percent cover of ground layer vegetation; tree species, heights and DBH; shrub species; visual obstruction readings in grasslands; amount of coarse woody debris; amount of deer browse; a rapid earthworm assessment; a soil profile; photo points; and pH and conductivity of water in wetlands. Plots were permanently marked with rebar in uplands and PVC pipes in wetlands, buried magnets, tagged witness trees, and nails along transects. Locations were also recorded using GPS.

We also collected data from two non-randomly selected sites with new groundwater monitoring wells in partnership with DNR hydrologists. MBS zoologists placed Anabat SD2 acoustic detectors in one of our sites to experiment with collecting information on bat activity levels and bat species richness on our plots. An MBS entomologist prepared to visit one or more sites to experiment with collecting moths and butterflies on our plots in the fall.

Activity Status as of March 31, 2018**:**
The data from the 48 plots visited in 2017 were entered into the Access Database.

Activity Status as of September 30, 2018**:**
For the historic vegetation sampling part of the project, 79 releve sites were visited and new vegetation data were collected between May and September (one site was removed from the sample set, as there was no reasonable access available).

For the EMN part of the project, data were collected from 68 plots between May 22nd and September 13th. Of these, 9 were resampled from the 2017 field season to obtain information about year to year variation, and 59 were new. Most of the data collection was done by the Project Coordinator, one Natural Resource Specialist, and three Seasonal Monitoring Botanists. They were joined by twelve DNR ecologists from the Minnesota Biological Survey and other programs at various times. Plots were placed in 34 counties and encompassed 10 ecological systems. Twenty-eight plots were in upland forest, 14 in wet forest, 12 in open wetlands, one in wet prairie, and 13 in upland grassland. Forty-five plots were on public lands, ranging from federal to state to

county-owned lands. Twenty-three were on private lands, including two on land owned by The Nature Conservancy.

To address pollinators in monitoring plots, MBS program bee specialists visited six of the plots from which vegetation data were collected this year, and spent 30-60 minutes hand-netting any bees observed. They caught and collected more than 75 bees in total, and will be identifying them over the fall and winter. In addition, a MBS entomologist visited five EMN plots, including two that were sampled in 2017, two that were sampled in 2018, and one that was sampled both years. He used a variety of methods to sample for moths and butterflies, and will be identifying them over the fall and winter.

Activity Status as of February 27, 2019:
For the historic vegetation sampling project, the data from the 80 releves sampled in 2018 are in the process of being entered into the statewide releve database, and analyses of the data will be completed by the end of April. A report summarizing field methods and lessons learned by the contractor was completed. For the Ecological Monitoring Network, all data were entered into the Access database. Potential plot locations for the 2019 field season were selected from the GRTS random sample set.

Final Report Summary:
For the Ecological Monitoring Network part of this project, a sample frame of 20,000 random points were generated across the state using a generalized random-tessellation stratified (GRTS) design. Those points that fell within cultivated areas, lakes, impervious surfaces, and mining areas were eliminated. Each year prior to the field season, the remainder of the points were reviewed in consecutive order to select plots that met our criteria for native vegetation. This process ensured we would have sampling points that were relatively evenly distributed.   The first year we added the criterion that we would have equal numbers of upland forests, wet forests, upland prairies, and open wetlands. However, because prairies occupy such a small area, we developed a method of selecting points from the random sample that fell within areas that had already been mapped as prairie plant communities to ensure we would have enough plots. The requirement of equal samples per vegetation group was dropped in subsequent years, but we did make sure we had adequate samples of upland prairie because of the rarity and conservation significance of this system.

Permission and permits were then obtained from private and public landowners to place plots in selected locations.

Plot sampling was done in July-September 2017, May-September 2018, and May-June 2019. Most of the data collection was done by the Project Coordinator, one Natural Resource Specialist, and three Seasonal Monitoring Botanists. They were joined by twelve DNR ecologists from the Minnesota Biological Survey and other programs at various times. It was determined that the minimum number of people needed to sample plots is four in forests and two in prairies. In forests, one of the four people can be a biologist who is not a skilled botanist, but the other members of the sampling teams need to be botanists with expertise in the plant communities being sampled.

A total of 125 randomly-placed plots were sampled during the three-year grant period, and nine of those were sampled in both 2017 and 2018 to measure year to year variation. The 125 plots were placed in 43 counties and encompassed 11 ecological systems, with Mesic Hardwood Forests having the highest number (40), followed by Upland Prairies (18) and then by Fire-Dependent Forests (15). The wetland systems had fewer plots, ranging from nine to two per system. Fifty-five plots were on public lands, ranging from federal to state to county-owned lands. Thirty-one plots were on private lands, including two on land owned by The Nature Conservancy. Two plots were located within the *Enhancing Forest Inventory using Multiple Remote Sensing Technologies* LCCMR project area. We also collected data from two non-randomly selected sites with new groundwater monitoring wells in partnership with DNR hydrologists, and two non-randomly selected sites in R.J. Dorer Forest to monitor the effects of timber management in a Mesic Hardwood Forest.

Data collected in the plots included species and percent cover of ground layer vegetation; tree species, heights and DBH; shrub species; visual obstruction readings in grasslands; amount of coarse woody debris; amount of deer browse; a rapid earthworm assessment; a soil profile; photo points; and pH and conductivity of water in wetlands. Plots were permanently marked with rebar in uplands and PVC pipes in wetlands, buried magnets, tagged witness trees, and nails along transects. Locations were also recorded using GPS.

On nine of our plots, we contracted with the University of Minnesota to collect lichen and bryophyte surveys using their standard plot methodology. They will submit reports of the species found, abundance scores, and estimates of lichen and bryophyte biomass for each site visited after the field season ends and species identification has been completed.

We also experimented with sampling different kinds of animals on our plots to help inform future work. MBS zoologists placed Anabat SD2 acoustic detectors in one of our sites to experiment with collecting information on bat activity levels and bat species richness on our plots. To address pollinators in monitoring plots, MBS program bee specialists visited six of the plots from which vegetation data were collected this year, and spent 30-60 minutes hand-netting any bees observed. They caught and collected more than 75 bees in total, and will be identifying them in the future. In addition, a MBS entomologist visited five EMN plots, including two that were sampled in 2017, two that were sampled in 2018, and one that was sampled both years. He used a variety of methods to sample for moths and butterflies, and will be identifying them in the future. We will evaluate the usefulness of these data collection techniques after species are identified and all of the data are compiled.

For the historic vegetation sampling part of this project, 80 historic releve plots in State Parks and SNAs in southeast and east-central Minnesota were resampled in 2018. We selected plots that were spatially balanced across the Mesic Hardwood Forest, Fire-Dependent Forest, and Upland Prairie Systems, across sites, and across whether or not they had experienced prescribed burning in the past. We began sampling historic releve plots in State Parks and SNAs on the North Shore of Lake Superior in June 2019.   We sampled eight plots; the remainder will be done July-September 2019.

ACTIVITY 3: Data analysis
The project team will evaluate data after each pilot study field season for its effectiveness in addressing monitoring questions (developed in Activity 1). Data analysis will also guide refinement of methods. Data from resurveys of historic vegetation plots will be analyzed for preliminary information on trends in Minnesota's prairie, forest, and wetland habitats. Results of analyses will help guide use of resurveys of historic vegetation plots for monitoring statewide. Preliminary information on recent change will also be provided to resource managers, researchers, and for habitat protection and management.

Summary Budget Information for Activity 3:	**ENRTF Budget:**	$ ~~64,331~~
		$58,732
	Amount Spent:	$58,732
	Balance:	$0

Outcome	Completion Date
1. Data quality assessed and controlled	1/2019
2. Pilot study data evaluated for effectiveness in addressing monitoring questions and for feedback in revising methods	6/2019
3. Pilot study data and historic vegetation plot data analyzed	6/2019
4. Information on recent trends and other habitat monitoring results published and distributed	6/2019

Activity Status as of December 31, 2016**:**
No activity in this period.

Activity Status as of March 31, 2017**:**
No activity in this period.

Activity Status as of September 30, 2017:
No activity in this period.

Activity Status as of March 31, 2018**:**
The data from the 2017 field season were summarized. Analyses showed that 63% of the plots fell within MBS Sites of Biodiversity Significance, and 40% fell within native plant community polygons mapped by the DNR. These numbers were relatively low because a number of counties do not yet have finalized MBS Sites or native plant community polygons. A total of 665 species were recorded, ranging from 10 species in one plot to 92 species in the most diverse. Sixty-seven % of the plots contained at least one non-native invasive species; prairie plots had the most invasives. Northern forests had the highest average number of species per plot, while emergent marshes, acid peatlands, and sedge meadows had the lowest. A contract extension for additional statistical analyses by WEST was completed, and analyses were initiated by them to help inform the 2018 field season.

Activity Status as of September 30, 2018**:**
Statistical analyses were completed for the EMN field season, helping to inform the number of quadrats per plot needed as well as the number of plots needed. Since field work just ended, we have not entered and analyzed all of the EMN plot data. Sixty-five percent of the 68 plots fell within MBS Sites of Biodiversity Significance.

No analyses were completed for the releve data.

Activity Status as of February 27, 2019:
Summaries of the data from the 107 plots sampled in the first two years of this project were completed. A total of 885 vascular plant species were recorded, which is 44% of the total number of species in the state. The plot with the highest number of species was a tamarack swamp in Becker County, with 112 species, while the plot with the lowest number was a cattail marsh, with 9 species. Over half (52%) of the plots contained at least one non-native plant species, and the most frequent non-native species was Kentucky bluegrass. Upland and wetland prairies were the plant communities with the most non-native species, followed by mesic hardwood forests in southeastern Minnesota. The 107 plots represented a broad spectrum of quality, from high quality, diverse communities, to more disturbed communities with lower diversity, such as young aspen-dominated forests, disturbed prairies dominated by non-native brome grass, and cattail marshes.

Final Report Summary:
There were 125 plots sampled over the three-year sampling period. The plots represented a broad spectrum of quality, from high quality, diverse communities, to more disturbed communities with lower diversity, such as young aspen-dominated forests, disturbed prairies dominated by non-native brome grass, and cattail marshes. Over half of the plots occurred in mapped MBS Sites of Biodiversity Significance.

Plot data have just been entered for the 107 plots completed after the 2018 field season, so species information is summarized here just for those plots and does not include 2019 plot data.

As of the end of the 2018 field season, we had recorded a total of 885 vascular plant species, which represents 44% of the total number of species in Minnesota. The plot with the highest diversity was a tamarack swamp with 112 species. The plot with the lowest diversity was a cattail marsh with 9 species. Over half (52%) of the plots contained at least one non-native plant species, and the most frequent non-native species was Kentucky

bluegrass. Upland and wetland prairies were the plant communities with the most non-native species, followed by mesic hardwood forests in southeastern Minnesota.

Future data analyses will include summaries of how native prairies, forests, and wetlands change over time, and how those changes are related to habitat patch size, past management, and other factors.

For the historic vegetation sampling part of this project, we began analyses of the 80 releve plots that were resampled in southeastern and east-central Minnesota 20-40 years after they were originally sampled. Our initial analyses indicate that we can detect significant changes in vegetation using the releve resampling technique. For example, in Upland Prairies, we found that prairies that have had fire management had fewer non-native invasive species, less cover by vines such as Virginia creeper and wild grape, and higher native species diversity than those that have not had fire management. However, we did detect increasing frequency of non-native invasive species such as smooth brome and common buckthorn, as well as increasing frequency of native vines, over time on all plots, including burned and unburned. In Fire-Dependent Woodlands without fire, buckthorn frequency increased. In those managed with fire, prickly ash became more abundant, but buckthorn amounts did not increase. Further analyses will be completed in the coming months.

V. DISSEMINATION:

Description:
Project objectives, methods, and results will be published on the Habitat Monitoring Network website created under Activity 1. The web-accessible Habitat Monitoring Database, also created under Activity 1, will be available for data submission and download by collaborators. Both the database and the website will be hosted by DNR. GIS data will be made publically available via the MN Geospatial Commons website, with access to locations of rare plant and animal species and other sensitive data subject to non-public data sharing rules.

Reports and field data collection manuals and associated forms will be available at the Monitoring Network website and in paper form. Project activities and results may also be communicated by maps and poster displays; presentations to professional associations, stakeholder groups, local government units, and university staff and students; and written articles for newsletters, professional journals, magazines, and newspapers.

The project will provide free access to comprehensive high-quality data by DNR and external users, and will encourage data sharing among participants. This project and the state will benefit from analyses performed by academic and other researchers on raw datasets. These partnerships are complementary to efforts to bring in additional matching funds and in-kind services.

Activity Status as of December 31, 2016**:**
No activity in this period.

Activity Status as of March 31, 2017**:**
No activity in this period.

Activity Status as of September 30, 2017:
A Project Update report was developed and distributed to project team members, partners, and all DNR Ecological and Water Resources staff on June 21. A folder for this project was established on a DNR shared drive so that DNR partners could access documents and spreadsheets that tracked the progress of the field work.

Activity Status as of March 31, 2018**:**
A Project Update brochure was developed and distributed to owners/managers of lands where plots were completed. A new web page was created in April and can be accessed here: www.mndnr.gov/ecomonitoring

A PowerPoint presentation describing methods and first-year results was presented at the winter MBS meeting in December and at the March 1st Minnesota Native Plant Society meeting.

Activity Status as of September 30, 2018**:**
No activity in this period.

Activity Status as of February 27, 2019:
Reports summarizing data collected in each plot were sent to the respective landowner or land manager for that plot.   The Standard Operating Procedures report describing field protocols in detail was revised to reflect changes in field protocols. A PowerPoint presentation was presented to The Nature Conservancy (TNC) as part of their 2018 Science Slam for scientists who had collected data from TNC preserves in 2018. A longer presentation describing the project and the first two years of results was presented as part of the University of Minnesota's Conservation Science Symposium on February 22nd.

Final Report Summary:
A web page for this project was created and can be accessed here:
https://www.dnr.state.mn.us/mbs/ecologicalmonitoring/index.html
The project goals, objectives, most recent brochure, and field methods, including a link to the Standard Operating Procedures (DNR Biological Report Number 121), can be found here.

Reports summarizing data collected in each plot were sent to the respective landowner or land manager for that plot following each field season.

Email updates regarding the project's progress were shared with DNR Oversight and Project Teams following 2017 and 2018 field seasons.

PowerPoint presentations were developed and presented at a number of venues, including the Minnesota Biological Survey annual meeting, the Minnesota Native Plant Society, The Nature Conservancy, and the University of Minnesota's Conservation Science Symposium.

VI. PROJECT BUDGET SUMMARY:

A. ENRTF Budget Overview:

Budget Category	$ Amount	Overview Explanation
Personnel:	$348,779	Project Coordinator 0.60 FTE (70% salary, 30% benefits) for each of 3 years; Natural Resource Specialists 0.8 FTE (70% salary, 30% benefits) for each of 2 years; Student Worker 0.10 FTE for each of 2 years; Seasonal Natural Resource Specialists 0.4 FTE (70% salary, 30% benefits) for 1 year.
Professional/Technical/Service Contracts:	$37,369	Biometrician contracts (competitive RFP); biologists to collect field data through service level agreements or RFP.
Equipment/Tools/Supplies:	$33,533	Field supplies needed to collect data at monitoring plots, including sub-meter GPS receivers (2 @ $3,520), data recorders (2 @ $650), mapping GPS units (2 @ $350), cameras (2 @ $450), soil pH meters (2 @ $360), pH meters (2 @ $300), soil augers (2 @ $280), tree corers (2 @ $200), plant specimen collecting and preservation supplies (2 @ $140), first aid kits (2 @ $50), and misc field supplies ($800 for tapes, plot markers, waterproof notebooks, insect repellant, safety gear, etc.)
Travel Expenses in MN:	$54,845	Monthly vehicle charges ($2,400), mileage ($5,239), lodging ($19,379), and meals ($6,732) to collect field data at pilot study monitoring sites in northern, southeastern, and western MN for 2 field seasons
Direct & Necessary	$25,475	Direct & Necessary expenses: HR Support (~$6,548), Safety Support (~$1,235), Financial Support (~$6,644), Communication Support (~$1,236), IT Support (~$10,058), Planning Support (~$829) and Procurement Support (~$235) necessary to accomplishing funded programs/projects.
TOTAL ENRTF BUDGET:	**$500,00**	

Explanation of Use of Classified Staff: Any classified staff position paid for by ENRTF will either:
1) be backfilled with a new position OR 2) the work done by this position will be delayed, eliminated, or completed by the start of the project. Use of classified staff is unlikely in this project; the biometrician position being a possible exception.

Explanation of Capital Expenditures Greater Than $5,000: N/A

Number of Full-time Equivalents (FTE) Directly Funded with this ENRTF Appropriation: 3.6

Number of Full-time Equivalents (FTE) Estimated to Be Funded through Contracts with this ENRTF Appropriation: TBD. ~1.15

B. Other Funds:

Source of Funds	$ Amount Proposed	$ Amount Spent	Use of Other Funds
Non-state			
State Wildlife Grants – Federal (in-kind support)	$14,000	$2,000	Personnel
State			
General Fund (in-kind support)	$61,500	$73,000	Personnel
Heritage Enhancement (in-kind support)	$52,000	$69,000	Personnel
Game and Fish Fund (in-kind support)	$51,000	$1,900	Personnel, travel expenses
Parks and Trails Legacy Fund	$6,300	$24,300	Personnel, contracts, expenses
Forest Management Investment Account (in-kind support)	$10,000	$480	Personnel
TOTAL OTHER FUNDS:	**$194,800**	**$170,240***	***** Spend concurrently with ENTRF funds but some may be spent before July 1, 2016 to take full advantage of the field season.

VII. PROJECT STRATEGY:

A. Project Partners: The Minnesota Biological Survey will coordinate this project with participation and review from the following collaborators: DNR divisions of Forestry, Ecological and Water Resources, Parks and Trails, and Fish and Wildlife; Minnesota Pollution Control Agency; The Nature Conservancy; University of Minnesota; U.S. Forest Service; U.S. Fish & Wildlife Service, tribal representatives, and Minnesota Association of County Land Commissioners. None of the project partners listed will receive ENRTF funds from this appropriation. The DNR Divisions listed will contribute in-kind support per the estimated dollar amounts listed in section VI.B – Other Funds.

B. Project Impact and Long-term Strategy: This project will design and test a statewide monitoring network that will provide ongoing scientifically rigorous information on long-term statewide trends in Minnesota's diverse habitats. Government agencies, land managers and local communities need this information to mediate the impacts of invasive species, climate change, and other stressors on Minnesota's prairie, forest, and wetland habitats. Monitoring is an important focus of the Minnesota Biological Survey; as such, the Biological Survey will provide the needed stability to manage this monitoring network and ensure long-term collection of and access to high-quality data.

C. Funding History: N/A

VIII. FEE TITLE ACQUISITION/CONSERVATION EASEMENT/RESTORATION REQUIREMENTS: N/A

IX. VISUAL COMPONENT or MAP(S): See attached figure and graphic.

X. RESEARCH ADDENDUM: N/A

XI. REPORTING REQUIREMENTS:
Periodic work plan status update reports will be submitted no later than December 31, 2016, March 31, 2017**,** September 30, 2017**,** March 31, 2018, September 30, 2018, and March 31, 2019. A final report and associated products will be submitted between June 30 and August 15, 2019.

A Statewide Monitoring Network for Minnesota's Changing Habitats
Informed Conservation Through Better Monitoring

Habitat stressors, Including...
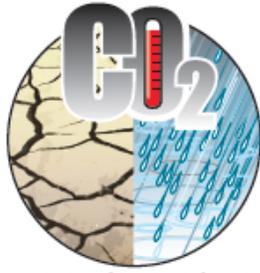
warmer temperatures extreme precipitation

invasive species

habitat fragmentation

Statewide Monitoring Network
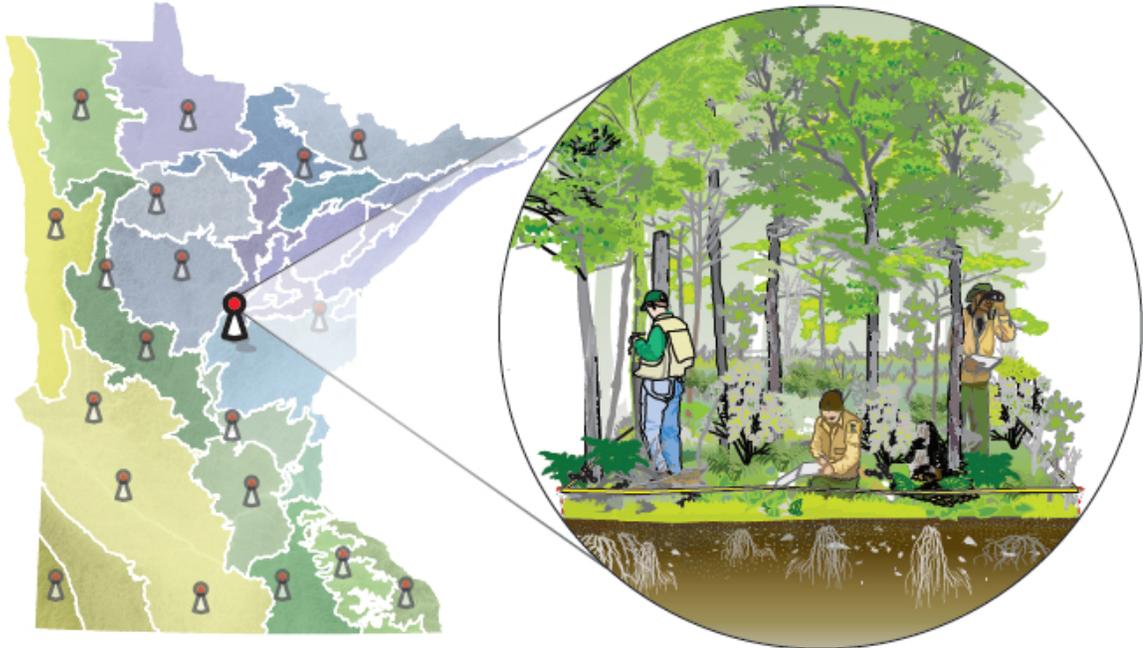
**Informed conservation,** such as...

effective habitat restoration
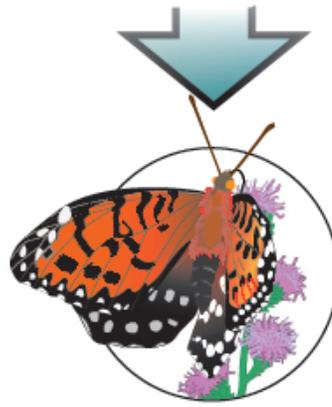
prioritized habitat conservation

focused habitat management

Expanding the Minnesota Ecological Monitoring Network
Improving land use decision making and sustainable resource management through greater reliance on scientific knowledge
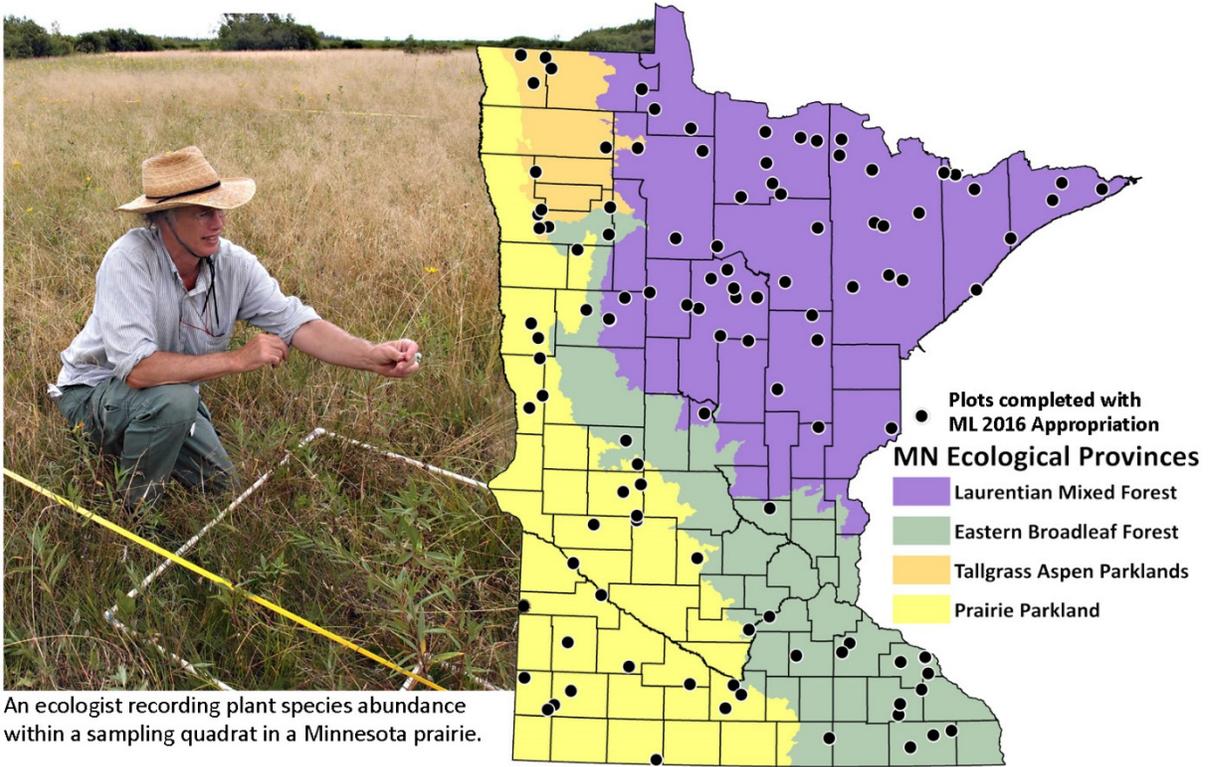
An ecologist recording plant species abundance within a sampling quadrat in a Minnesota prairie.

Plots completed with ML 2016 Appropriation

MN Ecological Provinces
- Laurentian Mixed Forest
- Eastern Broadleaf Forest
- Tallgrass Aspen Parklands
- Prairie Parkland
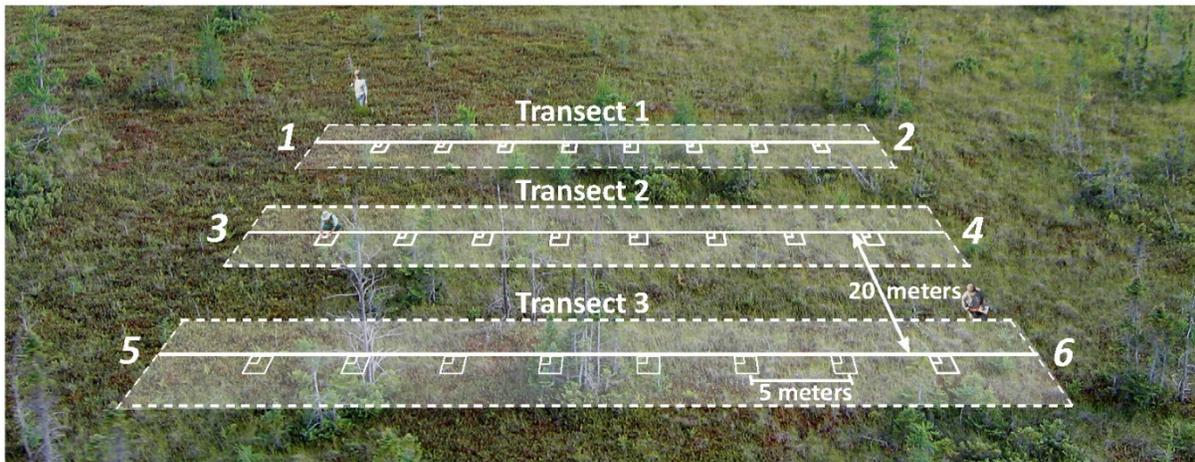
A scale diagram of the plot, showing three 45-meter transects along which vegetation, soils, water chemistry, deer browse, and other measurements

Environment and Natural Resources Trust Fund
M.L. 2016 Project Budget

Project Title: Statewide Monitoring Network for Changing Habitats in Minnesota
Legal Citation: M.L. 2016, Chp. 186, Sec. 2, Subd. 03d
Project Manager: Hannah Texler
Organization: MN DNR - MN Biological Survey
M.L. 2016 ENRTF Appropriation: $ 500,000
Project Length and Completion Date: 3 Years, June 30, 2019
Date of Report: March 31, 2018

ENVIRONMENT AND NATURAL RESOURCES TRUST FUND BUDGET	Activity 1 Budget	Amount Spent
BUDGET ITEM		
Personnel (Wages and Benefits)	$11,846	$11,846
Project Coordinator 0.60 FTE (70% salary, 30% benefits) for each of 3 years; $144,000.		
Natural Resource Specialists 0.8 FTE (70% salary, 30% benefits) for each of 2 years; $128,000.		
Student Worker 0.10 FTE for each of 2 years; $5,300.		$0
Professional/Technical/Service Contracts		
Biometrician contracts. (Competitive RFPs) $62,598	$15,598	$15,598
TBD. IT professional contracts for database and website development (MN.IT service-level agreements or competitive RFP) and for biologists to collect field data (service level agreements or RFP). $$7,552	$4,750	$4,750
Equipment/Tools/Supplies		
Field supplies needed to collect data at monitoring plots, including sub-meter GPS receivers (2 @ $3,520), data recorders (2 @ $650), mapping GPS units (2 @ $350), cameras (2 @ $450), soil pH meters (2 @ $360), pH meters (2 @ $300), soil augers (2 @ $280), tree corers (2 @ $200), plant specimen collecting and preservation supplies (2 @ $140), first aid kits (2 @ $50), and misc field supplies ($800 for tapes, plot markers, waterproof notebooks, insect repellant, safety gear, etc.). Total $13,400.		
Travel expenses in Minnesota		

Monthly vehicle charges ($2,400), mileage ($5,239), lodging ($19,379), and meals ($6,732) to collect field data at pilot study monitoring sites in northern, southeastern, and western MN for 2 field seasons. Total $33,750.		
Other		
Direct & Necessary expenses: HR Support (~$5,238), Safety Support (~$1,235), Financial Support (~$6,644), Communication Support (~$1,236), IT Support (~$10,058), Planning Support (~$829) and Procurement Support (~$235) necessary to accomplishing funded programs/projects. $25,475.	$1,086	$1,086
COLUMN TOTAL	**$33,280**	**$33,280**

Activity 1 Balance	Activity 2 Budget 7/30/2019	Activity 2 Budget 8/5/2019	Amount Spent	Activity 2 Balance	Activity 3 Budget 7/30/2019
$0	~~$289,585~~	$296,431	$296,431	$0	~~$45,150~~
			$0		
$0					$14,850
$0	~~$5,000~~	$2,171	$2,171	$0	
	~~$32,519~~	$33,533	$33,533	$0	

	~~$55,227~~	<u>$54,845</u>	$54,845	$0	
$0	~~$20,058~~	<u>$21,008</u>	$21,008	$0	~~$4,331~~
$0	**$402,389**	**$407,988**	**$407,988**	**$0**	**$64,331**

Activity 3 Budget 8/5/2019	Amount Spent	Activity 3 Balance	TOTAL BUDGET	TOTAL BALANCE
$40,502	$40,502	$0	$348,778	$0
	$0			
$14,850	$14,850	$0	$30,448	$0
			$6,921	$0
			$33,533	$0

			$54,845	$0
$3,381	$3,381	$0	$25,475	$0
$58,732	**$58,732**	**$0**	**$500,000**	**$0**