M.L. 2015 Project Abstract
For the Period Ending June 30, 2017

PROJECT TITLE: Minnesota Biological Survey
PROJECT MANAGER: Bruce Carlson
AFFILIATION: MN DNR, Division of Ecological & Water Resources
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FUNDING SOURCE: Environment and Natural Resources Trust Fund
LEGAL CITATION: M.L. 2015, Chp. 76, Sec. 2, Subd. 03c

APPROPRIATION AMOUNT: $2,450,000
AMOUNT SPENT: $
AMOUNT REMAINING: $

Overall Project Outcome and Results

Minnesota Biological Survey plant and vegetation surveys continued towards statewide coverage, focusing on the last counties in the state for MBS to deliver: St. Louis, Koochiching, Beltrami and Lake of the Woods. Over 1,000 rare and notable terrestrial and aquatic vascular plant species were documented with specimens. Over 200 vegetation plots were placed in representative or rare forests, wetlands and peatlands.

MBS continued towards statewide collection of lake aquatic plant surveys, focusing in central and north-central Minnesota counties and putting the total to 2,025 lakes in 48 counties. This effort provides highly-valued foundational data to broaden DNR efforts to establish indices of biotic integrity for Minnesota lakes.

MBS continued to collaborate on monitoring efforts in prairies and forests. Long-term monitoring of rare prairie plant species continued from previous biennia. Prairie vegetation monitoring continued in high-priority prairie sites subject to cattle grazing. Surveys to establish baseline conditions for forest plant and animal monitoring projects were initiated in northern, north-central and southeast Minnesota. All of these monitoring efforts were selected and continued for their relevance to goals and desired outcomes found in Minnesota prairie and forest management and conservation plans.

MBS continued in several west-central counties to target sites in Minnesota Prairie Plan core areas that had not previously been surveyed by MBS. This involves use of LiDAR and high resolution aerial photography not available when MBS first surveyed these counties in the 1980s and 1990s. Over 200 previously undocumented high quality sites were completed.

MBS compiled and entered field survey and monitoring data to MBS databases. MBS information systems improvements were made that enhance data integration and accessibility. MBS continues to provide leadership in the management and use of the DNR's Native Plant Community database.

MBS provided survey and monitoring results to DNR and other partners and projects. MBS delivered a final manuscript to UMN Press for a new book on Minnesota sedges and rushes and completed major updates and improvements to the DNR Rare Species Guide

(http://dnr.state.mn.us/rsg/index.html). MBS outreach included highly popular plant and native plant community field workshops throughout the state targeted at natural resource professionals and volunteers.

MBS Data Summary Table

Data Type	# added since July, 2015	Total since 1987
Rare species records (Biotics) (all taxa)	360	21,838
Rare aquatic plant species records	6	1,251
Lakes with MBS botanical surveys	42	2,025
Counties with MBS lake botanical surveys	2	48
Vegetation plots (relevés)	174	5,540
Sites of Biodiversity Significance GIS polygons*	8	10,732
Native Plant Community GIS polygons*	1,929	84,626
Plant specimens submitted to the University of MN Bell Museum	640	~50,000 (source: Welby's estimate, includes Heritage Program submissions too)
Exotic aquatic plant species locations**	NA	302

*Numbers reported based on data available on the Minnesota Geospatial Commons
**Encountered incidentally during the course of native aquatic plant surveys

Project Results Use and Dissemination

MBS data are stored primarily in the Division of Ecological and Water Resources information systems, which are increasingly linked to other databases in the MN DNR. In addition, MBS procedures, updates, recent maps, and links to related data are presented on the DNR website. Many GIS datasets are delivered to clients through the online data portal, Minnesota Geospatial Commons. MBS regularly provides vegetation plot data from the relevé database to researchers at academic institutions, other agencies and organizations. Data on rare species are available through agreements with the requesting agency and the DNR. For data on locations or rare features, a data request form is available via the web: http://www.dnr.state.mn.us/nhnrp/nhis.html

MBS publishes and distributes survey results in a variety of formats for various audiences. Many products are available as enterprise datasets on the DNR website, including GIS shape files of native plant communities and MBS sites, native plant community field guides, and guides to sampling techniques such as vegetation plot data collection using the relevé method. MBS web pages are updated with new information and have links to associated resources. http://www.dnr.state.mn.us/mbs/index.html

The DNR and Legislative libraries and other local information repositories (such as libraries within counties) have access to published products, including books, maps, reports, field guides and digital media. MBS has published several books and field guides.

Staff routinely make presentations that describe MBS methodologies and results to a wide range of audiences including county boards, local planning groups, citizen advisory groups, other biologists, land managers, and students. MBS staff provide local planners with ecological interpretations describing important sites of biodiversity identified during the Survey to assist with management plans.

Physical collections are deposited at Minnesota repositories, primarily at the University of Minnesota's J.F. Bell Museum of Natural History and at the Science Museum of Minnesota, St. Paul. As part of a larger network of museums and herbaria, these cooperators are essential to the documentation and sharing of MBS results. MBS and museum staff meet periodically to address curatorial, data management, and interpretive needs.

MBS also delivers data through an international organization, NatureServe, and also shares data with cooperators at colleges and universities.

Environment and Natural Resources Trust Fund (ENRTF)
M.L. 2015 Work Plan Final Report

Date of Report: September 8, 2017

Final Report

Date of Work Plan Approval: August 7, 2015

Project Completion Date: June 30, 2017

Does this submission include an amendment request? No

PROJECT TITLE: Minnesota Biological Survey

Project Manager: Bruce Carlson

Organization: MN DNR

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Location: Baseline surveys: Beltrami, St. Louis, Koochiching and Lake of the Woods counties. These include portions of the Border Lakes (212La), Littlefork Vermillion Uplands (212Ma), Agassiz Lowlands (212Mb), and Chippewa Plains (212Na) ecological subsections.

Monitoring: Selected sites statewide

Total ENRTF Project Budget:		
	ENRTF Appropriation:	**$2,450,000**
	Amount Spent:	**$2,444,791**
	Balance:	**$5,209**

Legal Citation: M.L. 2015, Chp. 76, Sec. 2, Subd. 03c

Appropriation Language:

$2,450,000 the first year is from the trust fund to the commissioner of natural resources for continuation of the Minnesota biological survey to provide a foundation for conserving biological diversity by systematically collecting, interpreting, monitoring, and delivering data on plant and animal distribution and ecology, native plant communities, and functional landscapes. Expenses are limited to those specified in the required work plan and approved by the Legislative-Citizen Commission on Minnesota Resources.

I. PROJECT TITLE: Minnesota Biological Survey

II. PROJECT STATEMENT: The need to protect and manage functional ecological systems, including ecological processes and components is accelerating with increased demands for clean water, energy and arable land. Habitat fragmentation, loss of plant and animal species and genetic diversity, changing landscape patterns, contamination of water resources and invasive species expansion require data and analytical tools to optimize conservation of the most functional systems and provide guidance to maintain or restore declining systems. The Minnesota Biological Survey (MBS) systematically collects, interprets and delivers data on plant and animal distribution and the ecology of native plant communities and functional landscapes. These data help prioritize actions to conserve, manage and restore Minnesota's ecological systems and critical plant and animal habitats. MBS also engages in monitoring that includes assessment of outcomes of selected conservation and management activities.

MBS data inform implementation of plans for landscape and watershed conservation and management. Data are used to prioritize sites selected for parks, natural areas, conservation easements and management of forest, peatland, prairie and riparian areas. Baseline surveys will continue in northern Minnesota (see attached map). Monitoring projects will continue in collaboration with others in response to needs identified in various plans and assessments such as the Minnesota Prairie Conservation Plan, the State Wildlife Action Plan, and forest plans and certification. MBS sites identified as having high levels of biodiversity significance will be used for the establishment of long-term DNR vegetation monitoring sites. Improved access and delivery of MBS data continues to be a priority with delivery through web-based products and publications. MBS species and vegetation databases are part of national information system networks. Museums providing repositories for MBS plant and animal collections are important partners**.**

III. OVERALL PROJECT STATUS UPDATES:

AMENDMENT REQUEST August 5, 2015

The budget has been amended to comply with LCCMR direction regarding DNR direct and necessary expenses. To do so, $110,688 of Division direct expense was subtracted from the “Direct support services” budget line leaving the LCCMR approved balance of $123,684. The entire $110,688 was reallocated to personnel (wages and benefits): one unclassified position was increased from 0.5 FTE for 2 years to 1.0 FTE for 2 years; one classified position was added at 0.2 FTE for 2 years; the Student Worker position was eliminated; and the Information Officer position was edited to correct an error in wages and benefits calculation as reported in the May 28, 2015 work plan.

Amendment approved: 08/07/15 – retroactive to 07/01/15.

Project Status as of January 31, 2016

MBS Data Summary Table

Data Type	# added since July, 2015	Total since 1987
Rare species records (Biotics) (all taxa)	360	21,838
Rare aquatic plant species records	6	1,251
Lakes with MBS botanical surveys	42	2,025
Counties with MBS lake botanical surveys	2	48
Vegetation plots (relevés)	174	5,540
Sites of Biodiversity Significance GIS polygons*	8	10,732
Native Plant Community GIS polygons*	1,929	84,626

Plant specimens submitted to the University of MN Bell Museum	640	~50,000 (source: Welby's estimate, includes Heritage Program submissions too)
Exotic aquatic plant species locations**	NA	302

*Numbers reported based on data available on the Minnesota Geospatial Commons
**Encountered incidentally during the course of native aquatic plant surveys

MBS botanical and vegetation field surveys occurred in St. Louis, Koochiching, Beltrami and Lake of the Woods counties within the Border Lakes, Littlefork-Vermilion Uplands, and Agassiz Lowlands subsections. Botanical surveys documented numerous rare and notable terrestrial and aquatic vascular plant species. Vegetation surveys occurred in a variety of native plant communities that are either representative of these counties and subsections or are rare, unique or unusual for these areas. A minor amount of MBS field survey was targeted in other northern Minnesota counties to address questions stemming from native plant community mapping.

MBS continued to lead and collaborate on monitoring efforts in prairies and forests. Monitoring of rare prairie plant species, western prairie fringed orchid and small white lady's-slipper continued from previous biennia. Prairie management monitoring continued in high-priority prairie sites. Forest monitoring efforts were initiated in collaboration with the University of Minnesota Landscape Arboretum for the rare forest plant species, western Jacob's ladder, found in wet conifer forests.

MBS information systems critical to effective data storage and delivery continue to be maintained and enhanced. Improvements continue to be made among MBS databases and University of Minnesota Bell Museum databases that enhance data integration and consistency. MBS continues to provide leadership in the management and use of the DNR's integrated Native Plant Community database.

MBS continued to provide technical assistance, data delivery, and data interpretation to DNR and other partners and projects. A review of calcerous fen legal designation criteria relied on MBS data and technical expertise. Updates and improvements to the DNR Rare Species Guide were resumed that rely heavily on MBS data and technical expertise. MBS outreach included highly popular plant and native plant community field workshops targeted at natural resource professionals and volunteers.

Amendment Request February 12, 2016

The budget has been amended to move $20,835 from Activity 1 – Contractual Agreements to Activity 4 – Contractual Agreements ($4,575) and Personnel ($16,260). This change is requested to contribute to revisions and improvements to the DNR online Rare Species Guide (RSG). DNR has hired a project specialist (limited-term, unclassified position) to direct this project. The position is funded by State Wildlife Grant funds (federal dollars) to only cover work related to RSG animal profiles. Opportunity exists to utilize this position and a contractor for work related to RSG plants, lichens and other non-animal taxa. The budget has been amended to 1) cover salary and fringe for the limited-term, unclassified project specialist (unclassified, 0.5 FTE for 6 months, $16,260) and 2) provide for a contract ($4,575) with a lichenologist to update and develop RSG lichen profiles. This amendment request also results in a change to Activity 4 outcomes: an updated RSG replaces the first draft of a Minnesota mammals book to allow for the MBS mammologist work on the RSG project.

Minor text edits, unrelated to the above, in the Activity 4 overview are also suggested as part of this amendment.

Amendment approved by LCCMR 2-18-16.

Project Status as of October 31, 2016

MBS Data Summary Table

Data Type	# added since July, 2015	Total since 1987
Rare species records (Biotics) (all taxa)	845	22,323
Rare aquatic plant species records	6	1,251
Lakes with MBS botanical surveys	42	2,025
Counties with MBS lake botanical surveys	2	48
Vegetation plots (relevés)	332	5,619
Sites of Biodiversity Significance GIS polygons*	29	10,753
Native Plant Community GIS polygons*	4,080	90,006
Plant specimens submitted to the University of MN Bell Museum	1,540	~51,000
Exotic aquatic plant species locations**	NA	302

*Numbers reported based on data available on the Minnesota Geospatial Commons

**Encountered incidentally during the course of native aquatic plant surveys

MBS botanical and vegetation field surveys occurred in St. Louis and Koochiching counties and the Northwest Angle of Lake of the Woods County. Botanical surveys documented numerous rare and notable terrestrial and aquatic vascular plant species. Vegetation surveys occurred in a variety of native plant communities that are either representative of these counties and subsections or are rare, unique or unusual for these areas. A minor amount of MBS field survey was targeted in other northern Minnesota counties to address questions stemming from native plant community mapping.

MBS continued to lead and collaborate on monitoring efforts in prairies and forests. Monitoring of western prairie fringed orchid, small white lady's-slipper, prairie bush clover, and dwarf trout lily, continued from previous biennia. Prairie management monitoring continued in high-priority sites with new work emerging on prairie wetland basins. Forest monitoring efforts continued to focus on updating and expanding biological field survey in high conservation value forests including the collection of new relevés from sites first sampled over 20 years ago.

MBS information systems critical to effective data storage and delivery continue to be maintained and enhanced. Major efforts continue to be made to improve and increase vegetation plot data for an upcoming revision to DNR's *Field Guide to Native Plant Communities.* Improvements continue to be made among MBS databases and University of Minnesota Bell Museum databases that enhance data integration and consistency. MBS continues to provide leadership in the management and use of the DNR's integrated Native Plant Community database.

MBS continued to provide technical assistance, data delivery, and data interpretation to DNR and other partners and projects. To assist clean water efforts, MBS continued to provide interpretations of rare species and native plant communities relative to their dependence on groundwater. Updates and improvements to the DNR Rare Species Guide continued that rely heavily on MBS data and technical expertise. MBS outreach included highly popular plant and native plant community field workshops targeted at natural resource professionals and volunteers.

Amendment Request October 31, 2016

The budget has been amended to move $10,000 each from Activities 1 and 2 – Contractual Agreements to Activity 3 – Personnel. This change is requested to contribute to revisions and improvements to the DNR online Minnesota plant database (MN TAXA). DNR has hired a project coordinator who is retired MN.IT and who worked on MN TAXA and related databases when employed by MN.IT. Opportunity exists to utilize this position to efficiently and economically address specific high priority improvements to MN TAXA that were originally intended to be achieved by more expensive service level agreements with MN.IT. The budget has been amended to cover salary and fringe for the limited-term, post retirement option, unclassified project coordinator position.

Text has been added to language in 1) Work Plan Section VI, Project Budget Summary, for the explanation of use Professional/Technical/Service Contracts funds and 2) in the similar section in the Budget. Language was added to allow for use of these funds for Joint Powers Agreements with UMN Press and Work Orders with Conservation Corps of Minnesota.

Amendment approved by LCCMR 12/7/2016.

Amendment Request May 16, 2017

The budget has been amended to:

1. Move $11,000 from Activity 3 - Professional/Technical Contracts, GIS Services via MN.IT, to Activities 1 and 2 – Travel Expenses in Minnesota. This change is requested to cover travel expenses for project staff doing field survey and monitoring. Travel expenses were under-budgeted in the work plan while GIS services via MN.IT were over-budgeted.
2. Move $3,000 from Activities 1 and 2 – Personnel to Activity 2 – Travel Expenses in Minnesota. This change is requested to cover travel expenses (meals, mileage and lodging) for citizen volunteers who are critical to achieving Activity 2 outcomes in prairie sites. Reimbursing volunteer expenses increases volunteer turnout and total number of volunteer hours donated to the project. We only offer travel reimbursement to volunteers when budgets allow for it.

The Work Plan was edited to correct an error in the Summary Budget information for Activity 4: the numbers originally reported here were correct only for Personnel. The corrected numbers reflect the approved total budget for Activity 4. Work Plan edits were also made to update the date of the next Project Status update to June 30, 2017 which will also be the final project report. Text explaining use of Travel Expenses was edited to include expense reimbursement for volunteers.

The Work Plan was amended in Activity 4 Outcome 1 to change the Completion Date for the "Aspen Parklands book manuscript to the publisher" from June 30, 2016 to ongoing. Activity 4 Outcome 1b, Sedges and Rushes of Minnesota book manuscript delivered for publishing, was added to this Work Plan because it is finished ahead of schedule and reflects 30 years of ENRTF-funded MBS botanical work.

The Project Manager also requests pre-approval for minor adjustments to the budget as the project comes to close on June 30, 2017.

Amendment approved by LCCMR 5/19/2017.

Amendment Request June 28, 2017

The budget has been amended to decrease Personnel by $38,000 in Activity 4 and decrease Equipment/Tools/Supplies by $2,000 in Activity 3 and distribute all to Professional/Technical/Service Contracts in Activity 4 as follows:

- $20,000 for UMN Press Joint Powers Agreement for publishing of the book, *Sedges and Rushes of Minnesota.* This book was added to the Work Plan in the 5/16/2017 Amendment but budget dollars were not adjusted. This move corrects the budget to agree with the work plan outcomes.
- $18,500 for Work Orders with Conservation Corps of Minnesota (CCM). CCM Work Orders was added to eligible Contract expenses in the 10/31/2016 amendment but dollars budgeted for CCM were not moved at that time from Personnel to Contracts. This move corrects the LCCMR budget to recognize CCM Work Orders as contracts instead of personnel.
- $1,500 contract biologists contributing to work plan Activities 1, 2 and 4.

The Work Plan was amended accordingly to reflect the above budget changes.

Amendment approved by LCCMR 6/30/2017.

Overall Project Outcomes and Results:

MBS Data Summary Table

Data Type	# added since July, 2015	Total since 1987
Rare species records (Biotics) (all taxa)	1,037	23,360
Rare aquatic plant species records	26	1,251
Lakes with MBS botanical surveys	42	2,025
Counties with MBS lake botanical surveys	2	48
Vegetation plots (relevés)	413	5,700
Sites of Biodiversity Significance GIS polygons*	128	10,842
Native Plant Community GIS polygons*	6376	92,302
Plant specimens submitted to the University of MN Bell Museum	2,540	~52,000
Exotic aquatic plant species locations**	NA	302

*As available on the Minnesota Geospatial Commons

**Encountered incidentally during the course of native aquatic plant surveys

Minnesota Biological Survey plant and vegetation surveys continued towards statewide coverage, focusing on the last counties in the state for MBS to deliver: St. Louis, Koochiching, Beltrami and Lake of the Woods. Over 1,000 rare and notable terrestrial and aquatic vascular plant species were documented with specimens. Over 200 vegetation plots were placed in representative or rare forests, wetlands and peatlands.

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MBS also delivers data through an international organization, NatureServe, and also shares data with cooperators at colleges and universities.

IV. PROJECT ACTIVITIES AND OUTCOMES:

ACTIVITY 1: Field Surveys
Description: Data on the distribution and ecology of plants, animals, native plant communities and functional landscapes will be collected, providing a basis for the maintenance of elements of biological diversity and ecological systems through ecological management, planning, research, and critical habitat acquisition.

Data review and Survey site identification (see Map): Plant ecologists, botanists and zoologists review existing relevant natural resource data and record information using Geographic Information Systems and other DNR information systems to consolidate and organize data. Examples of these data include forest inventories, wetlands inventories, aquatic plant surveys, wildlife habitat inventories, park surveys, soil surveys, land-use data, historical public land surveys, academic research, and records from museum collections. Using these data, supplemented by the interpretation of aerial photography or other imagery, staff identify MBS sites and species habitats for targeted surveys.

Coordination: Staff notify and coordinate activities when possible with other divisions within the DNR, universities, counties, municipalities, surveys and monitoring efforts of tribal governments, watershed districts, federal natural resource agencies, conservation organizations, corporations, and individual landowners. This is critical to the success of data consolidation and field surveys.

Field Surveys: Ground surveys to assess MBS site and native plant community quality and condition include the collection of vegetation samples in coordination with other sampling (soils, water chemistry, etc.) when possible. Additional specialized techniques are used during field seasons to survey selected rare species or groups of species (e.g., plants, birds, mammals, reptiles, amphibians, insects, fishes).

Summary Budget Information for Activity 1:

ENRTF Budget: $ 825,964
Amount Spent: $ 823,612
Balance: $ 2,352

Outcome (see also attached map)	Completion Dates
1. Field survey Border Lakes subsection—St. Louis and Koochiching counties	Ongoing
2. Field survey Littlefork-Vermilion Uplands subsection – St. Louis County	June 30, 2017
3. Field survey Agassiz Lowlands subsection—Beltrami County	June 30, 2018
4. Field survey Agassiz Lowlands subsection—Lake of the Woods and Koochiching counties	Ongoing
5. Field survey Littlefork-Vermilion Uplands subsection – Koochiching County	Ongoing

Project Status as of January 31, 2016
Field Surveys
Botanical and native plant surveys prioritized filling county and state distributional gaps for plant species and native plant communities. Vegetation plots (relevés) were focused in under-sampled native plant communities that fill critical gaps in the DNR's 2003 *Field Guide to Native Plant Communities: Laurentian Mixed Forest*.

Highlights Northeastern Minnesota
Border Lakes Subsection in Koochiching and St. Louis counties
Native plant community and botanical surveys occurred throughout this region. Native plant community surveys were done in river terraces, forested swamps, rock outcrops/woodlands, old-growth pine forests, young fire-origin jack pine forests, lakeshores, ephemeral wetlands, and wild rice marsh. A previously undescribed native plant community, informally referred to as "boulder pavement," has now been documented from multiple sites. Rich forested swamps and peatlands were targeted for their rarity and association with rare orchid and other plant species. Floodplain forest, uncommon in the Border Lakes, was documented along the Vermillion River. Vegetation and soils data collection were intensified in sites where several uncommon upland forest and woodland types intertwine and have proven difficult to map.

Botanical surveys documented many rare and notable terrestrial and wetland vascular plants including *Bidens discoidea, Carex conoidea, C. katahdinensis, C. michauxiana, Cyprepedium arietinum, Eleocharis mamillata, Eleocharis nitida, Eleocharis quinqueflora, Fimbristylis autumnalis, Juncus articulatus, Littorella americana, Malaxis monophyllos var. brachypoda, Platanthera clavellata, Ranunculus lapponicus, Schoenoplectus smithii, Scirpus pendulus, Torreyochloa pallida* var. *fernaldii, Tetraplodon mnioides, Walsteinia fragarioides* var. *fragarioides,* and *Xyris montana.* Emphasis was placed on improving collections of *Rubus* species and graminoids (e.g. sedges, grasses) that to-date have been poorly documented from the western Border Lakes including *Rubus alumnus, R. steelei, R. allegeniensis, Poa saltuensis, Carex adusta, C. communis, Eriophorum gracile, and Eleocharis obtusa*.

Targeted searches for the 2012 state-record vascular plant, *Eleocharis mamillata*, and the elusive orchid, *Malaxis paludosa,* were conducted in suitable native plant communities but did not result in documentation of new locations for these species. Instead, in the course of these targeted searches, new locations of state special concern species, *Malaxis monophylus* var. *brachypoda* and *Ranunculus lapponicus*, were discovered.

22 new records of rare aquatic vascular plants included *Callitriche herterophylla* (state threatened), *Littorella americana* (state special concern) and *Waldsteinia fragarioides* (state special concern).

Littlefork Vermilion Subsection in Koochiching and St. Louis County

Vascular plant surveys documented new county records and rare species records. New documentations include *Caltha natans, Cardamine pratensis*, *Eleocharis mamillata* subsp. *mamillata*, *Geum laciniatum*, *Malaxis monophyllos* var. *brachypoda*, *Ranunculus lapponicus*, *Torreyochloa pallida*. Collections also included two new locations of a species of State-threatened liverwort, *Trichocolea tomentella*, including the first documented observation for St. Louis County.

Vegetation field survey occurred in high quality old-growth river terrace forest and adjacent upland forest types associated with the Littlefork River, Sturgeon River, and Beaver Brook; old-growth examples of the rare upland white cedar-yellow birch forest (western range extent); and forested peatlands. Examples of rare natural-origin pine woodland were documented from two sites in SE Koochiching County.

Border Lakes Subsection in Lake County

Botanical surveys at Basswood Lake in Lake County focused on improved documentation of the 2013 state record sedge, *Carex tincta*. Uncertainty exists among *Carex* experts about the taxonomy of this species. MBS collections made from this site (the only known MN location) were submitted for annotation to Flora of North America's *Carex* lead, Tony Reznicek, to help improve taxonomic understanding of this challenging and elusive species. Additional botanical discoveries included *Botrychium minganense*, *Carex katahdinensis,* and *Eleocharis quinqueflora*.

Highlights Northcentral & Northwestern Minnesota

Agassiz Lowlands Subsection

Field surveys in northern peatlands included establishment of long-term peatland vegetation monitoring plots in a spring fen as part of a series of peatland monitoring plots across Roseau, Beltrami, Lake of the Woods, and Koochiching counties. This work also documented several new locations of the state-threatened ram's head lady-slipper (*Cypripedium arietinum*) and one massive new population of the state special concern fern, *Gymnocarpium robertianum*.

Targeted field surveys in Cass and Itasca counties focused on vegetation plot collection in under-sampled native plant communities to inform native plant community mapping. A highlight of this work was documentation of a previously unknown acid peatland with water track features.

Highlights Central & Southern Minnesota

While providing technical guidance to Banning State Park staff regarding rare sandstone bedrock native plant communities, MBS plant ecologists discovered new records of the plants *Gaylussacia baccata, Hydrocotyle Americana* (state special concern)*,* and *Gymnocarpium jessoense*.

Aquatic Plant Surveys

Lake surveys for aquatic plants were completed in Wright, Sherburne, Stearns, Benton, Anoka, and Kittson counties. All common, rare, and exotic plant species observed were documented and vouchered as needed; observations and information were recorded about each lake; and photographs were made of various aquatic species and blue-green algae.

Project Status as of October 31, 2016

Field Surveys

Botanical and native plant community surveys prioritized filling county and state distributional gaps for plant species and native plant communities. Vegetation plots (relevés) were focused in under-sampled native plant communities that fill critical gaps in the DNR's 2003 *Field Guide to Native Plant Communities.*

Highlights Northeastern Minnesota

Border Lakes Subsection in Koochiching and St. Louis counties

Remote areas were often the focus of field survey in this portion of the Border Lakes Subsection. A seven-day trip to the Ahsub Lake area, Lake County and areas in adjacent St. Louis County delivered new relevés, a new record of *Rhynchospora fusca,* and several dozen plant specimens (many sub-county records).

A 12-day trip in late July and early August based on White Feather and Stuart lakes in St. Louis County included seven relevés and new documentation for plant records of *Ophioglossum pusillum, Carex michauxiana, Littorella uniflora, Myriophyllum tenellum,* and *Platanthera clavellata.* Over 70 plant specimens (several sub-county records) were prepared. Rare moss species were also documented including *Sphagnum compactum* and several other species.

A seven-day trip to survey remote areas in the western portion of the Vermillion Bedrock Complex focused on the collection of vegetation plots and rare plant surveys. Vegetation plots were collected from bedrock woodland (FDn32a and FDn33b), wet forest (WFn55), and wet meadow (WMn82) native plant communities. Plant collections included the rare Torrey's manna grass (*Torreyochloa pallida*) and at least 15 other notable or uncommon plant species for this area of Minnesota.

Other, less remote areas were also surveyed, including areas along the Rat Root River, Ash River, Ash Lake, and Big Island Scientific & Natural Area. Much of this work was focused on vegetation plot sampling of under-sampled native plant communities. Several relevé s were collected along the Ash River in floodplain forest (FFn67a), terrace forest (FFn57a), rare dry pine/spruce woodland (FDn32c2), and old-growth red-white pine forest communities. An updated flora was produced for Big Island SNA and old relevé s here were resampled as part of a larger effort to revisit old relevé locations.

Koochiching County on the whole is under-sampled for vegetation plots. MBS is making efforts to place as many vegetation plots as possible in selected locations within the county to better understand the distribution of plant communities, and variation in plant community composition across northern Minnesota. During the reporting period relevé s were collected from terrace forest (FFn57a) and floodplain forest (FFn67a); water track poor tamarack-black spruce swamp (APn81b1), poor fen (APn91c1), OPn91a, rich fen (OPn91b1), rich spruce swamp (FPn71a), and rich tamarack swamp (FPn81); and upland boreal hardwood-conifer forest (MHn44c), wet-mesic hardwood forest (MHn46b), old- growth white pine-red pine forest (FDn43a), and upland white cedar forest (FDn43c) communities.

Koochiching County on the whole is under-sampled for plant species. MBS is making efforts to collect and provide voucher specimens for as many native plant species as possible that have not yet been documented from the county. This involves collecting and pressing many common native plant species but also brings forth discoveries for rare species such as four new locations of *Ranunculus lapponicus* (SPC) and one new location of *Carex exilis* (SPC).

Littlefork-Vermilion Subsection in Koochiching and St. Louis counties

Preparation for field survey in this subsection involved GIS work to review air photos, satellite imagery, LiDAR, soils, geology, and hydrology to delineate survey priority sites and preliminary native plant communities. These upfront efforts are critical for focused and efficient field survey. Over 500 native plant community and over 65 priority survey sites were delineated as part of this effort.

MBS plant ecologists collaborated with the MN Historical Society at Grand Mound National Historic Landmark in northern Koochiching County on the floodplain of the Rainy and Big Fork rivers. This site contains the largest burial mound in the state, which is in the shape of a muskrat. Historical Society and MBS staff addressed management options that balance cultural and ecological objectives. Two relevé plots were collected from the floodplain terrace surrounding the mound. Rare plant species searches were conducted but did not produce new discoveries.

Vegetation plot collection in this area focused on the rich peatland communities at the edge of large peatland complexes and river shore vegetation along the Little Fork River. This work also brought forth new rare plant species records including *Botrychium pallidum, Botrychium simplex, Botrychium rugulosum*, *Ophioglossum pusillum,* and *Torreyochloa pallida.*

Superior National Forest

MBS collaborated with the Superior National Forest to collect vegetation plots in mutually beneficial locations. MBS is actively surveying within the SNF as part of the statewide baseline survey while the SNF is interested in certain vegetation plots to assist their land and vegetation classification systems to help inform vegetation management. MBS collected 57 relevés as part of this collaboration in a variety of upland forest types including dry conifer forests and rich mesic hardwood forests. Rare plant species documented during the course of this wokr included: *Botrychium pallidum*, *Botrychium simplex*, *Ophioglossum pusillum*, and *Ranunculus lapponicus*. MBS plant ecologists also provided training to SNF staff on plant ID, vegetation sampling methods, and vegetation classification.

Highlights Northcentral Minnesota

Lake of the Woods County

Field surveys occurred in southern Lake of the Woods County and in the Northwest Angle.

Survey of the NW Angle required considerable planning and logistical efforts. The NW Angle is remote, only accessible by boat across many miles of Lake of the Woods or by secondary roads through Canada. Given the level of effort necessary to survey this area, MBS assigned several botanists/plant ecologists and zoologists to the NW Angle for a 2-week period in August.

Field surveys targeted sites that were representative of high-quality NW Angle native plant communities and had good potential for new rare species discoveries. About 200 plant specimens were collected during this effort.

Several rare species were documented, including *Malaxis monophyllos* (SPC), *Juniperus horizontalis* (SPC), *Ranunculus lapponicus* (SPC), and a rare species of moss, *Sphagnum compactum* (THR). Several county plant records were collected, and new locations of Cyperaceae (sedges and rushes) species were documented to include in the forthcoming *Sedges and Rushes of Minnesota* book.

One plant discovery of particular note is *Opuntia fragilis* (prickly pear cactus) found on a remote, uninhabited island in Lake of the Woods. This is a significant range extension – the nearest location is in northeast Koochiching County on an island in Rainy Lake, collected in 1948 with no specific location information.

A total of 42 relevé s were collected from Lake of the Woods County (in the NW Angle and the southern portion of the county) during this reporting period. These vegetation plots describe a range of plant communities including high-quality upland cedar forests, undisturbed northern cedar swamp, poor conifer swamp with dwarf mistletoe, a Lake of the Woods island native plant community influenced by lake water levels that approximate a floodplain community not described in DNR's *Field Guide to Native Plant Communities,* and a resample of a plot first collected in 1996 in a dry jack/red pine woodland. This effort also resulted in the discovery of two State-listed plant species, *Malaxis monophyllos* (SPC) and *Ranunculus lapponicus* (SPC).

Aquatic Plant Surveys

Lake surveys for aquatic plants were completed in Aitkin, Carlton, Cass, Crow Wing, Itasca, Lake, Pine, St. Louis, Stearns, and Todd counties. All common, rare, and non-native invasive plant species observed were documented and vouchered as needed; observations and information were recorded about each lake; and photographs were made of various aquatic species and blue-green algae. This effort coordinates with and

provides highly-valued foundational data to broader DNR efforts to establish indices of biotic integrity for Minnesota lakes. Specific highlights from this work will be provided with the March 31, 2017 Project Status.

Final Report Summary:

Field Surveys

2015-2017 MBS plant and native plant community field surveys continued in Koochiching, St. Louis, Beltrami, and Lake of the Woods counties. Botanical and native plant community surveys prioritized filling county and state distributional gaps for native and rare plant species and native plant communities. Vegetation plots (relevés) were focused in under-sampled native plant communities that fill critical gaps and on representative native plant communities that document the range of native plant communities in the region. Large landscapes that represent native vegetation patterns were also a priority for field survey.

A significant amount of planning for field surveys occurred as part of this appropriation. This included review and interpretation of air photos, satellite imagery, LiDAR, and soils, geology and hydrology data; review of biological specimen collections and species data to develop identification skills and identify survey priorities; determining access routes, obtaining permissions and permits to access lands for survey; and developing maps to aid field survey. These upfront efforts are critical for focused and efficient field survey in prioritized locations.

Highlights Northeastern Minnesota

Border Lakes Subsection in Koochiching and St. Louis counties

Koochiching County on the whole is under-sampled for vegetation plots. MBS is making efforts to place as many vegetation plots as possible in selected locations within the county to better understand the distribution of plant communities, and variation in plant community composition across northern Minnesota. Relevé s were collected from terrace forest (FFn57a) and floodplain forest (FFn67a); water track poor tamarack-black spruce swamp (APn81b1), poor fen (APn91c1), OPn91a, rich fen (OPn91b1), rich spruce swamp (FPn71a), and rich tamarack swamp (FPn81); and upland boreal hardwood-conifer forest (MHn44c), wet-mesic hardwood forest (MHn46b), old- growth white pine-red pine forest (FDn43a), and upland white cedar forest (FDn43c) communities.

In addition to relevé sampling MBS also conducted meander surveys in numerous native plant communities including river terraces, forested swamps, rock outcrops/woodlands, old-growth forests, young fire-origin jack pine forests, lakeshores, ephemeral wetlands, and wild rice marsh. A previously undescribed native plant community, informally referred to as “boulder pavement,” has now been documented from multiple sites. Rich forested swamps and peatlands were targeted for their rarity and association with rare orchid and other plant species. Floodplain forests, uncommon in the Border Lakes, was documented along the Vermillion River. Ground-verification of native plant communities was completed to inform eventual GIS mapping of native plant communities in this area.

Koochiching County on the whole is under-sampled for plant species. MBS is making efforts to collect and provide voucher specimens for as many native plant species as possible that have not yet been documented from the county. This involves collecting and pressing many common native plant species but also documenting dozens of rare and notable terrestrial and wetland vascular plants including rare orchids, grasses, sedges and forbs. Examples include: *Bidens discoidea, Carex conoidea, C. katahdinensis, C. michauxiana, Cyprepedium arietinum, Eleocharis mamillata, Eleocharis nitida, Eleocharis quinqueflora, Fimbristylis autumnalis, Juncus articulatus, Littorella americana, Malaxis monophyllos var. brachypoda, Platanthera clavellata, Ranunculus lapponicus, Schoenoplectus smithii, Scirpus pendulus, Torreyochloa pallida* var. *fernaldii, Tetraplodon mnioides, Walsteinia fragarioides* var. *fragarioides,* and *Xyris montana.* Emphasis was placed on improving collections of *Rubus* species (raspberry and blackberry species) and graminoids (e.g. sedges, grasses) that to-date have been poorly documented from the western Border Lakes. Plant surveys in lakes recorded over twenty new records of rare aquatic vascular plants including *Callitriche herterophylla* (state threatened) and *Littorella americana* (state

special concern). MBS staff documented and prepared specimens of dozens of new county plant records and subcounty plant records.

MBS botanist/plant ecologist led a small group of volunteers to help evaluate the population extent and size of a recently discovered population of ram's head lady's-slipper (*Cypripedium arietinum*) at the southern edge of the Border Lakes subsection. With the help of volunteers more than 200 individual plants were documented.

Remote areas were often the focus of field survey in this portion of the Border Lakes Subsection that require considerable amounts of planning and logistics. Several multiday trips into some of Minnesota's most remote areas were completed. Examples include:

- A seven-day trip to the Ahsub Lake area, Lake County and areas in adjacent St. Louis County delivered new relevés, a new record of *Rhynchospora fusca,* and several dozen county and subcounty plant specimen records.
- A 12-day trip based on White Feather and Stuart lakes in St. Louis County included seven relevés and new documentation for plant records of *Ophioglossum pusillum, Carex michauxiana, Littorella uniflora, Myriophyllum tenellum,* and *Platanthera clavellata.* Over 70 plant specimens (several sub-county records) were prepared. Rare moss species were also documented including *Sphagnum compactum* and several other species.
- A seven-day trip to survey remote areas in the western portion of the Vermillion Bedrock Complex focused on bedrock woodland (FDn32a and FDn33b), wet forest (WFn55), and wet meadow (WMn82) native plant communities. Plant collections included the rare Torrey's manna grass (*Torreyochloa pallida*) and several other notable or uncommon plant species for this area of Minnesota.

Other, less remote areas were also surveyed, including areas along the Rat Root River, Ash River, Ash Lake, and Big Island Scientific & Natural Area. Several relevés were collected along the Ash River in floodplain forest (FFn67a), terrace forest (FFn57a), rare dry pine/spruce woodland (FDn32c2), and old-growth red-white pine forest communities. An updated flora was produced for Big Island SNA and old relevés (>20 years old) here were resampled as part of a larger statewide effort to revisit old relevé locations.

Littlefork Vermilion Subsection in Koochiching and St. Louis County

Vascular plant surveys documented new county records and rare species records. New documentations include including *Botrychium pallidum, Botrychium simplex, Botrychium rugulosum*, *Caltha natans, Cardamine pratensis*, *Eleocharis mamillata* subsp. *mamillata*, *Geum laciniatum*, *Malaxis monophyllos* var. *brachypoda*, *Ophioglossum pusillum, Ranunculus lapponicus*, *Torreyochloa pallida*. Collections also included two new locations of a species of State-threatened liverwort, *Trichocolea tomentella*, including the first documented observation for St. Louis County.

Vegetation field survey occurred in high quality old-growth river terrace forest and adjacent upland forest types associated with the Littlefork River, Sturgeon River, and Beaver Brook; old-growth examples of the rare upland white cedar-yellow birch forest (western range extent); and forested peatlands, especially rich spruce forests at the edge of peatlands for their rarity and high potential to contain rare plant species.

MBS plant ecologists collaborated with the MN Historical Society at Grand Mound National Historic Landmark in northern Koochiching County on the floodplain of the Rainy and Big Fork rivers. This site contains the largest burial mound in the state, which is in the shape of a muskrat. Historical Society and MBS staff addressed management options that balance cultural and ecological objectives. Two relevé plots were collected from the floodplain terrace surrounding the mound. Rare plant species searches were conducted but did not produce new discoveries.

Superior National Forest

MBS collaborated with the Superior National Forest through a cost-share agreement to collect vegetation plots in mutually beneficial locations. MBS is actively surveying within the SNF as part of the statewide baseline

survey while the SNF is interested in certain vegetation plots to assist their land and vegetation classification systems to help inform vegetation management. MBS collected over 60 relevés as part of this collaboration in a variety of upland forest types including dry conifer forests, rich mesic hardwood forests, and lowland conifer forests including black spruce and cedar swamps. Rare plant species documented during the course of this work include: *Botrychium pallidum*, *Botrychium simplex*, *Ophioglossum pusillum*, and *Ranunculus lapponicus*. MBS plant ecologists also provided training to SNF staff on plant ID, vegetation sampling methods, and vegetation classification.

Highlights Northcentral & Northwestern Minnesota

Agassiz Lowlands Subsection – Beltrami, Lake of the Woods and Koochiching counties

Field surveys in northern peatlands included establishment of long-term peatland vegetation monitoring plots in a spring fen as part of a series of peatland monitoring plots across Roseau, Beltrami, Lake of the Woods, and Koochiching counties. This work also documented several new locations of the state-threatened ram's head lady-slipper (*Cypripedium arietinum*) and one massive new population of the state special concern fern, *Gymnocarpium robertianum*.

Survey of the Lake of the Woods County NW Angle required considerable planning and logistical efforts. The NW Angle is remote, only accessible by boat across many miles of Lake of the Woods or by secondary roads through Canada. Given the level of effort necessary to survey this area, MBS assigned several botanists/plant ecologists and zoologists to the NW Angle for a 2-week field work assignments.

Field surveys targeted sites that were representative of high-quality NW Angle native plant communities and had good potential for new rare species discoveries. About 200 plant specimens were collected during this effort.

Several rare species were documented, including *Malaxis monophyllos* (SPC), *Juniperus horizontalis* (SPC), *Ranunculus lapponicus* (SPC), and a rare species of moss, *Sphagnum compactum* (THR). Several county plant records were collected, and new locations of Cyperaceae (sedges and rushes) species were documented to include in the forthcoming *Sedges and Rushes of Minnesota* book.

One plant discovery of particular note is *Opuntia fragilis* (prickly pear cactus) found on a remote, uninhabited island in Lake of the Woods. This is a significant range extension – the nearest location is in northeast Koochiching County on an island in Rainy Lake, collected in 1948 with no specific location information.

A total of 42 relevé s were collected from Lake of the Woods County (in the NW Angle and the southern portion of the county) during this reporting period. These vegetation plots describe a range of plant communities including high-quality upland cedar forests, undisturbed northern cedar swamp, poor conifer swamp with dwarf mistletoe, a Lake of the Woods island native plant community influenced by lake water levels that approximate a floodplain community not described in DNR's *Field Guide to Native Plant Communities,* and a resample of a plot first collected in 1996 in a dry jack/red pine woodland. This effort also resulted in the discovery of two State-listed plant species, *Malaxis monophyllos* (SPC) and *Ranunculus lapponicus* (SPC).

Aquatic Plant Surveys

Lake surveys for aquatic plants were completed in Aitkin, Anoka, Benton, Carlton, Cass, Crow Wing, Itasca, Kittson, Lake, Pine, Sherburne, St. Louis, Stearns, Todd, and Wright counties. All native and rare plant species observed were documented and vouchered as needed; observations and information that help interpret lake and vegetation quality were recorded about each lake; and photographs were made of native and rare aquatic plant species. This effort coordinates with and provides highly-valued foundational data to broader DNR efforts to establish indices of biotic integrity for Minnesota lakes.

Lake surveys and associated data and specimen processing were temporarily put on hold during the last half of this appropriation due to the unexpected retirement of the long-standing MBS aquatic plant biologist. A search

for a replacement ensued during this reporting period with a new hire established shortly after the end of this reporting period.

Activity 2: Monitoring

MBS will conduct selected monitoring activities collaboratively in response to needs identified in various plans and assessments. Monitoring needs have been highlighted in a number of recent initiatives such as the Minnesota Prairie Conservation Plan, the revision of the State's Wildlife Action Plan, and the State's Forest Certification related to areas of high conservation value. For example, in the prairie region, vegetation data collection is underway and proposed to continue to assess the effectiveness of grazing management at three grassland Wildlife Management Areas.

As related to the State's dual forest certification, botanists and plant ecologists will continue to collect detailed data on populations of rare plants that characterize several sites of high conservation value in southeastern Minnesota. For example, in 2014, a population of green violet *(Hybanthus concolor)* a state endangered plant, was mapped at a forest of high conservation value and staff engaged in a discussion with the managers of the DNR divisions of Forestry and Fish and Wildlife to ensure that trout stream restoration and forest management practices were accomplished to sustain this population. This work will continue and will be expanded to northern forest sites with similar methods and objectives.

Due to technical expertise in skills such as plant identification, knowledge of rare species and native plant communities, MBS staff are qualified to conduct this monitoring and work with information management staff to provide for long-term public storage of data. These activities will continue at a reduced level of effort from past biennia

Summary Budget Information for Activity 2:

ENRTF Budget: $ 345,453
Amount Spent: $ 344,003
Balance: $ 1,450

Outcome	Completion Dates
1. Sample at least 5 sites to assess outcomes of prairie management activities.	June 30, 2017
2. Sample at least 5 sites to assess outcomes of forest management in high conservation value sites.	June 30, 2017
3. Sample at least 5 sites to establish monitoring baseline data for species or native plant communities in northern forest sites of biodiversity significance.	June 30, 2017

Project Status as of January 31, 2016

Minnesota Prairie Plan Monitoring
MBS field survey, monitoring and analysis continued from previous biennia as part of Minnesota Prairie Plan implementation. The following prairie sections provide specific accomplishments that relate to Prairie Plan priorities.

Prairie Species Monitoring
Western Prairie Fringed Orchid (*Plantanthera praeclara*)
Long-term monitoring of western prairie fringed orchid continued from previous biennia. MBS botanists and volunteers completed censuses of 30 populations—including populations on private lands, with permission granted to census a population that had not been visited in nearly 20 years. Demographic monitoring was completed at four sites across the latitudinal gradient of the species in Minnesota. Leaf tissue samples were

collected for DNA analysis in collaboration with researchers at North Dakota State University. MBS coordinated with U.S. Fish and Wildlife Service staff on surveys for the species in conjunction with proposed site burns.

MBS compiled survey information in a report, "Summary of 2015 *Platanthera praeclara* Recovery Activities". This report is available upon request.

Small White Lady's-Slipper (*Cypripedium candidum*)
Long-term monitoring of the key Minnesota Prairie Plan indicator, small white lady's-slipper, continued from previous biennia. Survey effort focused on sites in central and west-central Minnesota that are in conservation ownership (e.g. Wildlife Management Areas, Scientific and Natural Areas, The Nature Conservancy [TNC] preserves, and Native Prairie Bank easements on private lands). Most of the sites had not been surveyed in recent years. A total of 52 sites were surveyed during the 2015 field season; 43 sites contained previously known populations while 8 sites produced newly documented occurrences in Big Stone, Grant, Otter Tail, Pope, Stevens, and Wilkin counties.

MBS compiled survey information in a report, "2015 Summary of Small White Lady's Slipper Monitoring Activities in Minnesota," that was distributed to project partners, stakeholders, and other agencies with an interest in this species. This report is available upon request.

Prairie Vegetation Surveys
MBS prairie vegetation and botanical surveys focused on Minnesota Prairie Plan Core Areas in Marshall, Pennington, and Red Lake counties. These included the New Solum, Pembina Prairie, Florian, East Park-Thief Lake, and Espelie Prairie sites in the Glacial Ridge Core Area. Documentation of native plant communities that had not been previously surveyed was a primary focus.

Field survey was also completed in 45 under-sampled prairie sites outside of Minnesota Prairie Plan Core Areas. Vegetation surveys targeted sites in Marshall, Red Lake, Pope, and Kandiyohi counties that had either not been surveyed in the past or had not been surveyed in over 20 years. This work provided important new native plant community documentation and mapping to current MBS standards. Highlights included documentation of several new wet prairie occurrences, one of which is a 42-acre wet prairie complex in Marshall County that is among the very few such occurrences of this native plant community in the Glacial Lake Agassiz lake plain within the county. A 50-acre occurrence of high-quality mesic oak and spruce savanna in Marshall County and 117 acres of high-quality southern wet and mesic prairie in Pope County were also notable.

Botanical surveys in these areas documented over 100 plant species that had not previously been documented from these counties. Rare plant species documented include *Carex sterilis* (state threatened) and multiple collections of *Avenula hookeri* (state special concern).

Prairie Management Monitoring
MBS plant ecologists continued, from previous biennia, to lead vegetation monitoring efforts as part of collaborative Patch-Burn-Graze prairie management efforts. Highlights of this work include:

1. Chippewa Prairie: sampling of 40 wetland basins was completed. This was the second year of sampling these basins. Noticeable differences in vegetation were documented this year compared to the previous year. Differences were driven by the amount of standing water present when cows were released to graze. For example, less standing water in 2015 resulted in more extensive cattle browsing of the non-native reed canary grass.
1. Caribou WMA: sampling of 50 permanent vegetation plots (25 pairs) was completed with assistance and collaboration from contractors, TNC, and DNR staff. A Carleton College professor and a team of students were trained in vegetation sampling protocols that complemented their work with soil carbon and nutrient dynamics.

2. Field surveys of wetland basins in 8 other managed areas (WPA, WMA, and TNC preserves) near Chippewa Prairie were completed to assess wetland basin vegetation types and condition. Work was accomplished in collaboration with USFWS staff, DNR staff, and a seasonal field assistant. This information will be useful in planning a potential expansion of the Chippewa Prairie project to monitor wetland basins in sites undergoing management with cattle grazing.

Forest Monitoring

Northern forest sites (wet cedar and wet spruce native plant communities) with occurrences of the rare Western Jacob's-ladder (*Polemonium occidentale* subsp. l*acustre*) were targeted to establish baseline conditions necessary for forthcoming monitoring. This state-endangered species is known to occur in only 6 sites worldwide, all of which occur in Minnesota (4) and Wisconsin (2). The targeted survey sites had not been surveyed since the late 1980s. This effort is in collaboration with the University of Minnesota Landscape Arboretum, which is focusing on genetic analysis and greenhouse growth trials. Field work was accomplished with assistance from volunteers and St. Louis County Land & Minerals Department foresters. This work resulted in other notable botanical discoveries including documentation of *Cardamine pratensis* (greatly expands known extent of a 2013 record) and a new record of the state special concern species *Malaxis monophyllos* var. *brachypoda*.

Project Status as of October 31, 2016

Minnesota Prairie Monitoring

MBS field survey, monitoring and analysis continued from previous biennia as part of Minnesota Prairie Plan implementation and prairie management. The following prairie sections provide specific MBS accomplishments that relate to Prairie Plan goals, ecological prairie management, and biodiversity conservation.

Prairie Species Monitoring

Western Prairie-fringed orchid (*Platanthera praeclara)*

Long-term monitoring of western prairie fringed orchid continued from previous biennia with census and field surveys at sites across the species' range in the state. The work of dozens of volunteers are critical to this effort.

MBS coordinated and implemented counts and demographic monitoring of *Platanthera praeclara* at Blue Mounds State Park in Rock County; collected survivorship data on a subset of plants at Pembina Preserve Prairie in Polk County; and collected demographic monitoring data at 4 sites across the species' latitudinal gradient in the state.

MBS compiled data and information on Minnesota populations of western prairie fringed orchid to be used by researchers to analyze factors contributing to fluctuations in the number of observed flowering plants from year-to-year. This effort was challenging as it included incorporation of information scattered in numerous archived e-mails and paper files relating to the condition and management of individual sites spanning over 25 years. MN DNR census of the orchid is the leading monitoring program in the U.S. A forthcoming publication will be the first to include analyses of trends on a statewide basis.

MBS is a co-author of a forthcoming western prairie fringed orchid publication analyzing results for four cycles of experimental management at Pembina Trail Preserve. Review of this draft is in process at the moment. This work is important because the Pembina study is the only research project in the species' range in which the study was designed with multiple random replications to support statistical analyses.

MBS provided information to the U.S. Fish and Wildlife Service relating to population locations and possible impacts from fall seed harvest of prairies where western prairie fringed orchid occurs.

Small White Lady's Slipper (*Cypripedium candidum*)

Long-term monitoring of a key Minnesota Prairie Plan indicator, small white lady's-slipper, continued from previous biennia. With the aid of volunteers, a total of 30 sites were surveyed during the 2016 field season in Big Stone, Grant, Otter Tail, Pope, Stevens, and Wilkin counties; 26 sites contained previously known populations while 4 sites produced newly documented occurrences.

MBS also coordinated and assisted with surveys to assess potential impacts to the species from cattle grazing. This involved baseline survey work to compare populations at Santee Prairie SNA, which is not being grazed, with populations at Wambach WMA, where grazing occurs. Analysis from this work is ongoing at the time of this report.

Prairie Bush Clover (*Lespedeza leptostachya)*
Long-term monitoring of prairie bush clover continued from previous biennia. Demographic monitoring of the species occurred at two sites in southwestern Minnesota, Great Bend 9, and Kilen Woods State Park.

MBS collaborated with a researcher from the Chicago Botanical Gardens on a climate change germination research project. This included leading the researcher to sites in both southwestern and southeastern Minnesota for seed collection. The project will compare Minnesota populations with populations at Nachusa grasslands, Illinois, which represent the extremes of the species' range. Greenhouse trials are also proposed to study germination and early survivorship of seedlings from these same source populations under simulated climate change regimes.

Dwarf Trout Lily (*Erythronium propullans*)
Long-term monitoring of dwarf trout lily continued from previous biennia. MBS conducted annual monitoring of Nerstrand-Big Woods State Park (2 subpopulations) and TNC Grace Nature Preserve. MBS set up random monitoring plots at Clinton Falls SNA to establish this site as a new monitoring location for this species and collected initial first-year data. The work and dedication of volunteers are critical to achieving field work goals.

Additional activities included 1) a MBS examination of sites at River Bend Nature Center where goats are being used to control invasive species (garlic mustard); and 2) MBS botanical field survey with MN DOT staff for dwarf trout lily in suitable habitat that will be impacted by road improvement projects, but no plants were found.

Prairie Vegetation Surveys
MBS prairie vegetation and botanical surveys continued from 2015 in Minnesota Prairie Plan core areas and selected areas outside of core areas. Identifying and prioritizing areas to survey involves use of LiDAR and high resolution aerial photography not available when MBS first surveyed these counties in the 1980s and 1990s.

Priority for vegetation and botanical field survey was placed on sites that appear to have never been cultivated, have yet to be surveyed for native plant communities and rare species, or were surveyed over 20 years ago. To identify additional sites for survey and further refine survey priorities, MBS coordinated with local natural resource professionals, the Minnesota River Valley Local Technical Team, and Prairie Plan technical teams. Assessments are continuing, but so far over 300 sites that need survey have been identified. These sites amount to over 15,000 acres of unbroken land, the majority of which is within or closely associated with prairie plan core areas.

2016 field surveys occurred in 94 sites in the Minnesota River, Cottonwood River, and Glacial Lakes prairie plan core areas and sites in Marshall, Pennington and Red lake counties. Field surveys targeted undocumented floodplain and mesic hardwood forests, wet meadows, and wet and mesic prairies. It is estimated that 2016 field surveys will result in the addition of 150-200 new MBS prairie sites of biodiversity significance with newly documented prairie, forest, and wetland plant communities and/or rare species populations. Areas of note include a number of rock outcrop sites along the Minnesota River core area and a number of southern wet and mesic prairies in the Cottonwood River core area. Rare species records from these efforts include Franklin's ground squirrel, *Gymnocladus dioica*, *Cirsium hillii*, and *Cyprus acuminatus*. Peripheral or cursory surveys of an

additional 221 sites also occurred; about half of these were determined to be of adequate quality to receive more thorough ground surveys during future field seasons.

Prairie Management Monitoring

MBS plant ecologists continued, from previous biennia, to lead and collaborate on prairie vegetation monitoring efforts as part of collaborative Patch-Burn-Graze prairie management efforts and Prairie Plan implementation priorities. Highlights of this work include:

1. *Wet meadows:* MBS plant ecologists and USFWS biologists have been collaborating on a new project to monitor the effects of cattle grazing on wet meadow wetland plant communities embedded in prairie pothole complexes. A study plan was developed by MBS and USFWS for the project with input from USGS, University of Minnesota, and TNC. Volunteer crews assisted USFWS and MBS staff in locating and laying out monitoring plots.
2. *Caribou WMA:* MBS completed an interim report for Caribou Wildlife Management Area that includes analysis of data from 2012 and 2015. The report was submitted to The Nature Conservancy as fulfillment of terms for a permit, posted to an internal DNR grazing list-serve, and sent to NRCS and other agency staff who work on grazing in prairies.
3. *Hastad WPA:* MBS and USFWS partners collaborated on an inventory and classification of several hundred wetland basins from which a subset was selected for monitoring plots. 30 monitoring sites with a total of 150 vegetation transects were laid out and sampled.
4. *Hole in the Mountain WMA, Lincoln County*: MBS plant ecologists surveyed and classified prairie wetland vegetation to select monitoring plot locations. Plots were placed in areas subject to cattle grazing and in similar areas that are fenced to exclude cattle grazing. 30 vegetation sites with a total of 150 vegetation transects were sampled in August. MBS collaborates with DNR Wildlife Managers to establish connections between management questions and monitoring objectives.
5. *Chippewa Prairie*: MBS plant ecologists collaborated with TNC ecologists to sample 36 vegetation transects in prairie wetland basins within the Chippewa Prairie Patch-Burn-Graze project area.
6. *Rare species*: 10 rare plant species records were documented from prairie and rock outcrop native plant communities. Highlights include two records of *Bacopa rotundifolia*, one record of *Cyperus acuminatus,* and one of *Elatine triandra;* all three of these species were recorded from shallow wetland basins at Chippewa Prairie. There are thousands of similar wetland basins on terraces of glacial River Warren that have not been surveyed and hold great potential for additional rare species discoveries.
7. *Calcerous fen*: MBS documented a new location of the rare and sensitive calcareous fen plant community at Sweep WPA in Kandiyohi County.

Forest Monitoring

Southeast Minnesota

Whitewater State Park and Great River Bluffs State Park

MBS botanists and plant ecologists surveyed high conservation value sites in Whitewater and Great River Bluffs state parks. The work in state parks helps to serve as references or controls for high conservation value sites subject to timber management. Field surveys involved targeted searches for rare species, relevé collection, and field checks for mapping of native plant communities.

Vegetation surveys occurred throughout the park with relevé collection focused on native plant communities that were under-sampled per DNR's *Field Guide to Native Plant Communities*: sedge meadows, sedge fens, seepage meadows, calcareous fens, and other seepage wetlands. Many new locations of rare or geographically uncommon plant species were documented including *Hamamelis virginiana* (THR), *Jeffersonia diphylla* (SPC), *Carex laxiculmis* var. *copulata* (THR), *Dryopteris goldiana* (SPC), *Hydrastis canadensis* (END), *Panax quinquefolius*

(SPC), *Deparia acrostichoides* (SPC), *Trichophorum clintonii* (THR; new to park and Winona County, and a significant range extension), *Asclepias amplexicaulis* (THR; new to park), *Pellaea atropurpurea* (SPC; new to park), *Galium circaezans* var. *hypomalacum* (new to park and Winona County; third and fourth locations known for this plant in MN), *Taenidia integerrima* (SPC), *Silene nivea* (THR; new to the park), *Vitis aestivalis var. bicolor* (THR), *Sanicula trifoliate* (SPC), *Sullivantia sullivantii* (THR), *Eupatorium sessilifolium* (THR; new record for park), and leadplant flower moth *(Schinia lucens)* (SPC).

One plant species of note documented in Whitewater State Park is *Carex communis.* Two populations were found, which provide significant range extensions updates to Minnesota occurrence records; the only other Minnesota record is from 1915 from a location in Fillmore County.

MBS botanists continued annual monitoring of *Aureolaria pedicularia* at Whitewater State WMA. Numbers are up slightly from 2015 and significantly up from years prior to 2015.

Northern Minnesota

Nemadji State Forest

MBS plant ecologists initiated assessment of high conservation value forest sites in mesic hardwood forests in the Nemadji State Forest of southeast Carlton County and northeast Pine County. This work provides important foundational data necessary to launch monitoring of high conservation values vis-à-vis forest management in similar forest types throughout the region. Work included: 1) an expansion of rare species searches and native plant community evaluations started during MBS's first pass through these counties in the 1990s and early 2000s; and 2) revisiting and sampling of relevés first collected at least 20 years ago. MBS collaborated in this effort with DNR Forestry, Wildlife, and Ecological & Water Resources, the DNR Divisions responsible for delivering sustainable forest management on state lands.

Banning State Park

MBS collaborated with DNR Parks & Trails to survey rare species and native plant communities in portions of Banning State Park to establish baseline data in an area of high conservation value and high recreational interest (rock climbing). This baseline work sets the stage for monitoring change in rare plants and native plant communities in areas open to and closed to recreational use.

New locations for rare plants, lichens, and bryophytes (mosses and liverworts) were discovered on wet cliffs, bedrock outcrops, seepage habitats, and caves along the Kettle River. Highlights include new locations of the following rare plants: *Chrysosplenium iowense, Hydrocotyle americana, Carex media, Juglans cinerea, Gaylussacia baccata, Geum laciniatum, Gymnocarpium jessoense, Hydrocotyle Americana, Poa paludigena,* and *Torreyochloa pallida.*

Vegetation sampling of the wet sandstone cliffs in Banning State Park will greatly advance the classification of these communities in DNR's *Field Guide to Native Plant Communities* as they were under-sampled at the time of publication.

Final Report Summary:

Minnesota Prairie Plan Monitoring

MBS field survey, monitoring and analysis continued from previous biennia intended to complement Minnesota Prairie Plan implementation and prairie management priorities. The following prairie sections provide specific MBS accomplishments that relate to Prairie Plan goals, ecological prairie management, and biodiversity conservation.

Prairie Species Monitoring

The results reported below reflect funding contributions from the ENRTF (this appropriation), USFWS endangered species funding, and State General Fund.

Western Prairie Fringed Orchid (*Plantanthera praeclara*)

Long-term monitoring of western prairie fringed orchid continued from previous biennia with census and field surveys at sites across the species' range in the state. The work of dozens of volunteers are critical to this effort.

MBS botanists and volunteers completed censuses of 30 populations—including populations on private lands, with permission granted to census a population that had not been visited in nearly 20 years. Demographic monitoring was completed at four sites across the latitudinal gradient of the species in Minnesota. Leaf tissue samples were collected for DNA analysis in collaboration with researchers at North Dakota State University. MBS coordinated with U.S. Fish and Wildlife Service staff on surveys for the species in conjunction with proposed site burns.

MBS coordinated and implemented counts and demographic monitoring of *Platanthera praeclara* at Blue Mounds State Park in Rock County; collected survivorship data on a subset of plants at Pembina Preserve Prairie in Polk County; and collected demographic monitoring data at 4 sites across the species' latitudinal gradient in the state.

MBS compiled data and information on Minnesota populations of western prairie fringed orchid to be used by researchers to analyze factors contributing to fluctuations in the number of observed flowering plants from year-to-year. This effort was challenging as it included incorporation of information scattered in numerous archived e-mails and paper files relating to the condition and management of individual sites spanning over 25 years. MN DNR census of the orchid is the leading monitoring program in the U.S. A forthcoming publication will be the first to include analyses of trends on a statewide basis.

MBS is a co-author of a forthcoming western prairie fringed orchid publication analyzing results for four cycles of experimental management at Pembina Trail Preserve. Review of this draft is in process at the moment. This work is important because the Pembina study is the only research project in the species' range in which the study was designed with multiple random replications to support statistical analyses.

MBS provided information to the U.S. Fish and Wildlife Service relating to population locations and possible impacts from fall seed harvest of prairies where western prairie fringed orchid occurs.

MBS compiled survey information in a report, "Summary of 2015 *Platanthera praeclara* Recovery Activities". This report is available upon request.

Small White Lady's-Slipper (*Cypripedium candidum*)

Long-term monitoring of the key Minnesota Prairie Plan indicator, small white lady's-slipper, continued from previous biennia. Survey efforts are greatly enhanced by the dozen or more volunteers who assist MBS botanists each year. Surveys focused on sites in central and west-central Minnesota that are in conservation ownership (e.g. Wildlife Management Areas, Scientific and Natural Areas, The Nature Conservancy [TNC] preserves, and Native Prairie Bank easements on private lands). Most of the sites had not been surveyed in recent years. At least 30 sites were visited each field season from 2015-17. Most sites contained previously known populations that had not been sampled in recent years. Several new occurrences of this species were discovered in Big Stone, Grant, Otter Tail, Pope, Stevens, and Wilkin counties. Volunteers are a major contributor to this effort.

MBS also coordinated and assisted with surveys to assess potential impacts to the small white lady's-slipper from cattle grazing. This involved baseline survey work to compare populations at Santee Prairie SNA, which is not being grazed, with populations at Wambach WMA, where grazing occurs. Analysis from this work is ongoing at the time of this report.

MBS compiled survey information in a report, "2015 Summary of Small White Lady's Slipper Monitoring Activities in Minnesota," that was distributed to project partners, stakeholders, and other agencies with an interest in this species. This report is available upon request.

Prairie Bush Clover (*Lespedeza leptostachya)*
Long-term monitoring of prairie bush clover continued from previous biennia. Demographic monitoring of the species occurred at two sites in southwestern Minnesota, Great Bend 9 and Kilen Woods State Park.

MBS collaborated with a researcher from the Chicago Botanical Gardens on a climate change germination research project. This included leading the researcher to sites in both southwestern and southeastern Minnesota for seed collection. The project will compare Minnesota populations with populations at Nachusa grasslands, Illinois, which represent the extremes of the species' range. Greenhouse trials are also proposed to study germination and early survivorship of seedlings from these same source populations under simulated climate change regimes.

Dwarf Trout Lily (*Erythronium propullans*)
Long-term monitoring of dwarf trout lily continued from previous biennia. MBS conducted annual monitoring of Nerstrand-Big Woods State Park (2 subpopulations) and TNC Grace Nature Preserve. MBS set up random monitoring plots at Clinton Falls SNA to establish this site as a new monitoring location for this species and collected initial first-year data. Annual resurvey of each of these sites relies on the assistance of US Fish and Wildlife Service, DNR staff, and over 25 volunteers donating over 200 hours each year.

Additional activities included

- a MBS examination of sites at River Bend Nature Center where goats are being used to control invasive species (garlic mustard);
- MBS botanical field survey with MN DOT staff for dwarf trout lily in suitable habitat that will be impacted by road improvement projects;
- MBS botanist completed survey work at River Bend Nature Center in Faribault with the help of the Executive Director and staff. Plant colonies were relocated that had not been seen since 1992. Follow-up coordination on management considerations that favor Dwarf Trout Lily viability on their lands;
- MBS field work in Nerstrand – Big Woods State Park found the presence of the invasive plant, garlic mustard, among dwarf trout lily populations. State Park staff were alerted by MBS to this threat and they immediately started removing it; and
- MBS efforts in Trout Lily Preserve (TNC Ownership near Faribault) updated data and relocated species locations last documented in 1978 and documented several new locations of the species within the preserve. USFWS and DNR Regional Plant Ecologist assisted with these efforts.

A Summary Report was written for Dwarf Trout Lily monitoring. This report was sent to relevant land managers, staff, and partners in January. The report is available upon request.

Prairie Vegetation Surveys
MBS prairie vegetation and botanical surveys continued from previous ENRTF MBS appropriations in Minnesota Prairie Plan core areas and selected areas outside of core areas. Identifying and prioritizing areas to survey involves use of LiDAR and high resolution aerial photography not available when MBS first surveyed these counties in the 1980s and 1990s; it also includes assessments of forests and wetlands that typically were not part of the original MBS work in this region.

Priority for vegetation and botanical field survey was placed on sites that appear to have never been cultivated, have yet to be surveyed for native plant communities and rare species, or were surveyed over 20 years ago. To identify additional sites for survey and further refine survey priorities, MBS coordinated with local natural resource professionals, the Minnesota River Valley Local Technical Team, and Prairie Plan technical teams. So

far, over 950 sites and 25,000 acres have been identified for field survey in Lac Qui Parle, western Chippewa, western Swift, Big Stone, Traverse, Stevens, Douglas, Grant, Wilkin, Marshall, Red Lake, Pope, and Kandiyohi counties. Priority areas often occur adjacent to lakes and rivers.

Areas of note include a number of rock outcrop sites along the Minnesota River core area and a number of southern wet and mesic prairies in the Cottonwood River core area. Rare species records from these efforts include Franklin's ground squirrel, *Gymnocladus dioica*, *Cirsium hillii*, and *Cyprus acuminatus*. Peripheral or cursory surveys of an additional 221 sites also occurred; about half of these were determined to be of adequate quality to receive more thorough ground surveys during future field seasons.

Over 125 sites were field surveyed during 2016-2017 with peripheral or cursory surveys of an additional 220+ sites. Documentation of native plant communities that had not been previously surveyed was a primary focus. This work provided important new native plant community documentation that will be critical to updating vegetation mapping to modern DNR and partner standards. Highlights included documentation of several new wet and mesic prairie occurrences, high-quality mesic oak and spruce savanna, floodplain and mesic hardwood forests, wet meadows, a number of rock outcrop sites along the Minnesota River, and new discoveries of calcareous fens. These field surveys resulted in an addition of over 150 new MBS prairie sites of biodiversity significance with newly documented prairie, forest, and wetland plant communities and/or rare species populations.

Botanical surveys in these areas documented over 100 plant species that had not previously been documented from these counties (i.e. "county records"). Rare plant species documented include *Cypripedium canadense, Carex sterilis*, multiple collections of *Avenula hookeri, Gymnocladus dioica, Cirsium hillii,* and *Cyprus acuminatus*.

Prairie Management Monitoring

MBS plant ecologists continued, from previous biennia, to lead and collaborate on prairie vegetation monitoring efforts as part of collaborative Patch-Burn-Graze prairie management efforts and Prairie Plan implementation priorities. This project combines ENRTF funds for a MBS botanist to provide expert plant and vegetation field survey with Game and Fish Fund providing a MBS research ecologist to lead project design and management and also provide botanical field expertise.

Highlights of this work include:

3. *Caribou WMA*: sampling of 50 permanent vegetation plots (25 pairs) was completed with assistance and collaboration from contractors, TNC, and DNR staff. A Carleton College professor and a team of students were trained in vegetation sampling protocols that complemented their work with soil carbon and nutrient dynamics. MBS completed an interim report for Caribou Wildlife Management Area that includes analysis of data from 2012 and 2015. The report was submitted to The Nature Conservancy, an internal DNR grazing list-serve, and to NRCS and other agency staff who work on grazing in prairies.

4. *Wet meadows*: MBS plant ecologists and USFWS biologists have been collaborating on a new project to monitor the effects of cattle grazing on wet meadow wetland plant communities embedded in prairie pothole complexes. A study plan was developed by MBS and USFWS for the project with input from USGS, University of Minnesota, and TNC. Volunteer crews assisted USFWS and MBS staff in locating and laying out monitoring plots.

5. *Hastad WPA:* MBS and USFWS partners collaborated on an inventory and classification of several hundred wetland basins from which a subset was selected for monitoring plots. 30 monitoring sites with a total of 150 vegetation transects were laid out and sampled.

6. *Hole in the Mountain WMA, Lincoln County*: MBS plant ecologists surveyed and classified prairie wetland vegetation to select monitoring plot locations. Plots were placed in areas subject to cattle

grazing and in similar areas that are fenced to exclude cattle grazing. 30 vegetation sites with a total of 150 vegetation transects were sampled. MBS collaborates with DNR Wildlife Managers to establish connections between management questions and monitoring objectives.

7. *Chippewa Prairie*: sampling of 35-40 wetland basins was completed each year in collaboration with TNC, USFWS and DNR staff. Many sites were sampled for second and third years. Noticeable differences in vegetation were documented each year. Some significant vegetation differences were driven by the amount of standing water present when cows were released to graze. For example, less standing water in 2015 resulted in more extensive cattle browsing of the non-native reed canary grass. MBS wrote a report, "*A progress report on monitoring the composition of wetland vegetation at the Chippewa Prairie Patch-Burn-Graze Project*," that was presented at an annual meeting of the MN Chapter of the Wildlife Society. The report is available upon request.

8. Field surveys of wetland basins in 8 other managed areas (WPA, WMA, and TNC preserves) near Chippewa Prairie were completed to assess wetland basin vegetation types and condition. This information will be useful to providing greater context to the Chippewa Prairie project and new sites for a potential expansion of the Chippewa Prairie PBG project.

9. *Rare species*: 10 rare plant species records were documented from prairie and rock outcrop native plant communities. Highlights include two records of *Bacopa rotundifolia*, one record of *Cyperus acuminatus,* and one of *Elatine triandra;* all three of these species were recorded from shallow wetland basins at Chippewa Prairie. There are thousands of similar wetland basins on terraces of glacial River Warren that have not been surveyed and hold great potential for additional rare species discoveries.

10. *Calcerous fen*: MBS documented a new location of the rare and sensitive calcareous fen plant community at Sweep WPA in Kandiyohi County.

Forest Monitoring

Northern Minnesota

Western Jacob's-ladder

This state-endangered species is known to occur in only 6 sites worldwide, all of which occur in Minnesota (4) and Wisconsin (2). Northern forest sites (wet cedar and wet spruce native plant communities) with occurrences of the rare Western Jacob's-ladder (*Polemonium occidentale* subsp. l*acustre*) were targeted to establish baseline conditions necessary for forthcoming monitoring. The targeted survey sites had not been surveyed since the late 1980s. This effort is in collaboration with the University of Minnesota Landscape Arboretum, which is focusing on genetic analysis and greenhouse growth trials.

Study design was progressed significantly through collaboration with biometricians on contract with MBS. This will help inform the feasibility and methodology of an effective and efficient longer-term monitoring effort to evaluate the species' population trends and viability.

Notable botanical discoveries include documentation of *Cardamine pratensis* (greatly expands known extent of a 2013 record) and a new record of the rare orchid, *Malaxis monophyllos* var*. brachypoda*. Field work was accomplished with assistance from volunteers and St. Louis County Land & Minerals Department foresters.

Nemadji State Forest

MBS plant ecologists and zoologists initiated assessment of high conservation value forest (HCVF) sites in mesic hardwood forests in the Nemadji State Forest of southeast Carlton County and northeast Pine County. This work provides important foundational data necessary to improve conservation priorities and to launch monitoring of high conservation values vis-à-vis forest management in similar forest types throughout the region.

Field survey included: 1) revisiting and sampling of previously documented rare species locations and relevé plots first collected at least 20 years ago and 2) rare species searches and native plant community evaluations in new areas not visited by MBS or where MBS has negative finds during MBS's first pass through these counties in the 1990s and early 2000s. MBS collaborated in this effort with DNR Forestry, Wildlife, and Ecological & Water Resources, the DNR Divisions responsible for delivering sustainable forest management on state lands.

MBS zoologists initiated field work to revisit rare salamander (spotted salamander and 4-toed salamander) records from the 1990s in HCVF sites that had been logged since the original rare species documentation. Efforts to search and locate new populations of rare salamanders in intact forest sites also occurred. Final results were not available at the time of this report but initial informal results indicate relocation of most rare salamander records in logged sites and several new populations were documented for both species. The Nemadji State Forest contains some of the State's most significant populations of 4-toed and spotted salamanders. This work is important to informing conservation of the rare species and sustainable forest management in the Nemadji State Forest and similar mesic hardwood forest sites elsewhere in central and northern Minnesota.

Banning State Park
MBS collaborated with DNR Parks & Trails to survey rare species and native plant communities in portions of Banning State Park to establish baseline data in an area of high conservation value and high recreational interest (rock climbing). This baseline work sets the stage for monitoring change in rare plants and native plant communities in areas open to and closed to recreational use.

New locations for rare plants, lichens, and bryophytes (mosses and liverworts) were discovered on wet cliffs, bedrock outcrops, seepage habitats, and caves along the Kettle River. Highlights include new locations of the following rare plants: Chrysosplenium iowense, Hydrocotyle americana, Carex media, Juglans cinerea, Gaylussacia baccata, Geum laciniatum, Gymnocarpium jessoense, Hydrocotyle Americana, Poa paludigena, and Torreyochloa pallida.

Vegetation sampling of the wet sandstone cliffs in Banning State Park will greatly advance the classification of these communities in an upcoming revision and update of DNR's *Field Guide to Native Plant Communities* as they were under-sampled at the time of 2003-05 publications.

<u>Southeast Minnesota</u>
Whitewater State Park and Great River Bluffs State Park
MBS botanists and plant ecologists surveyed high conservation value sites in Whitewater and Great River Bluffs state parks. The work in state parks helps to serve as references or controls for high conservation value sites subject to timber management on other lands. Field surveys involved targeted searches for rare species, relevé collection, and field checks for mapping of native plant communities.

Vegetation surveys occurred throughout the park with relevé collection focused on native plant communities that were under-sampled per DNR's *Field Guide to Native Plant Communities*: sedge meadows, sedge fens, seepage meadows, calcareous fens, and other seepage wetlands. Many new locations of rare or geographically uncommon plant species were documented including *Hamamelis virginiana* (THR), *Jeffersonia diphylla* (SPC), *Carex laxiculmis* var. *copulata* (THR), *Dryopteris goldiana* (SPC), *Hydrastis canadensis* (END), *Panax quinquefolius* (SPC), *Deparia acrostichoides* (SPC), *Trichophorum clintonii* (THR; new to park and Winona County, and a significant range extension), *Asclepias amplexicaulis* (THR; new to park), *Pellaea atropurpurea* (SPC; new to park), *Galium circaezans* var. *hypomalacum* (new to park and Winona County; third and fourth locations known for this plant in MN), *Taenidia integerrima* (SPC), *Silene nivea* (THR; new to the park), *Vitis aestivalis var. bicolor* (THR), *Sanicula trifoliate* (SPC), *Sullivantia sullivantii* (THR), *Eupatorium sessilifolium* (THR; new record for park), and leadplant flower moth *(Schinia lucens)* (SPC).

One plant species of note documented in Whitewater State Park is *Carex communis.* Two populations were found, which provide significant range extensions updates to Minnesota occurrence records; the only other Minnesota record is from 1915 from a location in Fillmore County.

Whitewater WMA
MBS botanists continued annual monitoring of *Aureolaria pedicularia* at Whitewater State WMA. Numbers are up slightly from years prior to 2015. Additional field survey focused on updated older (>20 years old) rare plant records and searching new areas for rare plants resulting in new documented locations and specimens for *Carex laxiculmis, C. jamesii, C. trichocarpa, Dryopteris goldiana, Deparia acrostichoides, Sanicula trifoliata,* and *Panax quinquefolius.*

Activity 3: Information System Expansion

Description: MBS data will be stored in information systems and specimens will be deposited in museums. This results in long-term storage of collections and databases for analysis and distribution of information to individuals, organizations, and agencies with diverse natural resource goals.

Procedure: Data collected by MBS are entered into manual and computerized files in the DNR's information systems. Key databases include those tracking locations of plants and animals, rare features, relevés (vegetation plot samples), aquatic plant lists/lakes, MBS sites, native plant community polygons (GIS), and animal aggregations. Locations of native plant communities and MBS sites are mapped in a recently developed DNR enterprise database using ArcGIS. Shape files of native plant communities and MBS sites are available on the Minnesota Geospatial Commons website (replaced DNR's Data Deli).

Targeted species locations are entered into an Observation Database that is connected to Biotics, an information system developed by NatureServe, an international organization with a major focus on the storage, distribution, and interpretation of biodiversity data. Photographic vouchers, imagery, and other digital media are stored at the DNR, St. Paul. Field data sheets or data collected on field data recorders are filed electronically (scanned) and/or manually.

Data generated by monitoring activities are entered into the databases listed above or in related databases that provide for analysis. Monitoring data collected for animals might include timed searches, point counts, and plot counts, which are also stored in the Observation Database.

Information System Development: The collection and management of data utilizes GIS, global positioning systems, web-based tools and products, and field data recorders. MBS participates in the DNR's efforts to maintain data standards and quality of data, to integrate databases, and to improve information delivery on the web. Data delivery using the web requires data standards, data security, metadata, and other documentation.

MBS also coordinates with other state and national information system developments. MBS will continue to collaborate with museums on developments related to collections management and information delivery. Specific attention related to the rapidly changing revisions of floral and faunal taxon will continue. Long-term monitoring of species and habitats is especially influenced by the need to "crosswalk" new and old names of species, which is critical to reliable analysis, interpretation and communication of results.

Preparation of Collections: All plant and animal specimens are identified and collections are prepared for permanent storage and deposited in appropriate repositories at the University of Minnesota's J.F. Bell Museum of Natural History.

Summary Budget Information for Activity 3:

ENRTF Budget:	**$ 757,726**
Amount Spent:	**$ 756,319**
Balance:	**$ 1,407**

Outcome	Completion Dates
1. Survey data entered and managed in DNR's information systems. Includes GIS mapping and entry of species distribution data (Primary activity October through April)	Ongoing
2. Preparation & delivery of plant & animal collections to museums. Includes identification or validation of collections & preparation of labels and specimens using museum quality standards. (Primary staff activity October through April)	Ongoing
3. Monitoring data entered for future analysis (DNR Info Systems) (Primary staff activity October through April)	Ongoing

Project Status as of January 31, 2016

Data Entry and Updates

Programing and plant taxonomy enhancements progressed that improve relationships among related databases, including the Plant Specimen Label Database, MNTaxa (plant species) Database, Biotics (rare species) Database, Relevé (vegetation plot) Database, and the University of Minnesota Bell Museum's Specify Database.

Ongoing work continued to enter MBS plant, vegetation, and monitoring data to all of the above mentioned databases. Examples: MNTaxa was updated with new county and sub-county records submitted by MBS botanists and collaborators; 2015 lake and aquatic plant data were submitted to the MBS Lakes Database for all lakes surveyed in Wright, Sherburne, Benton, Stearns, Anoka and Kittson counties; and prairie and forest monitoring data was submitted to multiple MBS databases.

A major effort was initiated to enter a growing backlog of new relevés into the Relevé Database. This included relevés collected by MBS staff as well as relevés collected and submitted to MBS by partners such as Boise Cascade, private consultants, Three Rivers Park District, and the U.S. Forest Service. These data are critical to a forthcoming re-analysis of MBS vegetation plot data, as they fill significant gaps present when the DNR published the 2003 3-volume *Field Guide to Native Plant Communities.*

Work started to migrate the state's recognized bryophyte database from bryologist, Jan Janssen, to MBS.

The state list of lichens was updated with modern nomenclature and associated improvements were made to the MNTaxa and Relevé databases. This work replaced a long-standing outdated list.

MBS began a reanalysis of bryophyte indicators for calcareous fens. This work is part of a DNR review of existing calcareous fen classification and designation criteria per MN statute.

MBS and USFS collaborated to update Biotics and related USFS databases to reflect current USFS Regional Forester Sensitive Species designations and MNTAXA updates.

MBS continued GIS mapping of native plant communities in numerous locations statewide and entry of map polygons into the MN DNR Native Plant Community Polygon Database. Highlights include:

- Cass County: Native plant community mapping that occurred in the 1990s was updated and expanded. This effort utilized methods, data, and technology that were not available during initial mapping. During this period over 400 polygons totaling nearly 10,000 acres were mapped.
- Crow Wing County: Mapping continued for MBS sites of high and outstanding biodiversity significance. Over 74,000 acres of native plant communities have been delineated to date.
- St. Louis County: Over 1,300 native plant community polygons were mapped in the Border Lakes Subsection, covering 20 MBS sites of high and outstanding biodiversity significance.

- Beltrami County: Native plant community mapping started for this county. Two MBS sites were completed.

MBS continued to lead database management and to provide subject matter expertise to users of the MN DNR Native Plant Community Polygon Database. This database is used by all DNR divisions that map native plant communities (Ecological & Water Resources, Forestry, Fish & Wildlife, and Parks & Trails).

Specimen collection, identification, and labels

During the 2015 field season MBS botanists and plant ecologists collected nearly 1,000 plant specimens. Many of these specimens require detailed identification determinations using laboratory-based methods. Most of these specimens will be deposited at the University of Minnesota's Bell Museum Herbarium (an ongoing activity). A significant component of documenting and collecting plant specimens is the development and management of specimen labels that follow museum standards.

During this reporting period over 600 mounted plant specimens complete with labels were submitted for accession to the Bell Museum herbarium.

Photographic Images

MBS field biologists use digital photography to document ecological conditions, species, native plant communities, and other relevant features. Photos are quality controlled and selected images are stored and made available for use in presentations and interpretive publications.

Project Status as of October 31, 2016

Data Entry and Updates

Programming and plant taxonomy enhancements progressed that improve connections and communication among related databases, including the Plant Specimen Label, MNTaxa (plant species), Biotics (rare species), and Relevé (vegetation plot) databases, and the University of Minnesota Bell Museum's Specify Database. Rather urgent work occurred in these areas due to recent and pending retirements of the long-standing staff who know these systems best.

Ongoing work continued to enter MBS plant, vegetation, and monitoring data into all of the above mentioned databases. Examples: MNTaxa was updated with new county and sub-county records submitted by MBS botanists and collaborators; MBS Relevé Sites GIS layer was updated in DNR Quick Layers; and Biotics (i.e., rare species) was updated daily with new records from MBS, DNR, and partners such as the Superior National Forest, MPCA, MN Landscape Arboretum, River Bend Nature Center, Friends of the Mississippi River, volunteers, and contractors.

Major work continued to enter and quality control relevé data in preparation for a new classification analysis that will update DNR's 2003 *DNR native plant community classification v2.0.* One example of quality control is asserting modern plant nomenclature standards and the associated efforts to crosswalk older, now outdated plant names to modern plant taxonomy. During this reporting period, MBS finalized the cross-walking to a common DNR standard nomenclature.

Coordination with the Bell Museum is ongoing, with attention this reporting period paid to the integration of Bell Museum herbarium data into the DNR's MNTaxa database and the DNR Rare Species Guide. The Bell Museum contained records for a number rare species that were not in DNR databases including *Carex muskingumensis, Crataegus calpodendron, Crotalaria sagittalis, Gaylussacia baccata, Gymnocarpium robertianum, Phlox maculata, Rubus fulleri, Rubus missouricus, Rubus multifer, Rubus semisetosus, Rubus vermontanus, Salix pseudomonticola, Shepherdia canadensis, Thaspium barbinode,* and *Woodsia alpina.*

Work continued to migrate the state's recognized bryophyte database from bryologist, Jan Janssen, to MBS. This reporting period work focused on converting the bryophyte data into a format that can communicate and integrate with existing MBS databases (e.g., MN Taxa, Relevé, Biotics).

Work on the state list of lichens continued this reporting period, focusing on converting the lichen data into a format that can communicate and integrate with existing MBS databases (e.g. MN Taxa, Relevé, Biotics).

Mapping Native Plant Communities and Sites of Biodiversity Significance
Native plant community mapping in GIS continued with over 2,500 polygons delineated covering over 80,000 acres of moderate to high-quality native plant communities.

Mapping during the reporting period focused on Cass County, northern St. Louis County, Crow Wing County, Whitewater State Park in southeast MN, and various sites in the prairie region. A few examples include:

- digital (GIS) mapping of prairie sites originally mapped on paper nearly 30 years ago. This effort provides improved spatial precision, improved data currency and accuracy, and the benefits that come with converting paper records to more accessible digital formats.
- mapping of mesic hardwood forests near Leech Lake in Cass County that are worm-free and have a suite of plant species more typical of central, rather than northern, Minnesota; and
- mapping of intact examples of floodplain forests along the Vermillion River in northern St. Louis County. Floodplain forests of any kind are uncommon in the Border Lakes region of Minnesota;and

Specimen collection, identification, and labels
During the 2015 field season MBS botanists and plant ecologists collected nearly 1,000 plant specimens. Many of these specimens require detailed identification determinations using laboratory-based methods. Most of these specimens will be deposited at the University of Minnesota's Bell Museum Herbarium (an ongoing activity). A significant component of documenting and collecting plant specimens is the development and management of specimen labels that follow museum standards. During this reporting period over 600 mounted plant specimens complete with labels were submitted for accession to the Bell Museum herbarium.

Photographic Images
MBS field biologists use digital photography to document ecological conditions, species, native plant communities, and other relevant features. Photos are quality controlled and selected images are stored and made available for use in presentations and interpretive publications.

Final Report Summary:

Field data processing
A significant part of MBS plant ecologists' time from late September through early May is processing specimens, entering field data into electronic databases, and interpreting those data. Field data includes specimens, notes, data sheets for rare species and relevés, GPS waypoints, and digital photographs and video. Highlights at an individual staff level include:

- Completed identification of 2016 plant specimen collections from Lake of the Woods and Koochiching counties, prepared labels for plant specimens to be submitted to the Bell Museum herbarium, and completed Biotics submissions for 2016 rare species collections.
- Completed data entry, quality-control, and editing of 60 relevés from 2016 field season.
- Completed quality control of 54 native plant community condition ranking forms from 2016 field season.
- Transcribed hand-written field notes from botanical and vegetation field work in the NW Angle to the digital MBS Site Database. Integrated field notes with digital photos and GPS waypoints for use in ongoing survey, map production, and reports.
- Wrote field-survey-site summaries and vegetation descriptions in the MBS Site Database for sites in the Border Lakes subsection in Lake and St. Louis counties. Summaries and descriptions include statistics on NPC classifications and frequencies; presence of rare species; background information on geology, soil, and topography; site ranking justification; threats to persistence; and management recommendations.

- Incorporated new field data into the defining and continued development of MBS Sites of Biodiversity Significance in the Border Lakes and Laurentian Uplands subsections in Cook and Lake counties.

Data Entry and Updates

Programming and plant taxonomy enhancements progressed that improve connections and communication among related databases, including the Plant Specimen Label, MNTaxa (plant species), Biotics (rare species), and Relevé (vegetation plot) databases, and the University of Minnesota Bell Museum's Specify Database. Rather urgent work occurred in these areas due to recent and pending retirements of the long-standing staff who know these systems best.

Ongoing work continued to enter MBS plant, vegetation, and monitoring data into all of the above mentioned databases. Examples:

- MNTaxa was updated with new county and sub-county records submitted by MBS botanists and collaborators;
- MBS Relevé Sites GIS layer was updated in DNR Quick Layers; of note include new relevés from under-sampled Koochiching County in forests, wetlands and peatlands;
- Biotics (i.e., rare species) was updated daily with new records from MBS, DNR, and partners such as the Superior National Forest, MPCA, MN Landscape Arboretum, River Bend Nature Center, Friends of the Mississippi River, volunteers, and contractors; of note include new rare species records from under-sampled Koochiching County were added to Biotics.
- prairie and forest monitoring data was submitted to multiple MBS databases;

Major work continued to enter and quality control relevé data in preparation for a new classification analysis that will update DNR's 2003 *DNR native plant community classification v2.0.* One example of quality control is asserting modern plant nomenclature standards and the associated efforts to crosswalk older, now outdated plant names to modern plant taxonomy. During this reporting period, MBS finalized the cross-walking to a common DNR standard nomenclature.

Data Integration

Collaboration with the Bell Museum is ongoing, with attention this reporting period paid to extracting batches of Bell Museum Herbarium records for inclusion in statewide MBS databases and the DNR Rare Species Guide. The Bell Museum contained records for numerous rare species that were not in DNR databases. Work continues but to-date over 80 species have been completed.

Ongoing work continued to receive, vet, and enter into MBS databases rare species and vegetation data from partners. This includes data from other DNR programs and Divisions, MNDOT, National, State, County and Regional parks, researchers, private contractors, and volunteers. This includes acquiring data on taxa that help address major data gaps and for which MBS lacks expertise including lichens, fungi and bryophytes. This work also adds to more robust and complete Rare Species Guide profiles.

Work was completed to migrate the state's recognized bryophyte database from bryologist, Jan Janssen, to MBS. This reporting period work focused on converting the bryophyte data into a format that can communicate and integrate with existing MBS databases (e.g., MN Taxa, Relevé, Biotics). An additional product of this effort is online delivery of Dr. Janssen's field guides to Minnesota mosses available at the MBS website at http://www.dnr.state.mn.us/eco/mbs/mnbryophytes.html.

Work on the state list of lichens continued this reporting period, focusing on converting lichen data into a format that can communicate and integrate with existing MBS databases (e.g. MN Taxa, Relevé, Biotics).

MBS and USFS collaborated to update Biotics and related USFS databases to reflect current USFS Regional Forester Sensitive Species designations and MNTAXA updates.

Mapping Native Plant Communities and Sites of Biodiversity Significance

MBS continued to lead database management and provide subject matter expertise to users of the MN DNR Native Plant Community Polygon Database. This database is used by all DNR divisions that map native plant communities (Ecological & Water Resources, Forestry, Fish & Wildlife, and Parks & Trails) and can accept data submitted to standards from external partners.

MBS continued GIS mapping of native plant communities in numerous locations statewide and entry of map polygons into the MN DNR Native Plant Community Polygon Database. MBS added 6,376 polygons covering over 200,000 acres of moderate to high-quality native plant communities. Highlights include:

- *Cass County*: Native plant community mapping that occurred in the 1990s was updated and expanded. This effort utilized methods, data, and technology that were not available during initial mapping. During this period over 400 polygons totaling nearly 10,000 acres were mapped. Of note included mapping of increasingly rare worm-free central mesic hardwood forests near Leech Lake.
- *Crow Wing County*: Over 80,000 acres of forest and wetland native plant communities mapped in MBS sites of high and outstanding biodiversity significance.
- *St. Louis County*: Over 1,300 native plant community polygons were mapped in the Border Lakes Subsection, covering 20 MBS sites of high and outstanding biodiversity significance. mapping of intact examples of floodplain forests along the Vermillion River in northern St. Louis County, Border Lakes subsection. Floodplain forests of any kind are uncommon in this region of Minnesota.
- *Itasca County:* 250 polygons covering 3,206 acres in 7 Scientific & Natural Areas in Itasca County were mapped to native plant community. SNAs included Botany Bog, Pokegama Islands, Forever Wild, Ladies' Tresses, Potato Lake, Wabu Woods, and Lost 40.
- *Prairies:* GIS mapping of prairie sites originally mapped on paper nearly 30 years ago. This effort provides improved data currency, accuracy, precision and accessibility. 4,289 acres mapped, including 1,307 acres of rare southern wet and mesic prairie communities and previously unmapped rare rock outcrop systems in the Minnesota River valley.
- *Pine County:* MBS collaborated with State Parks to revise and update the native plant community GIS map for Banning State Park. ~ 1,500 acres were reviewed and re-mapped based on MBS 2016 ground data, Lidar derived products, and high resolution imagery. This field and mapping work resulted in the discovery and delineation of numerous rare native plant communities associated with sandstone bedrock and cliffs.
- *NW Minnesota:* MBS collaborated with DNR Divisions of Forestry and Fish & Wildlife to update and expand native plant community mapping in far NW Minnesota. MBS native plant community mapping and data for this part of Minnesota often dates from the late 1980s and early 1990s. Updates are necessary to maintain and enhance reliability, accessibility, and relevancy of these data.

Specimen collection, identification, and labels

During the 2015-17 field season MBS botanists and plant ecologists collected nearly 2,000 plant specimens that document county records, rare species, and notable native species. Many of these specimens require detailed identification determinations using laboratory-based methods. Most of these specimens will be deposited at the University of Minnesota's Bell Museum Herbarium (an ongoing activity).

A significant component of documenting and collecting plant specimens is the development and management of specimen labels that follow museum standards. During this reporting period about 1,000 mounted plant specimens complete with labels were submitted for accession to the Bell Museum herbarium.

Photographic Images
MBS field biologists use digital photography to document ecological conditions, species, native plant communities, and other relevant features. Photos are quality controlled and selected images are stored and made available for use in presentations and interpretive publications. Of note include over 200 photos taken to document native plant communities and rare species in Koochiching and Lake of the Woods counties.

Activity 4: Guidance for Conservation and Management
MBS will provide interpretation of results through products and technical assistance to guide conservation and management of ecological systems, rare resources, and sites of biodiversity significance.
MBS web pages are updated with new information and have links to associated resources.
www.dnr.state.mn.us/mbs/index.html

This activity includes website maintenance; book publications; participation in conservation and management planning; delivery of information to agencies, landowners and tribal organizations.

Book Publications: MBS has published or been a collaborator in the publication of several books including: *Minnesota's St. Croix River Valley and Anoka Sandplain*, *Native Orchids of Minnesota*, *Trees and Shrubs of Minnesota, Amphibians and Reptiles in Minnesota,* and series of field guides to the native plant communities of the state. A current project is a guide book to the Aspen Parkland and Red River Valley portion of Minnesota. This book is in part a response to local interest from residents of northwestern Minnesota who suggested this publication several years ago to fill a void in coverage of the natural history of the area and the lack of a substantive information to guide, interpret and increase appreciation of this landscape by residents and visitors of the region. The MBS biologists who conducted field surveys in the region are the lead authors. Their specialties are in plant ecology and rare species biology, but for this book they also have researched the history of the land, geological settings and suitable sites that highlight distinctive features of this landscape. The University of Minnesota Press has agreed to publish this book. Below is an outline of the book's contents. As of June 30, 2016 all portions will be completed and this proposal will fund the work required for final publication including review following copy-editing; review of page proofs, photography and maps.

Part 1: Landscape History
Geologic History and Major Landforms
Postglacial Landscape
Vegetation at the Time of the Public Land Surveys
Cultural Change and the Landscape
Summary

Part 2: Native Plant Communities
Introduction
Fire-Dependent Forests and Woodlands
Mesic Hardwood Forests
Floodplain Forests
Wet Forests
Forested Rich Peatlands
Lakeshores
River Shores
Upland Prairies
Wet Prairies
Open Rich Peatlands
Wet Meadows/Carrs
Marshes
Summary and Outlook

Part 3: Guide to Important Sites
Up to 30 sites will be featured in this section

A publisher requested that MBS write a book on the mammals of Minnesota. Scoping of this book began in 2014. Part of the information officer's time will be expended assisting others with this publication.

Participation in conservation and management planning

Assistance from MBS biologists and ecologists with field experience is an important element to ensure that the data collected are utilized effectively. One tool is to provide the data through the internet, yet technical advice at specific planning events will continue to be important. For example when pollination legislation was implemented, the plant ecologists and entomologists in MBS were consulted to assist with the development of Best Management Practices based on the large vegetation dataset collected and maintained by MBS. Another example included the participation of an MBS ecologist in a DNR Forest planning event. The ecologist had very recently visited a remote forested area that was part of a discussion about lowland conifer management. Members of the work group benefitted from the recent data and interpretation to assist with decisions. At the local level, MBS ecologists provided staff of St Louis County with information about some recent surveys of resources in St Louis County Special Sites including an area in the Lost Lake Peatlands.

Rare resources and sites of biodiversity significance

Outcomes of MBS continue to improve understanding of the distribution of rare plants and animals and the application of MBS sites of biodiversity significance to planning efforts ranging from County Park acquisition to Scientific and Natural Area management plans. An ecologist prepared an ecological evaluation for an area in Hubbard County known as Badoura Woodlands which is now a Scientific and Natural Area that includes Jack Pine Woodland. Groundwater protection is a key issue in the area and retaining native cover as opposed to agricultural conversion will help to avoid possible threats to groundwater. Minnesota's Rare Species list was updated recently largely based on MBS surveys.

Summary Budget Information for Activity 4:

ENRTF Budget: $ 520,857
Amount Spent: $ 520,857
Balance: $ 0

Outcome	Completion Dates
1a. Aspen Parkland-Red River Valley guide book in development to be published by the University of Minnesota Press	Ongoing
1b. Sedges and Rushes of Minnesota book manuscript delivered to University of Minnesota Press for publishing.	June 30, 2017
2. DNR Rare Species Guide (online) updated and enhanced with MBS data, analysis, and interpretation.	June 30, 2017
3. Prairie and Forest preliminary monitoring results delivered to the Prairie plan implementation team and wildlife managers; to the DNR's Forest Certification teams; and to climate change teams.	January 31, 2016 October 31, 2016 June 30, 2017
4. Technical assistance: e.g., deliver and interpret data to inform conservation and management planning related to native plant communities & sites of biodiversity significance. (These include activities such as implementation of Superior National Forest projects, watershed plans, Land asset management, SNA plans, State Forest Plans, State Wildlife Action plans, climate change plans).	Throughout project period
5. DNR's website provides updated and accurate survey & monitoring procedures, results and tools (Examples given at right--not an exhaustive list)	January 31, 2016: Add GIS data for 1 ecological subsection to the Minnesota Geospatial Commons.

	June 30, 2016: Collaborate to add lakes of biological significance to the Minnesota Geospatial Commons.

Project Status as of January 31, 2016

Data Delivery, Data Interpretation, and Technical Assistance

Native Plant Communities

MBS created and delivered relevé datasets to DNR and external users for projects including:

- Development of Wet Meadow condition indicator species for Grassland Monitoring Team work in Minnesota and adjacent states;,
- Classification of Calcareous Fens in the prairie-forest transition zone in central MN;
- Conservation of native plant communities along the St. Louis River estuary in Duluth;
- An educational field trip to the Cannon River Wilderness Area in Rice County;
- Use of native hop plants (*Humulus* spp.) by U of MN researchers to breed disease resistance and other qualities into agricultural hop plants;
- Delineation of calcareous fens and wet seepage meadows in northwestern MN for environmental review projects;
- Adaptive management plans for 4 Scientific and Natural Areas in Wright, Stearns, Jackson and Chippewa counties, and a habitat management plan for the Little Elbow Lake project in St. Louis County;
- Locations of seepage wetland communities in Chisago County and locations of wet seepage forests statewide to aid the DNR's statewide spring survey.

Water and Watersheds

MBS aquatic botanist produced reports for each lake surveyed in the 2015 field season and delivered these to relevant DNR Area Fisheries offices for technical use and local dissemination.

MBS aquatic plant survey data were provided to inform MPCA work on biological measures of water impairments. These data fill a critical gap not otherwise available.

Data delivery and technical guidance were provided for the Ecological Limits of Hydrologic Alteration project in the Lake Superior North watershed. The goal of this project is the development of ecological criteria for sustainable water management. MBS also provided technical review and comment on the draft North Superior 1 Watershed 1 Plan.

MBS helped with examination of the native plant communities in the Pine River Watershed that may contribute to "Ground-Water Dominated" lakes.

Rare Species

MBS plant ecologist provided site-level guidance regarding a reroute of the Border Route Trail at the South Fowl Lake Cliff Natural Area Registry site. This effort resulted in avoidance of direct impacts to state-listed plant species.

MBS provided technical guidance on sites and rare plant collection permits to University of Minnesota Landscape Arboretum botanist, David Remucal, related to seed collection of the state special concern plant *Pinguicula vulgaris*.

MBS assisted with a request for identification of the aquatic plant *Potamogeton vaseyi* in the metro area. The MBS aquatic botanist provided information to the observer on how to separate the species from similar species and on processing an acceptable specimen. This was an important record of a species uncommon in the metro area and statewide.

MBS assisted staff with the Division of Ecological and Water Resources' aquatic invasive species program with identification of common and rare *Sparganium* species.

MBS assisted a biological consultant and a resident near Stillwater with identification and processing of a plant specimen collected from a large pond. MBS botanists suspect the specimen to be the State-endangered *Potamogeton bicupulatus* but they await annotation by taxon expert, Dr. Robert Haynes, Alabama Museum of Natural History.

Climate Change

MBS ecologists provided program and biodiversity conservation technical input to DNR and Division of EWR Climate Change Adaptation Teams. A new DNR Op-Order mandates that programs address climate change adaptation relative to their core responsibilities.

Minnesota Prairie Plan

MBS plant ecologist participated in an ad hoc committee for the Prairie Plan Implementation Team to consider recommended changes to boundaries for priority conservation areas identified in the plan.

MBS plant ecologist coordinated the Science Team subgroup of the Prairie Plan Implementation Team to address updates to the Ecosystem Measures component of the Plan.

MBS plant ecologist provided site-level interpretation of calcareous fens on USFWS land in Becker County by request of the USFWS. One of the sites visited was a calcareous fen not previously mapped by MBS.

MBS plant ecologist participated in an annual conservation grazing tour in Clay County organized by DNR Wildlife that included several TNC, DNR and USFWS staff from western Minnesota.

ENTRF Projects

MBS prairie ecologists provided data interpretation and technical guidance to an LCCMR-funded project, ML2015 Effects of Grazing Versus Fire for Prairie Management, studying the impacts of cattle grazing and fire on native prairie vegetation and pollinators in Minnesota. MBS staff consulted with the project team several times about site selection and impacts of land-use history on prairie condition. MBS provided a list and GIS shapefile of sites to consider in research with comments on current management and land-use history.

DNR Environmental Review

MBS prairie ecologist and botanist provided technical input to a relocation plan for several hundred individuals of the State-threatened tuberous Indian plantain (*Arnoglossum plantagineum*). Plants were moved from a proposed gravel mine site to Kasota Prairie SNA and Minneopa State Park.

MBS plant ecologist provided technical input on a proposed transmission line route in northern Minnesota that would pass through several MBS Sites of Biodiversity Significance.

MBS provided technical advice on a groundwater pumping proposal within one mile of a population of the State-endangered aquatic plant, Oakes' pondweed (*Potamogeton oakesianus*).

DNR Scientific & Natural Areas Program

MBS prairie ecologists provided technical guidance and site-level interpretations to SNA program staff in southwest Minnesota. Several prairie SNA sites were visited. Topics covered included cattle grazing as a management tool (currently being implemented on some Prairie Bank sites) and vegetation monitoring methods.

MBS plant ecologist led a field survey with SNA program staff to high-quality, upland old-growth white cedar - yellow birch forests in the Lost Lake SNA in northern St. Louis County. MBS provided technical training in plant identification, vegetation classification and relevé collection.

MBS plant ecologist provided data and technical assistance to DNR Region 3 SNA staff regarding acquisition prioritization in central and southeastern Minnesota.

MBS plant ecologists provided technical input on a management plan for the recently established Badoura Jack Pine Woodland SNA in Hubbard County.

DNR State Wildlife Action Plan

MBS plant ecologist provided technical guidance to the Grassland Monitoring Team on methods for classifying wet meadow plant communities and ranking their quality.

MBS provided Sites of Biodiversity Significance, rare species, and native plant community data and interpretation to the State Wildlife Action Plan revision effort. MBS provided preliminary data and ad hoc interpretations for areas of northern Minnesota where MBS is in progress.

DNR Parks & Trails

MBS plant ecologist/botanist provided site-level interpretation and field survey in a newly acquired Banning State Park parcel open to rock climbing. MBS provided technical guidance on vegetation and plants relative to climbing on bedrock exposers and associated dispersed recreation activities in adjacent upland forests and seepage swamps.

MBS plant ecologist/botanist provided site-level technical guidance at Lake Vermilion-Soudan Underground Mine State Park. MBS surveyed shoreline and aquatic vegetation of a newly acquired Lake Vermilion island as part of an assessment of the site for potential recreational development.

DNR Forestry

MBS continued ongoing coordination of mapping efforts in areas where both Forestry and MBS are actively delineating native plant communities. MBS delivered 2015 field survey data to DNR foresters who are mapping native plant communities in north-central and northeastern Minnesota.

MBS assisted a relocation effort for a 2009 MBS documentation of the state-endangered orchid, *Malaxis paludosa.* The species occurs on State lands in a forested swamp proposed for timber harvest.

Minnesota Pollution Control Agency

MBS plant ecologists provided technical input to the MPCA's Wetland Quality Assessment methodologies and analysis results. A primary area of focus was methods for ranking wetland quality based on plant species.

Minnesota Land Trust

MBS plant ecologist provided site-level native plant community and biodiversity significance interpretation for a Minnesota Land Trust parcel adjacent to Encampment Forest in Lake County. The parcel and the landscape in which it occurs are part of MBS sites of outstanding and high biodiversity significance.

Minnesota Counties

MBS plant ecologist/botanist provided technical field assistance to Itasca County Land Department foresters working on a forest site with State-listed ferns (*Botrychium* spp.) documented by MBS.

MBS plant ecologist provided interpretation of biodiversity significance, rare species, and native plant communities for a new master plan for Wildwood County Park in Stearns County. The park is within a MBS Site of High Biodiversity Significance purchased by the county based on MBS survey and results.

Minnesota Colleges and Universities

MBS plant ecologist/botanist provided technical guidance to St. Johns University and Arboretum on a proposal to do a floristic survey their property and an inventory of plant collections made from the property stored in the universities' Bailey Herbarium. Much of the property is within a MBS Site of Outstanding Biodiversity Significance.

MBS plant ecologists provided input and field survey assistance to University of Minnesota Landscape Arboretum botanist, David Remucal, related to a Center for Plant Conservation seed bank/conservation project for the state-endangered *Polemonium occidentale* subsp. *lacustre*.

Superior National Forest

MBS provided USFS staff with 2015 MBS field survey results from the Superior National Forest (SNF), including relevés, species occurrence data, USFS Region 9 Sensitive Species data (for those species that are not also State-listed) and associated interpretive information. MBS fulfilled a SNF request for relevé data from an MBS site in Lake County where the rare insect, emerald darner, has been documented.

Outreach: Presentations and Training

MBS prairie ecologist delivered a talk on wetland basin sampling methods and results at a conservation grazing workshop in Big Lake, MN organized by the Minnesota Chapter of the Wildlife Society.

MBS botanists co-led a wetland shrub identification field class with staff from the DNR's Ecological and Water Resources and Forestry divisions. The class was well attended (max of 30 people with a waiting list) and received rave reviews. Participants included natural resource professionals, volunteer master naturalists, volunteer SNA site stewards, and the interested public.

MBS botanists co-lead a prairie plant and native plant community field workshop in south-central Marshall County. This workshop involved plant identification and native plant community classification at a high-quality, least-disturbed prairie and several prairies with different management histories (e.g., former pasture now in Prairie Bank Easement, active pasture). More than thirty people attended from organizations including NRCS, SWCD, USFWS, DNR Wildlife, DNR Ecological and Water Resources, DNR Parks & Trails, BWSR, North Dakota State University, TNC, Pheasants Forever, and private consultants. Feedback was very positive feedback and there were requests for sessions again next year.

MBS staff guided a Lake Superior College ecology class on a field trip to Allison Savanna SNA and Cedar Creek Natural History Area to learn about the native plant communities and landscape history of the Anoka Sandplain.

MBS delivered a presentation, *Native Plant Communities of Floodplains*, at the Upper Mississippi Floodplain Forest Workshop held in Dubuque, Iowa.

MBS presented survey results from work in the Superior National Forest at a first-annual Superior National Forest Research Slam and collaboration event held in Duluth.

Outreach: Publications and Products

DNR Rare Species Guide

A project manager was hired with State Wildlife Grant funds by DNR's EWR Division. This allowed work to resume on updating and improving the DNR's web-based Rare Species Guide (RSG). MBS data and analysis funded by the ENRTF is the basis of much of this work. During this reporting period progress was made on vascular plant, bryophyte, lichen, and nongame wildlife RSG species profiles.

MBS Aspen Parkland-Red River Valley Book

During this period review continued of draft landscape history, native plant community, and site guide chapters.

Background maps and elevation profiles were created for developing six landscape transects to illustrate complex patterns of native vegetation in relation to the region's glacial lake plain, beach ridge, till plain, and moraine landforms. Maps were developed showing landforms, shaded relief and beach ridge patterns, and the context of the region in central North America.

MBS Ecological Evaluations

MBS Site Ecological Evaluations were completed for two sites in western MN, Langhei 30 and White Earth 19. These reports describe the important native plant communities and rare species populations of the sites and discuss options for management and conservation.

DNR Website

MBS made additions and corrections to the DNR's Grassland Bees and Pollinator and Pollinator Resources pages, made periodic updates to the DNR's White-nose Syndrome web page, and created and posted a web page with an html version of the list of state native plant and animal species records documented by MBS. MBS worked with the DNR divisions of Forestry and Enforcement to update and clarify content on the DNR's Ginseng web page.

Project Status as of October 31, 2016

The outcomes reported in Activity 4, Outcome 4 are delivered by Minnesota Biological Survey staff who provide technical guidance related to the other Activities in this and previous LCCMR Minnesota (County) Biological Survey appropriations. Technical guidance is most often provided upon request from colleagues, partners, and the public but may also be initiated by MBS. The type of technical guidance and the level of involvement are managed by MBS supervisors and affected staff to a level appropriate for the ML15 LCCMR MBS work plan and budget.

MBS staff funded by this appropriation are among the second line of technical guidance communication or outreach behind DNR Regional Plant Ecologists, Regional Nongame Ecologists, other DNR positions, and MBS staff who are not funded by ML15 LCCMR MBS. These positions lead applied ecological efforts and serve as standing members on DNR and partner planning teams, decision-making bodies, land management teams, environmental reviews, and similar. These positions consult with or seek technical assistance from MBS and other programs in their ongoing work.

Data Delivery, Data Interpretation, and Technical Assistance

Native Plant Communities

MBS created and delivered relevé datasets to DNR and external users for projects including:

- USFS – Superior National Forest for vegetation sampling in collaboration with MBS
- NRCS for development of their Ecological Site Descriptions in Minnesota
- UMN request to query relevé database for study on invasive species in Minnesota
- UMN research to develop models to predict habitats and areas of MN at greatest risk of invasion by particular exotic plant species
- UMD research on genetic diversity of lingonberry (*Vaccinium vitis-idaea*) across its MN range
- Private consultant working on a lichen survey on algific talus slopes in SE MN
- MN Forest Resources Council research to analyze forest disturbance patterns and develop model for generating maps of historic predicted canopy cover
- Private consultant for survey work at Gully, Sandpiper, and Santee SNAs in NW MN
- Whitewater State Park to review relevé data collected at the park
- Xerxes Society for development of native thistle conservation guide

MBS created and delivered native plant community and landscape photographs to external users for projects including:

- St. Paul Parks outdoor classroom guidebook
- Reprint of essay 'Luminaries of the Bog' in online magazine *Agate*
- Canadian National Vegetation Classification factsheets for tallgrass prairie and fescue prairie
- DNR Regional Ecologist for lowland conifer photos in the Agassiz Lowlands ECS Subsection

Lowland Conifers

MBS continued to provide data and technical input to interdisciplinary discussions on lowland conifer survey, monitoring, conservation, and management. For example, MBS plant ecologist advised DNR staff on black spruce and tamarack dendrochronology techniques, issues with standard methods for calculating black spruce site indices, and a research proposal to more accurately measure stand ages of black spruce NPCs. MBS also contributed to a UMN LCCMR proposal to monitor lowland conifer stands in north central MN.

Wetlands and Peatlands

MBS botanists and plant ecologists worked with a DNR Calcareous Fen Group and various other individuals to begin updating the 2002 criteria for identifying calcareous fens. Initial discussions included: 1) existing statutory language and fen criteria conflict with modern MBS native plant community classifications causing issues with defining fens on the ground and 2) the need for additional relevé data in central and SW Minnesota to more thoroughly understand the range of calcareous fen conditions and to ultimately refine the legal definition of calcareous fens.

Botany

MBS prairie plant ecologist provided technical guidance to the development of coefficients of conservatism (c.c. values) to plant species that occur in Minnesota's prairie region. At some point, the assigned values from several botanists will be collated to create final c.c. values for plants in Minnesota's prairie region. The MN Native Plant Society is organizing this effort.

Peer Review

MBS scientists reviewed a paper on demography and insect damage in two woodland *Platanthera* species in a New Hampshire forest for the journal Botany. Justifications for MBS being called upon for this review include 1) there are only a handful of previously published papers on insect damage to North American orchids, 2) MBS is one of two groups presently addressing the issue, and 3) MBS has long-standing work on the same genus.

The MN Conservation Volunteer magazine requested and MBS delivered technical review of an upcoming article on the Lost Lake Peatland and the upcoming Sense of Place issue.

Water and Watersheds

MBS completed information on rare bryophytes associated with or dependent on groundwater. Habitat associations and a distinction of whether or not the species is aquatic or not were also developed. MBS also completed information on native plant communities associated with or dependent on groundwater. This work is important to development of interagency groundwater restoration and protection plans.

Sites of Biodiversity Significance

MBS botanist provided input and guidance to regional DNR staff regarding projects on Minnesota Point, Duluth, an area of High and Outstanding Biodiversity Significance. MBS was called upon to provide guidance related to dune systems/dune dynamics, native plant communities, and sensitive species on Minnesota Point. MBS provided suggestions and considerations regarding project plans and species lists for mitigation/restoration efforts. MBS also provided field survey to assess rare species, native plant communities, and invasive species. The work included field survey to expand the known information regarding the rare species, *Hudsonia tomentosa,* population on Minnesota Point.

DNR Scientific & Natural Areas Program

MBS continued to work closely with the SNA program that included a range of collaborations and opportunities for MBS technical guidance including:

- Review of a draft management plan for Hemlock Ravine SNA;
- Review of a site on the Mississippi River in Itasca County as a potential SNA;
- Technical guidance and field survey on four potential future SNA designations in north-central MN. One site in Cass County involves collaboration with the Chippewa National Forest and Leech Lake Reservation;
- MBS provided native plant community mapping to an area adjacent to Iron Springs Bog SNA being offered by a private landowner for donation to the SNA program.
- MBS plant ecologist provided ground survey for a jack pine woodland in Roseau County near the Red Lake WMA. A local resident had suggested to Wildlife staff that it be considered for SNA designation. MBS survey determined that the site did not meet minimum SNA standards due to the small size and lack of significant conservation values.

DNR Forest Management Coordination

- MBS continued to coordinate NPC mapping efforts with DNR foresters in places that overlap with MBS High and Outstanding Sites of Biodiversity Significance.
- MBS provided plant ID and native plant community classification assistance to DNR foresters.
- MBS participated in an interdisciplinary field visit with DNR Wildlife and Forestry to a High Conservation Value Forest in the Nemadji SF. MBS provided visits to rare species locations and high quality forest native plant communities and interpretation of landscape-level biodiversity values.

DNR Parks & Trails

MBS and Parks cost-shared field survey to begin to address priority botanical and vegetation needs for Banning, Whitewater, Latsch, and Great River Bluffs State Parks. This was in part instigated by MBS plant ecologists working in these parks for biological monitoring purposes. MBS worked closely with a lichenologist on contract with Parks that proved highly valuable to MBS staff and in terms of rare species discoveries.

MBS consulted with and provided technical guidance to DNR Regional Plant Ecologist for a new section of the Gitchee Gami Trail. Topics of interest included rare species, native plant communities, and invasive species.

MN Pollution Control Agency

MBS is coordinating with the MPCA statewide wetland monitoring project. During this reporting period MBS and MPCA wetland scientists coordinated on methods for evaluating and ranking wetland vegetation condition (i.e. quality ranking).

Universities and Colleges

- UMN graduate students requested MBS botanical expertise for research related to *Vaccinium oxycoccos*, *V. macrocarpon*, and *V. vitis-idaeus* (cranberries and lingonberry) in Beltrami, Lake of Woods, and Koochiching counties.
- UMN bee and pollinator researchers sought MBS prairie ecologist input to upcoming research on pollinators and grazing
- MBS provided potential study site locations to a University of Montana researcher who is conducting research on soil fungi associated with *Asclepias speciose* (showy milkweed).
- Dort College, Iowa, researcher sought MBS botanical and site expertise for locating sites to study the grass genus, *Elymus,* across Minnesota, Iowa, and South Dakota prairies.

MN Counties

- Responded to a request from Lake of the Woods County for MBS information and interpretation on a wetland sites in the county being considered for wetland banks.
- MBS presented to the Koochiching County Board and Land Department regarding MBS biological surveys in the county. MBS provided a program overview and specifics on MBS efforts within the county. The meeting and an MBS piece were reported in the International Falls Journal http://www.ifallsjournal.com/news/local/county-to-survey-northome-industrial-site/article_58502ad6-5ed2-51a9-8295-5e4fbfc901cd.html.

LCCMR Projects

MBS botanists and plant ecologists provided assistance to the MBS LCCMR-funded Wild Bee Survey in terms of locating transects in native vegetation.

MBS botanists provided technical input to a work plan for a UMN LCCMR-recommended study of concentrations of contaminants in roadside plants and pollinators.

MN Prairie Plan

MBS prairie ecologists and botanists continue to participate with the Minnesota Prairie Plan Implementation Team and associated projects. For example, MBS is using new aerial and LiDAR imagery to identify new, previously unsurveyed or under-surveyed prairie, wetland, and forest locations in Prairie Plan Core Areas.

MN Odonata Survey

MBS plant ecologists and botanists provide technical guidance and data interpretation on native plant communities and Sites of Biodiversity Significance to the MN Odonata Survey.

North Shore Forest Collaborative

MBS provided vegetation and rare species expertise to the North Shore Forest Collaborative in their development of Desired Future Conditions for the Split Rock Till Plain along the north shore of Lake Superior.

US Forest Service

MBS provided technical review and input to the Superior National Forest projects within areas of active MBS baseline survey. Examples include input to guidelines for managing wildfire and prescribed burning in Research Natural Areas and input to vegetation management projects (i.e. forest management). SNF sought MBS technical input on wildlife, plant ecology, and silvicultural methods for emulating ecological forest processes.

US Fish & Wildlife Service

MBS provided field survey findings and interpretations for Hamden Slough National Wildlife Area to USFWS staff. MBS field work had identified the presence of a potential calcareous fen and documented a rare plant, *Carex sterillis*.

Outreach: Presentations and Training

MBS staff were requested or instigated several presentations and trainings during the reporting period including:

- A native fern identification workshop at Itasca State Park in collaboration with DNR Regional Ecologists.
- A presentation on the rare native thistle species, *Cirsium pumilum* var. *hillii*, at a MN Native Plant Society meeting.
- A one-day vegetation classification and plant ID training for UMN forestry students.
- A presentation and field tour of the vegetation of Minnesota Point, Duluth to the Wild Ones native plants and habitats group. Presentation included description of native plant communities, rare and common plants, and MBS/DNR resources.
- Four two-day plant ID and native plant community classification field workshops. Workshops were held

near Windom, at Chippewa Prairie, at Wambach WMA in Mahnomen County, and Santee Prairie in NW MN. The sessions were advertised and quickly filled beyond capacity.

- MBS plant ecologists and botanists organized and led a relevé training day for SNF staff involved in field survey and mapping of native plant communities.

Outreach: Publications and Products

MBS Red River Valley-Aspen Parkland Book

During this reporting period, MBS continued work on the Red River Valley-Aspen Parkland book. Examples include:

- Background maps and elevation profiles to show patterns of presettlement vegetation on landforms in region.
- Major progress on the acid peatland, wet forest, forested rich peatland, lakeshore, rivershore, and floodplain forest chapters.
- Finalized shaded relief and landform maps.
- Continued development of NPC distribution maps for NPC chapters.
- Major progress on five site descriptions (Frenchman's Bluff, Huot WMA, Malmberg Prairie, Pembina Trail, and Pembina WMA)

Sedges and Rushes of Minnesota Book

During this reporting period, the penultimate revision of the manuscript was completed, all of the photographs needed for final publication were selected provided for final editing, and individual species distribution maps were finalized. The last of the field work and specimen collection were completed during this period as well. MBS graphic artist created a design concept to guide upcoming book production in collaboration with the MN Press.

Rare Species Guide

Major progress continued on the revision and updating of the DNR online Rare Species Guide. 62 new profiles were finalized for newly listed vascular plant species that were not previously included in the guide. 54 existing vascular plant profiles were significantly updated. Continued work on overall editing, map production, photo acquisition, and database connections. MBS staff made major efforts to submit all rare species field data to-date to MBS databases for use in the RSG. MBS also collaborated with the UMN Bell Museum of Natural History Herbarium to account for all rare plant species on file at the herbarium and their inclusion in the RSG.

One notable enhancement of the RSG is the inclusion of newly listed bryophytes (i.e. mosses and liverworts). Several species profiles have been completed including *Aphanorrhegma serratum, Atrichum crispum, Atrichum tenellum, Aulacomnium androgynum, Aulacomnium (Arrhenopterum) heterostichum, Bryoxiphium norvegicum, Bryum cyclophyllum, Buxbaumia aphylla, Cirriphyllum piliferum, Cryptocolea imbricate, Cynodontium schist, Cyrto-hypnum pygmaeum,* and *Encalypta procera*.

Lakes

MBS Lakes and Aquatic Plant species lists for over 2000 lakes are available on Lakefinder on the DNR Website as "Aquatic Plant Surveys" at www.dnr.state.mn.us/lakefind/index.html.

All MBS Lakes and Aquatic Plant data are also available in the MNGEO Commons (1995-2015 surveys) at https://gisdata.mn.gov/ .

The "MBS Lakes and Aquatic Plant Data" shapefile in DNR's internal GIS data mart, Quick Layers, has been updated to include the information collected in recent MBS aquatic plant surveys.

A major project was completed involving the transfer and delivery of MBS lake and aquatic plant photographs taken over the last 20 years to the EWR Photo Library. A long-term MBS volunteer was critical to this effort by providing database design expertise and computer programing that automated photo labeling.

- Three or more images of most of the 2023 lakes surveyed can be accessed at the EWR Photo Library at: http://eco-app.dnr.state.mn.us/gallery/v/eco/lakes/
- Images of aquatic plants, rare and common, can be accessed at the EWR Photo Library at http://eco-app.dnr.state.mn.us/gallery/v/eco/aquatic/

Pollinators

MBS graphic artist provided layout and design for a 17-page handout highlighting the results of wild bee/pollinator surveys in Minnesota's grassland habitats.

MBS Website

MBS continued ongoing website (http://www.dnr.state.mn.us/mbs/index.html) maintenance and enhancements. MBS updated the White-nose Syndrome web page to include a "story map" and other hot-off-the-press WNS information as it unfolds. MBS made accessible and posted documents related to new USFWS rulings on Northern Long-eared Bat.

MBS Social Media

MBS wrote and submitted Facebook posts (for use on the Department's Facebook page) reflecting MBS survey activity over the course of the 2016 field season. Several of these posts were also featured in the department's DNR Spotlight (employee newsletter).

Final Report Summary:

Outreach: Publications and Products

DNR Rare Species Guide

Major progress continued on updating and improving the DNR's web-based Rare Species Guide (RSG) Rare Species Guide: Minnesota DNR. MBS data and analysis funded by the ENRTF is the basis of much of this work.

During this reporting period progress was made on vascular plant, bryophyte, lichen, and nongame wildlife RSG species profiles. 62 new profiles were finalized for newly listed vascular plant species that were not previously included in the guide. 54 existing vascular plant profiles were significantly updated. Continued work on overall editing, map production, photo acquisition, and database connections. MBS staff made major efforts to submit all rare species field data to-date to MBS databases for use in the RSG. MBS also collaborated with the UMN Bell Museum of Natural History Herbarium to account for all rare plant species on file at the herbarium and their inclusion in the RSG. One notable enhancement of the RSG is the inclusion of newly listed bryophytes (i.e. mosses and liverworts).

MBS Aspen Parkland-Red River Valley Book

Review and editing continued on the Red River Valley-Aspen Parkland book. Landscape history, native plant community, and site guide chapters progressed. Major progress was made on the acid peatland, wet forest, forested rich peatland, lakeshore, rivershore, and floodplain forest chapters.

Map production was a major focus including native plant community distribution maps. Background maps and elevation profiles were created for developing seven landscape transects to illustrate complex patterns of native vegetation in relation to the region's glacial lake plain, beach ridge, till plain, and moraine landforms. Maps were developed showing landforms, shaded relief and beach ridge patterns, and the context of the region in central North America.

Descriptions of important sites in the NW region are an important part of the book. Major progress on several site descriptions was made during this ENRTF appropriation including Frenchman's Bluff, Huot WMA, Malmberg

Prairie, Pembina Trail, and Pembina WMA.

MBS secured a two-year extension of the Joint Powers Agreement (i.e. publishing agreement) with U of M Press to allow adequate time to develop a high quality book.

Sedges and Rushes of Minnesota Book

During this reporting period, the completed manuscript of "Sedges and Rushes of Minnesota" was delivered to the publisher (University of Minnesota Press). Photographs needed for final publication were selected and provided for final editing, and individual species distribution maps were finalized. The last of the field work and specimen collection were completed during this period as well. MBS graphic artist created a design concept to guide upcoming book production in collaboration with the MN Press. MBS field surveys and staff expertise developed under LCCMR MBS appropriations have been essential to making this publication thorough, reliable and based on an otherwise much smaller and incomplete collection of specimens and documented field locations for every species.

The expectation is that the book will be published in May, 2018 and be offered to the public for $34.95. The book will cover 246 species, have over 1,000 photos, 250 maps, and be approximately 600 pages long.

MBS Ecological Evaluations

MBS Site Ecological Evaluations were completed two sites in western MN, Langhei 30 and White Earth 19, one in southern MN, Drake Woods, and one in northern MN, Upper Mississippi Oxbows. These reports describe the important native plant communities and rare species populations of the sites and discuss options for management and conservation. Among other uses, these reports are valuable to the DNR Scientific & Natural Areas program for identifying acquisition priorities. Ecological Evaluation reports are available upon request.

MBS Photographs

MBS delivered native plant community and landscape photographs to internal and external users and projects including: St. Paul Parks outdoor classroom guidebook; reprint of essay 'Luminaries of the Bog' in the online magazine *Agate*; and Canadian National Vegetation Classification factsheets for tallgrass prairie and fescue prairie; and significant contributions to the DNR Rare Species Guide and the forthcoming book, *Sedges and Rushes of Minnesota*.

A major project was completed involving the transfer and delivery of MBS lake and aquatic plant photographs taken over the last 20 years to the EWR Photo Library. A long-term MBS volunteer was critical to this effort by providing database design expertise and computer programing that automated photo labeling.

- Three or more images of most of the 2023 lakes surveyed can be accessed at the EWR Photo Library at: http://eco-app.dnr.state.mn.us/gallery/v/eco/lakes/
- Images of aquatic plants, rare and common, can be accessed at the EWR Photo Library at http://eco-app.dnr.state.mn.us/gallery/v/eco/aquatic/

MBS Vegetation plot data (relevés)

MBS created and delivered relevé datasets to DNR and external users statewide and nationally. Outcomes reported here are led by MBS staff funded by non-ENRTF funds but the data being delivered is or was ENRTF-funded. Relevés serve as foundational data to a wide variety of projects. Examples from 2015-2017 include:

- efforts to update Minnesota's technical criteria for calcareous fens;
- UMN projects including research on native hop plants (*Humulus* spp.) to breed disease resistance and other qualities into agricultural hop plants and models to predict habitats and areas of MN at greatest risk of invasion by particular exotic plant species
- UMD research on genetic diversity of lingonberry (*Vaccinium vitis-idaea*) across its MN range
- adaptive management plans for Scientific and Natural Areas and vegetation management in State Parks;
- locations of seepage wetland communities and wet seepage forests statewide to aid the DNR's statewide spring survey.

- MN Forest Resources Council research to analyze forest disturbance patterns and develop model for generating maps of historic predicted canopy cover
- U.S. Forest Service and U.S. Dept of Interior LANDFIRE vegetation mapping efforts to aid wildland strategic fire and resource management planning and analysis;
- Private consultants working on a lichen surveys, algific talus slope surveys, and SNA surveys.
- Xerxes Society for development of native thistle conservation guide.
- Locations of selected prairie plant species populations for DNR restoration and modeling of Regal Fritallary butterfly distribution in Minnesota;

MBS Website

MBS continued ongoing website (http://www.dnr.state.mn.us/mbs/index.html) maintenance and enhancements to communicate the results of statewide MBS surveys, monitoring and analysis. MBS made additions and corrections to the DNR's Grassland Bees and Pollinator and Pollinator Resources pages; made periodic updates to the DNR's White-nose Syndrome web page including a "story map" and other hot-off-the-press WNS information as it unfolds; and created and posted a web page with the list of state native plant and animal species records documented by MBS. MBS worked with the DNR divisions of Forestry and Enforcement to update and clarify content on the DNR's Ginseng web page. Additional website updates include:

Lakes

MBS Lakes and Aquatic Plant species lists for over 2000 lakes are available on Lakefinder on the DNR Website as "Aquatic Plant Surveys" at www.dnr.state.mn.us/lakefind/index.html. This delivers MBS information to a broad constituency who visit Lakefinder for Minnesota lake information – a very popular DNR website.

All MBS Lakes and Aquatic Plant data (1995-2015 surveys) are also available in the MNGEO Commons at https://gisdata.mn.gov/ and a similar internal DNR data platform, QuickLayers. This delivers MBS information in GIS formats to DNR staff, other natural resource professionals, university students and researchers, schools, and anyone else who uses GIS and needs MBS information for their work.

The "MBS Lakes and Aquatic Plant Data" shapefile in DNR's internal GIS data mart, Quick Layers, has been updated to include the information collected in recent MBS aquatic plant surveys. This delivers MBS information to all DNR staff who use MBS information in their GIS work.

Bryophytes

MBS created and hosts a web page for JA Jansenns' (the state's first and only bryology expert) field guides for the identification of bryophytes. MBS assembled and made compliant downloadable versions of four booklets on Minnesota bryophytes: http://www.dnr.state.mn.us/eco/mbs/mnbryophytes.html

Prairies

MBS prairie ecologists and graphic artist provided an update to the widely used map, *Minnesota's Remaining Native Prairie a Century after the Public Land Survey,* available at http://files.dnr.state.mn.us/eco/mcbs/prairie_map.pdf. This update is important to recent initiatives to update the MN Prairie Plan.

MBS Social Media

Starting in 2016, MBS wrote and submitted Facebook posts (posted to the DNR Facebook page and the SNA Facebook page) reflecting MBS survey activity during 2016-17 field seasons and highlights from earlier MBS work.

Outreach: Presentations and Training

MBS staff were requested or instigated several presentations and trainings during this project. Attendees come from a wide range of organizations including NRCS, SWCD, USFWS, DNR Wildlife, DNR Ecological and Water Resources, DNR Parks & Trails, BWSR, North Dakota State University, TNC, Pheasants Forever, and private consultants. Examples include:

- Field workshops on prairie native plant communities and prairie plant ID. 2017 locations included Chanarambie Creek (Murray County), Glacial Lakes/Ordway (Pope County), and Thorson WMA (Polk County).
- A workshop on the rare plants of the Anoka Sandplain hosted by the Coon Creek Watershed District.
- A talk on wetland basin sampling methods and results at a conservation grazing workshop in Big Lake, MN organized by the Minnesota Chapter of the Wildlife Society.
- A wetland shrub identification field class with staff from the DNR's Ecological and Water Resources and Forestry divisions.
- A Lake Superior College ecology class on a field trip to Allison Savanna SNA and Cedar Creek Natural History Area to learn about the native plant communities and landscape history of the Anoka Sandplain.
- Presentation on survey results from work in the Superior National Forest at a first-annual Superior National Forest Research Slam.
- A native fern identification workshop at Itasca State Park in collaboration with DNR Regional Ecologists.
- A presentation on the rare native thistle species, *Cirsium pumilum* var. *hillii*, at a MN Native Plant Society meeting.
- A one-day vegetation classification and plant ID training for UMN forestry students.
- A presentation and field tour of the vegetation of Minnesota Point, Duluth.

Data Delivery, Data Interpretation, and Technical Assistance

The outcomes reported here for Activity 4, Outcome 4, are delivered by Minnesota Biological Survey staff who provide technical guidance related to the other Activities in this and previous LCCMR Minnesota Biological Survey ENRTF appropriations. Technical guidance is most often provided upon request from colleagues, partners, and the public but may also be initiated by MBS. The type of technical guidance and the level of involvement are managed by MBS supervisors and affected staff to a level appropriate for the ML15 LCCMR MBS work plan and budget.

MBS staff funded by this appropriation for Activity 4, Outcome 4, are among the second line of technical guidance communication or outreach behind DNR Regional Plant Ecologists, Regional Nongame Ecologists, other DNR positions, and MBS staff who are not funded by ML15 LCCMR MBS. These other positions lead applied ecological efforts and serve as standing members on DNR and partner planning teams, decision-making bodies, land management teams, environmental reviews, and similar. These positions consult with or seek technical assistance from MBS and other programs in their ongoing work.

MBS delivered a variety of data, interpretations, analysis, and reports (resulting from this and previous ENRTF MBS appropriations) to a wide range of partners including DNR SNA program, Environmental Review, State Parks & Trails, Forestry, Lands & Minerals; MPCA, Minnesota counties and cities, USFS, NRCS, USFWS, MN Historical Society, UMN Bell Museum of Natural History, UMN Landscape Arboretum; Minnesota colleges and universities; MN Land Trust; MN Odonata Survey; and the North Shore Forest Collaborative.

MBS delivered a variety of data, interpretations, analysis, and reports (resulting from this and previous ENRTF MBS appropriations) related to a wide range of topics including native plant communities, vegetation plot data (relevés), water and watersheds, native and rare plant and animal species, state or federal-listed species, climate change, lowland conifer forests, wetlands and peatlands, prairies, pollinators and pollination, and other ENRTF projects and proposals.

MBS delivered a variety of data, interpretations, analysis, and reports (resulting from this and previous ENRTF MBS appropriations) related to a wide range of Minnesota conservation and land management plans: State

Wildlife Action Plan, Minnesota Prairie Plan, DNR Section Forest Resource Management Plans, and third-party Forest Certification standards that many public forest management organizations follow.

Environmental Review

MBS delivered data, interpretations, analysis, and reports (resulting from this and previous ENRTF MBS appropriations) to a variety of small and large DNR Environmental Review projects. Examples include projects that affect rare species or sites of biodiversity significance; relocation of rare species; proposed transmission line routes; groundwater pumping proposals and permitting; road development; airport renovation; and development mitigation plans and outcomes.

Environmental Review staff and DNR Lands & Minerals staff consult with MBS scientists on mineral exploration activities relative to rare species, native plant communities and sites of biodiversity significance. Examples include: decorative stone exploration lease in NE Minnesota; Proposed copper-nickel mining in NE Minnesota; and proposed peat mining in northern Minnesota.

DNR Scientific & Natural Areas Program

MBS ecologists provided technical guidance and site-level interpretations to SNA program staff for sites throughout Minnesota. Examples included cattle grazing as a management tool (currently being implemented on some Prairie Bank sites) and vegetation monitoring methods; field survey and technical training on plant ID and vegetation classification with SNA program staff in high-quality, upland old-growth white cedar - yellow birch forests in the Lost Lake SNA in northern St. Louis County; provided data and technical assistance to SNA staff regarding acquisition prioritization in central and southeastern Minnesota; technical input on a management plan for the recently established Badoura Jack Pine Woodland SNA in Hubbard County.

V. DISSEMINATION:

DESCRIPTION:

MBS data are stored primarily in the Division of Ecological and Water Resources information systems, which are increasingly linked to other databases in the MN DNR. In addition, MBS procedures, updates, recent maps, and links to related data are presented on the DNR website. Many GIS datasets are delivered to clients through the web. MBS regularly provides vegetation plot data from the relevé database to researchers at academic institutions, other agencies and organizations. Data on rare species are available through agreements with the requesting agency and the DNR. For data on locations or rare features, a data request form is available via the web: http://www.dnr.state.mn.us/nhnrp/nhis.html

MBS publishes and distributes survey results in a variety of formats for various audiences. Many products are available as enterprise datasets on the DNR website, including GIS shape files of native plant communities and MBS sites, native plant community field guides, and guides to sampling techniques such as vegetation plot data collection using the relevé method. MBS web pages are updated with new information and have links to associated resources. http://www.dnr.state.mn.us/mbs/index.html

The DNR and Legislative libraries and other local information repositories (such as libraries within counties) have access to published products, including books, maps, reports, field guides and digital media. MBS has published several books and field guides.

Staff routinely make presentations that describe MBS methodologies and results to a wide range of audiences including county boards, local planning groups, citizen advisory groups, other biologists, land managers, and students. MBS staff provide local planners with ecological interpretations describing important sites of biodiversity identified during the Survey to assist with management plans.

Physical collections are deposited at Minnesota repositories, primarily at the University of Minnesota's J.F. Bell Museum of Natural History and at the Science Museum of Minnesota, St. Paul. As part of a larger network of museums and herbaria, these cooperators are essential to the documentation and sharing of MBS results. MBS and museum staff meet periodically to address curatorial, data management, and interpretive needs.

MBS also delivers data through an international organization, NatureServe, and also shares data with cooperators at colleges and universities.

Project Status as of January 31, 2016
See Project Status updates for activities 3 and 4.

Project Status as of October 31, 2016
See Project Status updates for activities 3 and 4.

Final Report Summary:
See above Description and Final Report Summaries for Activities 3 and 4.

VI. PROJECT BUDGET SUMMARY:
A. ENRTF Budget Overview:

Budget Category	$ Amount	Overview Explanation
Personnel:	$2,017,028	Botanists, Ecologists, Zoologists, and student worker for surveys, monitoring, technical assistance and interpretation. Botanists (2 classified 1.75 FTE for two years) position# 1 82% salary, 18% benefits; position #2 80% salary 20% benefits) Ecologists (10 unclassified 8.0 FTE for two years) position #1 72% salary, 28% benefits; positions #2 68% salary, 32% benefits; position #3 65% salary, 35% benefits; position # 4 78% salary, 22% benefits; position #5 70% salary, 30% benefits; position #6 and #7 80% salary, 20% benefits); position #8 66% salary 34% benefits; position #9 78% salary 22% benefits; position #10 93% salary 7% benefits; Ecologists (2 classified 1.0 FTE for two years) position #1 81% salary, 19% benefits; position #2 73% salary 27% benefits Information officer to deliver data, assist with web and publications (1 FTE for two years) 67% salary 33% benefits. Zoologists (2 unclassified 0.5 FTE for two years) position #1 78% salary 22% benefits; position #2 68% salary 32% benefits. Data Manager with botanical data management expertise (1 classified 0.2 FTE for two years) 68% salary 32% benefits. Project Specialist (1 unclassified 0.5 FTE for 0.5 years) 65% salary 35% benefits. Project Coordinator (1 unclassified 0.6 FTE for 6 months) 90% salary 10% benefits.
Professional/Technical/Service	$ 100,292	GIS services via MNIT

Contracts: MNIT		
Professional/Technical/Service Contracts: Biologists TBD, MNIT service level agreements, UMN Press Joint Powers Agreements, Conservation Corps Work Orders, TBD.	$76,996	Contractual agreements TBD. Examples include: biologists following standard DNR procedures for contract processing for activities such as vegetation survey and monitoring; Service Level Agreements with MNIT for application development, information system support, and product development support following procedures required by MNIT; Joint Powers Agreements with the University of Minnesota Press for book publication; Work Orders with Conservation Corps Minnesota for survey and outreach purposes per DNR-CCM Master Contract Agreement; and support for other product developments.
Direct and necessary costs as approved by LCCMR :	$123,684	Direct support services. DNR's direct and necessary costs pay for activities that are directly related to and necessary for accomplishing appropriated programs/projects. In addition to itemized costs captured in our proposal budget, direct and necessary costs cover HR Support (~$31,824), Safety Support (~$7,872), Financial Support (~$27,356), Communication Support (~$1,141), IT Support (~$54,552), Planning Support (~$704), and Procurement Support (~$235) that are necessary to accomplishing funded programs/projects.
Equipment/Tools/Supplies:	$18,000	Field equipment/supplies. Equipment is used from previous survey periods when at all possible (for example-GPS units, cameras, canoes, communication equipment etc.) and items such as batteries, collecting materials, uniforms and aerial photography need to be replaced or updated.
Travel Expenses in MN:	$114,000	This is largely related to field survey and monitoring. Travel expenses are subject to State of Minnesota labor agreements and DNR policy. Most travel expense is related to the 4-5 months of time when staff and volunteers are conducting field work that requires food, transport in seasonal DNR fleet vehicles, and lodging
TOTAL ENRTF BUDGET:	$2,450,000	

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. The activities of all or portions of the following five classified staff are directly related to this work program.

A portion of the time of two plant ecologists (1.0 FTE for two years) is directed to field survey and monitoring and the authorship of the Aspen Parkland-Red River Valley natural history/guide book that is specifically identified in Activity #4. Due to decades of their field experience and investigation in the prairie and parkland region, these ecologists bring knowledge and perspectives that will result in a professional and accessible publication.

Two botanists (1.75 FTE for two years) are needed for plant field survey and monitoring, to verify identification of plants collected by MBS botanists and plant ecologists, to coordinate with the repositories of these collections (herbaria), and to assist with data management.

One data manager (0.2 FTE for two years) with expertise in botanical data management is needed to prepare plant specimens for herbarium accession.

Explanation of Capital Expenditures Greater Than $5,000: NA

Number of Full-time Equivalents (FTE) Directly Funded with this ENRTF Appropriation 12.625 FTE each year

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

B. Other Funds:

Source of Funds	$ Amount Proposed	$ Amount Spent	Use of Other Funds
Non-state			
State Wildlife Grant-Federal grant	$ 300,000	$300,000	Animal surveys, data management and monitoring.
USFWS Endangered Species Funds	$0	80,000	Federal and state-listed plant monitoring, data management, field expenses, salary.
State			
General Funds	$ 564,000,	$575,300	Office rent, salary of supervisor
Heritage Enhancement Account and RIM Critical	$ 1,244,000	$1,281,400	Salaries, contracts, supplies, office rent
Game and Fish Account	$ 120,000	$117,200	Contracts, salaries
TOTAL OTHER FUNDS:	**$ 2,228,000**	**$2,353,900**	

VII. PROJECT STRATEGY:

A. Project Partners: The following are some of the primary partners related to this project: The Bell Museum, the Science Museum, the Superior National Forest, and Voyageurs National Park. Nature Northwest and U of M Crookston. Red Lake Reservation lands are being surveyed in collaboration with Red Lake Department of Natural Resources. NatureServe provides guidance in database structure, collection, and distribution standards.

B. Project Impact and Long-term Strategy: Future funding will be requested to address: Data gaps, including species groups or systems previously inadequately surveyed; Re-survey of landscapes altered due to habitat fragmentation, development, and invasive species, especially areas surveyed during 1980s–1990s; Additional monitoring of ecological impacts of policies and management on ecological systems and species populations; Use of new technology in remote sensing, data collection, analysis, modeling, and information delivery; Updates to DNR's Rare Species Guide.

C. Funding History: Below is the most recent summary of significant MBS funding. The general fund is used for expenses not covered by ENRTF (office space and some equipment for example) and supervisors' salaries. The State Wildlife grants fund many of the animal surveys, Heritage Enhancement funds salaries and recently RIM Critical has funded the core staff of the animal survey (3 FTEs). See attached for a sampling of projects.

Funding Source and Use of Funds	Funding Timeframe	$ Amount
ENRTF M.L. 2013, Chp. 52, Sec. 2, Subd. 03a Gen Fund State Wildlife Grant Heritage Enhancement/RIM Critical Habitat	1 July 2013- 30 June 2015	$2,650,000 $ 420,000 $ 450,000 $1,162,000
ENRTF M.L. 2011, First Special Session, Chp. 2, Art.3, Sec. 2, Subd. 03a Gen Fund State Wildlife Grant Heritage Enhancement RIM Critical Habitat	1 July 2011-30 June 2013	$2,250,000 $520,000 $500,000 $934,000 $226,500
ENRTF M.L. 2009, Chp. 143, sec. 2, subd. 3a. Gen Fund State Wildlife Grant Heritage Enhancement	1 July 2009-30 June 2011	$ 2,100,000 $ 700,000 $ 500,000 $ 1,159,000

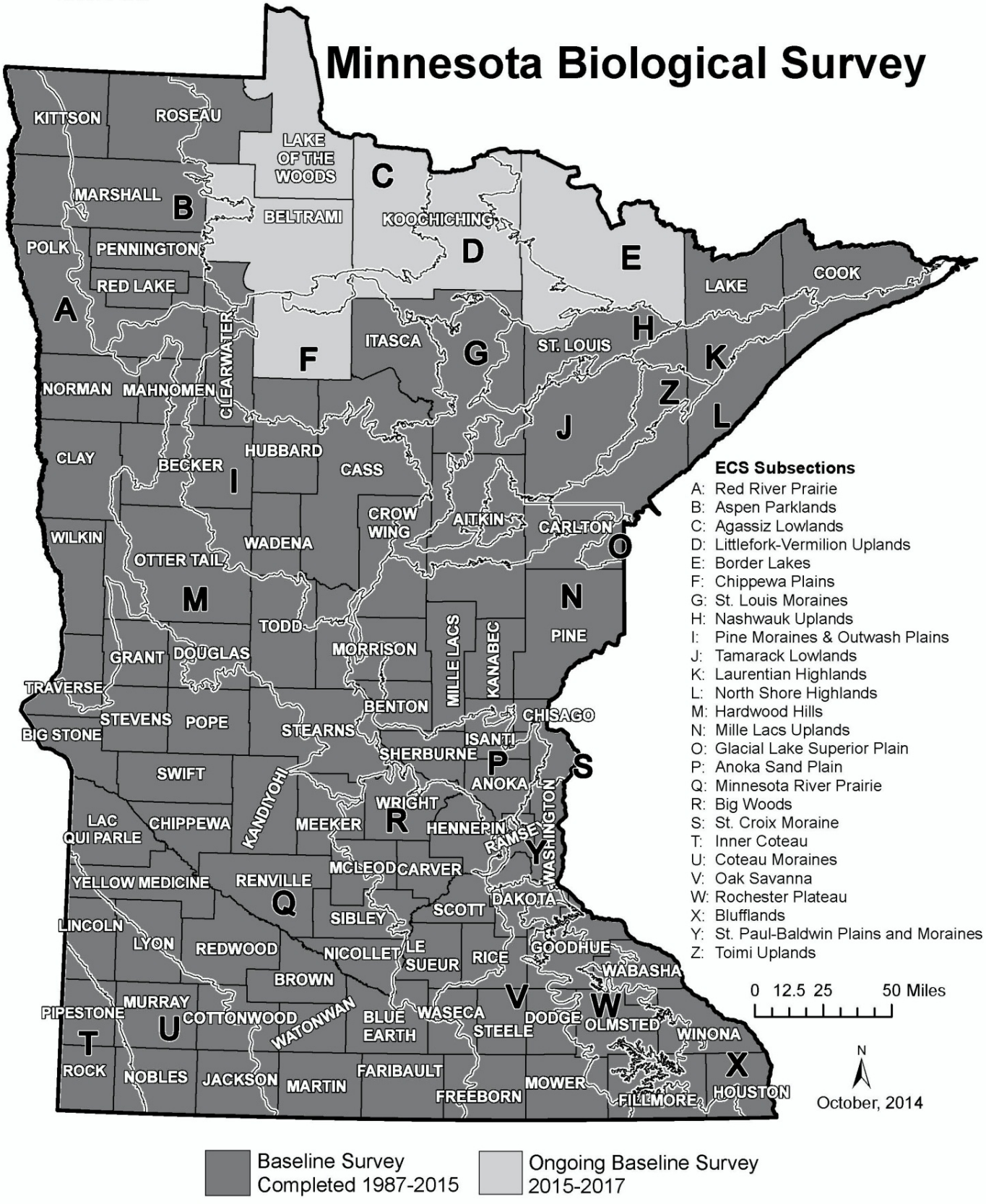
VIII. FEE TITLE ACQUISITION/CONSERVATION EASEMENT/RESTORATION REQUIREMENTS: NA

IX. VISUAL COMPONENT or MAP(S): See attached maps

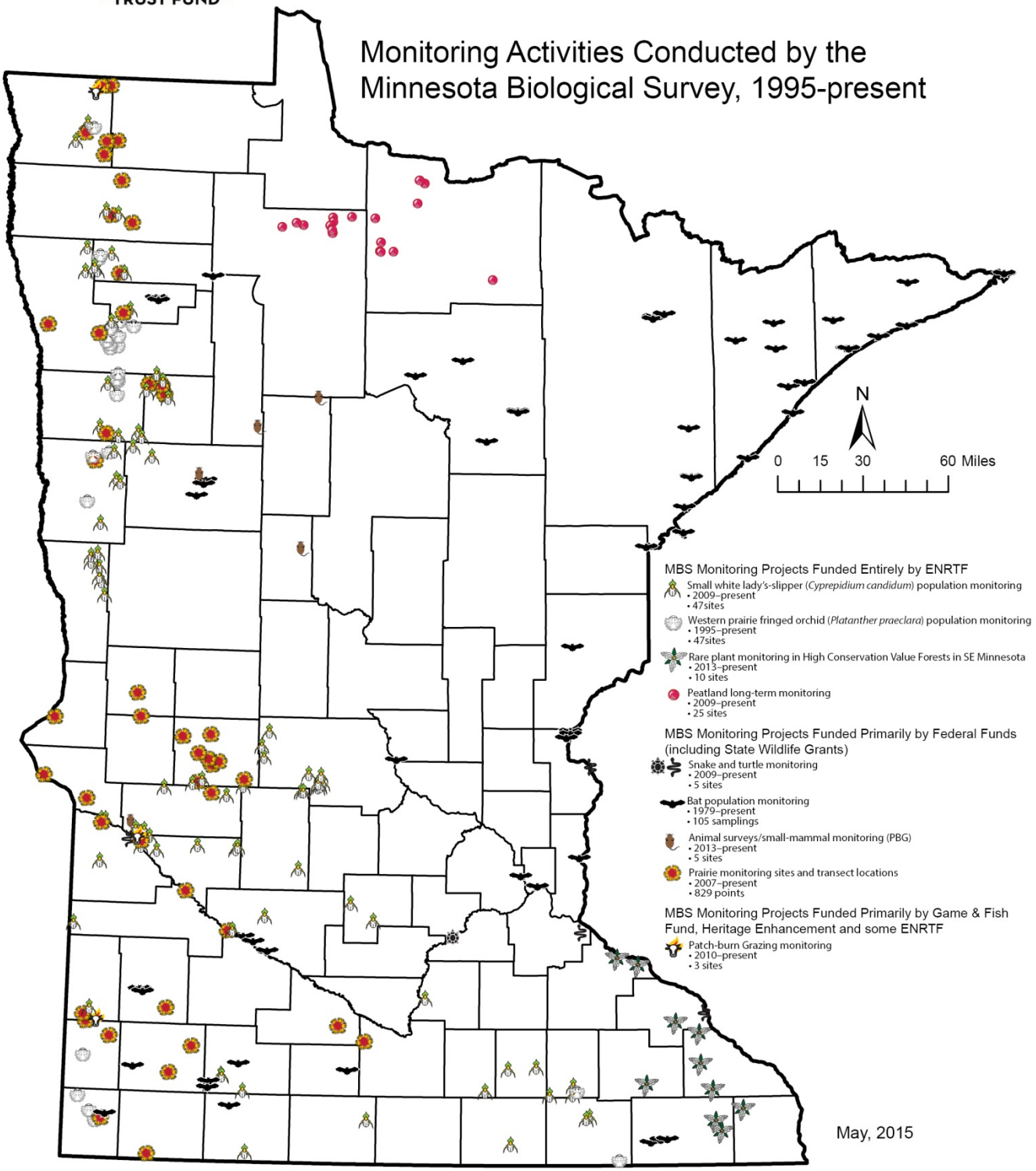
X. RESEARCH ADDENDUM: NA

XI. REPORTING REQUIREMENTS: Periodic work plan status update reports will be submitted not later than January 31, 2016, October 31, 2016, and March 31, 2017 (LCCMR directed the project manager to incorporate the March update into the final project report). A final report and associated products will be submitted between June 30 and August 15, 2017 as requested by the LCCMR.

Environmental and Natural Resources Trust Fund (ENRTF)
2015 Work Program
Project Title: Minnesota Biological Survey



Environmental and Natural Resources Trust Fund (ENRTF)
2015 Work Program
Project Title: Minnesota Biological Survey



Environment and Natural Resources Trust Fund
M.L. 2015 Final Project Budget

Project Title: Minnesota Biological Survey
Legal Citation: M.L. 2015, Chp. 76, Sec. 2, Subd. 03c
Project Manager: Bruce Carlson
Organization: Minnesota Department of Natural Resources
M.L. 2015 ENRTF Appropriation: $ 2,450,000
Project Length and Completion Date: 2 years June 2017
Date of Report: September 8, 2017

ENVIRONMENT AND NATURAL RESOURCES TRUST FUND BUDGET	Activity 1 Budget	Amount Spent	Activity 1 Balance	Activity 2 Budget	Amount Spent	Activity 2 Balance	Activity 3 Budget	Amount Spent	Activity 3 Balance	Activity 4 Budget	Amount Spent	Activity 4 Balance	TOTAL BUDGET	TOTAL BALANCE
BUDGET ITEM														
Personnel (Wages and Benefits)	$645,455	$645,446	$9	$282,383	$282,383	$0	$625,276	$625,276	$0	$463,914	$463,914	$0	$2,017,028	$9
Personnel: (18 positions) 12.45 FTE each year include the proposed following State of MN employees. Salary and fringe are included in actvity item. Most positions require specialized professional skills in plant and animal surveys (understanding of taxonomy, behavior, field survey techniques, statistics, sampling design, specimen preparation and documentation/data management). In addition, use of remote-sensing equipment, interpretation of aerial imagery, understanding of soils, geology, hydrology, and landscape processes are critical to accomplishing many required tasks. Finally, the understanding of the resource data enables information management staff to create programs to effectively manage data for analysis and interpretation of results. Staff skills focused on the communication of results is especially needed during this project period to meet deadlines for web-based and published products.													
Botanists (2 classified 1.75 FTE for two years) position# 1 82% salary, 18% benefits; position #2 80% salary 20% benefits): $296,590														
Ecologists (10 unclassified 8.0 FTE for two years) position #1 72% salary, 28% benefits; positions #2 68% salary, 32% benefits; position #3 65% salary, 35% benefits; position # 4 78% salary, 22% benefits; position #5 70% salary, 30% benefits; positions #6 & #7 80% salary, 20% benefits; position #8 66% salary 34% benefits; position #9 78% salary 22% benefits; position #10 93% salary 7% benefits): $1,251,999														
Ecologists (2 classified 1.0 FTE for two years) position #1 81% salary, 19% benefits; position #2 73% salary 27% benefits: $201,524														
Information officer (1 unclassified 1.0 FTE for two years) 67% salary 33% benefits: $176,143														
Zoologists (2 unclassified 0.5 FTE for two years) position #1 78% salary, 22% benefits; position #2 68% salary 32% benefits: $62,142														
Data Manager (1 classified 0.2 FTE for two years) 68% salary, 32% benefits: $33,334														
Project Specialist (1 unclassified 0.5 FTE for 6 months) 65% salary, 35% benefits: $16,260														
Project Coordinator (1 unclassified 0.5 FTE for 6 months) 90% salary, 10% benefits														
Professional/Technical/Service Contracts														
GIS services via MNIT							$100,292	$98,885	$1,407				$100,292	$1,407
Contractual agreements TBD. Examples include biologists following standard DNR procedures for contract processing for activities such as vegetation survey and monitoring; service level agreements with MNIT for application development, information system support, and product development support following procedures required by MNIT; Joint Powers Agreement with the University of Minnesota Press for book publication; Work Orders with Conservation Corps Minnesota for program support purposes per DNR-CCM Master Contract Agreement; and support for other product developments.	$16,193	$16,000	$193	$16,228	$15,022	$1,206	$0	$0	$0	$44,575	$44,575	$0	$76,996	$1,399
Equipment/Tools/Supplies: Field supplies to conduct biological surveys, including GPS units, data recorders, cameras, communication safety equipment (especially in Border Lakes and remote peatlands), plant and animal specimen collecting and preservation supplies, water chemistry sampling supplies, batteries, air photos, maps, water resistant note books, etc.	$10,000	$10,000	$0	$8,000	$7,756	$244	$0	$0	$0	$0	$0	$0	$18,000	$244
Travel expenses in Minnesota														
Travel: In-state travel, including food (estimated $15,000) and lodging (estimated $20,000) expenses when in travel status. Especially used by field staff where vehicle mileage is paid for temporary use of DNR vehicles (estimated $35,000) during the summer field surveys. This will be suplemented by other funding. Also includes expense reimbursement for volunteers.	$90,000	$87,850	$2,150	$24,000	$24,000	$0	$0	$0	$0	$0	$0	$0	$114,000	$2,150
Other														
Direct support services. DNR's direct and necessary costs pay for activities that are directly related to and necessary for accomplishing appropriated programs/projects. In addition to itemized costs captured in our proposal budget, direct and necessary costs cover HR Support (~$31,824), Safety Support (~$7,872), Financial Support (~$27,356), Communication Support (~$1,141), IT Support (~$54,552), Planning Support (~$704), and Procurement Support (~$235) that are necessary to accomplishing funded programs/projects.	$64,316	$64,316	$0	$14,842	$14,842	$0	$32,158	$32,158	$0	$12,368	$12,368	$0	$123,684	$0
COLUMN TOTAL	**$825,964**	**$823,612**	**$2,352**	**$345,453**	**$344,003**	**$1,450**	**$757,726**	**$756,319**	**$1,407**	**$520,857**	**$520,857**	**$0**	**$2,450,000**	**$5,209**