M.L. 2017 Project Abstract
For the Period Ending June 30, 2021

PROJECT TITLE: Minnesota Biological Survey – Continuation
PROJECT MANAGER: Bruce Carlson
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FUNDING SOURCE: Environment and Natural Resources Trust Fund
LEGAL CITATION: M.L. 2017, Chp. 96, Sec. 2, Subd. 03d as extended by M.L. 2020, First Special Session, Chp. 4, Sec. 2
APPROPRIATION AMOUNT: $2,900,000
AMOUNT SPENT: $2,900,000
AMOUNT REMAINING: $0

Sound bite of Project Outcomes and Results
The Minnesota Biological Survey (MBS) collects, interprets and delivers foundational data on native plants, animals, plant communities and functional landscapes. These data help prioritize actions to conserve, manage and restore Minnesota's biological diversity and ecological systems.

Overall Project Outcome and Results
MBS baseline terrestrial plant field surveys occurred in Lake of the Woods, St. Louis and Koochiching counties within the Border Lakes, Littlefork-Vermilion Uplands, and Agassiz Lowlands subsections. MBS baseline aquatic lake plant surveys occurred in lakes in central Minnesota counties. Plant surveys documented numerous rare and notable terrestrial and aquatic vascular plant species. Native plant community surveys occurred in areas that are either representative of the native vegetation in these counties and subsections or are rare, unique or unusual for these areas. MBS field surveys were also targeted in other northern Minnesota counties to address questions stemming from GIS mapping of native plant communities and sites of biodiversity significance.

Pollinator surveys in MBS sites of biodiversity significance focused on native and rare moths and butterflies in far northern, northwest, and southeast Minnesota. Over 3,000 specimens of at least 900 species were collected, some of which have potential to be new state records.

Targeted surveys occurred in southeast, east-central, and northern forests in MBS sites of biodiversity significance to update and expand MBS data from surveys that occurred in the 1990s and early 2000s. Likewise, similar surveys occurred in the Prairie Province to document new sites or expand on previous MBS surveys from the 1980s. This work resulted in the documentation of many new and updated records of rare species and high quality native plant communities.

Updates and improvements to the DNR Rare Species Guide continued that rely heavily on MBS data and technical expertise arising from this a previous MBS ENRTF appropriations. The book, Sedges and Rushes of Minnesota, was published by the MN Press and the final manuscript for the book, Minnesota Red River Valley and Aspen Parkland - A Guide to Native Plant Communities, was submitted to the UMN Press for publishing.

Project Results Use and Dissemination
MBS data are stored in the DNR's Natural Heritage Information System and biological specimens accessioned to the UMN Bell Museum of Natural History. This includes information on rare species, native plant communities, sites of biodiversity significance. MBS distributes survey results on the MBS website, DNR GIS QuickLayers, and MN Geospatial Commons. Presentations, technical guidance, biological reports, and published books are

delivered that describe and interpret MBS results for use by local government units, conservation groups, citizen advisory groups, scientists, land managers, and students. MBS data, products, and staff expertise are used throughout the state to assist conservation decisions.

Environment and Natural Resources Trust Fund (ENRTF)
M.L. 2017 LCCMR Work Plan Final Report

Date of Submission: August 16, 2021

Final Report

Date of Work Plan Approval: 06/07/2017

Project Completion Date: June 30, 2021

PROJECT TITLE: Minnesota Biological Survey – Continuation

Project Manager: Bruce Carlson

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Location: Aitkin, Becker, Carlton, Carver, Cass, Chippewa, Chisago, Clay, Crow Wing, Dakota, Dodge, Fillmore, Houston, Itasca, Kittson, Koochiching, Lac qui Parle, Lake of the Woods, Mahnomen, Marshall, Meeker, Mille Lacs, Mower, Nicolet, Norman, Ottertail, Pennington, Polk, Pope, Red Lake, Rock, St. Louis, Scott, Swift, Wabasha, Washington, Wilkin, Wright.

Total ENRTF Project Budget:		
	ENRTF Appropriation:	**$2,900,000**
	Amount Spent:	**$2,900,000**
	Balance:	**$ 0**

Legal Citation: M.L. 2017, Chp. 96, Sec. 2, Subd. 03d as extended by M.L. 2020, First Special Session, Chp. 4, Sec. 2

Appropriation Language:
$2,900,000 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. This appropriation is available until June 30, 2020, by which time the project must be completed and final products delivered.

M.L. 2020 - Sec. 2. ENVIRONMENT AND NATURAL RESOURCES TRUST FUND; EXTENSIONS. [to June 30, 2021]

I. PROJECT TITLE: Minnesota Biological Survey

II. PROJECT STATEMENT:
The Minnesota Biological Survey (MBS) collects, interprets and delivers foundational data on native plants, animals, plant communities and landscapes. These data help prioritize actions to conserve, manage and restore Minnesota's biological diversity and ecological systems.

The Minnesota Biological Survey (MBS) will in this project 1) continue toward statewide completion of baseline surveys started in 1987; 2) provide targeted field surveys for sensitive species, pollinators, and high-quality native plant communities; 3) process, store and deliver field survey data; and 4) provide new biological reports, book drafts, technical guidance, and outreach.

This work plan will bring to completion baseline field surveys (Activity 1) in all of Lake of the Woods County, at least 90% of St. Louis County, and at least 25% of Koochiching County. Targeted field surveys (Activity 2) are proposed in select native prairies, wetlands, and forests in response to needs identified in various plans and assessments such as the Minnesota Prairie Conservation Plan, the State Wildlife Action Plan, forest plans and third-party forest certification.

This work will build off of decades of MBS efforts to process and deliver new data, collections, and products (Activities 3 and 4) that are foundational to biodiversity conservation and management in Minnesota. Recent examples of delivery and interpretation of data by MBS include identification, restoration and management of Scientific and Natural Areas; updates and revisions to Minnesota's list of endangered, threatened and special concern species; development of pollinator best-management practices; site selection and seed mix development for cover crop, buffer, and clean water initiatives; and technical support tools for stream and watershed management.

III. OVERALL PROJECT STATUS UPDATES:

Project Status as of December 31, 2017
MBS Data Summary Table

Data Type	# added July 1 – Dec. 31 2017	Total since 1987*
Rare species records (Biotics) (all taxa)	302	23,662
Rare aquatic plant species records	18	1,263
Lakes with MBS botanical surveys	27	2,052
Counties with MBS lake botanical surveys	0	48
Vegetation plots (relevés)	228	5,228
Sites of Biodiversity Significance GIS polygons*	123	10,965
Native Plant Community GIS polygons**	817	92,302
Plant specimens submitted to the University of MN Bell Museum	450	~52,500

* MBS started in 1987 with an ENRTF appropriation; MBS has received continuous ENRTF biennial appropriations since 1987.
**Numbers reported based on data available on the Minnesota Geospatial Commons

MBS botanical and vegetation field surveys occurred in St. Louis and Koochiching 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. MBS field survey was also targeted in other northern Minnesota counties to address questions stemming from GIS mapping of native plant communities.

MBS continued to lead and collaborate on monitoring and targeted surveys in prairies and forests. Monitoring of rare prairie plant species, western prairie fringed orchid and small white lady's-slipper continued from previous biennia. Targeted surveys occurred in the Prairie Province to document previously unsurveyed or undocumented prairies, wetlands, forests, and prairie-wetland complexes with many significant finds of rare species and high quality native plant communities. Targeted surveys occurred in southeast, east-central, and northern forests in MBS sites of biodiversity significance to update and expand MBS data from surveys that occurred in the 1990s and early 2000s.

MBS information systems critical to effective data storage and delivery continue to be populated with new data on rare species and native plant communities discovered during this reporting period. MBS continues to provide leadership in the management and use of the DNR's integrated Native Plant Community database. The UMN Bell Museum of Natural History and MBS continue to collaborate on biological specimens and their accession and curation in Bell Museum collections.

MBS continued to provide technical assistance, data delivery, and data interpretation as it relates to this project to DNR and other partners and projects. 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.

Project Status as of June 30, 2018

A significant part of MBS field ecologists' time on this project, in winter and early spring, is processing specimens, entering field data into electronic databases, and interpreting those data. Work from previous biennia continued to enter MBS field data from this project into databases of the Natural Heritage Information System and preparing specimens for accession to the University of Minnesota Bell Museum and Entomology collections. Processing data and results from 2017 field surveys and developing priorities and preparing for 2018 field work occupied much of time and budget associated with this reporting period.

Baseline field surveys started in early June concentrating on relevé collection and floristic surveys in Koochiching County and aquatic lake plant surveys in central Minnesota. Surveys to finish Lake of the Woods County were pushed back to 2019 in order to focus more staff on Koochiching in 2018. St. Louis county field surveys had not resumed yet at the time of this report due to an extended illness of the lead ecologist.

MBS targeted surveys in the Prairie Province commenced in June with continued attention to surveying prairie wetland complexes and installation of permanent vegetation monitoring transects in places where conservation grazing is occurring. Surveys elsewhere in the Prairie Province focused on documenting vegetation and rare species in unsurveyed prairies, forests, and wetlands in west-central Minnesota.

Long-term annual monitoring of western prairie fringed orchid and small white lady's slipper orchid with the help of a team of highly dedicated volunteers started in June. MBS is a co-author on two publications arising out of this work.

Pollinator surveys in MBS sites of biodiversity significance focused on baseline surveys for native and rare moths in far northern, northwest, and southeast Minnesota. Over 3,000 specimens of at least 900 species were collected, some of which have potential to be new state records.

MBS staff participated in several presentations and technical trainings related to outcomes of this project. MBS submitted Facebook posts (posted to the DNR Facebook page and the SNA Facebook page) and updated its website regarding MBS survey activity during 2017 field seasons and highlights from earlier MBS work. Major progress continued on updating and improving the DNR's web-based Rare Species Guide (RSG) with new data fresh from field work accomplished under this appropriation. The final manuscript for the new book, "Sedges and Rushes of Minnesota," was submitted to the publisher and progress on the early stages of a new book, "Mammals of Minnesota," continued.

Amendment Request (08/01/2018)

1. Extend the project to 3 years with an end date of June 30, 2020. This change is consistent with the appropriation language that allows for 3 years. Project Status report dates have been added to the work plan to account for an additional year.
2. Move $19,000 from Activity 2 Equipment/Tools/Supplies for Entomology to Activity 4 Contracts with Conservation Corps of Minnesota. This is done because entomology equipment and supply needs are coming in well under budget and we would like to add to our work with CCM on outreach (assisting with MBS website and social media content related to this project).
3. Move $14,000 from Activity 1 Professional/Technical/Service Contracts to Activity 4 Professional/Technical/Service Contracts. This is done to address higher priority contract needs for book development and final manuscript editing before delivering manuscripts to the publisher.
4. Move $6,000 from Activity 2 Professional/Technical/Service Contracts to Activity 3 Professional/Technical/Service Contracts to increase work on data entry, processing and management associated with this project. Needs for contractors in Activity 2 is less than expected while data management needs associated with this project are on track to exceed budgeted amounts.

Amendment approved by LCCMR 9/26/2018.

Project Status as of January 31, 2019

Significant progress was made on botanical and vegetation field surveys in Koochiching County. Field surveys of native plant communities (NPCs) focused on wet forests, peatlands, mesic hardwood forests, fire-dependent forests, and islands and shorelines of Rainy Lake and the Bigfork River. Many sites comprised NPCs that are under-surveyed in the county or for which classification is unique or currently unclear for the geography. Field surveys for native and rare plant species in Koochiching County continue to document with specimens county and sub-county records of common and uncommon native plants. Many interesting plant species were documented in ecotonal margins between more common native plant communities.

Aquatic plant species surveys in Kandiyohi, Meeker, and Wright counties were conducted on smaller lakes with suspected moderate to high diversity and/or high probability to contain rare plants. Aquatic plant community surveys in the nearshore, shallow depth zone focused on larger recreation lakes in the North Fork Crow River Watershed in Kandiyohi, McLeod and Meeker counties.

MBS conducted select ground-verification of native plant communities to inform GIS mapping of native plant communities in Crow Wing, Cass, and Anoka counties. Desktop GIS mapping of native plant communities continued in Koochiching, St. Louis, Itasca, Cass, Crow Wing, Pine, and Aitkin counties. Mapping of native plant communities involves considerable amounts of collaboration with DNR Forestry, Fish & Wildlife, and Parks & Trails.

MBS plant and vegetation surveys in the Prairie Province continued work in prairie wetland complexes, initiated a special focus on calcareous fens, continued ongoing work with rare orchids, and continued documenting vegetation and rare species in unsurveyed prairies, forests, and wetlands in west-central Minnesota.

Pollinator surveys in MBS sites of biodiversity significance focused on baseline surveys for native and rare moths in far northern and northwest Minnesota. Over 1,000 specimens were collected, some of which have potential to be new state records.

Work from previous biennia continued to enter MBS field data from this project into a collection of related databases within the Natural Heritage Information System including the MBS Plant Specimen Label database, MNTaxa (plant species), Biotics (rare species), and Relevé (vegetation plot) databases, and the University of

Minnesota Bell Museum's Specify Database. Hundreds of biological specimens were identified and prepared for ascension to the UMN Bell Museum herbarium or UMN Entomology collection.

MBS staff participated in several presentations and technical trainings related to outcomes of this project. MBS submitted Facebook posts (posted to the DNR Facebook page and the SNA Facebook page) and updated its website regarding MBS survey activity during 2017-18 field seasons and highlights from earlier MBS work. Major progress continued on updating and improving the DNR's web-based Rare Species Guide (RSG) with new data fresh from field work accomplished under this appropriation.

Progress continued on the final editing of the Minnesota Red River Valley and Aspen Parkland book, progress continued on the early stages of a new book, Mammals of Minnesota, while the book, Sedges and Rushes of Minnesota, was published by the MN Press.

Project Status as of July 31, 2019

A significant part of MBS field ecologists' time on this project, in winter and early spring, is processing specimens, entering field data into electronic databases, and interpreting those data. Work from previous biennia continued to enter MBS field data from this project into databases of the Natural Heritage Information System and preparing specimens for accession to the University of Minnesota Bell Museum and Entomology collections. Processing data and results from 2018 field surveys and developing priorities and preparing for 2019 field work occupied much of time and budget associated with this reporting period. With the help of volunteers, significant progress continues to organize, georeference, and stage for scanning and archiving MBS paper and digital files originating from MBS county surveys spanning the past 30+ years.

Baseline field surveys were delayed throughout much of the state in spring/early summer 2019 due to a long-lasting winter and slow arrival of spring weather. Baseline field surveys in St. Louis County focused on vegetation plot collection in collaboration with Superior National Forest and botanical surveys for rare species in areas burned by the 2011 Pagami Creek fire.

MBS targeted surveys in the Prairie Province commenced in June with continued attention to surveying prairie wetland complexes and documenting vegetation and rare species not previously documented in prairies, forests, and wetlands in northwest and west-central Minnesota.

MBS in collaboration with State Parks and SNA revisited vegetation plots (relevés) that were first collected over 20 years ago. Focus was on the North Shore Highlands subsection in NE Minnesota and on using this work to detect and describe changes in flora and vegetation over the past couple decades.

Botanical field surveys focusing on ferns and fern allies commenced in MBS Sites of Biodiversity Significance in central and SE Minnesota. This work provides critical updates and new information on rare fern occurrences and new documentations that fill major gaps in our understanding of Minnesota's fern flora. This work is also critical to a forthcoming book on Minnesota ferns and fern allies (see ML20 MN Biological Survey project).

Long-term annual monitoring of western prairie fringed orchid and small white lady's slipper orchid with the help of a team of highly dedicated volunteers started in June.

Pollinator surveys in MBS sites of biodiversity significance focused on baseline surveys for native and rare moths in Lake of the Woods, Koochiching, Beltrami, and Clearwater counties. Over 3,000 specimens of at least 900 species were collected, some of which have potential to be new state records.

Desktop GIS mapping of native plant communities based on MBS field surveys continued in Koochiching, St. Louis, Itasca, Cass, Crow Wing, Pine, Cook, Lake, and Lake of the Woods counties. Mapping of native plant

communities involves considerable amounts of collaboration with DNR Forestry, Fish & Wildlife, and Parks & Trails.

MBS staff participated in several presentations and technical trainings related to outcomes of this project. MBS submitted Facebook posts (posted to the DNR Facebook page and the SNA Facebook page) and updated its website regarding MBS survey activity during 2018 field seasons and highlights from earlier MBS work. Major progress continued on updating and improving the DNR's web-based Rare Species Guide (RSG) with new data fresh from field work accomplished under this appropriation.

Amendment Request (07/31/2019)

1. Move $2,006 from Activity 3 Personnel to Activity 4 Professional/Technical/Service Contracts to correct an under-budgeted amount for contract biologist/photographer to conduct specialized fern field surveys and photography towards development of a ferns of Minnesota publication.
2. Move $25,000 from Activity 3 Personnel to Activity 4 Personnel to cover the addition of 0.1 FTE unclassified Information Officer for editing of the NW book manuscript.

Amendment approved by LCCMR 9/26/2019.

Project Status as of January 31, 2020

A significant part of MBS field ecologists' time on this project, in fall through early spring, is processing specimens, entering field data into electronic databases, and interpreting those data. Work from previous biennia continued to enter MBS field data from this project into databases of the Natural Heritage Information System and preparing specimens for accession to the University of Minnesota Bell Museum and Entomology collections. Processing data and results from 2019 field surveys and developing priorities and preparing for 2020 field work occupied much of time and budget associated with this reporting period.

Baseline field surveys in St. Louis County continued with collaborative work with the Superior National Forest to collect vegetation plots (e.g. relevé) in locations that fill important gaps in relevé distribution or address questions in current vegetation classifications used by both parties. Baseline field surveys in Lake of the Woods County focused on documenting larval amphibian diversity and targeted searches for newts.

Aquatic plant species surveys in Pope, Stevens, and Swift counties. Surveys focused on moderate to high quality lakes with a probability to contain rare plants and lower quality lakes that have not been surveyed. Aquatic plant species lists were completed for each lake and notable rare botanical finds and county records.

Vegetation and botanical field surveys occurred in Kittson County in previously undocumented native prairies, forests and wetlands in the Prairie and Aspen Parklands Province. Focus was on working prairies that are important connecting pieces between other significant tracts of native vegetation.

MBS continued the collaboration with State Parks and SNA to revisit vegetation plots (relevés) that were first collected over 20 years ago. Focus was on the North Shore Highlands subsection in NE Minnesota and on using this work to detect and describe changes in flora and vegetation over the past couple decades.

Worked continued from the previous reporting period to update and expand data and specimen collections on native and rare ferns in Minnesota. Work occurred throughout the state with special emphasis centered on the Nemadji State Forest in Carlton and Pine counties and the difficult *Botrychium* genus.

Sensitive prairie orchid field surveys and volunteer coordination continued from previous reporting periods. Utilizing volunteer help, MBS conducted annual census of orchid populations in Kittson, Mower, Norman, Pennington, Polk and Rock Counties in conjunction with TNC, USFWS, and NPS. The annual report,, *2019 Summary of Small White Lady's Slipper Activities in Minnesota,* was prepared and provided to partners.

Pollinator surveys in MBS sites of biodiversity significance focused on baseline surveys for native and rare moths in several northwestern and north-central counties. Surveys yielded over 2,000 specimens and include numerous new county records as well as potential new state records (identifications pending) and possible yet-to-be determined new species to science.

Desktop GIS mapping of native plant communities based on MBS field surveys continued in Koochiching, St. Louis, Cass, Crow Wing, Pine, Lake, and Lake of the Woods counties. Mapping of native plant communities involves considerable amounts of collaboration with DNR Forestry, Fish & Wildlife, and Parks & Trails.

MBS staff participated in several presentations and technical trainings related to outcomes of this project. MBS submitted Facebook posts (posted to the DNR Facebook page and the SNA Facebook page) and updated its website regarding MBS survey activity during 2019 field seasons and highlights from earlier MBS work. Major progress continued on updating and improving the DNR's web-based Rare Species Guide (RSG) with new data fresh from field work accomplished under this appropriation.

Amendment Request (01/31/2020)

For the remaining 6 months of this appropriation continued increased emphasis is being placed on Personnel to process data (Activity 3) from Activities 1 and 2 and to develop products (Activity 4) arising from Activities 1-3 and previous ENRTF MN Biological Survey appropriations. Previous amendments (8/1/2018 and 7/31/2019) moved in similar directions.

Within Professional/Technical/Service Contracts:

1. Move $14,676.37 from Service Level Agreements with MN.IT for specific database, GIS, and map projects (liquidate all remaining balances per Activity for this budget item) to MN.IT for day-to-day GIS and IT services (allocate equally across the 4 Activities). This is done because we are able to achieve GIS-related outcomes and activities with DNR embedded MN.IT GIS staff as opposed to using service level agreements (i.e. contracts) with MN.IT staff.
2. Activity 4 Contract Biologists was under-budgeted at project outset and use of contract biologists in Activities 1 and 2 was over-budgeted at project outset. Progress on field work (Activities 1 and 2) has been greater than expected by using only MBS Personnel, thereby requiring less need for contractors. In turn, we are placing more emphasis on Activity 4 Contracts to a) accelerate progress on processing and synthesizing data, specimens, and large volume of publication-quality photos collected for the ferns of Minnesota project. This work is being done by the same contractor who has been a major collaborator on collecting fern data, specimens, and, in particular, high quality, publication quality photographs (see July 31, 2019 Activity 2 update and amendments). The following budget moves are made as a result of the above:
    a. Move $5,705.81 from Activity 1 Contract Biologists to Activity 4 Contract Biologists.
    b. Move $860.00 from Activity 3 Contract Biologists to Activity 4 Contract Biologists.
    c. Move $260.28 from Activity 2 Contract Biologists to Activity 4.

Within Travel Expenses: move $18,649.50 from Activity 2 to Activity 1. This reflects the greater amount of travel necessary to achieve Activity 1 Outcomes than what was originally planned at project start. Likewise, Activity 2 Outcomes have not proven to need as large of a travel budget. Also, Activity 1 travel expenses for the 2019 field season came in slightly over budget while 2019 Activity 2 travel expenses continued to come in under budget.

Within Equipment/Tools/Supplies: move $174.67 from Activity 2 Equipment necessary to complete targeted field surveys to Activity 2 Entomology-specific field equipment. This is done to account for a small amount of entomology-specific supplies that were necessary for processing insect specimens after the 8/1/2018 amendment where the project-start entomology equipment/supply budget was liquidated.

Within Personnel:

1. Move $165,000 from Activity 1 to Activity 3. This is done because more time will be spent on data and specimen processing than Activity 1 field survey for the remainder of the appropriation.

2. Move $50,000 from Activity 2 to Activity 4. This is done because more time will be spent on products and outreach than Activity 2 field survey for the remainder of the appropriation.

Move $2,784.50 from Activity 4 Work Order with Conservation Corps of MN to Activity 4 Personnel. This is done because the work order with CCMN came in under budget.

Move $4,484.00 from Activity 4 Joint Powers Agreement with UMN Press to Activity 4 Personnel. This is done because the remaining obligation to the UMN Press is $15,000.

Move $5,113.33 from Activity 1 Equipment to Activity 3 Personnel. This is done because Equipment was over-budgeted and Activity 3 Personnel under-budgeted for the remainder of the appropriation.

Move $1,521.40 from Activity 2 Equipment to Activity 3 Personnel. This is done because Equipment was over-budgeted and Activity 3 Personnel under-budgeted for the remainder of the appropriation.

Move $422.975 from Activity 2 Contract Biologists to Activity 3 Personnel. This is done because Activity 2 contract biologists were over-budgeted and Activity 3 Personnel under-budgeted for the remainder of the appropriation.

Amendment approved by LCCMR 5/10/2020.

Project extended to June 30, 2021 by LCCMR 6/18/20 as a result of M.L. 2020, First Special Session, Chp. 4, Sec. 2, legislative extension criteria being met.

Project Status as of July 31, 2020:
Activities 1 and 2, with mostly field-based outcomes, were delayed in spring/early summer 2020 due COVID-19 and the Governor's Stay at Home Executive Order. For these reasons, progress on this work plan was redirected to Activities 3 and 4, with mostly office-based outcomes. MBS was eventually approved by the DNR in early June, 2020 to resume limited field survey following the precautions outlined in the Governor's Executive Orders and DNR guidance.

A significant part of MBS field ecologists' time on this project, in winter and early spring, is processing specimens, entering field data into electronic databases, and interpreting those data. Work from previous biennia continued to enter MBS field data from this project into databases of the Natural Heritage Information System and preparing specimens for accession to the University of Minnesota Bell Museum and Entomology collections. Processing data and results from 2019 field surveys and developing priorities and preparing for 2020 field work occupied much of time and budget associated with this reporting period.

Significant progress continues to organize, georeference, and stage for digitizing and archiving MBS paper and digital files originating from MBS county surveys spanning the past 30+ years. Most the accomplishments for this project are achieved with volunteers.

Collaborative work with the Superior National Forest continued from previous reporting periods. This work combines mutual priorities among MBS and the SNF to fill gaps in vegetation plot (relevé) distribution. With field work restrictions in place, project staff redirected to related data analysis, mapping, and planning future field work priorities.

Desktop GIS mapping of native plant communities based on MBS field surveys continued in Cass, Clearwater, Crow Wing, Beltrami, Koochiching, Lake, St. Louis, and Goodhue counties. Mapping of native plant communities involves considerable amounts of collaboration with DNR Forestry, Fish & Wildlife, and Parks & Trails. Over 230,000 acres of native plant communities were mapped during the reporting period.

A limited amount of lake surveys for aquatic plants occurred in June with surveys occurring in six lakes with several significant rare plant discoveries. Work continued on charophytes as part of an ongoing effort to better

document this under-studied macro-algae in collaboration with the DNR Lake Ecology Unit and the New York Botanical Garden.

Pollinator surveys in MBS sites of biodiversity significance focused on baseline surveys for native and rare moths in Lake of the Woods, Koochiching, Beltrami, and Roseau counties. Over 1,500 specimens were collected with many new county records and at least one with potential to be a new state record.

MBS staff provided technical guidance and advice to a wide range of audiences related to outcomes of this project and previous MBS ENRTF appropriations. MBS submitted Facebook posts (posted to the DNR Facebook page and the SNA Facebook page) and updated its website regarding MBS survey activity during 2019 field seasons and highlights from earlier MBS work. Major progress continued on updating and improving the DNR's web-based Rare Species Guide (RSG) with new data fresh from field work accomplished under this appropriation.

Amendment Request (07/31/2020):
Due to COVID-19 and Governor's Stay at Home Executive Order, emphasis was reduced on Activities 1 and 2 that involve field work and travel and increased on Activities 3 and 4 that involve office/home-based work. As of June 30, 2020, work on Activities 1 and 2 are considered complete in terms of this work plan but most outcomes continue on the ENRTF ML19 MBS Work Plan. The remainder of this work plan through its completion of June 30, 2021 will be directed to Activities 3 and 4.

1. Reduce A1 Personnel by $30,824.46 and redirect it as follows:
    a. Move $1,386.00 to A1 Equipment/Tools/Supplies to correct a negative balance resulting from a limited amount of general supplies and minor equipment needs necessary for working from home and for modified field work plans;
    b. Move $450.00 to A2 Equipment/Tools/Supplies to correct a negative balance resulting from a limited amount of general supplies and minor equipment needs necessary for modified field work plans;.
    c. Move $494.70 to A2 Equipment/Tools/Supplies Entomology-specific to correct a negative balance resulting from a limited amount of entomology supplies and minor equipment needs necessary for modified field work plans;.
    d. Move $28,494.76 to A4 Personnel to close out A1 Personnel for this work plan and redirect those funds to A4 where work will be redirected.
2. Move $1,208.37 from Contracts – MN.IT to Activity 3 Personnel proportioned evenly across each Activity ($302.10 each) due to lower amounts needed to cover this need and that the contract with MN.IT. This move closes out this budget item.

Reduce A2 Personnel by $57,608.96 and redirect $15,000 to A4 Personnel and $42,608.96 to A3 Personnel. This is done as a result of COVID limitations on field work/travel. Activity 2 on this work plan is closed out with the remaining balance being redirected to A4 where work will continue this fiscal year.

Reduce A1 Travel Expenses by $16,866.00 and move entire amount to A3 Personnel. This is done as a result of COVID limitations on field work/travel. Activity 1 on this work plan is closed out with the remaining balance being redirected to A3 where work will continue this fiscal year.

Reduce A2 Travel Expenses by $7,978 and move entire amount to A3 Personnel. This is done as a result of COVID limitations on field work/travel. Activity 2 on this work plan is closed out with the remaining balance being redirected to A3 where work will continue this fiscal year.

Amendment Approved by LCCMR **9/8/2020**.

Project Status as of January 31, 2021:
Final outcomes on this appropriation for Activity 1 and Activity 2 were completed as of the 7/31/2020 update report. Final outcomes under Activity 3 and all but one outcome under Activity 4 were completed for this appropriation during this reporting period.

A significant part of MBS field ecologists' time on this project, in winter and early spring, is processing specimens, entering field data into electronic databases, and interpreting those data. Work from previous biennia continued to enter MBS field data from this project into databases of the Natural Heritage Information System and preparing specimens for accession to the University of Minnesota Bell Museum and Entomology collections.

Significant progress continues to organize, georeference, and stage for digitizing and archiving MBS paper and digital files originating from MBS county surveys spanning the past 30+ years. Most the accomplishments for this project are achieved with volunteers.

A significant component of documenting and collecting biological specimens is the creation and management of mounted specimens and associated labels that meet museum standards. Mounted plant and insect specimens complete with labels were submitted for accession to the UMN Insect Collection or Bell Museum herbarium. During this reporting period, moth specimen identification, labeling, and data entry were completed for over 1,000 specimens from the 2019-2020 field seasons.

MBS continued GIS polygon mapping of native plant communities (NPCs) in numerous locations statewide for inclusion in the MN DNR Native Plant Community Polygon Database. Mapping involves review of and determining relationships among a number of references including MBS field ecologist notes, relevés, rare species records, color infrared aerial imagery, LiDAR, National Wetlands Inventory, SSURGO soils data, and forestry inventories. Accomplishments include creation of over 2,000 polygons classified to native plant community covering 34,000 acres in MBS Sites of High or Outstanding Biodiversity Significance in Cass and Itasca counties.

Progress continued on the final manuscript for the book, MN Red River Valley and Aspen Parklands. Work focused on fine-tuning the text, maps, images, and graphics. Reviews of the draft manuscript were received from targeted individuals who have a particular areas of expertise or experience relevant to certain parts of the manuscript. Final editing was completed for several complex maps including a map series on glacial periods and glacial Lake Agassiz and maps of important sites of biodiversity significance in the book region. The manuscript is on track for submission to the UMN Press for publishing by June 2021.

Overall Project Outcomes and Results: Submitted between June 30 and August 1, 2021.
MBS baseline terrestrial plant field surveys occurred in Lake of the Woods, St. Louis and Koochiching counties within the Border Lakes, Littlefork-Vermilion Uplands, and Agassiz Lowlands subsections. MBS baseline aquatic lake plant surveys occurred in lakes in central Minnesota counties. Plant surveys documented numerous rare and notable terrestrial and aquatic vascular plant species. Native plant community surveys occurred in areas that are either representative of the native vegetation in these counties and subsections or are rare, unique or unusual for these areas. MBS field surveys were also targeted in other northern Minnesota counties to address questions stemming from GIS mapping of native plant communities and sites of biodiversity significance.

Pollinator surveys in MBS sites of biodiversity significance focused on native and rare moths and butterflies in far northern, northwest, and southeast Minnesota. Over 3,000 specimens of at least 900 species were collected, some of which have potential to be new state records.

Targeted surveys occurred in southeast, east-central, and northern forests in MBS sites of biodiversity significance to update and expand MBS data from surveys that occurred in the 1990s and early 2000s. Likewise, similar surveys occurred in the Prairie Province to document new sites or expand on previous MBS surveys from the 1980s. This work resulted in the documentation of many new and updated records of rare species and high quality native plant communities.

Updates and improvements to the DNR Rare Species Guide continued that rely heavily on MBS data and technical expertise arising from this a previous MBS ENRTF appropriations. The book, Sedges and Rushes of Minnesota, was published by the MN Press and the final manuscript for the book, Minnesota Red River Valley and Aspen Parkland - A Guide to Native Plant Communities, was submitted to the UMN Press for publishing.

IV. PROJECT ACTIVITIES AND OUTCOMES:

ACTIVITY 1: Statewide Baseline Biological Survey.

Description: Conduct baseline field surveys in Lake of the Woods, Koochiching and St. Louis counties on the distribution and ecology of native plants and animals, native plant communities, and the most intact landscapes. Conduct baseline aquatic plant surveys in high quality and moderate quality lakes in eight central Minnesota counties. Conduct vegetation field surveys to inform native plant community mapping.

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.

Staff notify and coordinate activities with other DNR Divisions, universities, counties, municipalities, tribal natural resource departments, watershed districts, federal natural resource agencies, conservation organizations, corporations, and individual landowners. This is critical to the success of field surveys, data richness, and outreach.

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).

In Lake of the Woods County, ground surveys to assess sites, native plant communities and rare plants will focus primarily on the Northwest Angle in the far northern reaches of the county and state. This area is difficult to access and requires considerable planning and collaboration to achieve field survey goals. Data entry and mapping of sites and native plant communities will be completed for this county during this biennium. In addition, animal surveys will be conducted throughout the county.

In Koochiching County, ground surveys to assess sites, native plant communities and rare species will continue from last biennium. Koochiching County contains many large, remote areas that meet MBS preliminary survey priority criteria (e.g. areas of intact vegetation, good potential for rare species, minimal fragmentation). These areas take considerable effort to access and survey. Surveys will focus primarily on peatlands, forested wetlands, river terraces and floodplain forests throughout the county.

In St. Louis County, MBS will focus survey work in the two remaining subsections in the county: the Littlefork-Vermillion Uplands and Border Lakes. MBS has completed field surveys in much of St. Louis County during

previous biennia. Data entry and mapping of sites and native plant communities will continue for all portions of the county. Animal surveys will be completed in this biennium.

The baseline survey for aquatic lake plants will continue with this biennium's focus in the central part of the state. Lakes to be surveyed will include a mix of high quality lakes with a high probability of rare plant populations and lower quality lakes that are predicted to have lower potential for rare species but have never been surveyed. Lake plant species lists are used for the Index of Biotic Integrity assessments of Minnesota lakes and are available on Lakefinder on the DNR Website.

MBS continues to make progress mapping native plant communities and sites for areas where MBS is complete. This work often requires limited but very specific field survey to address mapping questions. During this biennium, field survey to inform mapping efforts may occur in Crow Wing, Cass, Itasca, St. Louis, Lake, Cook, and Beltrami counties.

Summary Budget Information for Activity 1:

ENRTF Budget: $ 593,778
Amount Spent: $ 593,778
Balance: $ 0

Outcome	Completion Date
1. Baseline field survey Lake of the Woods County – bring to 100% complete.	June 2020
2. Baseline field survey St. Louis County – bring to >90% complete.	June 2020
3. Baseline field survey Koochiching County – bring to >25% complete.	June 2020
4. Baseline field survey for aquatic (lake) plants – ~125 lakes in 8 counties.	Ongoing
5. Ground truthing and verification for native plant community mapping.	Ongoing

Project Status as of December 31, 2017

Field Surveys

MBS field surveys prioritized filling county and state distributional gaps for native and rare plant species, rare animals, and native plant communities in Lake of the Woods, Koochiching, and St. Louis counties. 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*.

Baseline field survey Lake of the Woods County

Field surveys for native and rare moths occurred in numerous sites in Lake of the Woods and Koochiching counties from July-October. Efforts yielded many new and interesting records; highlights include several new localities for moth Species of Greatest Conservation Need including *Boloria chariclea* and *Xestia mixta*. At least one species not previously documented in Minnesota was discovered, an extreme boreal species, *Xestia imperita*.

Baseline field survey St. Louis County

MBS collaborated with the Superior National Forest through a cost-share agreement to collect vegetation plots in mutually beneficial locations in St. Louis County. 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 34 relevés as part of this collaboration during this reporting period. Plant communities sampled included wet cedar forest, black ash swamp, forested rich peatland (black spruce and tamarack), floodplain forest, poor fen, and northern boreal-conifer mesic forest. MBS plant ecologists also provided training to SNF staff on plant ID, vegetation sampling methods, and vegetation classification.

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 (i.e. county records). 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 (Table 1).

Table 1. MBS rare and unique plants documented, St. Louis County, July-Sept 2017		
Cardamine pratensis	*Gypsophila spp.*	*Ranunculus lapponicus*
Carex prairea, Carex pellita	*Hudsonia tomentosa*	*Scirpus hattorianus*
Cypripedium arietinum	*Lycopodium dendroideum*	*Sisyrinchium montanum var. montanum*
Eleocharis cf. mamillata subsp.mamillata	*Pilea fontana*	*Trichocolea tomentella*

Baseline field survey Koochiching County

Koochiching County on the whole has been under-sampled for native plant species. MBS is making efforts to collect and provide voucher specimens for as many county records as possible. Highlights from this period are provided in tables 2 and 3 below.

Table 2. MBS state-listed plants documented, Koochiching County, July-Sept 2017		
Caltha natans	*Cladium mariscoides*	*Ranunculus lapponicus*
Cardamine pratense var *palustris*	*Drosera anglica*	*Shepherdia Canadensis*
Carex exilis	*Malaxis monophyllos* var. *brachypoda.*	*Utricularia gibba*

Table 3. MBS county record plant collections, Koochiching County, July-Sept 2017		
Agalinis tenuifolia	*Cystopteris bulbifera*	*Micranthes pensylvanica*
Agastache foeniculum	*Dasiphora fruticosa*	*Monarda fistulosa*
Amerorchis rotundifolia	*Desmodium canadense*	*Monotropa hypopitys*
Anthoxanthum hirtum	*Diphasiastrum complanatum*	*Osmorhiza longistylis*
Apios americana	*Epipactis helleborine*	*Pedicularis lanceolatus*
Asclepias incarnate	*Euphrasia cf stricta*	*Physostegia virginiana*
Bidens vulgata	*Gentianopsis cf procera*	*Platanthera orbiculata*
Caltha natans	*Gratiola neglecta*	*Smilax ecirrhata*
Carex chordorrhiza	*Helenium autmnale*	*Smilax lasioneura*
Carex magellanica	*Helenium autumnale*	*Spinulum canadense*
Carex tuckermanii	*Juncus cf alpinoarticulatus*	*Symphyotrichum laeve*
Chenopodium capitatum	*Lilium philadelphicum*	*Symplocarpus foetidus*
Chrysosplenium americanum	*Maianthemum racemosa*	*Vitis riparia*
Corallorhiza striata	*Maianthemum stellatum*	*Zanthoxylum americanum*
Cypripedium parviflorum var. pubescens		

Koochiching County on the whole is under-sampled for relevés. MBS is making efforts to place as many vegetation plots as possible in selected locations within the county to better understand the distribution, composition and classification of plant communities across northern Minnesota. MBS collected 53 relevés in during this period in a wide range of native plant communities (Table 4) that included old-growth examples of wet-mesic boreal hardwood forest and terrace forest.

Table 4. Native plant communities with MBS relevé collections, Koochiching County, July-Sept 2017		
Northern poor confer swamp (APn81b)	Northern terrace forest (FFn57)	Northern Jack Pine – Black Spruce Woodland (Sand) (FDn32d)

Northern cedar swamp (FPn63)	Northern wet ash swamp (WFn55)	Northern mesic mixed white pine – red pine forest (FDn43a)
Northern rich tamarack swamp (water track) (FPn81)	Northern rich mesic hardwood forest (MHn47)	Northern sedge wet meadow (WMn82b)
Northern rich spruce swamp (water track) (FPn71)	Northern wet-mesic Boreal Hardwood-Conifer Forest (MHn44)	Northern willow-dogwood shrub swamp (WMn82a)
Northern rich tamarack swamp (western basin) (FPn82)	Northern mesic hardwood forest (MHn35)	Northern rich fen (water track) (OPn91)
Northern wet cedar forest (WFn53)	Northern wet-mesic hardwood forest (MHn46)	Northern extremely rich spring fen (OPn93a)
Northern wet alder swamp (WFn74)		

Baseline field survey for aquatic (lake) plants

MBS aquatic plant and plant community surveys occurred in 27 lakes among Washington, Isanti, Kandiyohi, Meeker, Pope, and Wright counties. Rare and notable plant species documented, many of them from multiple lakes, are listed in Table 5 below.

Table 5. MBS rare aquatic plants documented, July-Sept 2017		
Decodon verticillatus	*Ruppia cirrhosa*	*Hippuris vulgaris*
Ruppia cirrhosa	*Najas marina*	*Heteranthera dubia*

MBS aquatic plant surveys target high quality, least disturbed lakes or portions of lakes where native species dominate. In the course of this work MBS botanists are among the earliest detectors of non-native invasive aquatic plant species in areas not known to have invasives. A MBS lake survey on Pleasant Lake, Wright County, resulted in a new record of *Myriophyllum spicatum*, a listed invasive species in MN, while MBS lake surveys in Lake Minnewaska, Pope County, resulted in a new discovery of *Nitellopsis obtusa*, a listed invasive species in MN. MBS reports these observations to the DNR invasives species program and database.

Ground truthing and verification for native plant community mapping.

MBS also conducted select ground-verification of native plant communities to inform GIS mapping of native plant communities in Koochiching, St. Louis, Itasca, Cass, Crow Wing, Pine, and Aitkin counties. MBS surveyed river terraces and floodplains, forested swamps, rock outcrops/woodlands, old-growth forests, young fire-origin jack pine forests, lakeshores, ephemeral wetlands, wild rice marshes, and rich forested swamps and peatlands were targeted during this reporting period.

Project Status as of June 30, 2018

1. Baseline field survey Lake of the Woods County

Remaining field surveys for Lake of Woods County are restricted to the Northwest Angle. This area will be targeted for final field surveys in 2019 thereby bringing this county to completion. See also Activity 2 update for moth surveys in Lake of the Woods County. Data work reported in Activity 3 included Lake of the Woods County data.

2. Baseline field survey St. Louis County

The MBS lead ecologist for St. Louis County has been on extended medical leave due to contracting a tick-borne illness. Field surveys here will resume in later 2018 and extend into 2019. See also Activity 2 for update on rare plant monitoring in St. Louis County. Data work reported in Activity 3 includes St. Louis County data.

3. Baseline field survey Koochiching County

Preparation 2018 for field surveys included summarizing current relevé records in the county and identifying deficiencies to target for 2018. These include cedar-dominated MHn44c, MHn35, MHn46, FFn67, high-quality FDn, and rock outcrops, "cedar barrens", confusing ecotonal transitions, riparian NPCs, and DNR designated old-growth forests. Priorities were set for rare plant species surveys with targets including *Cypripedium arietinum*, *Caltha natans*, *Nymphaea leibergii*, *Malaxis paludosa*, *Shepherdia canadensis,* ferns and fern allies, aquatic and shoreline species, and county record voucher specimens. All aquatics and most common plants have been under-collected in the county.

Field surveys started in early June concentrating on relevé collection and floristic surveys in rock outcrop communities (rare in the county), mesic hardwood forests (limited intact occurrences in the county), ecotones between MHn forests and other NPC types. Priority species searches include early-flowering sedges and forbs not previously collected in county and the elusive *Cypripedium arietinum.*

Plant specimen collections included county and sub-county records *Viola cucullata, Carex umbellata,* and *Corallorhiza striata.* Rare plant searches discovered new locations for *Ranunculus lapponicus* (Special Concern) and two new populations of *Cardamine pratensis* (Threatened).

Relevé collection included documentation of FPn62, which extends the known distribution of this NPC much farther west than previously known, along with FDn33a, FDn33b, FDn43c, FPn81, FPn81/82, MHn44a, MHn44c, OPn91a, WFn53, and WFn64.

4. Baseline field survey for aquatic (lake) plants

Preparation for 2018 field surveys involved a new MBS aquatic botanist who assumed this position recently, replacing the previous MBS aquatic botanist who had been in that for 20 years. Much of the off-season work involved reviewing MBS aquatic plant work over the past 20 years, reviewing herbarium aquatic plant collections, and talking with others with knowledge on aquatic plants and lakes. Specific focus was placed on reviewing data and information on central Minnesota lakes, aquatic plant communities, and rare aquatic plants.

Field surveys occurred in June focused on smaller lakes with suspected moderate to high aquatic plant diversity or high potential for rare aquatic plants such as *Utricularia purpurea, Najas marina,* and *Ruppia cirrhosa.* Surveys were completed for Deer Lake and Goose Lake in Wright County and Minnesota Lake and Willie Lake in Meeker County. Results from 2018 aquatic plant surveys will be reported in the next update.

5. Ground truthing and verification for native plant community mapping.

During this reporting period, MBS did not conduct select ground-verification of native plant communities to inform GIS mapping of native plant communities. Desktop GIS mapping of native plant communities continued in Koochiching, St. Louis, Itasca, Cass, Crow Wing, Pine, and Aitkin counties. Ground verification for NPC mapping is likely to occur later in the 2018 field season.

Project Status as of January 31, 2019

1. Baseline field survey Lake of the Woods County

Remaining field surveys for Lake of Woods County are restricted to the Northwest Angle. This area will be targeted for final field surveys in 2019. See also Activity 2 update for moth surveys in Lake of the Woods County. Data work reported in Activity 3 includes Lake of the Woods County data.

2. Baseline field survey St. Louis County

The MBS lead ecologist for St. Louis County continued to be on extended medical leave due to contracting a tick-borne illness. Field surveys here were limited in 2018. See also Activity 2 for update on rare plant monitoring in St. Louis County. Data work reported in Activity 3 includes St. Louis County data.

Collaborative work with the Superior National Forest continued from previous reporting periods. This work combines mutual priorities among MBS and the SNF to fill gaps in vegetation plot (relevé) distribution. Filling these data gaps is important to MBS efforts to completely classify and map native plant communities in the state and the SNF's similar goal within their boundaries. Twelve relevés were collected by MBS for this project during this reporting period. Relevés were collected from vegetation types that do not fit neatly into DNR's existing native plant community classification.

3. Baseline field survey Koochiching County

Significant progress was made on botanical and vegetation field surveys in Koochiching County. Collaboration occurred among MBS and Voyageurs National Park to complete initial MBS surveys within VNP.

Field surveys of native plant communities (NPCs) focused on wet forests, peatlands, mesic hardwood forests, fire-dependent forests, and islands and shorelines of Rainy Lake and the Bigfork River. Many sites comprised NPCs that are under-surveyed in the county or for which classification is unique or currently unclear for the geography (e.g., MHn46). MBS collected 46 relevés among 18 different native plant communities in Koochiching County during this reporting period.

Table. Native plant communities documented in Koochiching County by MBS with relevés

APn81b	MHn44b	RVx32
FDn43a	MHn44c	WFn53
FFn57	MHn44/46	WFn64a
FPn62/63	MHn46b	WFn64c
FPn63	OPn81a	WMn82a
MHn44a	OPn91a	WMn82b

One site of particular note is Grassy Island, a privately owned island run as a camp that contains old-growth pine woodland. Both pine woodlands and old-growth forests are rare and unusual in Koochiching County.

Vegetation along river shores and on terraces adjacent to rivers proved to be confounding compared to similar settings elsewhere in Minnesota – part of the reason is the presence this far north in Minnesota of a flora that includes a significant number of central Minnesota plant species.

Field surveys for native and rare plant species in Koochiching County continue to document with specimens county and sub-county records of common and uncommon native plants. Many interesting plant species were documented in ecotonal margins between more common native plant communities.

Table. State-listed plant species documented in Koochiching County by MBS

Caltha natans (THR)	*Drosera linearis* (SC)	*Ranunculus lapponicus* (SC)
Cardamine pratensis subsp. palustris (THR)	*Malaxis monophyllos* (SC)	

Table. County record plant species documented in Koochiching County by MBS

Agrimonia gryposepala	*Crataegus submollis*	*Oenothera parviflora var. oakesiana*
Calystegia sepium	*Eleocharis mamillata*	*Osmunda regalis*
Celtis occidentalis	*Festuca saximontana var. saximontana*	*Ranunculus hispidus var. caricetorum*
Cerastium arvense subsp. strictum	*Leucophysalis grandiflora*	*Solanum dulcamara*
Chrysosplenium americanum	*Liatris sp*	*Stuckenia pectinata*

Table. Sub-county record plant species documented in Koochiching County by MBS

Arethusa bulbosa	*Desmodium canadense*	*Malaxis uniflora*
Bidens frondosa	*Elodea canadensis*	*Mertensia paniculata*
Carex comosa	*Elymus wiegandii*	*Monotropa hypopitys*
Carex diandra	*Epipactis helleborine*	*Myriophyllum sibiricum*
Carex limosa	*Festuca subverticillata*	*Potamogeton richardsonii*
Carex siccata	*Geocaulon lividum*	*Pyrola chlorantha*
Carex tuckermanii	*Goodyera repens*	*Spartina pectinata*
Cerastium fontanum subsp. *vulgare*	*Glyceria grandis* var. *grandis*	*Stachys palustris* var. *pilosa*
Ceratophyllum demersum	*Lonicera oblongifolia*	*Trichophorum alpinum*
Cornus racemosa	*Lonicera villosa*	*Utricularia vulgaris*
Cryptotaenia canadensis		

4. Baseline field survey for aquatic (lake) plants

Aquatic plant surveys in Kandiyohi, Meeker, and Wright counties were conducted on smaller lakes with suspected moderate to high diversity and/or high probability to contain rare plants. Most surveys were conducted by kayak and shoreline wading with lesser amounts by motorboat.

Table. Lakes targeted for native and rare aquatic plant surveys by MBS

Kandiyohi County	Meeker County	Wright County	Sherburne County
Bass Lake	Arvilla Lake	Moose Lake*	Ann Lake*
Elkhorn Lake	Erie Lake		
Henderson Lake	Little Swan Lake		
Long Lake	Manuella Lake		
Willmar Lake	Round Lake		

* The uncommon *Schoenoplectus subterminalis* documented, a county record for both counties. Ann Lake was targeted for survey upon a tip provided by DNR aquatic invasive plant survey crews.

Surveys at public water accesses were completed during the course of scouting lakes for future survey in Kandiyohi County. Rare plant species such as *Najas marina* and *Ruppia cirrhosa* can be found in fragments near the shoreline. Lakes included: Ringo Lake, George Lake, Games Lake, and Norway Lake.

Continued to collect aquatic plants during surveys and pressed them for preservation and eventual UMN Bell Museum herbarium ascension. One collecting focus was on *Characeae* specimens to fill major gaps in their known distribution in the state.

Water chemistry samples were collected from lakes with the endangered aquatic plant *Utricularia purpurea*. Lakes sampled included Blue and Four lakes in Aitkin County and Fool Lake and Placid lakes in Crow Wing County. These same lakes offered convenient opportunity to make collections of under-sampled *Isoetes* spp. that fill notable gaps important to a forthcoming fern and fern allies book by MBS.

Aquatic plant community surveys in the nearshore, shallow depth zone focused on larger recreation lakes in the North Fork Crow River Watershed (this watershed chosen to coincide with MPCA/DNR watershed assessments and planning here) in Kandiyohi, McLeod and Meeker counties. These quantitative surveys consist of 20-25 survey plots (5m x 5m each) per lake that are systematically and equally spaced along shoreline. At each plot all plant species are recorded along with water depth and lake substrate type.

Table. Lakes targeted for native aquatic plant community nearshore surveys by MBS

Kandiyohi County	McLeod County	Meeker County	Pope County

Calhoun Lake* Diamond Lake Nest Lake	Hook Lake	Big Swan Lake Jennie Lake Ripley Lake	Grove Lake**

* new records of the rare aquatic plant species *Ruppia cirrhosa* and *Najas marina.*
** new record of the rare aquatic plant species *Najas marina.*

This systematic sampling was supplemented with species lists generated by subjectively chosen points in deeper water or areas where we observed or suspected other aquatic plant species to be found. These surveys turned up new rare species observations for a few lakes and contribute to broader efforts by the DNR Lake IBI Unit and MBS Unit to develop a MN native aquatic plant community classification.

5. Ground truthing and verification for native plant community mapping.
During this reporting period, MBS conducted select ground-verification of native plant communities to inform GIS mapping of native plant communities in Crow Wing, Cass, and Anoka counties. Desktop GIS mapping of native plant communities continued in Koochiching, St. Louis, Itasca, Cass, Crow Wing, Pine, and Aitkin counties.

Project Status as of July 31, 2019
1. Baseline field survey Lake of the Woods County
See also Activity 2 update for moth surveys in Lake of the Woods County.
No updates at this time.

2. Baseline field survey St. Louis County
Collaborative work with the Superior National Forest continued from previous reporting periods. This work combines mutual priorities among MBS and the SNF to fill gaps in vegetation plot (relevé) distribution. Filling these data gaps is important to MBS efforts to completely classify and map native plant communities in the state and the SNF's similar goal within their boundaries. Five relevés were collected by MBS for this project during this reporting period. Relevés were collected from vegetation in FDn32 and FDn43 forest types that do not fit neatly into DNR's existing native plant community classification. NRCS soil scientists joined plant ecologists during field sampling and provided rigorous soil profile descriptions for each relevé plot.

Botanical field surveys were completed in areas of far northern St. Louis County and adjacent Lake County in forested areas that are regenerating from major wildfire (Pagami Creek Fire) that occurred within the past decade. Of particular note was the discovery of new locations of a very rare plant species, *Phacelia franklinii* (threatened), that is known to occupy burned over areas but slowly disappears over time as the forest grows up.

Work also focused on lake aquatic plant surveys in several lakes yielding aquatic plant species lists for these lakes and notable new records for *Littorella americana* (special concern), *Cladium mariscoides* (special concern), *Viola lanceolata* var. *lanceolata* (threatened), and *Utricularia resupinata* (threatened).

3. Baseline field survey Koochiching County
See also Activity 2 update for moth surveys in Koochiching County.
No updates at this time.

4. Baseline field survey for aquatic (lake) plants
See also Outcome 2 above.

5. Ground truthing and verification for native plant community mapping
A lot of mapping occurred during the reporting period (see Activity 3) but no ground truthing was needed during the reporting period.

Project Status as of January 31, 2020

1. Baseline field survey Lake of the Woods County

Baseline field surveys focused on documenting larval amphibian diversity and targeted searches for newts. See also Activity 2 update for moth surveys in Lake of the Woods County.

2. Baseline field survey St. Louis County

Collaborative work with the Superior National Forest continued from previous reporting periods. This work combines mutual priorities among MBS and the SNF to fill gaps in vegetation plot (relevé) distribution. Filling these data gaps is important to MBS efforts to completely classify and map native plant communities in the state and the SNF's similar goal within their boundaries. Soil scientists with NRCS continued their work with MBS vegetation ecologists and SNF staff to provide detailed soil profile descriptions for each relevé plot. 15 relevés w/ soil profiles were completed across multiple Land Type Associations and slope gradients targeting questions around differences among FDn32, FDn43, and MHn44 forest classification units.

3. Baseline field survey Koochiching County

See also Activity 2 update for moth surveys in Koochiching County.
No updates at this time.

4. Baseline field survey for aquatic (lake) plants

Aquatic plant surveys conducted on lakes in Pope, Stevens, and Swift counties. Surveys focused on moderate to high quality lakes with a probability to contain rare plants and lower quality lakes that have not been surveyed. Aquatic plant species lists were completed for each lake and notable rare botanical finds and county records as follows:

Pope County

- Amelia Lake: new records for *Alisma gramineum*, *Ruppia cirrhosa*, and *Najas marina*
- Emily Lake: county record of *Potamogeton crispus*
- Scandinavian Lake: new record for *R. cirrhosa*
- Villard Lake: new record of *A. gramineum* and a county record of *A. gramineum*
- Gilchrist Lake: county records of *Potamogeton amplifolius* and *P. nodosus*
- Nelson Lake: new record for *R. cirrhosa*
- Westport Lake: county record of *Nymphaea odorata*
- Ann Lake, Johanna Lake, Leven Lake: surveys completed but no rare species or county records documented

Stevens County

- Charlotte Lake: no rare species or county records documented
- Long Lake: county record of *P. crispus*
- Page Lake: county record of *Zannichellia palustris*
- Hattie Lake, Perkins Lake: surveys completed but no rare species or county records documented

Swift County

- Camp Lake: county records of *P. zosteriformis, Myriophyllum sibiricum, Heteranthera dubia,* and *P. praelongus*
- Hassel Lake: county record of *Utricularia vulgaris*
- Oliver West Lake: county record of *P. crispus*
- Oliver East Lake, Hollerberg Lake, Johnson Lake, Spring Lake: surveys completed but no rare species or county records documented

5. Ground truthing and verification for native plant community mapping

A lot of mapping occurred during the reporting period (see Activity 3) but no ground truthing was needed during the reporting period.

Activity 1 Status as of July 31, 2020:

1. Baseline field survey Lake of the Woods County

See also Activity 2 update for moth surveys in Lake of the Woods County.
No other accomplishments for this outcome during the reporting period.

2. Baseline field survey St. Louis County

Collaborative work with the Superior National Forest continued from previous reporting periods. This work combines mutual priorities among MBS and the SNF to fill gaps in vegetation plot (relevé) distribution. Filling these data gaps is important to MBS efforts to completely classify and map native plant communities in the state and the SNF's similar goal within their boundaries. Field sampling was put on hold for the 2020 field season due to the pandemic. Project staff are instead redirecting their time on this project to related data analysis, mapping, and planning future field work priorities.

3. Baseline field survey Koochiching County

See also Activity 2 update for moth surveys in Koochiching County.
No other accomplishments for this outcome during the reporting period.

4. Baseline field survey for aquatic (lake) plants

Continued 2020 field work planning which consists of compiling a list of lakes to survey in priority counties (Chisago, Ramsey, Washington). To establish priority lakes to survey we consider water clarity data, lake profiles, on-site and nearby aquatic rare species records and charophyte collections, distribution gaps in taxa, etc.

- Field work planning included coordination with DNR Lake Ecology Unit on collecting plant material for a genetic study on *Nelumbo* and *Sagittaria* populations as encountered incidentally through planned field work.
- Began field work in late June – later than normally planned due to COVID-related restrictions on travel, field work, etc.
- Conducted aquatic plant surveys on lakes in Chisago) and Lower St. Croix River:
    - Horseshoe Lake, Chisago County (meander survey)
        - County record of *Zannichellia palustris*
    - Fish Lake, Chisago County (meander survey)
        - County record of *Potamogeton friesii*
    - Rabour Lake, Chisago County (meander survey)
    - Mandall Lake, Chisago County (meander survey)
- Field visits to lakes to collect charophytes, as part of an ongoing collaborative project with NYBG to fill gaps in charophyte distribution in MN, at the following lakes:
    - Little Horseshoe Lake, Chisago County
    - Skogman Lake, Isanti County.

Planning for 2020 aquatic plant surveys included starting the hiring process for a summer internship position. We received 62 intern applications. Internship was offered but subsequently put on hold due to COVID-related State hiring freeze.

5. Ground truthing and verification for native plant community mapping

A lot of mapping occurred during the reporting period (see Activity 3) but no ground truthing was needed during the reporting period.

Activity 1 Status as of January 31, 2021:

As of June 30, 2020, work on Activity 1 is complete in terms of this work plan and budget (most outcomes continue on the ENRTF ML19 MBS Work Plan). The remainder of this work plan through its completion of June 30, 2021 will be directed to Activities 3 and 4.

Final Report Summary: Submitted between June 30 and August 1, 2021.
MBS field surveys prioritized filling county and state distributional gaps for native and rare plant species, rare animals, and native plant communities in Lake of the Woods, Koochiching, and St. Louis counties. 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*.

MBS collaborated with the Superior National Forest through a cost-share agreement to collect vegetation plots in mutually beneficial locations in St. Louis County. 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 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 (i.e. county records). 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.

MBS aquatic plant surveys occurred in dozens of lakes in several central Minnesota counties. Rare and notable plant species were documented, many of them from multiple lakes. MBS aquatic plant surveys target high quality, least disturbed lakes or portions of lakes where native species dominate. In the course of this work MBS botanists are among the earliest detectors of non-native invasive aquatic plant species in areas not previously known to have invasive species.

MBS also conducted select ground-verification of native plant communities to inform GIS mapping of native plant communities in Koochiching, St. Louis, Itasca, Cass, Crow Wing, Pine, and Aitkin counties. MBS surveyed river terraces and floodplains, forested swamps, rock outcrops, woodlands, old-growth forests, young fire-origin jack pine forests, lakeshores, ephemeral wetlands, wild rice marshes, and rich forested swamps and peatlands.

ACTIVITY 2: Targeted Field Surveys

Description: This work is distinct from Activity 1 (i.e. it is not part of the statewide systematic baseline survey) and occurs in different locations than where Activity 1 occurs (see map). Activity 2 focuses field survey in specific locations to collect and deliver field survey data and provide analysis on select native plant communities, sensitive species, or pollinators. This work delivers new data and analysis that either 1) add value to existing ENRTF investments in data collection and analysis or 2) address foundational needs in Minnesota science and collaborative plans and projects.

Field survey needs in Minnesota have been highlighted in a number of initiatives such as the Minnesota Prairie Conservation Plan, Minnesota Wildlife Action Plan, and third-party Forest Certification. For example, in the prairie region vegetation surveys in high quality prairie sites provide a basis from which to assess the effect of cattle grazing on native vegetation and rare species. Previous work in this area has revealed the presence and biodiversity values of wetland complexes within the prairie matrix. These prairie wetlands are under-surveyed and not yet adequately described in DNR's native plant community classification.

During this biennium, MBS staff will target prairie wetlands on end moraines and glacial river terraces in Big Stone, Swift, Chippewa and Lac Qui Parle counties. Vegetation plots (relevé), rare species searches, and mapping are the priority tasks. These activities will help identify significant natural areas, locate sites for monitoring the effects of cattle grazing in prairie wetlands, and improve ecological classification of prairie wetland plant communities.

Vegetation and rare species surveys in previously undocumented prairie sites will continue to provide new data that improves scientific understanding, expands the known extent of Minnesota prairie, and provides critical contributions to achieving the goals of the collaborative-based Minnesota Prairie Conservation Plan. About 200 sites in 14 counties will be visited during this biennium.

Surveys will be conducted throughout the prairie region of Minnesota to continue documenting and monitoring the extent, status and range of small white lady's slippers in Minnesota. This will include surveying new sites, resurveying and updating old sites, and follow-up surveys at sites where management activities have occurred. MBS will compile data on population size, associated habitat, invasive species, and other observed activities or conditions that may be impacting populations. This work will continue the statewide effort to assess the state's population of small white lady's slippers. Minnesota holds the world's largest concentration of this rare and sensitive species by a large margin. Volunteers from across the state provide invaluable field survey assistance with this project.

Targeted surveys will be conducted in MBS sites in northern, central and southeast Minnesota where the baseline MBS survey was done ten or more years ago. Outstanding and high biodiversity sites with high potential to support rare species populations will be visited in order to document and map native plant communities and rare species with greater precision than was possible in the past. This is now possible because of better technology (GPS units and LiDAR) and better digital imagery. In addition, now that baseline surveys have been completed for major sections of the state, MBS has developed a more comprehensive landscape perspective that helps to target some of the most significant sites with focused, detailed surveys. The information will be used to assist landowners and managers with protection, management and restoration of these sites, and to broaden our understanding of rare species populations and native plant communities. This work is also relevant to achieving sustainable forest management in Minnesota and will assist multiple public and private forest land owners and managers in their efforts to maintain third-party certification of their forest lands.

MBS will add two entomologists to the program to focus on targeted field survey of insects and insect pollinators in native plant communities, sites of biodiversity significance, and other priority insect survey

locations. The new entomologists will expand work with moths and butterflies and/or establish new surveys for under-sampled insect taxa (e.g. beetles or flies). The work will be new and distinct from other MBS insect and pollinator projects (e.g. wild bees, imperiled butterflies). Precise plans for field survey will be developed based on the specific entomologists hired and their area(s) of expertise in combination with broader MBS priorities as outlined in this work plan and MBS program plans. Specific plans for this Outcome will be provided in the first Work Plan activity update.

Summary Budget Information for Activity 2:

ENRTF Budget: $ 472,217
Amount Spent: $472,217
Balance: $ 0

Outcome	Completion Date
1. Targeted, plant and vegetation field surveys in high-quality prairie wetland complexes in Lac qui Parle, Big Stone, Swift, and Chippewa counties.	June 2020
2. Vegetation and botanical field surveys in previously undocumented native prairies, forests and wetlands in the Prairie and Aspen Parklands Province. ~200 sites in 11 counties.	June 2020
3. Sensitive prairie orchid field surveys and volunteer coordination. ~75 sites in 24 counties. >500 volunteer hours.	Ongoing
4. Targeted field surveys of native plant communities and rare species in MBS Sites of Biodiversity Significance. ≥10 sites in SE, east-central and/or northern Minnesota.	June 2020
5. Pollinator (insect) field survey in MBS Sites of Biodiversity Significance.	June 2020

Activity 2 Status as of December 31, 2017

1. Targeted, plant and vegetation field surveys in high-quality prairie wetland complexes.

MBS coordinated with the USFWS and DNR-SNA to establish and sample 40 permanent transects in prairie pothole wetland basins at the Prairie Complex (Prairie WMA, Prairie WPA, and a private Prairie Bank site) and at the Clinton Prairie SNA. Both of these sites are in Big Stone County. Most of the wetlands are little-disturbed wet meadows in excellent condition. Prairie WMA and Prairie WPA are planned for conservation grazing management starting in 2018. The prairie bank site and the SNA will remain ungrazed. These transects will allow the tracking of long-term vegetation change and management effects in wet meadows in prairie potholes.

MBS coordinated with DNR groundwater hydrologists to conduct site visits to potential calcareous fens in SW Minnesota. Calcareous fens were confirmed in Big Stone County and Blue Mounds State Park. Field survey in both calcareous and non-calcareous fen sites included hydrology and vegetation data collection to help improve understanding of groundwater-rare plant species relationships in fens.

2. Vegetation and botanical field surveys in previously undocumented native prairies, forests and wetlands in the Prairie and Aspen Parklands Province.

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.

MBS prairie vegetation and botanical surveys during this reporting period focused on and near Minnesota Prairie Plan Core Areas in Lac Qui Parle, Big Stone, Chippewa, western Swift and Traverse counties. Vegetation surveys targeted sites in 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. Noteworthy results include significant additions to the documented acreage of 1) saline wet prairie and wet meadows in the western portion of Lac qui Parle County and 2) saline wet prairie, dry prairie, and mesic prairie in southern Big Stone County and 3) the collection of 20 new prairie vegetation plots (relevés).

MBS vegetation and botanical surveys were completed in Godwit Prairie, Polk County, a large area in two main ownerships, this is one of the largest areas of privately-owned prairie left in Minnesota. The most well-drained prairie in one of the two ownerships has been significantly degraded by cattle grazing since MBS last surveyed it in 1993; the other ownership still has outstanding prairie where it hasn't been mined for sand and gravel. It is still a significant site for conservation action.

3. Sensitive prairie orchid field surveys and volunteer coordination.

Western Prairie Fringed Orchid (*Plantanthera praeclara*)

The intensity and results of this project are critically enhanced by the help of 14 volunteers donating over 300 hours. Contributions from this ML17 LCCMR appropriation cover travel expenses for the volunteers, a critical element in recruiting and retaining high quality volunteers. This project leverages state and federal funds to collectively enhance outcomes.

Accomplishments include 1) annual census monitoring of the species across the state in conjunction with The Nature Conservancy, US Fish and Wildlife Service, the National Park Service, and private landowners and 2) demographic monitoring at four locations across the latitudinal gradient of the species' range in the state (Lake Bronson SNA, Crookston Prairie SNA, Burnham WMA, and Blue Mounds State Park); and 3) a project report, "Summary of 2017 *Platanthera praeclara* Recovery Activities". This report is available from MBS upon request.

In conjunction with North Dakota State University, completed a preliminary trapping of the moth pollinators of western prairie fringed orchid. Five moths were collected during the one week sampling period. All of the moths were the bedstraw hawk moth (*Hyles gallii*). This is a native moth found in Eurasia and North America. In terms of conservation it is considered a secure species, though could be considered rare in parts of its extensive range. This species has not previously been collected over a prairie fringed orchid in Minnesota or North Dakota. One of the Minnesota moth collections had western prairie fringed orchid pollinia attached to its eyes, this may be the first time the species has been collected in the state with attached pollinia.

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 during summer months preceding this reporting period. MBS compiled survey information in a report, "2017 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.

4. Targeted field surveys of native plant communities and rare species in MBS Sites of Biodiversity Significance.

Southeast Minnesota: Fillmore and Winona counties

MBS plant and vegetation field surveys in Outstanding Biodiversity sites, Rushford Sand Barrens in Fillmore County and Whitewater South Fork in Winona County, delivered important new information on several rare plant records greater than 20 years old, new rare species locations, and numerous plant collections of rare and

county record species. New records included the following species: *Agastache neptoides, Asclepias amplexicaulis, Woodsia obtusa, Deparia acrostichoides, Sanicula trifoliata, Panax quinquefolius.* Updates to the existing records >20 years old included *Dryopteris filix-mas, D. marginalis, Asplenium platyneuron, Asclepias amplexicaulis, Hieracium longipilum.* A new location of old-growth forest was documented that contained 160+ year old red and white oaks, was free of the invasive tree, buckthorn (an increasing rarity in SE MN), and with occurrences of the rare species, *Sanicula trifoliata* and *Panax trifolius.* Field surveys were completed for the purpose of relocating previous occurrences of rare ferns providing approximately 15 useful updates to existing records and 10 new documented occurrences. This is important work towards an eventual MBS project, a *Ferns of Minnesota* book.

East-Central Minnesota: Banning State Park, Pine County

MBS botanical and vegetation work was focused in Sites of Biodiversity Significance in and adjacent to Banning State Park and the Kettle River in central Pine County. Notable highlights include documentation of a large population of *Gaylusaccia baccata* and a county record specimen of *Vaccinium cespitosum*.

Northern Minnesota, Nemadji State Forest, Carlton and Pine counties

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 botanical surveys this period documented three new occurrences of the rare fern, *Sceptridium oneidense.* MBS collaborates in this effort with DNR Forestry, Wildlife, and Ecological & Water Resources.

St. Louis County

Northern forest sites (wet cedar and wet spruce native plant communities) in St. Louis and Itasca counties with occurrences of the rare Western Jacob's-ladder (*Polemonium occidentale* subsp. l*acustre*) were surveyed to set the groundwork to monitor population viability over time. This state-endangered species is known to occur in only 6 sites worldwide, all of which occur in Minnesota (4) and Wisconsin (2). This effort is in collaboration with the University of Minnesota Landscape Arboretum, which is focusing on genetic analysis and greenhouse growth trials, and the St. Louis County Lands and Minerals Department, who provides access and permission for permanent plot establishment on lands they administer.

Data collection included population counts, mapping new occurrences, and estimating areal extent. MBS consulted with biometricians on study design to produce sample frames for all four MN populations and randomized sample points across all four populations. Pilot monitoring was initiated in two of Minnesota's four populations, both in St. Louis County: the Polemonium Bog and the Leander Site. Work included field evaluation of more than 45 randomized sample points and establishment of 21 permanent plots; testing of various population metrics and data collection in permanent plots including: presence/absence, density (tested in multiple quadrats of varying dimensions), percent cover using line intercept methodology and number of flowering stalks per macroplot/quadrat; data collection in small demographic study plot where putative discrete genets will be monitored over time; and coordinating volunteer help.

5. Pollinator (insect) field survey in MBS Sites of Biodiversity Significance.

NW Minnesota

Several sites were surveyed in eastern Roseau County in July and October as part of efforts to document moth communities following a natural wildfire in jack pine.

Numerous sites were surveyed in Kittson County rare moths and butterflies. Unfortunately, this was the 3rd consecutive year of negative results for all target prairie skippers; it appears that they have been extirpated

from the region. Despite these negative results, several unusual prairie moths (including potential new state records) were documented during the surveys.

SE and East-central Minnesota

Numerous sites were surveyed from July-October in southeastern (Houston, Winona counties) and north central Minnesota (Carlton, Aitkin, St. Louis, Itasca counties) in MBS Sites of Biodiversity Significance. Efforts yielded many new and interesting records; highlights include a multitude of new regional records, and at least a couple new state records (e.g. *Papaipema marginidens*).

Three sites were also surveyed in October (Olmsted, Beltrami, Kittson counties) as part of LTEMN funded surveys. The main purpose was to test sampling protocol, which was successful. Numerous new county records were documented in the process, including a rare tropical stray sphinx moth, *Erinnyis ello*.

Activity 2 Status as of June 30, 2018

1. Targeted, plant and vegetation field surveys in high-quality prairie wetland complexes.

MBS surveys and installation of permanent monitoring transects in prairie wetlands continued from last reporting period. MBS collaborated with DNR hydrologists to measure the depth below high water mark for wetland complexes that are subject to cattle grazing. Previous work has led to a hypothesis that wetland depth may be a controlling factor in wetland vegetation response to cattle grazing. Surveys were completed in and adjacent to Clinton Prairie SNA and Victory WMA in Big Stone County.

2. Vegetation and botanical field surveys in previously undocumented native prairies, forests and wetlands in the Prairie and Aspen Parklands Province.

Planning for 2018 field surveys focused on a section-by-section air photo interpretation, establishing survey priorities, collecting ownership information for sites, reviewing site notes and maps for sites previously surveyed by MBS (in the 1980s) in Ottertail, Douglas, Stevens, Grant and Wilkin counties. Sites that were not surveyed in the past were considered for survey in 2018. 133,000 acres were identified as unsurveyed or undersurveyed throughout these counties. Areas of special interest include: a 6,000 acre prairie and wetland corridor along the Pome de Terre River and, in eastern Ottertail County, large areas of tamarack swamp, rich fen, and fire-dependent forest.

June field surveys focused on calcareous fens, rich fens, wet meadows, wet prairies, and tamarack swamps. 15 plant voucher specimens (county and sub-county records) were collected to document fen vegetation. 8 relevés were collected from previously undocumented native plant communities including 3 relevés located in Anderson WPA in cooperation with the USFWS and DNR groundwater hydrology unit that will be used to monitor the effects of land and water management on fen vegetation.

3. Sensitive prairie orchid field surveys and volunteer coordination.

Western Prairie Fringed Orchid (*Plantanthera praeclara*)

During most the reporting period, accomplishments were made in analyzing data and writing reports for this long-term monitoring effort. MBS worked with external partners to develop phenologic paper on orchid emergence and anthesis and a paper published in *Ecology Letters* on plant dormancy. Field surveys started in late June in northwestern Minnesota – results to be reported in the next update report.

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

Field surveys were completed in sites in west-central and northwestern Minnesota and ongoing at the time of this report – results to be reported in the next update.

4. Targeted field surveys of native plant communities and rare species in MBS Sites of Biodiversity Significance.

St. Louis County

Analysis of data and observations from the 2017 pilot monitoring project for the state-listed species *Polemonium occidentale* subsp. *lacustre* (western Jacob's-ladder) was completed. Planning for future monitoring efforts included an update to the sampling protocol and methodology based on information captured in 2017.

Northern Minnesota, Nemadji State Forest, Carlton and Pine counties

Results from rare species field surveys from the 2017 field season were analyzed and priorities set for 2018 were established. 2018 field surveys were completed in May and June that focused on new data on two rare salamander species, 4-toed salamander and spotted salamander. Field surveys were prioritized in and adjacent to historic spotted and 4-toed salamander records in this landscape. This work is intended to address information gaps critical to the conservation of these species in managed forests including discerning the full extent of discrete populations, the distribution of discrete populations across the landscape (in this case, mesic hardwood forests on the Nickerson end-moraine landform), and salamander-forest habitat relationships.

5. Pollinator (insect) field survey in MBS Sites of Biodiversity Significance

Planning for the 2018 field season was conducted January-April, 2018. Focal areas and focal time periods were identified for 3 different areas in Minnesota: northwest, far north-central, and southeast.

A total of 38 sites were surveyed in Kittson (4 sites), Roseau (5 sites), Lake of the Woods (6 sites), Koochiching (9 sites), Beltrami (7 sites), Clearwater (3 sites), Wabasha (1 site), Winona (1 site), and Olmsted (1 site) counties from April-June, 2018. These sites were surveyed with varying intensities (from brief diurnal searches to multiple visits and intensive sampling) and various methods (diurnal search, UV/MV sheets, UV traps, fermenting fruit baits, and pheromone traps).

Surveys yielded over 3,000 specimens, and include countless new county records, as well as a number of potential new state records. The most significant find was *Lycia rachelae* (Twilight Moth) which is not only a new state record, but fills a major range gap between northern Appalachia/eastern Canada and Canada's Prairie Provinces. Other significant finds include new records for *Lasionycta taigata* (first Beltrami Co. record, and 1 new site in Lake of the Woods Co.), a SCGN species restricted to peatlands in the northern fringe of the state. Also significant was the continued failure to find any prairie skippers in Kittson Co. for the fifth year in a row.

Activity 2 Status as of January 31, 2019

1. Targeted, plant and vegetation field surveys in high-quality prairie wetland complexes.

A team of MBS and The Nature Conservancy ecologists surveyed 64 wetland basins for native and rare plant species and plant communities at Chippewa Prairie, Victory WMA, and Clinton Prairie SNA. This is work continued from previous reporting periods. Sampling involves both resampling previously installed transects per an established monitoring plan relative and establishing new transects and surveys in undocumented prairie wetland complexes.

2. Vegetation and botanical field surveys in previously undocumented native prairies, forests and wetlands in the Prairie and Aspen Parklands Province.

Sites in Ottertail, Douglas, Stevens, Grant and Wilkin counties were targeted for survey in 2018. Priority was placed on visiting the 133,000 acres identified by MBS assessments of the area (see previous update), those sites that were either not surveyed or considered under-surveyed during 1980-90s MBS surveys. Areas of special interest include: a 6,000 acre prairie and wetland corridor along the Pome de Terre River and, in eastern Ottertail County, large areas of tamarack swamp, rich fen, and fire-dependent forest.

August field surveys focused on calcareous fens. Sites visited include Burnsville 27 fen, Mantrap fen (SNA), Viking strip 4, Agassiz Olsen tract, Agassiz Nelson tract, and Anderson WPA fen. This summer's survey of Mantrap fen was an important factor for DNR moving forward with site's designation as a SNA. MBS discovered a previously undocumented calcareous fen at Big Stone Wildlife Refuge.

MBS work continued on Anderson WPA in cooperation with the USFWS and DNR groundwater hydrology unit and regional plant ecologists to monitor the effects of land and water management on fen vegetation. This collaborative team designed and installed a specific monitoring grid at the Anderson fen intended to assess vegetation and hydrology response to cattle grazing.

3. Sensitive prairie orchid field surveys and volunteer coordination.

Western Prairie Fringed Orchid (*Plantanthera praeclara*)

During the 2018 field season, MBS revisited a population on privately owned land (Floan Prairie) for the fourth time since the early 1990s. Using GPS, MBS mapped the extent of this population. We also used GPS to update the spatial distribution of the following sites: Blue Mounds State Park, Foxboro Unit of Pembina Trail Preserve, Marcoux Corners (DOT), Pipestone National Monument, Tympanuchus WMA, and Weber Prairie (private). The results of these surveys are reflected in the 2018 report available upon request.

MBS was contacted by a private individual about two additional sites in Rock County where unknown populations of western prairie fringed orchid could be found. Plants were confirmed at one of these sites near Hardwick, Minnesota. The second site was identified as being in the right-of-way between a county road and railroad near Manley, Minnesota. A goal for the 2019 season is to visit and fully survey these sites.

Annual monitoring was carried out during peak anthesis in 2018 with the help of citizen volunteers. Monitoring is tiered with three levels. There were eight Level I monitoring updates during the project period. Level 1 is essentially updating existing data and databases. Level II, census of flowering plants, was completed by MBS, other DNR staff, volunteers, and various other agencies. Sites are located in Kittson, Mower, Norman, Pennington, Polk, and Rock Counties.

Demographic, monitoring (Level III) occurred at Blue Mounds State Park, Bluestem Prairie (TNC), Burnham Wildlife Management Area WMA, Crookston Prairie Area SNA, and Lake Bronson Parkland SNA. When compared to the observations made in 2017, numbers of both flowering and vegetative plants in monitored plots were similar to those observed at Burnham WMA in 2017, slightly up at Lake Bronson Parkland SNA and Crookston Prairie SNA, and slightly down at Blue Mounds State Park.

Phenology observations were carried out at Blue Mounds State Park in southwestern Minnesota and at Burnham WMA in northwestern Minnesota. Data on both spring emergence and fall dehiscence were collected by citizen scientists. Data collected on the emergence, growth, and seed capsule development were captured by repeat visits to the same plants through the growing season. It continues to be difficult to collect fall dehiscence data.

MBS also contributed to pilot pollinator (moth) trapping at Burnham WMA in accordance with methods developed by Marion Harris and Kirk Anderson of North Dakota State University.

Data was again collected at Pembina Trail Preserve documenting the survivorship of plants impacted by a weevil infestation in 2012.

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

Field surveys to complete census/population estimates were completed at fifteen sites across the state in 2018. Eleven of these sites contained previously documented populations. Four of the fifteen sites were newly

documented populations with one located in Kandiyohi County, two located in Polk County, and one located in Pope County.

More than ten thousand plants were estimated in total for all sites visited in 2018. Sites with the largest populations are Rush WMA of Mahnomen County, Dugdale WMA, Liberty WMA, Pankratz Memorial Prairie (TNC), and Thorson WMA of Polk County, and Marcoux WMA of Red Lake County. All had populations with more than one thousand plants. Most of these sites also had additional suitable habitat and will require more survey work in the future.

4. Targeted field surveys of native plant communities and rare species in MBS Sites of Biodiversity Significance.

Calcareous Fens

SE Minnesota

Three calcareous fens were surveyed in the Rochester area. One of these fens is being considered for conservation action (SNA) with MBS adding targeted field surveys in the site to fill important information gaps necessary to make a final decision on this site. Another had impacts from adjacent land use; MBS collected plant and vegetation data and worked with DNR hydrologists, regional plant ecologists and land managers to draft a new management plan the emphasizes fen recovery.

Western Minnesota

MBS field surveys discovered and documented a calcareous fen at Big Stone Wildlife Refuge.

5. Pollinator (insect) field survey in MBS Sites of Biodiversity Significance

Native moth and butterfly baseline survey

A total of 37 sites were surveyed in Kittson, Lake of the Woods, Koochiching, Beltrami, Norman, Clay, and Yellow Medicine counties in August, 2018. These sites were surveyed with varying intensities (from brief diurnal searches to multiple visits and intensive sampling) and various methods (diurnal search, UV/MV sheets, UV traps, fermenting fruit baits, and pheromone traps).

Surveys yielded over 1000 specimens, and include numerous new county records, as well as potential new state records. Significant finds include *Syngrapha selecta* (probable new state record, Koochiching Co.), *Papaipema aweme* (globally elusive species, new Beltrami Co. record), *Boloria chariclea* (SGCN boreal peatland species; new Beltrami Co. record), *Apodrepanulatrix liberaria* (rare prairie/savanna species; new for Agassiz Lowlands), *Eucosma millerana* (recently described prairie species; new Yellow Medicine Co. record), *Stiria rugifrons* (prairie species restricted to SW corner of MN; new Yellow Medicine Co. record), and *Xestia mixta* (SCGN species restricted to peatlands in the northern fringe of the state; new site in Koochiching Co.).

Activity 2 Status as of July 31, 2019

1. Targeted, plant and vegetation field surveys in high-quality prairie wetland complexes in Lac qui Parle, Big Stone, Swift, and Chippewa counties.

During this reporting period, work focused on planning for field surveys and collaboration with USFWS on sampling schedule and site selection. Field surveys during this reporting period were limited to installing equipment for forthcoming monitoring field work.

2. Vegetation and botanical field surveys in previously undocumented native prairies, forests and wetlands in the Prairie and Aspen Parklands Province. ~200 sites in 11 counties.

Co-ordinated with MN Audubon's Aspen Parklands Restoration Specialist on sites to visit in Kittson and surrounding counties for NPC mapping next summer.

Reviewed mapping of Kittson and Roseau counties to prepare for surveys. Identified 214 sites covering 49,000 acres to be field checked and potentially mapped. Ground surveyed portions of sites in Kittson County totaling around 5,000 acres of wet and mesic prairie and 1,000 acres of wet and mesic prairie in Roseau County.

Identified an additional ca. 1500 acres that appear to be wet and mesic prairie to be ground surveyed pending landowner permission. Five releves were collected from calcareous fens and eight releves were collected from mesic and wet prairies. Ground surveys also occurred in Clearbrook fen in Clearwater County and targeted at a "peat pimple" on Tanberg 32-2 prairie bank which was reported to us as a potential calcareous fen.

1. **Sensitive prairie orchid field surveys and volunteer coordination. ~75 sites in 24 counties. >500 volunteer hours.**

   Western Prairie Fringed Orchid (*Platanthera praeclara*)

   - Submitted permits for surveying on DNR Parks properties and TNC Preserves.
   - Completed Technical Service Contract for Monitoring work in NW Minnesota.
   - Completed final year of data collection for the survivorship study initiated in 2012 where we are following plants at Pembina Trail Preserve that were impacted by several catastrophic events that season (weevil herbivory infestation, late season hard frost, and drought).
   - Started volunteer coordination for upcoming surveys and monitoring in early July.

   Small white lady's slippers (*Cypripedium candidum*)

   - Submitted permits for surveying on DNR Parks properties and TNC Preserves.
   - Coordinated volunteer help with monitoring and survey needs
   - Visited sites in Big Stone, Clay, Douglas, Jackson, Lac Qui Parle, Mahnomen, Meeker, Polk, Stevens, and Wilkin Counties. (Highlights Below)
     - About 500 plants on a newly added Prairie Bank Easement in Big Stone County
     - Revisit two sites newly discovered in 2017 by ENRTF-funded Ecological Monitoring Network biologists; one site in Wilkin County had about 300 plants and another site in Clay County had about 250 plants.
     - Finding plants at a site in Stevens County, last documented in 1950.

2. **Targeted field surveys of native plant communities and rare species in MBS Sites of Biodiversity Significance. ≥10 sites in SE, east-central and/or northern Minnesota.**

   Historic vegetation plot resampling

   Planning, study design and field surveys for a North Shore Relevé Resampling Project in June 2019, a collaborative project with funding from State Parks, SNA, and this appropriation. Work was focused on resampling relevés that were collected ≥20 years ago in the North Shore Highlands Subsection in St. Louis, Lake, and Cook counties. The purpose is to detect change in flora and vegetation over the past 20+ years.

   Relevés to resample were selected from MBS Sites of Biodiversity Significance across multiple ownerships with certain attention to State Parks and Scientific & Natural Areas. Sites included Gooseberry Falls State Park, Tettegouche State Park, Myhr Creek Ridge SNA, MN Point Pine Forest SNA, and areas in between within MBS Sites of Biodiversity Significance.

   MBS coordinated a field survey day among DNR staff at MN Point, Duluth to resample an old relevé in the signature pine forest of MN Point Pine Forest SNA and search for rare plants. Discoveries include*:* *Botrychium pallidum* (~5 populations)**,** *Botrychium michiganense* (1 population), *Deschampsia flexuosa* (expansion of existing record)**,** *Juniperus horizontalis* (new record, origin unknown).

   Ferns

   Field surveys were completed for the purpose of updating previous occurrences of rare ferns that were last documented ≥20 years ago and expanding on previous surveys that were known to be incomplete. This work provide critical updates to existing rare species records and documentation of previously unknown occurrences. This is also important work towards a *Ferns of Minnesota* book (see ML19 MN Biological

Survey). Primarily to get specimens, photos and phenological documentation of *Equisetum* (the earliest arising of the ferns). But also general collecting of county record fern specimens.

Sites visited: Dakota County (Spring Lake Park), Banning State Park (Pine County), Carlos Avery WMA (Anoka County), Afton State Park (Washington County), and along the Gateway Trail (Ramsey County), Gordon Yeager WMA in Olmsted County, Minnesota River in Renville County, Cannon River in Goodhue County

Example highlights:

- Targeted surveys for early appearing fertile stems of uncommon *Equisetum* species, specifically the forest-dwelling *Equisetum pretense*. Succeeded in finding fertile stems of *Equisetum pretense* at Banning State Park, Pine County, a first documentation of this life stage in the state that has been rarely documented anywhere in the species' North American range.
- Visited Gordon Yeager WMA in Olmsted County to get specimens, photos and phenological/ecological data of several species of ferns and lycophytes of specialized habitats known to occur there (including a very nice sandstone cliff). I got several unexpected county records including *Dendrolycopodium dendroideum.* Surveys occurred in rock outcrops along the Minnesota River in Renville County to get photos, specimens and phenological/habitat data of rare cliff ferns. Succeeded in getting new records of *Cystopteris* spp. and *Woodsia* spp. (determinations yet to be finalized).
- Searched for rare *Cystopteris tennesseeensis* along the Cannon River in Goodhue County – had unexpectedly great success. Also visited 3 SNAs in the Upper Minnesota River Valley to search for rare rock ferns in habitats where Granite (gneiss) outcrops provided specialized habitat. Had success there too (determinations yet to be finalized).
- Over 100 fern specimens were collected. A large but uncounted number of photos of ferns in situ, the best of which will appear in the upcoming fern book.

Amphibians

Targeted field surveys for rare salamanders associated with seasonal ponds were completed in Pine County this spring. Spotted salamanders were the main focus with surveys timed to intersect with the time when adults are entering the ponds to lay eggs (spotted salamanders have rarely been documented by observation of adults in the field, instead, salamander egg masses are much more frequently found and can be identified to species). Nearly 50 adulth spotted salamanders we observed at night in and near (traveling to) seasonal ponds embedded in rich mesic hardwood forests.

Reptiles

Work focused on tracking 4 bullsnakes with active radio transmitters from the 2018 field season in the MN River valley (part of a larger, multi-partner MN River Reptile Project). Telemetry on bullsnakes in Yellow Medicine County has produced intriguing results where individuals within the same population are emerging from their winter hibernation over the span of late April to early June (typically all of the individuals within a population emergence within days of each other). A volunteer is tracking the snakes at least once a week.

Surveys for rare snakes were completed in and adjacent to MBS Sites of Biodiversity Significance along the Minnesota River. Discoveries include Plains hog-nosed snakes in multiple sites and updates on county records had not be revisited for several years. Data and results are yet to be finalized.

3. Pollinator (insect) field survey in MBS Sites of Biodiversity Significance.

Moth surveys focused on 45 sites across Beltrami (7 sites), Cass (1 site), Clearwater (3 sites), Koochiching (14 sites), Lake of the Woods (20 sites, including 6 in the Northwest Angle) from April – July, 2019. These sites were

surveyed with varying intensities (from brief one-time diurnal searches to multiple visits and intensive sampling) and various methods (diurnal search, UV/MV sheets, UV traps, fermenting fruit baits, and pheromone traps).

Emphasis was placed on understanding peatland butterfly distribution and associated habitats in Lake of the Woods, Koochiching, Beltrami, and Clearwater counties. Surveys yielded 3,000+ specimens and include numerous new county records, as well as potential new state records.

Revisiting and expanding 2018 surveys in 2019 for the Taiga Alpine, *Erebia mancinus* in the Northwest Angle, Lake of the Woods County was a particular focus during the reporting period. However, the biggest surprise was the Grizzled Skipper (*Pyrgus centaureae*) in the Northwest Angle. This species was previously known in Minnesota from a single site in Lake Co. and hadn't been seen there since the early 1980s. The butterfly is associated with wild strawberry (*Fragaria virginiana*), usually on sandy or rocky soil in this part of North America.

Table. Summary of notable MBS moth species discoveries:

Species	**Comments**
Boloria freija	boreal peatland species; 4 new sites in Beltrami, Koochiching, and Lake of the Woods Co. counties; former SGCN.
Boloria frigga (Frigga Fritillary)	Sevenmile Swamp, Northwest Angle, Lake of the Woods Co, (June 13)
Boloria Eunomia (Bog Fritillary)	A notable addition to the Sevenmile Swamp list, making it the second site in the state to have all nine of the completely (or nearly so) peatland-dependent butterflies recorded (Sand Lake Peatland in Lake Co. is the other).
*Copivaleria grote*i	Blue Lake, northern Clearwater Co. (April 23)
Erebia mancinus (Taiga Alpine)	The single Taiga Alpine location in the Northwest Angle (Sevenmile Swamp - discovered in 2017 and re-documented in 2018) is the only record for the entire Agassiz Lowlands Subsection (US and Canada).
Exaeretia ciniflonella	Blue Lake, northern Clearwater Co. (April 23). A small, rather seldom encountered species of the boreal region.
Lasionycta secedens	SGCN boreal species; 2 new sites in Koochiching and Lake of the Woods counties
Lasionycta taigata	SGCN boreal species, 2 new sites in Koochiching and Lake of the Woods counties
Lycia rachelae (Twilight Moth)	Blue Lake, northern Clearwater Co. (April 23). This was a new state and regional record last year, with 3 specimens between 2 sites (Kittson and Beltrami counties). Saw at least six individuals in one night.
Oeneis jutta (Jutta Arctic)	Pickerel Creek Peatlands, Northwest Angle, Lake of the Woods Co. Minnesota (June 10)
Polia propodea	multiple sites in Koochiching Co.
Pyrgus centaureae (Grizzled Skipper)	Special Concern species which hadn’t been seen in in the state since the 1980s; new county record and major range extension in the Northwest Angle, Lake of the Woods Co
Papaipema aweme	globally elusive species, new Koochiching Co. record and new sites in Beltrami and Lake of the Woods counties. Western Water Track of Red Lake Peatland and Mulligan Lake Peatland.
Pediasia truncatellus	Sevenmile Swamp, Northwest Angle, Lake of the Woods Co. Minnesota (June 13). A seldom reported boreal moth, usually associated with peatlands.

Trichordestra rugosa	multiple sites in Koochiching Co.
Xestia oblata	boreal species with only 1 previous record in northwestern MN: 2 new sites and new county record in Koochiching Co.

Activity 2 Status as of January 31, 2020

1. **Targeted, plant and vegetation field surveys in high-quality prairie wetland complexes in Lac qui Parle, Big Stone, Swift, and Chippewa counties.**

No updates at this time.

2. **Vegetation and botanical field surveys in previously undocumented native prairies, forests and wetlands in the Prairie and Aspen Parklands Province. ~200 sites in 11 counties.**

Surveys occurred in working prairies (i.e. prairies with active grazing or haying) that are important ecological connections between the larger adjacent conservation prairie complexes. The most important connecting pieces being a complex of fen, fire dependent forest and prairie to the east of Caribou WMA/TNC preserve which connects the area to the large fen and woodland complexes in Kittson County. Also, a large prairie in SW Kittson County that is an important ecological connection between the East Park WMA area and the large prairie complexes to the north.

3. **Sensitive prairie orchid field surveys and volunteer coordination. ~75 sites in 24 counties. >500 volunteer hours.**

   a. Western Prairie Fringed Orchid (*Platanthera praeclara*)
   - Coordinated and managed volunteers using DNR Volunteer Web Portal.
   - Utilizing volunteer help, conducted annual census of orchid populations in Kittson, Mower, Norman, Pennington, Polk and Rock Counties.
   - Coordinated census of other sites in conjunction with TNC, USFWS, and NPS.
   - Collected demographic data of populations at Blue Mounds State Park, Burnham WMA, Crookston Unit of Pembina Trail Preserve SNA and Lake Bronson Parkland SNA.
   - Coordinated with researchers from NDSU for a third season on moth pollinators at Burnham WMA.
   - Collaborated with resource staff at Pipestone National Monument about future collaboration possibilities with pollinators.
   - Completed Annual plan with contractor to collect phenological data at Burnham WMA.
   - Entered 2019 census and demography data into spreadsheets to be utilized in future reports.
   - Worked with regional ecologist and wildlife managers at Pembina WMA (Goose Lake area) to establish relevés to track impacts/changes from aspen girdling at site.
   - Prepared final reports for submission to relevant partners (available upon request).
   - Completed update of Rare Species Guide Profile

   b. Small white lady's slippers (*Cypripedium candidum*)
   - Began organizing and mapping data for data entry and reports this fall.
   - Prepared final report, *2019 Summary of Small White Lady's Slipper Activities in Minnesota,* for submission to relevant partners (available upon request).

4. **Targeted field surveys of native plant communities and rare species in MBS Sites of Biodiversity Significance. ≥10 sites in SE, east-central and/or northern Minnesota.**

Historic vegetation plot resampling

See also previous update for project overview.

36 relevés were resampled across sites in 1) the North Shore Highlands including Gooseberry Falls, Split Rock Lighthouse, Tettegouche, and Crosby-Manitou State Parks, Moose Mountain, Iona's Beach, and MN Point SNAs, and Flood Bay Wayside; and 2) St. Croix State Park, Pine County. Analysis of this work is forthcoming and may not begin in earnest until more plots have been resampled.

Incidental to this work is the discovery of new locations for rare species and updating of known, often old, rare species records including:

- A new discovery of *Osmorhiza depauperata* in Spring Beauty Northern Hardwoods SNA;
- Iona's Beach SNA, a new population of *Carex pallescens*, a state endangered sedge and updates to *Euphrasia hudsoniana* and *Trisetum spicatum*;
- MN Point SNA new discoveries and updates to existing records for Deschampsia flexuosa (T) and Hudsonia tomentosa (T).
- Sugarloaf SNA, updates to *Euphrasia hudsoniana*, *Trisetum spicatum*, and *Heterocladium dimorphum* (moss).

Vegetation Monitoring Plots

MBS installed new vegetation plots, either using the relevé method or the plot method developed for MBS's Ecological Monitoring Network (i.e. "EMN plots"), depending on location and purpose for the plot.

Relevés are used to describe, classify, and monitor native plant communities. Relevés were placed in locations that fill geographic or ecological gaps in our statewide relevé distribution. 15 new relevés were installed in various native plant communities within MBS sites of biodiversity significance in Pine, Carlton, St. Louis, Lake, and Cook counties.

EMN plots are used to establish long-term vegetation monitoring locations. EMN plots were established in locations that help fill gaps in the statewide distribution of randomly selected EMN plot locations and to install EMN plots in certain (i.e. subjectively selected) locations. EMN plots were established in forests, wetlands, and prairies within MBS sites of biodiversity significance during the reporting period. Several rare plant species were documented during the course of this work including *Polygala verticillata*, *Astragalus missouriensis, Gymnocarpium robertianum, Malaxis monophyllos, Eleocharis nitida, Platanthera clavellata, Astragalus missouriensis, and Aristida purpurea.* Note that some of this work could also be reported under Activity 2, Outcomes 1 and 2 (above).

Ferns

Worked continued from the previous reporting period to update and expand data and collections on native and rare ferns in Minnesota. This is also important work towards a *Ferns of Minnesota* book (see ML19 MN Biological Survey). Work this period centered on the Nemadji State Forest in Carlton and Pine counties and focused on the difficult *Botrychium* genus. Notable discoveries included:

- *Botrychium oneidense* (T)– 3 new observations
- *Botrychium oneidense* (T)– 1 relocation of existing EO
- *Botrychium lanceolatum* (T)– 2 new observations
- *Botrychium tenebrosum* (SPC)– 1 new observations

5. Pollinator (insect) field survey in MBS Sites of Biodiversity Significance.

Baseline moth diversity surveys were completed at 26 sites across Beltrami (6 sites), Cass (1 site), Clearwater (2 sites), Koochiching (2 sites), Lake of the Woods (9 sites), Roseau (5 sites), and Washington (1 site) counties. These sites were surveyed with varying intensities (from brief diurnal searches to multiple visits and intensive sampling) and various methods (diurnal search, UV/MV sheets, UV traps, fermenting fruit baits, and pheromone traps).

Surveys yielded over 2,000 specimens and include numerous new county records as well as potential new state records (identifications pending). The most significant find was an undescribed noctuid (new genus, new species) from Koochiching Co. This moth was first discovered in the Red Lake Peatland (Beltrami Co.) in 2018, and so far appears to be unique from anything else known to science; its description is currently in progress. Other significant finds include *Exaeretia canella* (probable new state record, Roseau Co.), *Papaipema aweme* (globally elusive species, new sites in Beltrami and Lake of the Woods counties), and *Apodrepanulatrix liberaria* (uncommon/declining species of barrens with Ceanothus; new Roseau Co. record). Also of note was the failure to find any prairie/barrens skippers (esp. Leonard's Skipper) in eastern Roseau and Cass counties.

Activity 2 Status as of July 31, 2020:

1. **Targeted, plant and vegetation field surveys in high-quality prairie wetland complexes in Lac qui Parle, Big Stone, Swift, and Chippewa counties.**

No updates at this time.

2. **Vegetation and botanical field surveys in previously undocumented native prairies, forests and wetlands in the Prairie and Aspen Parklands Province. ~200 sites in 11 counties.**

No updates at this time.

3. **Sensitive prairie orchid field surveys and volunteer coordination. ~75 sites in 24 counties. >500 volunteer hours.**

   a. Western Prairie Fringed Orchid (*Platanthera praeclara*)
   - Prepared and submitted permit applications for survey work in DNR Parks and The Nature Conservancy Projects
   - Prepared for field survey/monitoring activities (including contacting landowners, preparing requests for overnight travel, preparing field maps, and data collections forms)
   - Compiled information for USFWS 5-Year Review of the Western Prairie Fringed Orchid
   - Field work and volunteer participation delayed due to COVID.

   b. Small white lady's slippers (*Cypripedium candidum*)
   - Prepared and working on small white lady's slipper grazing impacts study plan.
   - Prepared permit for work on TNC properties.
   - Field work and volunteer participation delayed due to COVID.

4. **Targeted field surveys of native plant communities and rare species in MBS Sites of Biodiversity Significance. ≥10 sites in SE, east-central and/or northern Minnesota.**

No updates at this time.

6. **Pollinator (insect) field survey in MBS Sites of Biodiversity Significance.**

Planning for the 2020 field season was conducted January-June, 2020. Modification of initial plans was needed due to COVID-19, namely delay of field surveys until mid-June and removal of sites in the Northwest Angle and some Red Lake tribal lands due to lack of access.

Field work started in mid-June. A total of 22 sites were surveyed in Beltrami (3 sites), Koochiching (6 sites), Lake of the Woods (8 sites), and Roseau (5 sites) counties June 17-29, 2020. These sites were surveyed with varying intensities (from brief diurnal searches to multiple visits and intensive sampling) and various methods (diurnal search, UV/MV sheets, UV traps, fermenting fruit baits, and pheromone traps). High intensity surveys (multiple methods including nocturnal surveys which yield large number of species) were conducted at 9 sites in Beltrami (2 sites), Koochiching (2 sites), Lake of the Woods (3 sites), and Roseau (2 sites) counties.

Surveys yielded over 1,500 specimens, include numerous new county records, and at least one new state record. Significant finds include *Euxoa quebecensis* (new state record from Zippel Bay State Park, Lake of the Woods Co.; a dune specialist and solid candidate for Special Concern status during the next list revision), Northern Blue – *Plebejus idas* (new Roseau Co. record and significant northwestern range extension for this Special Concern species, previously known only from the Arrowhead region), and a currently unnamed species of tiger moth – *Virbia* sp. (1 new site each in Koochiching and Lake of the Woods counties).

Activity 2 Status as of January 31, 2021:
As of June 30, 2020, work on Activity 2 is complete in terms of this work plan and budget (most outcomes continue on the ENRTF ML19 MBS Work Plan). The remainder of this work plan through its completion of June 30, 2021 will be directed to Activities 3 and 4.

Final Report Summary: Submitted between June 30 and August 1, 2021.
MBS coordinated with the USFWS and DNR-SNA to establish and sample permanent transects in prairie pothole wetland basins in Big Stone County. Most of the wetlands are little-disturbed wet meadows in excellent condition with some areas planned for conservation grazing management starting in 2018. These transects will allow the tracking of long-term vegetation change and management effects of grazing in wet meadows in prairie potholes.

MBS coordinated with DNR groundwater hydrologists to conduct site visits to potential calcareous fens in SW Minnesota. Calcareous fens were confirmed in Big Stone County and Blue Mounds State Park. Field survey in both calcareous and non-calcareous fen sites included hydrology and vegetation data collection to help improve understanding of groundwater-rare plant species relationships in fens.

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 last 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. Priority areas (i.e. areas with intact native vegetation) often occur adjacent to lakes and rivers. Noteworthy results include significant new documentations of saline wet prairie, wet meadows, dry prairie, and mesic prairie and the collection of dozens of new prairie vegetation plots (relevés).

Long-term monitoring of the rare prairie orchid, Western Prairie Fringed Orchid (*Plantanthera praeclara*), continued from previous biennia. Accomplishments include 1) annual census monitoring of the species across the state in conjunction with The Nature Conservancy, US Fish and Wildlife Service, the National Park Service, and private landowners and 2) demographic monitoring at four locations across the latitudinal gradient of the species' range in the state and 3) project reports, "Summary of *Platanthera praeclara* Recovery Activities". This report is available from MBS upon request.

Long-term monitoring of a key Minnesota Prairie Plan indicator, small white lady's-slipper (*Cypripedium candidum*), continued from previous biennia. MBS compiled survey information in a report, "2017 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.

The intensity and results of the rare orchid projects are critically enhanced by the help of volunteers donating over 300 hours per year. Contributions from this ML17 LCCMR appropriation cover travel expenses for the

volunteers, a critical element in recruiting and retaining high quality volunteers. This project leverages state funds as match to federal funds to collectively enhance outcomes.

Field surveys for native and rare moths occurred in numerous sites in northwest, far northern, and southeast counties. Efforts yielded many notable new moth records including hundreds of new localities for moth Species of Greatest Conservation Need, nearly countless county records, and several new state records. Several sites were surveyed in eastern Roseau County in July and October as part of efforts to document moth communities following a natural wildfire in jack pine.

Targeted MBS plant and vegetation field surveys in parts of the state last surveyed over twenty years ago were targeted for updates and to expand on previous efforts. Surveys occurred in dozens of sites in southeast, north central, east-central Minnesota that delivered important new information on rare plant records greater than 20 years old, new rare species locations, and numerous plant collections of rare and county record species. A new location of old-growth forest was documented that contained 160+ year old red and white oaks, was free of the invasive tree, buckthorn (an increasing rarity in SE MN).

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 collaborates in this effort with DNR Forestry, Wildlife, and Ecological & Water Resources.

Northern forest sites (wet cedar and wet spruce native plant communities) in St. Louis and Itasca counties with occurrences of the rare Western Jacob's-ladder (*Polemonium occidentale* subsp. *lacustre*) were surveyed to set the groundwork to monitor population viability over time. This state-endangered species is known to occur in only 6 sites worldwide, all of which occur in Minnesota (4) and Wisconsin (2). This effort is in collaboration with the University of Minnesota Landscape Arboretum, which is focusing on genetic analysis and greenhouse growth trials, and the St. Louis County Lands and Minerals Department, who provides access and permission for permanent plot establishment on lands they administer.

Planning, study design and field surveys for a North Shore Relevé Resampling Project were completed, a collaborative project with funding from State Parks, SNA, and this appropriation. Work was focused on resampling relevés that were collected $\geq$20 years ago in the North Shore Highlands Subsection in St. Louis, Lake, and Cook counties. The purpose is to detect change in flora and vegetation over the past 20+ years. Relevés to resample were selected from MBS Sites of Biodiversity Significance across multiple ownerships with certain attention to State Parks and Scientific & Natural Areas. Sites included Gooseberry Falls State Park, Tettegouche State Park, Myhr Creek Ridge SNA, MN Point Pine Forest SNA, and areas in between within MBS Sites of Biodiversity Significance.

Field surveys were completed for the purpose of updating previous occurrences of rare ferns that were last documented $\geq$20 years ago and expanding on previous surveys that were known to be incomplete. This work provide critical updates to existing rare species records and documentation of previously unknown occurrences. This is also important work towards a *Ferns of Minnesota* book (see ML19 MN Biological Survey).

ACTIVITY 3: Data, Specimens, and Maps

Description: Process and enter data from Activities 1 and 2 into existing DNR databases. Prepare and submit plant and animal specimens to Minnesota collections (e.g., Bell Museum of Natural History, Science Museum). Create digital maps (GIS polygon data) for high-quality native plant communities and sites. This results in long-term storage of collections and databases for analysis and broad dissemination to individuals, organizations, and agencies with diverse natural resource goals.

The collection and management of data utilizes GIS, GPS, web-based tools and products, electronic field data recorders. Data collected by MBS are entered into manual and computerized files in the DNR's information systems. Key databases are part of the DNR Natural Heritage Information System (NHIS) and include those tracking locations and associated data for plants and animals, rare features, relevés (vegetation plot samples), aquatic plants, sites of biodiversity significance, and native plant communities.

Native plant community and MBS site polygon data are made publicly available on the Minnesota Geospatial Common. The NHIS is integrated with Biotics, a global biodiversity information system that is the standard of many Natural Heritage Programs in other states and countries. 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 if paper) or manually.

MBS participates in the DNR's Data Governance efforts to continuously improve data standards and quality, integration of databases, and information delivery. 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 taxa 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.

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, the Science Museum of Minnesota, or the University of Minnesota Entomology collection.

Summary Budget Information for Activity 3:

ENRTF Budget: $ 1,295,657
Amount Spent: $ 1,295,657
Balance: $ 0

Outcome	Completion Date
1. Field data processed and entered into DNR information systems.	Ongoing
2. Plant and animal collections prepared and delivered to Minnesota repositories.	Ongoing
3. Digital maps (GIS polygon data) created for native plant communities and sites.	Ongoing

Activity 3 Status as of December 31, 2017

1. Field data processed and entered into DNR information systems.

Field data processing

A significant part of MBS field ecologists' time in late fall, winter, and early spring 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 2017 plant specimen collections from Koochiching and St. Louis counties, prepared labels for plant specimens to be submitted to the Bell Museum herbarium, and completed Biotics submissions for 2017 rare species collections.
- Completed data entry, quality-control, and editing of ~80 relevés from the 2017 field season.
- Completed quality control of 54 native plant community condition ranking forms from 2017 field season.
- Transcribed hand-written field notes from botanical and vegetation field work 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 Lake of the Woods, Koochiching, and St. Louis counties.

Data Entry and Updates

Work from previous biennia continued to enter MBS plant, vegetation, and monitoring data from this project into a collection of related databases including the MBS Plant Specimen Label database, MNTaxa (plant species), Biotics (rare species), and Relevé (vegetation plot) databases, and the University of Minnesota Bell Museum's Specify Database.

Examples:

- MNTaxa was updated with new county and sub-county records submitted by this project;
- 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;
- 130 new relevés entered into the relevé database; of note include new relevés from under-sampled Koochiching County in forests, wetlands and peatlands;
- Uploaded photos taken from relevés sites into the EWR photo library.
- Biotics (i.e., rare species) was updated with over 200 new records and updates to over 450 existing records from MBS and partners contributing to this project including DNR, and partners such as the Superior National Forest, MN Landscape Arboretum, volunteers, and contractors; of note include new rare species records from under-sampled Koochiching County.
- Biotics was updated to include UMN Bell Museum Herbarium records representing those taxa that had a change in status with the 2013 list revision but that were not yet recorded in Biotics. This included important information on numerous rare species.
- Prairie and forest monitoring data was uploaded to MBS monitoring databases.
- Invasive plant species observations were recorded in EDDMapS, DNR's inventory and reporting system for invasive species.

Digital photographs

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 includes over 200 photos taken to document native plant communities and rare species in Koochiching and Lake of the Woods counties.

2. Plant and animal collections prepared and delivered to Minnesota repositories.

During the 2017 field season MBS botanists and plant ecologists collected over 500 plant specimens that document terrestrial and aquatic 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 450 mounted plant specimens complete with labels were submitted for accession to the Bell Museum herbarium.

Accomplishments at the individual staff level:

- 300 aquatic plant specimens were made of county record, uncommon, and rare aquatic plant species found in the counties targeted for aquatic plant surveys.
- Spent several days at the UMN Bell Herbarium working on identification of unknown plant and bryophyte collections from relevés in Koochiching and Lake of the Woods counties.
- Specimen labels were written for 52 Koochiching and St. Louis county records, sedge and fern distribution plant collections, and rare species observations (all *Cardamine pratense* v. *palustris*).
- Specimen labels were written for 2017 bryophyte collections including for three new *Trichocolea tomentella* (THR) records. Data was immediately incorporated into the bryophyte rare species profile in the DNR Rare Species Guide.
- 80 plant specimen vouchers will be submitted to the Bell Herbarium including vouchers for new populations of the MN listed species: *Cypripedium candidum* (2), *Berula erecta* (1), *Poa arida* (2), and *Cirsium hillii* (3)
- All *Lepidoptera* (moth and butterfly) specimens collected during the 2017 field season were prepared and those from Kittson, Polk, and Clay counties were labeled to species level. Specimen data were entered into databases; specimens were prepared for accession at the UMN Entomology insect collection.

3. Mapping Native Plant Communities and Sites of Biodiversity Significance

MBS continued GIS mapping of native plant communities (NPCs) in numerous locations statewide for inclusion in 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:

- 400 GIS map polygons of newly surveyed NPCs in Koochiching and St. Louis counties were created and submitted to the MBS NPC database.
- Completed the digitizing of NPCs in Great River Bluffs State Park and Banning State Park based on MBS work completed from this previous biennia (ML15 LCCMR MBS).
- Mapping of NPCs in Clearwater and southern Beltrami counties and the Red Lake Reservation continued from previous biennia.
- MBS collaborated with DNR Forestry to complete NPC mapping in areas of mutual interest in Cass County.
- Over 28,000 acres and nearly 200 polygons of peatland NPCs were mapped in Koochiching County.

Activity 3 Status as of June 30, 2018

1. Field data processed and entered into DNR information systems.

Field data processing

A significant part of MBS field ecologists' time in winter and early spring 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. Work from previous biennia continued to enter MBS field data from this project into a collection of related databases within the Natural Heritage Information System including the MBS Plant Specimen Label database, MNTaxa (plant species), Biotics

(rare species), and Relevé (vegetation plot) databases, and the University of Minnesota Bell Museum's Specify Database.

Highlights include:

- MNTaxa was updated with new county and sub-county records submitted by this project.
- 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;
- Completed and submitted 31 rare species occurrence data for entry into the Natural Heritage Information System including *Gaylussacia baccata, Hydrocotyle americana*, and *Torreyochloa pallida.*
- Completed entry and quality control of 122 relevés and native plant community condition ranking forms from 2017 field season
- Scan, organize, and quality control MBS paper field notes and survey forms into electronic PDF format.
- Entered 2017 aquatic plant field data for 20 lakes in central Minnesota.
- Uploaded to the DNR photo library 59 photos from native plant and rare species field surveys and photos from 50 relevés.

2. Plant and animal collections prepared and delivered to Minnesota repositories

During the 2017 field season MBS botanists and plant ecologists collected over 500 plant specimens that document terrestrial and aquatic 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. Mounted plant specimens complete with labels were submitted for accession to the Bell Museum herbarium.

Highlights include:

- Completed plant identification and herbarium labels for 230 plant specimens and 50 bryophyte collections from 2017;
- 3,789 moth specimens collected during the 2017 field season were identified and labeled; at least 950 different species were identified from this material. Moth survey and specimen data were entered into MBS databases and specimens were organized for accession to the U of MN Entomology Collection.

3. Mapping Native Plant Communities and Sites of Biodiversity Significance

MBS continued GIS mapping of native plant communities (NPCs) in numerous locations statewide for inclusion in the MN DNR Native Plant Community Polygon Database.

Highlights include:

- Completed delineating preliminary Sites of Biodiversity Significance for the Tamarack Lowlands Subsection portion of St. Louis County with 43 sites encompassing 467,745 acres.
- Delineated first-draft NPC polygons in 9 sites in Koochiching County; 759 polygons encompassing 28,121 acres.
- 2,940 polygons covering 13,857 acres were submitted to the MBS native plant community database.

- Completed revision of Border Lakes MBS sites based on survey results thus far in the region, and delivered to appropriate staff for review.

Activity 3 Status as of January 31, 2019

1. Field data processed and entered into DNR information systems.

A significant part of MBS field ecologists' time in fall and early winter is processing specimens, entering field data into electronic databases, interpreting those data, and delivering related information and products. Field data includes specimens, field notes, data sheets for rare species and relevés, GPS waypoints, and digital photographs and video. Work from previous biennia continued to enter MBS field data from this project into a collection of related databases within the Natural Heritage Information System including the MBS Plant Specimen Label database, MNTaxa (plant species), Biotics (rare species), and Relevé (vegetation plot) databases, and the University of Minnesota Bell Museum's Specify Database.

Highlights include:

- MNTaxa: updated with new county and sub-county records generated by this project; updated taxonomy to be current with the release of new additions to the Flora of North America (and thereby maintain taxonomic agreement with UMN Bell Museum); the MNTaxa platform was used as a template to start the design of a MNTaxa for MBS zoology data collected by this and other projects; fixed issues in MNTaxa with relevé pick list and voucher manipulation.
- Completed entry and quality control of 57 MBS relevés from 2017 and 2018 field seasons in Koochiching and St. Louis counties (including relevés from the MBS-Superior National Forest LTP-NPC project). Identified unknown plant species from these relevés and transcribed field forms to relevé database.
- The MBS Relevé Sites GIS layer was updated in DNR Quick Layers with new relevés collected under this and previous ENRTF appropriations, especially notable are new data from under-sampled Koochiching County.
- Completed and submitted 54 rare species documentations to the Natural Heritage Information System including *Gaylussacia baccata*, *Hydrocotyle americana*, *Torreyochloa pallida, Cardamine pratensis*, *Ranunculus lapponicus*, and *Eleocharis mamillata*.
- Entered 2017 aquatic plant field data into a variety of DNR databases for 20 lakes in central Minnesota.
- Uploaded to the DNR photo library nearly 300 photos from 2017 and 2018 MBS field surveys.
- Prepared and populated 2018 field survey waypoint data and distributed to MBS and other DNR staff who work in the survey areas.
- Added 8,900 records of invasive plant species to the DNR terrestrial invasives database (using Edmaps) based on all relevés that have been collected in MN to-date.
- Data management specific to *Polemonium* monitoring (see Activity 2): organized, compiled, and made available more than 30 datasets collected from six known populations (both MN and WI). Data spans a nearly 20 year period. Created a new integrated dataset for the *Polemonium* Bog site that includes new attributes for more than 350 data records. Organized all notes, data files, and folders related to *Polemonium* and MBS work with *Polemonium* for reference in the DNR Natural Heritage Information System.

2. Plant and animal collections prepared and delivered to Minnesota repositories

During the 2018 field season MBS botanists and plant ecologists collected over 300 plant specimens that document terrestrial and aquatic 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 creation and management of mounted specimens and associated labels that meet museum standards. Mounted plant specimens complete with labels were submitted for accession to the Bell Museum herbarium. During this reporting period, identification was completed for over 100 plant collections from 2017-2018, herbarium labels were prepared, and specimens were submitted for ascension to the UMN Bell Museum herbarium. This includes vouchers for

new records of *Cyperpedium candidum, Berula erecta*, *Aristisda longistylus*, *Calamagrostis montinais,* and *Characeae* species.

3. Mapping Native Plant Communities and Sites of Biodiversity Significance
MBS continued GIS mapping of native plant communities (NPCs) in numerous locations statewide for inclusion in the MN DNR Native Plant Community Polygon Database.

Highlights include:

- Updated the native prairie loss GIS layer based on new information gathered from this project.
- Mapped and wrote descriptions of Sites of Biodiversity Significance in the Tamarack Lowlands and the St. Louis Moraines subsections.
- Preliminary biodiversity ranks assigned to MBS Koochiching County sites.
- Littlefork-Vermilion Uplands Subsection (LFV): completed ranks and descriptions for Sites of Biodiversity Significance in St. Louis County. Total of 17 sites (114,000 acres).
- Defining and mapping preliminary Sites of Biodiversity Significance in the Nashwauk Uplands continued. Involved 11 sites and >100,000 acres.
- Completed final native plant community mapping in MBS Outstanding and High-ranked sites in Clearwater (16,764 acres, 417 polygons) and Crow Wing (30,175 acres, 3706 polygons) counties.

Border Lakes Subsection: continued refinement of ~ 150,000 acres of MBS sites of biodiversity significance in St. Louis County. Continued mapping native plant communities with 12,000 acres completed that includes wilderness and non-wilderness areas.

Activity 3 Status as of July 31, 2019
1. Field data processed and entered into DNR information systems.
A significant part of MBS field ecologists' time in fall and early winter is processing specimens, entering field data into electronic databases, interpreting those data, and delivering related information and products. Field data includes specimens, field notes, data sheets for rare species and relevés, GPS waypoints, and digital photographs and video. Work from previous biennia continued to enter MBS field data from this project into a collection of related databases within the Natural Heritage Information System including the MBS Plant Specimen Label database, MNTaxa (plant species), Biotics (rare species), and Relevé (vegetation plot) databases, the University of Minnesota Bell Museum's Specify Database, and newly developed(developing) MBS document management databases.

Highlights include:

- With the aid of an exceptional team of volunteers, organized, georeferenced, and staged for scanning and archiving MBS paper and digital files for MBS county surveys spanning 30+ years. Major progress was made for the following counties: Roseau field note locations for Roseau, Marshall, Kittson, Cook, Lake, Waseca, Freeborn, Steele, Dodge, Mower, Hennepin, Carver, Scott, Le Sueur, Sibley Nicollet, Brown, Blue Earth, Renville, Redwood, Yellow Medicine, Lac Qui Parle, Red Lake County, McLeod, Meeker, Pipestone, Rock, Murray, Goodhue and Rice.
- MNTAXA was updated with 27 sub-county and 11 county records for Koochiching and NNW St. Louis counties.
- Data on *Caltha natans* (END), *Cardamine pratensis* (THR), and *Utricularia geminiscapa* (THR) were entered into Biotics.
- 24 SGCN bird observations entered to the Observation Database from the past few years.
- Edited remaining 2018 aquatic plant survey data
- Created element occurrence records in Biotics for macro algae species discovered during aquatic plant surveys in lakes.
- Biotics was updated with results from this and previous appropriations as follows:
    - New EOs during Reporting Period: 150; Source Features 193

    - Updated and/or Converted old EOs because of new field observations: 228 Source Features (103 EOs)
- Data work continued specific to the *Polemonium* survey and monitoring project (see 1/31/2019 update on this work).
- Prepared and entered into the Observation Database all rare amphibian data from the 2018 field season, including remainder of MN River Reptile Project data (data from staff and volunteers).
- Submitted to the DNR Invasive Species Programs locations of invasive plant species encountered during the course of field work for native and rare species.

2. Plant and animal collections prepared and delivered to Minnesota repositories.
MBS botanists and plant ecologists collect hundreds of plant specimens that document terrestrial and aquatic 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) or the Department of Entomology Insect collection.

A significant component of documenting and collecting biological specimens is the creation and management of mounted specimens and associated labels that meet museum standards. Mounted plant specimens complete with labels were submitted for accession to the Bell Museum herbarium. During this reporting period, highlights include:

- Identification was completed for over 300 plant collections from 2017-2018, herbarium labels were prepared, and specimens were submitted for ascension to the UMN Bell Museum herbarium.
- Moth specimen labeling, identification, and data entry were completed for 2,745 specimens from the 2018 field season and submitted for accession at the University of Minnesota Entomology Collection.
- Amphibian photographic specimens from 2018 were submitted to the Bell Museum amphibian collection.
- Created labels for 2018 aquatic byrophytes collected and mailed specimens to subject matter expert, Jan Janssens, for annotation.
- Created labels for 2017 and 2018 *Characeae* spp. collections.
- Sent 2017 and 2018 *Characeae* specimens (~150 including duplicates) to subject matter expert, Ken Karol, at the New York Botanical Garden, for specimen annotation and genetic work.

3. Mapping Native Plant Communities and Sites of Biodiversity Significance
MBS continued GIS mapping of native plant communities (NPCs) in numerous locations statewide for inclusion in the MN DNR Native Plant Community Polygon Database.

Highlights include:

- Mapped two sites in the Glacial Lakes core area (Prairie Plan) that were ground surveyed and resulted in ca. 45 acres mapped of previously undocumented native prairie).
- <u>St. Louis County</u>
    - <u>Littlefork-Vermilion Uplands Subsection (LFV)</u>
        - Finalized and submitted data for subsection-wide analysis of MBS peatland sites and river sites in the St. Louis County portion of the LFV (involved 17 sites and ~114,000 acres).
        - Initiated NPC mapping in 2 larger peatland sites with extensive state land acreage. Approximately 7,000 acres mapped.
        - Created mapping guidelines for peatland landscape units of LFV based on field data and photo interpretation of npc assemblages and npc distributions.
    - <u>Border Lakes Subsection (BLS)- St. Louis County</u>
        - 106,944 acres in Cook County and 33,167 acres in Lake County mapped for native plant communities within MBS Sites

- Koochiching County
    - Rat Root Lake West: 573 polygons, 19,818 acres mapped.
    - Boomerang Bedrock Island: 239 polygons, 16,017 acres mapped
    - Between Two Rivers: 112 polygons, 7,674 acres mapped
    - Wisner North: 105 polygons, 6,172 acres mapped
    - Between Two Rivers: 196 polygons, 8,809 acres mapped
    - Between Fork and Bear: 41 polygons, 4,578 acres mapped
    - Highway 31 Peatland 132 polygons; 12,109 acres mapped

- 1,851 NPC polygons covering 53,888 acres were mapped in northern Cass County. The mapping was within 2 large Sites, both ranked as Outstanding Biodiversity Significance, that are dominated by peatland communities. Three factors made mapping NPCs in this area both interesting and difficult: 1) peatland and upland communities are finely interspersed, 2) the uplands include both fire dependent and mesic hardwood forests (often in close proximity), and 3) the area sits at the floristic crossroads between northern and central community types. The area mapped includes Hole-in-the-Bog SNA and also a designated High Conservation Value Forest. It is also one of the few places outside the large glacial lake peatlands to support examples of rich fen water tracks.

Activity 3 Status as of January 31, 2020

1. Field data processed and entered into DNR information systems.

A significant part of MBS field ecologists' time in late fall to early spring is processing specimens, entering field data into electronic databases, interpreting those data, and delivering related information and products. Field data includes specimens, field notes, data sheets for rare species and relevés, GPS waypoints, and digital photographs and video. Work from previous biennia continued to enter MBS field data from this project into a collection of related databases within the Natural Heritage Information System including the MBS Plant Specimen Label database, MNTaxa (plant species), Biotics (rare species), and Relevé (vegetation plot) databases, the University of Minnesota Bell Museum's Specify Database, and newly developed(developing) MBS document management databases.

Highlights include:

- With the aid of an exceptional team of volunteers, significant progress continues to organize, georeference, and stage for scanning and archiving MBS paper and digital files originating from MBS county surveys spanning the past 30+ years. Counties of focus this period: Winona, Sherburne, Isanti, Anoka, Chisago, Ramsey, Dakota, Kittson, Lake, Cook, St. Louis, Rice, Goodhue, Winona, Le Sueur, Hennepin, Carver, Scott, Roseau, Clay, Big Stone, Traverse, Wilkin, Redwood, Renville, Yellow Medicine, Murray, Pipestone, Rock, Pennington, Polk, Red Lake, Waseca, Freeborn, Steele, Dodge, Mower.
- 77 relevés with final prep/ QC completed for submission to the central MBS relevé database. Relevé-related images prepped and uploaded to MBS photo library. Created maps for all the relevés and sent them along with the original relevé forms to St. Paul for archiving.
    - Prepped and submitted element occurrence records to the statewide Biotics database including new records for *Phacelia*, *Cardamine pratensis, Ranunculus lapponicus, Platanthera clavellata, Cyperus houghtonii, Trisetum spicatum, Euphrasia hudsoniana, Carex pallescens.*
- Completed a synthesis of attributes of the MBS Site polygon and Site attributes databases for all of Cook and Lake county Sites, the Border Lakes Subsection Sites in St. Louis County, and the Agassiz Lowlands Subsection Sites of Koochiching County.
- Continued updating of older MBS amphibian and reptile datasets to modern standards for submission to the MBS Observation Database.
- Transcribed and/or uploaded EMN plot data to centralized databases; developed plot ownership summary and spatial summary for all EMN sites to-date.

2. Plant and animal collections prepared and delivered to Minnesota repositories.
MBS botanists collect hundreds of plant specimens and MBS entomologists collect thousands of insect specimens that document terrestrial and aquatic species distribution, 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) or the Department of Entomology Insect collection. MBS plant specimens at the Bell Herbarium are accessible through the ENRTF-supported Bell Museum online Biodiversity Atlas.

A significant component of documenting and collecting biological specimens is the creation and management of mounted specimens and associated labels that meet museum standards. Mounted plant specimens complete with labels were submitted for accession to the Bell Museum herbarium. During this reporting period, highlights include:

- completed plant specimen labeling and herbarium spreadsheet tasks for 2016-2019 collections; collections delivered to the Bell Museum Herbarium.
- Continue to process amphibian specimens and tissue samples for deposition to the Bell Mesuem of Natural History amphibian collection.
- Created herbarium labels for rare species and subcounty records including *Carex pallescens* and *Cynoglossum virginianum* var. *boreale*
- 2,000+ moth specimens were mounted and sorted into museum boxes for labeling.

3. Mapping Native Plant Communities and Sites of Biodiversity Significance
MBS continued GIS polygon mapping of native plant communities (NPCs) in numerous locations statewide for inclusion in the MN DNR Native Plant Community Polygon Database. Accomplishments include creation of 14,338 polygons classified to native plant community covering 470,695 acres in MBS Sites of High or Outstanding Biodiversity Significance in Crow Wing, Cass, Clearwater, Beltrami, Lake of the Woods, Roseau, Koochiching, and St. Louis counties.

Activity 3 Status as of July 31, 2020:
1. Field data processed and entered into DNR information systems.
A significant part of MBS field ecologists' time in late fall to early spring is processing specimens, entering field data into electronic databases, interpreting those data, and delivering related information and products. Field data includes specimens, field notes, data sheets for rare species and relevés, GPS waypoints, and digital photographs and video. Work from previous biennia continued to enter MBS field data from this project into a collection of related databases within the Natural Heritage Information System including the MBS Plant Specimen Label database, MNTaxa (plant species), Biotics (rare species), and Relevé (vegetation plot) databases, the University of Minnesota Bell Museum's Specify Database, and newly developed(developing) MBS document management databases.

Highlights include:
- Significant progress continues to organize, geo-reference, and stage for digitizing and archiving MBS paper and digital files originating from MBS county surveys spanning the past 30+ years. Counties of focus this period: Dodge, Freeborn, Mower, Steele, Waseca, Norman, Lincoln, Watonwan, Olmsted. Volunteers provide most of the work hours to this effort.
- Continued digitizing and updating of older MBS amphibian and reptile datasets to modern standards for submission to the MBS Observation Database.
- 65+ relevés with final prep/ QC completed for submission to the central MBS relevé database. Several of these with lichen determinations annotated by MN lichen expert.
- Brief descriptions written and stored in the MBS Site Database for Sites in St. Louis, Lake, and Koochiching counties.

- Created more than 40 source features for *Cardamine pratensis* and *Malaxis monophyllos* var. *brachypoda* observations over a five year period at the Polemonium Bog MBS Site of Biodiversity Significance. Delivered these data to St. Louis County Lands & Minerals Department for reference in their development of a preservation site prospectus.
- Relevé Resampling project: began data review focusing tree data (basal area, diameters) and relevant site attributes. Created a working database to manipulate and prepare data for analysis using both R and PCORD.

2. Plant and animal collections prepared and delivered to Minnesota repositories.
MBS botanists and plant ecologists collect hundreds of plant specimens that document terrestrial and aquatic 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) or the UMN Department of Entomology Insect collection.

A significant component of documenting and collecting biological specimens is the creation and management of mounted specimens and associated labels that meet museum standards. Mounted plant and insect specimens complete with labels were submitted for accession to the UMN Insect Collection or Bell Museum herbarium. During this reporting period, highlights include:

- Created herbarium labels for over 200 specimens of rare species and county/subcounty records including *Poa sylvestris, Juglans cinerea, Aristida purpurea, Astragalus flexuosus, Eleocharis nitida, Malaxis monophyllos, and Panax quinquefolius.*
- Over 160 plant specimens were mounted onto museum paper per herbarium standards and accessioned into the Bell Museum Herbarium. This work has been paused due to COVID restrictions on building access.
- Moth specimen identification, labeling, and data entry were completed for 2,467 specimens from the 2018-2019 field seasons. Basic analyses of data were conducted to look at sampling biases, which helped better inform planning for the 2020 field season.

3. Mapping Native Plant Communities and Sites of Biodiversity Significance
MBS continued GIS polygon mapping of native plant communities (NPCs) in numerous locations statewide for inclusion in the MN DNR Native Plant Community Polygon Database. Mapping involves review of and determining relationships among a number of references including MBS field ecologist notes, relevés, rare species records, color infrared aerial imagery, LiDAR, National Wetlands Inventory, SSURGO soils data, and forestry inventories. Accomplishments include creation of 6,821 polygons classified to native plant community covering 232,190 acres in MBS Sites of High or Outstanding Biodiversity Significance in Cass, Clearwater, Crow Wing, Beltrami, Koochiching, Lake, St. Louis, and Goodhue counties.

Activity 3 Status as of January 31, 2021:
1. Field data processed and entered into DNR information systems.
A significant part of MBS field ecologists' time in late fall to early spring is processing specimens, entering field data into electronic databases, interpreting those data, and delivering related information and products. Field data includes specimens, field notes, data sheets for rare species and relevés, GPS waypoints, and digital photographs and video. Work from previous biennia continued to enter MBS field data from this project into a collection of related databases within the Natural Heritage Information System including the MBS Plant Specimen Label database, MNTaxa (plant species), Biotics (rare species), and Relevé (vegetation plot) databases, the University of Minnesota Bell Museum's Specify Database, and newly developed(developing) MBS document management databases.

Highlights include:

- With the aid of an exceptional volunteer, significant progress continues to organize, georeference, and stage for scanning and archiving MBS paper and digital files originating from MBS county surveys spanning the past 30+ years. Counties of focus this period: Norman, Clay, Wilkin, Traverse, Big Stone, McLeod, Meeker, Murray, Lincoln, Pipestone, Rock, Nobles, and Watonwan.

2. Plant and animal collections prepared and delivered to Minnesota repositories
MBS botanists and plant ecologists collect hundreds of plant specimens that document terrestrial and aquatic 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) or the UMN Department of Entomology Insect collection.

A significant component of documenting and collecting biological specimens is the creation and management of mounted specimens and associated labels that meet museum standards. Mounted plant and insect specimens complete with labels were submitted for accession to the UMN Insect Collection or Bell Museum herbarium. During this reporting period, moth specimen identification, labeling, and data entry were completed for over 1,000 specimens from the 2019-2020 field seasons.

3. Mapping Native Plant Communities and Sites of Biodiversity Significance
MBS continued GIS polygon mapping of native plant communities (NPCs) in numerous locations statewide for inclusion in the MN DNR Native Plant Community Polygon Database. Mapping involves review of and determining relationships among a number of references including MBS field ecologist notes, relevés, rare species records, color infrared aerial imagery, LiDAR, National Wetlands Inventory, SSURGO soils data, and forestry inventories. Accomplishments include creation of over 2,000 polygons classified to native plant community covering 34,000 acres in MBS Sites of High or Outstanding Biodiversity Significance in Cass and Itasca counties.

Final Report Summary: Submitted between June 30 and August 1, 2021.
A significant part of MBS field ecologists' time in late fall, winter, and early spring 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.

Work from previous biennia continued to enter MBS plant, vegetation, and monitoring data from this project into a collection of related databases including the MBS Plant Specimen Label database, MNTaxa (plant species), Biotics (rare species), and Relevé (vegetation plot) databases, and the University of Minnesota Bell Museum's Specify Database.

MBS botanists and plant ecologists collected over 1,000 plant and insect specimens that document terrestrial and aquatic plants and rare moths and butterflies that are county records, rare species, and notable native species. Many of these specimens require detailed identification determinations using laboratory-based methods. Specimens are accessioned to the University of Minnesota's Bell Museum Herbarium and the Entomology Department's Insect Collection (an ongoing activity). A significant component of documenting and collecting plant specimens is the development and management of specimen labels that follow museum standards.

MBS continued GIS mapping of native plant communities (NPCs) in numerous locations statewide for inclusion in the MN DNR Native Plant Community Polygon Database.

ACTIVITY 4: Outreach and Technical Guidance

Description: Provide interpretation of results of Activities 1, 2 and 3 through products and technical assistance to guide conservation and management of native plant communities, rare species, and ecological systems (e.g., watersheds, sites of biodiversity significance). This activity includes website maintenance; book publications; biological reports; and technical guidance to public agencies, private citizens, tribal organizations and conservation and management planning initiatives.

MBS will deliver a first draft of a new book on the mammals in Minnesota and a final draft and publication of a new book on the sedges and rushes of Minnesota. Both books bring forth decades of ENRTF investments in MBS field survey, data management, collections management and technical guidance.

The book, *Mammals in Minnesota* (tentative title), incorporates the substantial statewide data set on mammalian distribution collected by MBS since the last state mammal book in 1982. It addresses changes to the distribution and abundance of over 85 wild mammal species, including three new species documented since the last publication. For each species, their natural history is described and illustrated with photographs and distribution maps. A guide to identification will be included. A first draft of the book is intended under this work plan.

The book, *Sedges and Rushes of Minnesota* (tentative title), will be the first of its kind for Minnesota. It will be a field guide to the identification, distribution and ecology of the sedges and rushes of Minnesota, which number about 250 species. Each species is described in detail, and fully illustrated with original photographs. The book is intended to be published by MN Press within this biennium.

The book, *A Guide to the Aspen Parkland and Red River Valley,* will be delivered for publishing by the University of Minnesota Press. It is in part a response to interest from local residents of northwestern Minnesota who suggested this publication several years ago to fill a void in natural history coverage of the area. It will provide substantive information to interpret and increase appreciation of this landscape and its native plant communities and rare species by residents, decision-makers and visitors of the region. The MBS biologists who conducted field surveys in the region over the past 30 years are the lead authors with specialties in plant ecology, rare species biology and natural history. The book will also include a guide to important sites that highlight distinctive biological and surficial geological features of this landscape.

See also Section V. Dissemination.

Summary Budget Information for Activity 4:

ENRTF Budget: $ 538,348
Amount Spent: $ 538,348
Balance: $ 0

Outcome	Completion Date
~~1. First draft of a new book on the mammals of Minnesota.~~ See Activity Status updates	~~June 2020~~
2. New book on sedges and rushes of Minnesota published by University of Minnesota Press.	July 2018
3. Final draft of the book, Minnesota's Red River Valley and Aspen Parkland: A Guide to Native Habitats, delivered for publishing by University of Minnesota Press	June 2021
4. Biological reports, technical guidance, presentations, and trainings delivered.	Ongoing
5. DNR's website and social media updated with current survey results.	Ongoing

Activity 4 Status as of December 31, 2017

1. First draft of a new book on the mammals of Minnesota.

Work was initiated to sort and organize over 1,000 small mammal specimens and associated data and databases in preparation for writing a new book on the mammals of Minnesota. This initial work is critical to providing the most up-to-date and thorough species descriptions and statewide treatment of mammals in Minnesota. This work is in-progress at the time of this report. The author of this book is also the MBS zoology supervisor; due to an unexpected retirement and an unexpected departure of a key staff person assisting with the book, progress on this book has been slower than expected.

2. New book on sedges and rushes of Minnesota.

The MBS lead author and the MBS information officer made significant progress on copy editing with the University of Minnesota Press to finalize the text of the book, "Sedges and Rushes of Minnesota". Progress on this book is well ahead of schedule with final text, photographs, and graphic material on track to go to the printer in late March 2018 and published by ~July 2018. 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 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.

3. Final draft of the book, Minnesota's Red River Valley and Aspen Parkland.

Review and editing continued from previous biennia on the Red River Valley-Aspen Parkland book. Editing of landscape history chapters on paleohistory, historic vegetation, and human history progressed. Major progress was made on 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.

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 reporting period including Bluestem Prairie, Miller Prairie, Norway Dunes, Fertile Dunes, Lake Bronson SP, and Felton Prairie.

4. Biological reports, technical guidance, presentations, and trainings delivered.

Biological Reports

During this reporting period, MBS reports came in the form of one-page posters and handouts related to this project. They included a large poster featuring Minnesota's bats for a MBS table at a Bat festival; a handout for a field workshop on identifying *Salix* species in the Aspen Parklands province; and a one-page handout containing all of MN's orchid species.

Technical Guidance

The technical guidance 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 ENRTF Minnesota 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 ML17 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 ML17 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) during this reporting period to a wide range of partners including DNR SNA program, Environmental Review, State Parks & Trails, Forestry, Lands & Minerals, Minnesota counties and cities, USFS, Bell Museum of Natural History, UMN Landscape Arboretum; Minnesota colleges and universities.

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.

Specific examples during this reporting period of MBS survey data (Activity 1) interpretation and delivery include:

- the Superior National Forest for use in their 1) active vegetation management plans (i.e. timber harvest plans); 2) scoping phase of a draft EIS for a USFS/State of MN land exchange; and 3) scoping phase of a proposed Lutsen Mt. ski area expansion;

1. a researcher working on the rare plant, *Woodsia scopulina*, for which MBS botanists have particular expertise and locational knowledge;

2. a small mammal researcher interested in MBS's recent discoveries, data and descriptions for the "boulder pavement" native plant community in Lake and Cook counties;

3. a graduate student at UMN working on aquatic plants and interested in MBS aquatic plant survey data;

4. the DNR Environmental Review Unit's Polymet mining project in regards to the location and condition of "Rare Natural Communities" as defined by the Wetlands Conservation Act;

- the MN DNR for use in the Governor's statewide Sustainable Timber Harvest Analysis project;
- The MN DNR SNA program for potential new SNA acquisitions and priorities in Koochiching County;
- Itasca County in relation to their designated Natural Areas and potential for expansions or new additions based on MBS work in the county;
- Dakota County in relation to prairie restorations at Lebanon Hills and Miesville Ravine Regional Parks;
- City of Duluth in relation to their management of significant rare species and rare plant communities on MN Point;
- White Water WMA (DNR) in relation to oak savanna restoration and rare plant management.

<u>Presentations and Training</u>

MBS staff participated in several presentations and technical trainings related to outcomes of this project. Requestors of and attendees to these events come from a wide range of organizations including NRCS, SWCD, USFWS, DNR Wildlife, DNR Ecological and Water Resources, DNR Parks & Trails, BWSR, colleges and universities, TNC, Pheasants Forever, and private consultants.

Examples include:

- MBS botanists and plant ecologists were instructors at plant identification and native plant community classification field workshops in northwestern Minnesota at the Thorson Prairie WMA in Polk County, at Chanarambie Creek in Murray County, and Ordway Prairie in Pope County. The workshops were hosted by a collaboration of MBS, DNR SNA program, and DNR Division of Wildlife;
- A MBS botanist was an instructor at a plant identification and native plant community classification field workshop on the Superior National Forest;

- A MBS plant ecologist presented on MBS findings from the BWCAW to the group, Northeastern MN for Wilderness;
- A MBS botanist was a visiting guest instructor for a prairie master naturalist course at Chippewa Prairie;
- A MBS botanist was an instructor at a plant identification and native plant community classification field workshop at MN Point in Duluth;
- A MBS botanist was an instructor at a fern identification workshop at Mille Lacs Kathio State Park.

5. DNR's website and social media updated with current survey results.

MBS Social Media

MBS wrote weekly Facebook posts (posted to the DNR Facebook page and the SNA Facebook page) reflecting MBS survey activity during 2017 field seasons and highlights from earlier MBS work. Examples include 1) a focus on the MBS aquatic plant survey that showcased plant survey work targeting the endangered species *Utricularia purpurea*, 2) a focus on tagging and monitoring northern long-eared bats, and 3) a focus on the 30th anniversary of MBS (also on the MBS website).

DNR Rare Species Guide

Major progress continued on updating and improving the DNR's web-based Rare Species Guide (RSG). MBS data and analysis funded by this and previous ENRTF appropriations are the basis of much of this work. Current work on the RSG is funded in part by State Wildlife Grant dollars that cover animal species while plants, bryophytes, and fungi are funded by this ENRTF appropriation.

During this reporting period progress was made on peer review of lichen and bryophyte RSG profiles. North American range maps were produced for vascular plants and bryophytes. Work was completed in collaboration with MN.IT to allow for the efficient uploading and display of photographs to complement each rare species profile. Work was started to develop a video of a MBS botanist showing how to collect and properly process vascular plant specimens that will be provided through the RSG. The final batch of vascular plant data from the UMN Bell Museum Herbarium was imported and added to rare plant RSG profiles.

Activity 4 Status as of June 30, 2018

Outcome 1. First draft of a new book on the mammals of Minnesota.

Work continued to sort and organize over 1,000 small mammal specimens and associated data and databases in preparation for writing a new book on the mammals of Minnesota. This initial work is critical to providing the most up-to-date and thorough species descriptions and statewide treatment of mammals in Minnesota. This work is in-progress at the time of this report. The author of this book is also the MBS zoology supervisor; progress on this book has been slower than expected due to the same reasons stated in the December 31st, 2017 update.

Outcome 2. New book on sedges and rushes of Minnesota.

The final manuscript of "Sedges and Rushes of Minnesota" was delivered to the UMN Press in late March 2018. Advance copies of the final product are on track to arrive by early August, 2018. MBS field surveys and staff expertise developed under ENRTF appropriations have been essential to making this publication thorough, reliable and based on an otherwise much smaller and incomplete Minnesota collection of specimens and documented field locations for each species.

Outcome 3. Final draft of the book, Minnesota's Red River Valley and Aspen Parkland.

Major progress continued for this publication focused on final editing for all major chapters, in preparation for submitting a final manuscript to the publisher by spring 2019. Lead authors completed review and editorial recommendations for Chapter 1 (geologic and paleo-vegetation history) and continued review and editing of Chapter 2 (prehistoric people) and Chapter 3 (historic vegetation), with aim of shortening to essential content and relating content across chapters.

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 reporting period including Caribou WMA, Faith WMA, Felton Prairie, Rothsay Prairie, Skull Lake WMA, Roseau River WMA, and Thief Lake WMA.

Outcome 4. Biological reports, technical guidance, presentations, and trainings delivered.

Biological Reports

- MBS plant ecologists compiled a report summarizing the 2017 pilot study activities for the western Jacob's-ladder survey effort described in the previous update. The report highlighted 2017 methods/metrics and results and observations from work done at two of the four Polemonium sites in Minnesota: Polemonium Bog and Leander.
- MBS botanist wrote a short article on the four Drosera species in Minnesota for the Conservation Volunteer.
- A new crosswalk between DNR/MBS's native plant community classification and NatureServe's national vegetation classification was completed. This allows Minnesota vegetation to be placed in a national context that allows for nationwide and global conservation ranking.

Technical Guidance

The technical guidance 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 ENRTF Minnesota 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 ML17 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 this appropriation. These staff and colleagues 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. They 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) during this reporting period to a wide range of partners including DNR SNA program, Environmental Review, State Parks & Trails, Forestry, Lands & Minerals, Minnesota counties and cities, USFS, Bell Museum of Natural History, UMN Landscape Arboretum; Minnesota colleges and universities.
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. Much of the data delivered was or is funded by the ENRTF as recommended by LCCMR.
Specific examples during this reporting period of MBS survey data (Activity 1) interpretation and delivery include:

- Contributed to request for information associated with the Sawtooth Bluff recreational developments on county land. Specific attention was paid to Rosebush Patterned Fen that is within a MBS site of biodiversity significance.
- Contributed to request for subject matter expertise on rare forest species and rare forested native plant communities for a DNR project developing forest management guidelines for rare species and plant communities.

- Reviewed and provided alternative text and image ideas for Spring Beauty SNA kiosk.
- Delivered MBS data to Superior National Forest for use in the Tait Twins Vegetation Management Project, Jeanette Scoping Report, and the Border to Border trail project.
- Provided technical guidance to the DNR Regional Ecologist on a proposed expansion of Temperance River Campground.
- Provided data and interpretation on conservation opportunities in the Tallgrass Prairie Aspen Parkland collaborative meeting that included DNR, TNC, USFW and local conservation staff.
- Technical guidance to DNR Area Hydrologists regarding shallow lake management and effects on rare aquatic plants.
- Provided data and technical interpretation for a ditch mitigation project being proposed by DNR Wildlife and Roseau Watershed District that may affect Sprague Creek SNA and MBS sites of biodiversity significance.
- Delivered MBS vegetation plot data (relevé; much of which is or was funded by ENRTF as recommended by LCCMR) to a variety of requesters including EPA, DNR pollinator teams, DNR forest management teams, Steger Wilderness Center, UMN, private consultants, and DNR invasive species programs.

Presentations and Training

MBS staff participated in several presentations and technical trainings related to outcomes of this project. Requestors of and attendees to these events come from a wide range of organizations including NRCS, SWCD, USFWS, USFS, DNR Wildlife, DNR Ecological and Water Resources, DNR Parks & Trails, BWSR, colleges and universities, TNC, Pheasants Forever, and private consultants.

Examples include:

- MBS plant ecologist led a field day with Superior National Forest staff and others for training in using MBS's native plant community classification and field guide.
- Presentation at the Avon Hills Conference on February 10th about MBS rare aquatic plant diversity and field surveys in central MN.
- With DNR colleagues, planned and delivered a prairie plant identification field workshop at Seven Sisters Prairie in Otter Tail County on June 26-27. Enrollment for this workshop was nearly full within one week after it was advertised.

Outcome 5. DNR's website and social media updated with current survey results.

MBS Social Media

MBS wrote weekly Facebook posts (posted to the DNR Facebook page and the SNA Facebook page) reflecting MBS survey activity during 2017 field seasons and highlights from earlier MBS work. Examples include 1) a post on MBS June botanical discoveries, 2) a post about MBS rare plant discoveries at Vermillion Highland WMA and 3) a post on dry barrens prairies and oak savannas in Minnesota.

DNR Rare Species Guide

Major progress continued on updating and improving the DNR's web-based Rare Species Guide (RSG) with new data fresh from field work being accomplished under this appropriation. MBS data and analysis funded by this and previous ENRTF appropriations are the basis of much of this work. Current work on the RSG is funded in part by State Wildlife Grant dollars that cover animal species while plants, bryophytes, and fungi are funded by this ENRTF appropriation.

Activity 4 Status as of January 31, 2019

Outcome 1. First draft of a new book on the mammals of Minnesota.
Recent work toward the mammal book has focused on 1) organizing MBS mammal specimens and associated data and 2) compiling and developing the base information necessary to create distribution maps for each mammal species and subspecies in the state.

Mammal specimens collected by MBS.

Mammal voucher specimens (1,500 skins and 3,000 skulls) collected by MBS over the past 25 years are being prepared for submission to the UMN Bell Museum mammal collection. This involves finalizing identification determination; organizing skins according to year and species; associating skins with skulls; and writing and verifying specimen label information.

Preparing distribution maps for all mammals documented in the state.

Distribution maps for Minnesota were plotted and boundaries between subspecies delineated according to ecological landscape units. References associated with distributional records were compiled.

Work began to associate occurrence data (i.e. distribution maps) from Hazard's 1982 Mammals of Minnesota book to physical specimen(s). According to Hazard, he disposed of all of his data recorded from regional mammal specimen collections. Dots on his distribution maps have been identified to township and will later be associated with physical specimens. Unfortunately, few regional mammal collections are digitized and available online, so revisits to the collections will be necessary.

MBS searched online biological collections portals VertNet and Arctos for Minnesota mammal specimens. These portals are particularly valuable for finding Minnesota mammal specimens curated in collections that are outside of our region. Fifty-four collections are represented containing approximately 10,000 mammal records from Minnesota. This does not include specimens at the UMN Bell Museum.

Outcome 2. New book on sedges and rushes of Minnesota.
The Sedge and Rush book was published during this time period (July 23, 2018), copies are available from the UMN Press and other book outlets. MBS field surveys and staff expertise developed under ENRTF appropriations have been essential to making this publication thorough, reliable, and based on an otherwise much smaller and incomplete Minnesota collection of specimens and documented field locations for each species.

Outcome 3. Final draft of the book, Minnesota's Red River Valley and Aspen Parkland.
Major progress continued for this publication that focused on final editing for all chapters, in preparation for submitting a final manuscript to the Minnesota Press by spring 2019. A most challenging time in book development for the lead authors, with their detailed and thorough content being reduced in order to reach final manuscript word-count limits.

Outcome 4. Biological reports, technical guidance, presentations, and trainings delivered.
Biological Reports

5. MBS botanist wrote an article for SNA web page on arctic disjuncts.
6. MBS provided subject matter expertise to the revision of the DNR Lake Plant Survey Manual providing data and experience gained from this and previous ENRTF MBS appropriations. MBS input focused on a chapter describing aquatic botanical inventories, rare aquatic plant surveys, and edits to a new chapter on collecting and preserving aquatic plants.
7. MBS submitted a summary report to the USFS Superior National Forest (SNF) regarding the MBS-SNF native plant community survey and crosswalk project.
8. MBS drafted summary reports to Meriwether Timber, Voyageurs National Park, and Camping & Education Foundation (Camp Kooch-i-ching) for 2018 field surveys in Koochiching County

9. Small White Lady's Slipiper: Completed annual report summarizing 2018 activities**.** Disseminated report to appropriate internal and external partners.
10. Western Prairie Fringed Orchid *(Plantanthera praeclara)*
    Completed annual report summarizing 2018 activities. Disseminated report to appropriate staff and external partners. Demographic data was shared with Dr. Rich Shefferson of the University of Tokyo, for inclusion in a meta-analysis of vegetative dormancy in the context of life history evolution across a latitudinal gradient. This article was published in Ecology Letters. Collaborated with Lori Biederman of Iowa State University on drivers of orchid phenology emergence and anthesis paper. The paper was accepted for publication in Global Ecology and Conservation.
11. Western Jacob's Ladder (*Polemonium occidentalis*)
    MBS completed and distributed the final report of 2017 pilot study activities, findings, and considerations for future efforts to various *Polemonium* partners including St. Louis County, the MN Landscape Arboretum, WI DNR, and the Chequamegon-Nicolet National Forest.

Technical Guidance

The technical guidance 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 ENRTF Minnesota 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 ML17 LCCMR MBS work plan and budget.

MBS delivered a variety of data, interpretations, analysis, and reports (resulting from this and previous ENRTF MBS appropriations) during this reporting period to a wide range of *partners* including DNR SNA program, Environmental Review, State Parks & Trails, Forestry, Lands & Minerals, Minnesota counties and cities, USFS, Bell Museum of Natural History, UMN Landscape Arboretum; Minnesota colleges and universities.

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. Much of the data delivered was or is funded by the ENRTF as recommended by LCCMR.

Examples include:

- Provided subject matter expertise on rare native plant communities and rare species DNR forest management guidelines.
- Provided subject matter expertise on State-listed species for the DNR State-listed Species Operational Order.
- Provided information, questions in regards to a public inquiry about the rare aquatic plant, *Utricularia purpurea*.
- Provided technical guidance to 1 Watershed 1 Plan related to native plant community patterns on the Nemadji River landscape of the Southern Superior Uplands subsection.
- Provided technical guidance and plant expertise related to the identification of challenging *Botrychium* and *Sceptridium* ferns occurring in DNR forest stands being considered for harvest.
- Provided expertise to the DNR Coastal Program and Duluth Cooperative Invasive Species Management Area coordinator related to ecological questions involving MN Point native plant communities, rare species, invasive species issues, and vulnerabilities post October storm surge on Lake Superior.
- Provided technical guidance and plant expertise to Regional Plant Ecologist related to review of Parks and Trails campground expansion projects and Forestry stand review and third-party forest certification. Input included plant identification and discussions about rare species and MBS Sites of Biodiversity Significance.

- MBS provided subject matter expertise for Western Prairie Fringed orchid to land mangers preparing site burns where the species is known to occur.
- Prepared list of 22 sites recommended for SNA or Prairie bank designation.

Presentations and Training

MBS staff participated in several presentations and technical trainings related to outcomes of this project. Requestors of and attendees to these events come from a wide range of organizations including NRCS, SWCD, USFWS, USFS, DNR Wildlife, DNR Ecological and Water Resources, DNR Parks & Trails, BWSR, colleges and universities, TNC, Pheasants Forever, and private consultants.

Examples include:

- July 11-13, MBS botanist was an instructor for a DNR Plant ID field training workshop in southern MN.
- MBS provided aquatic plant specimens and subject matter expertise for a DNR aquatic plant workshop held at the Itasca Biological Station.

12. MBS prepared and delivered presentation on the impacts and potential of climate change to NE MN native plants, animals and habitat at a Cook County speaker series.

Outcome 5. DNR's website and social media updated with current survey results.

MBS Website

The MBS web space was monitored and maintained to ensure content is functioning correctly, current, and relevant as related to this and previous ENRTF MBS appropriations.

MBS Social Media

MBS wrote weekly Facebook posts (posted to the DNR Facebook page and the SNA Facebook page) reflecting MBS survey activity during 2017 field seasons and highlights from earlier MBS work. Examples include 1) a post on old-growth woodlands in Koochiching County, 2) a post on Big Fork River mesic and terrace forests in Koochiching County and 3) a post (including video) on finding *Nitella tenuissima*, an uncommon aquatic macroalga in Minnesota.

MBS subject matter experts assist DNR social media coordinators with identification of native and rare plant and animal species flagged by the public on Twitter.

MBS supplies images of native and rare plants and animals as requested for use in DNR social media.

DNR Rare Species Guide

Major progress continued on updating and improving the DNR's web-based Rare Species Guide (RSG) with new data fresh from fieldwork being accomplished under this appropriation. MBS data and analysis funded by this and previous ENRTF appropriations provide much of the RSG's foundation. Current work on the RSG is funded in part by State Wildlife Grant dollars that cover animal species while plants, bryophytes, and fungi are funded by this ENRTF appropriation.

Example accomplishments include:

- Completed editing and uploading fungi profile text, photos, and bibliography for each profile.
- Completed data harvesting for rare plants and fungi from MyCoPortal and UMN Bell Museum online Biodiversity Atlas.
- Collected and archived RSG profile peer-review edits and comments.
- Updated 14 rare plant profiles that had not been updated for over 10 years. This involves improving the text, locating and uploading new and improved photos if available, and often expanding the management guidance section.

- MBS finalized confirmation that all state-listed endangered plant specimens from the UMN Bell Museum herbarium were accounted for and ready for use in updating the RSG.
- Photos were gathered and uploaded to the RSG from MBS publications funded by this and previous ENRTF appropriations: Orchids of MN, Trees & Shrubs of MN, Sedges & Rushes of MN.
- Photos of rare ferns and lycophytes from the MBS 2018 field season were gathered and uploaded to the RSG.

Activity 4 Status as of July 31, 2019

1. **First draft of a new book on the mammals of Minnesota.**
   No updates at this time.

2. **New book on sedges and rushes of Minnesota.**
   See previous updates. Book published by MN Press in August 2018.

3. **Final draft of the book, Minnesota's Red River Valley and Aspen Parkland.**

Major progress continued for this publication that focused on final editing for all chapters, in preparation for submitting a final manuscript to the Minnesota Press by fall 2019 (revised from previous update). A most challenging time in book development for the lead authors, with their detailed and thorough content being reduced in order to reach final manuscript word-count limits. Highlights of accomplishments include:

- completed review and editing of chapters 1 (geology/paleoecology), 3 (presettlement vegetation), 4 (Euro-American settlement), chapter 5 (river ecology) for style editing.
- completed development and editing of Forested Peatland and Acid Peatland chapters for style editing.
- coordinated with Fred Harris on development of modern era section for chapter 4
- assessed 80 draft sidebars to prioritize for 1) inclusion/deletion; 2) further content development; 3) content review by experts
- coordinated with MBS animal survey staff on review and content development of 9 draft animal sidebars
- worked with contractor to determine sources of high resolution files and obtain permissions for use of 75 historic images
- sent 24 edited site guides (text, draft maps, photos) to SNA, TNC, and DNR Wildlife managers for expert review
- sent chapter 1 glacial geology content to expert for review
- continued map production on site guide map base layers and NPC polygon layers
- continued refinement of NPC distribution map base layers and representation of mapped NPC locations
- continued refinement of base layers (esp shaded relief) for use in various Upper Midwest region-scale maps, including glacial lobes, Lake Agassiz stages, and others

4. Biological reports, technical guidance, presentations, and trainings delivered.

<u>Biological Reports</u>

MBS aquatic botanist continued collaboration with the DNR Lake Ecology Program in the development and editing of chapters describing aquatic botanical inventories, rare aquatic plant surveys, and aquatic plant collection and preservation in the DNR Lake Plant Survey Manual (manual developed by the Lake Habitat/Ecology Program to be used by DNR Fisheries and EWR sections).

MBS plant ecologist wrote and submitted annual progress report to Meriwether Timber summarizing MBS field surveys on their properties.

MBS submitted final activity report to Voyageurs National Park that provided relevé locations and NPC descriptions.

MBS plant ecologist submitted final activity report to Koochiching Camp that provided natural features findings and management considerations for their Rainy Lake island property that MBS surveyed.

MBS plant ecologist reviewed and submitted editorial comments to the Natural Areas Journal for recent article submission by colleagues: *Understanding uncertainty in broad-scale mapping of historical vegetation in the Great Lakes Region.*

Technical Guidance

The technical guidance 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 ENRTF Minnesota 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 ML17 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 ML17 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) during this reporting period to a wide range of *partners* including DNR SNA program, Environmental Review, State Parks & Trails, Forestry, Lands & Minerals, Minnesota counties and cities, USFS, Bell Museum of Natural History, UMN Landscape Arboretum; Minnesota colleges and universities.

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. Much of the data delivered was or is funded by the ENRTF as recommended by LCCMR.

Examples include:

- Assisted MN Land Trust with NPC identification on Conservation Easement property on Burntside Lake.
- Provided information on MBS vegetation sampling protocols to researchers working on small mammals in the Superior National Forest.
- Provided ecological information to State Parks Resource Specialist related to a reroute of a portion of the Superior Hiking Trail through designated old growth forest in Manitou State Park.
- MBS plant ecologist consulted with a DNR fisheries and wildlife team to review and comment on forest stands selected for harvest this year in Aquatic Management Area. Information was provided on the upland plant communities inland from the Lake Superior shore to help understand how vegetation might respond following harvest and goals for the upland vegetation in these areas.
- Coordinated with DNR Southern Regional Ecologist on targeted rare plant surveys at Lawrence Creek SNA.
- Coordinated with DNR Central Regional Ecologist, a DNR Forester and Goodhue County (including a site visit) on newly acquired park land near a dwarf trout lily site.
- Provided subject matter expertise to SNA land managers on a smooth brome management project.
- Provided subject matter expertise to DNR Hydrologists and Regional Ecologists re: calcerous fen identification and associated rare flora.

- Provided technical guidance to DNR Northeast Regional Plant Ecologist related to targeted surveys for rare *Botrychium* species in the Nemadji State Forest. Advised on potential rare species, phenology, and associated rare species habitat. Helped to assess target search areas using lidar and aerial imagery.
- Met with MN Wildflowers (Peter Dziuk and Katy Chayka). Collaborative meeting to see their set-up and aquatic plant photos (part of their recent focus). Provided them with a few common aquatic plant locations for photography for their website.
- Provided general aquatic plant and algae information to local Watershed District staff for a presentation they were going to give to a lake group.
- MBS plant ecologist provided SNA with comments on draft language for a sign at Botany Bog SNA in Itasca County.

Presentations and Trainings

MBS moth entomologist provided a presentation on moths to twenty-five 3rd graders at Lake of the Woods School in Baudette. The talk focused on a few basic questions, like "what are moths?", "why are they important?", and "how many kinds of moths are there?" and included a field component where students captured and viewed live moths (and various other insects).

MBS herpetologist led a reptile and amphibian hike at Kasota Prairie SNA on June 21st. Cope's gray treefrogs, northern leopard frogs, and eastern garter snakes were found. Over 20 participants in attendance.

MBS plant ecologist provided an oral presentation at the Heart of the Continent Partnership Science Symposium in Duluth. The talk focused on the status of the MBS baseline survey and future program direction.

MBS aquatic botanist assisted in leading two spring aquatic plant ID workshops (30 may 2019 at French Regional Park; 4 June 2019 Father Hennepin SP) for DNR staff (Fisheries, Wildlife, EWR) and LGUs.

5. DNR's website and social media updated with current survey results.

MBS Social Media

MBS wrote occasional Facebook posts (posted to the DNR Facebook page and the SNA Facebook page) reflecting MBS survey activity during 2018 field seasons and highlights from current and past MBS work. Examples include one with a focus on aquatic plants and their overwintering strategies and another about MBS mapping of Native Plant Communities.

DNR Rare Species Guide

Major progress continued on updating and improving the DNR's web-based Rare Species Guide (RSG). MBS data and analysis funded by this and previous ENRTF appropriations are the basis of much of this work. Current work on the RSG is funded in part by State Wildlife Grant dollars that cover animal species while plants, bryophytes, and fungi are funded by this ENRTF appropriation. During this reporting period progress was made on adding sources to the scientific nomenclature used in the species profiles and uploading new and improved photographs for many of the profiles.

Activity 4 Status as of January 31, 2020

1. First draft of a new book on the mammals of Minnesota.
No updates at this time. Ongoing work to review mammal specimen collections, prepare them for accession to the Bell Museum mammal collection, and related data synthesis are occurring at a reduced pace than anticipated. Budget for this Outcome was in large part redirected per previous budget amendments.

2. New book on sedges and rushes of Minnesota.
See previous updates. Book published by MN Press in August 2018.

3. **Final draft of the book, Minnesota's Red River Valley and Aspen Parkland.**
Major progress continued for this publication that focused on final editing for all chapters, in preparation for submitting a final manuscript to the Minnesota Press by spring 2020 (revised from previous update). Work continues to focus on bringing all of the individual parts into a final state that is whole, that reads with consistent language and style. This is painstaking work with authors and editors focused on fine-tuning text, final cartographic and image decisions, and the limited development of new content that becomes necessary to bring the whole product together – all within strict word and page-count maximums. In addition to this, accomplishments of note include 1) developed publication quality map templates to represent the distribution of each of the 65 native plant community types and subtypes described in the book; 2) near completion of the painstaking final editing of the design template and supporting data layers for the 40+ maps in the site guide portion of the book; and 3) secured permission for use of approximately 60 photos, maps, line-drawings, and other artwork from the Minnesota Historical Society, University of Minnesota Bell Museum of Natural History, scientific journals, publishers, and other repositories.

4. **Biological reports, technical guidance, presentations, and trainings delivered.**
Biological Reports
In cooperation with DNR Regional Plant Ecologists and DNR Division of Forestry, data was analyzed and reported on a deer browse study in a MBS Site of Biodiversity Significance mapped to central mesic hardwood (MHc26) in Pine County, MN. MBS completed baseline surveys in Pine in the early 2000s that provided a baseline for this study. It is through the ongoing curation and delivery of MBS data and information from this effort a study such as this was achievable. Final report, "Deer Exclosure Effects on Mesic Oak Forest in St. Croix State Forest (MN DNR)" was published to the online Great Lakes Silviculture Library hosted by the UMN Sustainable Forest Education Cooperative: https://silvlib.cfans.umn.edu/content/deer-exclosure-effects-mesic-oak-forest-st-croix-state-forest-mn-dnr

An Ecological Evaluation was completed for a MBS site of biodiversity significance in Anoka County's Oak Grove Township. In addition to writing and map production, targeted field survey was necessary to address gaps in the report. A relevé was sampled on a higher quality upland forest in the project area. Late-season botanical visits resulted in the development a much more complete plant list for the site including the discovery of an uncommon fern, *Dryopteris intermedia*, representing a range extension of approximately 30 miles.

An oral preliminary report on the north shore relevé resampling project was delivered by MBS to SNA and Parks.

A summary report for the MBS-Superior National Forest LTP-NPC crosswalk project was delivered to the SNF Forest Ecologist.

Popular Press
MBS staff are preparing an upcoming article one of Minnesota's rarest plants, *Polemonium occidentalis*, for the Minnesota Conservation Volunteer.

MBS's Ecological Monitoring Network was highlighted in a NPR radio interview with Dan Gunderson. The interview was conducted primarily in the field within a wet prairie.

Technical Guidance

The technical guidance 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 ENRTF Minnesota 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 ML17 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 ML17 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) during this reporting period to a wide range of partners including DNR SNA program, Environmental Review, State Parks & Trails, Forestry, Lands & Minerals, Minnesota counties and cities, USFS, Bell Museum of Natural History, UMN Landscape Arboretum; Minnesota colleges and universities.

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. Much of the data delivered was or is funded by the ENRTF as recommended by LCCMR.
Examples include:

- Subject matter expertise provided to the DNR Listed Species Coordinator on *Cardamine pratensis v. palustris* related to a land-use issue in Grand Marais
- Subject matter expertise provided to DNR NE Regional Ecologist and State Parks District Resource Specialist on rare species and native plant communities survey related to a Manitou State Park trail reroute.
- Technical guidance provided to Duluth-area natural resource managers on available data and consequences of the invasive *Gypsophila paniculata* (baby's-breath) observations from MN Point (encountered by MBS during surveys for native and rare species). Provided 2019 Gypsophila data to Baby's-breath working group. Partners include Duluth Collaborative Invasive Species Management Area, City of Duluth, Minnesota Department of Agriculture, and the 1854 Treaty Authority. Discussed ecology and distribution of spread on MN Point, Duluth.
- Subject matter expertise provided to the Army Corps of Engineers, Duluth Port Authority, and EWR staff on MN Point Army Corps "Beach Nourishment" project (2019 project year). Provided technical

input related to the dune communities, rare species, and invasive species issues within the project boundary.

- Provided technical guidance to DNR Wildlife staff related to WMA "grassland" restoration project. Assisted with species identification and vegetation assemblage considerations including areas dominated by native species and areas dominated by non-native/invasive species.
- Provided technical guidance to R2 Environmental review staff related to a St. Louis County Right-of-Way project in the vicinity of McCarthy Beach SP and the Polemonium Bog site of biodiversity significance. Input included information about native plant community composition and quality as well as larger landscape level considerations for endangered and threatened species downslope of the project area.
- Provided technical guidance to the DNR regional plant ecologist related to targeted surveys for rare *Botrychium* species in High Conservation Value Forest sites in the Nemadji State Forest scheduled for timber harvest review. Spent one day in the field to help them develop a sense for the rare species habitat in the NSF and the suite of rare species they are likely to encounter. Survey efforts from this one day (1 stand) yielded 6 new rare species observations.
- Provided aquatic plant identification consultation to DNR Aquatic Invasive Species staff, DNR Fisheries, and members of lakes associations who email with plant photos and questions around the importance of aquatic plants.
- Related to Western Prairie Fringed Orchid, provided site-specific and subject matter expertise to 1) Environmental Review on suitable habitat at a landfill expansion site in Polk County and 2) DOT in regards to Marcoux Corner (intersection of U.S. Hwy 2 and State Hwy. 32) and potential project impacts to population at this location.
- Technical guidance provided to EWR Forest Ecologist and DNR Forestry regarding the inclusion of DNR's Native Plant Communities in Forestry's "Next Gen" management application.

Workshops

A MBS botanist collaborated with SNA, Regional Ecologists, and DNR Forestry ECS Program to deliver a one day workshop on forest grasses based out of Itasca SP. Workshop had ~40 participants including folks from state, federal, and local government agencies, NGO's and education institutions.

A MBS aquatic botanist co-led with EWR Lake Ecologists two aquatic plant identification workshops in Itasca SP (31 July 2019; 1 August 2019). Workshop attended by DNR staff, tribal staff, and LGUs. Collected aquatic plants in preparation for the workshop from Villard Lake (Pope); Pelican Lake (Pope); and Dade Lake (Cass).

5. DNR's website and social media updated with current survey results.

MBS Social Media

MBS wrote occasional Facebook posts (posted to the DNR, SNA, or Nongame Facebook pages) reflecting MBS survey activity and highlights from current and past MBS work. Examples include one with a focus on aquatic plants and their overwintering strategies and another about MBS mapping of native plant communities.

DNR Rare Species Guide

Major progress continued on updating and improving the DNR's web-based Rare Species Guide (RSG). MBS data and analysis funded by this and previous ENRTF appropriations are the basis of much of this work. Current work on the RSG is funded in part by State Wildlife Grant dollars that cover animal species while plants, bryophytes, and fungi are funded by this ENRTF appropriation. During this reporting period progress

continued on updating species profiles and uploading new and improved photographs for many of the profiles.

Web

MBS is collaborating with Environmental Review to acquire, modify and launch an online data viewing and delivery platform. It will fill a major gap in our current data delivery approach by providing GIS-based data to non-GIS users using standard internet browsers. MBS data products developed from this and previous ENRTF appropriations will be a centerpiece of the data catalog this platform will provide.

Activity 4 Status as of July 31, 2020:

1. **First draft of a new book on the mammals of Minnesota.**
   Budget for this Outcome was in large part redirected per previous budget amendments. No updates at this time. Ongoing work to review mammal specimen collections, prepare them for accession to the Bell Museum mammal collection, and related data synthesis are occurring at a reduced pace than anticipated.

2. **New book on sedges and rushes of Minnesota.**
   See previous updates. Book published by MN Press in August 2018.

3. **Final draft of the book, Minnesota's Red River Valley and Aspen Parkland.**
   Delivery of the final manuscript is extended to spring 2021 due to COVID-related reduced progress and the unexpected extended leave by the lead editor.

   Progress continued for this publication that focused on fine-tuning the text, maps, images, and graphics. Reviews of the draft manuscript have been received from targeted individuals who have a particular areas of expertise or experience relevant to the book content. Final editing was completed for several sidebars highlighting spotted skunk, bison, moose, bears, elk, and wolves.

4. **Biological reports, technical guidance, presentations, and trainings delivered.**

Biological Reports

- Initiated writing of ecological evaluation for the Polemonium Bog MBS Site of Biodiversity Significance in St. Louis County (area of interest for preservation wetland bank). Compiled and reviewed existing data related to Polemonium, connected with groundwater experts on the hydrogeology of the site, and conferred with other MBS staff related to Polemonium current status, trends, and threats.
- Provided SNA program newly mapped NPC polygons of Burntside Islands MBS Site of Biodiversity Signifiance and SNA to be used for public outreach via SNA "virtual visits".

Popular Media

- Minnesota Conservation Volunteer, April-May 2020 edition*, The Big Reveal* by Hannah Texler.
  - As the Minnesota Biological Survey program begins wrapping the fieldwork in a decades-long assessment of the state's ecological health, the results are both sobering and hopeful-not to mention pretty darn cool. A DNR plant ecologist pulls back the curtain on this important project.
  - https://www.dnr.state.mn.us/mcvmagazine/issues/2020/mar-apr/survey.html

- MN Public Radio, All Things Considered, April 22, 2020, *DNR wrapping up Minnesota's first biological 'census': Hundreds of scientists have spent three decades cataloging the state's biological diversity,* Tom Crann and Megan Burks.
  - https://www.mprnews.org/story/2020/04/22/dnr-wrapping-up-minnesotas-first-biological-census

Technical Guidance

The technical guidance 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 ENRTF Minnesota 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 ML17 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 ML17 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) during this reporting period to a wide range of partners including DNR SNA program, Environmental Review, State Parks & Trails, Forestry, Lands & Minerals, Minnesota counties and cities, USFS, Bell Museum of Natural History, UMN Landscape Arboretum; Minnesota colleges and universities.

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. Much of the data delivered was or is funded by the ENRTF as recommended by LCCMR.

Examples include:

- Provided input to DNR NE Regional Plant Ecologist regarding forest rare species, access, and maintenance of natural hydrology. Delivered field data observations within forestry stands of interest.
- Worked in coordination with DNR NE Regional Plant Ecologist to develop survey plans for identifying stands of local *Ammophila breviligulata* genotype material that could be utilized as harvest zones for permitted revegetation work on MN Point, Duluth.
- Provided technical guidance to Univ of MN & USGS researcher, Dr. Diane Larson, with identification of prairie soil reference sites for research on soil mycorrhizae.
- Provided data and technical expertise to the 5 year update of the DNR Lake Ecology Program's Lakes of Biological Significance (LOBS) List/Layer. Compiled a list of lakes with recent rare aquatic plant records since the last LOBS review was conducted in 2015.
- Provided NPC data and interpretation to the Chippewa National Forest Soil Scientist to help in their development of a crosswalk between NPCs and USFS's ECS Land Type Phases.

Workshops

- Collaborated with the DNR SNA Program on the planning of a summer 2020 Forest Grasses Workshop to be held at Itasca State Park. Workshop cancelled due to COVID.
- Collaborated with the DNR Lake Ecology Unit on the planning of a summer 2020 Aquatic Plant Identification Workshops. Workshop cancelled due to COVID. Began review and edits to online aquatic plant training presentations in lieu of in-person workshops.

5. DNR's website and social media updated with current survey results.

MBS Social Media

MBS wrote occasional Facebook posts (posted to the DNR, SNA, or Nongame Facebook pages) reflecting MBS survey activity and highlights from current and past MBS work. Examples include a post on the pending completion of the 30+ year statewide biological survey, a post on MBS work with native bats, and a post on endangered species.

DNR Rare Species Guide

Major progress continued on updating and improving the DNR's web-based Rare Species Guide (RSG). MBS data and analysis funded by this and previous ENRTF appropriations are the basis of much of this work. Current work on the RSG is funded in part by State Wildlife Grant dollars that cover animal species while plants, bryophytes, and fungi are funded by this ENRTF appropriation. Major progress this reporting period on updating and editing over 60 species profiles and uploading over 300 new and improved photographs and writing associated captions.

Web

MBS continues collaboration with DNR Environmental Review to launch an online geographic data viewing and delivery platform. It will fill a major gap in our current data delivery options by providing GIS-based data to non-GIS users using standard internet browsers. The data the platform will provide are in large part generated by MBS from this and all previous ENRTF appropriations.

Activity 4 Status as of January 31, 2021:

1. **First draft of a new book on the mammals of Minnesota.**
   Budget for this Outcome was in large part redirected per previous budget amendments. No further updates.

2. **New book on sedges and rushes of Minnesota.**
   See previous updates. Book published by MN Press in August 2018.

3. **Final draft of the book, Minnesota's Red River Valley and Aspen Parkland.**
   Delivery of the final manuscript is extended to spring 2021 due to COVID-related reduced progress and the unexpected extended leave by the lead editor.

   Progress continued for this publication that focused on fine-tuning the text, maps, images, and graphics. Reviews of the draft manuscript continue from targeted individuals who have a particular areas of expertise or experience relevant to the book content. Final editing was completed for several maps including a map series on glacial periods and glacial Lake Agassiz and maps of important sites of biodiversity significance in the book region that will be profiled in chapter 3 of the manuscript.

4. **Biological reports, technical guidance, presentations, and trainings delivered.**
   No further updates. Work was completed here as of the previous update report.

5. **DNR's website and social media updated with current survey results.**
   No further updates. Work was completed here as of the previous update report.

Final Report Summary: Submitted between June 30 and August 1, 2021.

The final manuscript of "Sedges and Rushes of Minnesota" was delivered to the UMN Press in late March 2018 and published by the Press in August, 2018. The final manuscript of "Red River Valley and Aspen Parklands – A Guide to Native Plant Communities" was delivered to the UMN Press in June 2021 and is on track to be published by mid-year 2022. For both publications, MBS field surveys and staff expertise developed under LCCMR MBS appropriations have been essential to making them thorough, reliable and based on an otherwise much smaller and incomplete collection of data, specimens, documented field locations, and relevant staff expertise.

Work was initiated to sort and organize small mammal specimens and associated data and databases in preparation for writing a new book on the mammals of Minnesota. This initial work is critical to providing the most up-to-date and thorough species descriptions and statewide treatment of mammals in Minnesota. However, due to an unexpected retirement and an unexpected departure of a key staff person assisting with the book, progress on this book was been slower than expected and eventually this work plan was amended to remove this outcome.

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, Minnesota counties and cities, USFS, Bell Museum of Natural History, UMN Landscape Arboretum; Minnesota colleges and universities.

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. Much of the data delivered was or is funded by the ENRTF as recommended by LCCMR.

MBS staff participated in several presentations and technical trainings related to outcomes of this project. Requestors of and attendees to these events come from a wide range of organizations including NRCS, SWCD, USFWS, USFS, DNR Wildlife, DNR Ecological and Water Resources, DNR Parks & Trails, BWSR, colleges and universities, TNC, Pheasants Forever, and private consultants.

Major progress continued on updating and improving the DNR's web-based Rare Species Guide (RSG) with new data fresh from field work being accomplished under this appropriation. MBS data and analysis funded by this and previous ENRTF appropriations are the basis of much of this work. Current work on the RSG is funded in part by State Wildlife Grant dollars that cover animal species while plants, bryophytes, and fungi are funded by this ENRTF appropriation.

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 the Department of Entomology Insect Collection. 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.

Status as of December 31, 2017
See above dissemination description and the Activity 4 update.

Status as of June 30, 2018
See above dissemination description and the Activity 4 update.

Status as of January 31, 2019
See above dissemination description and the Activity 4 update.

Status as of July 31, 2019
See above dissemination description and the Activity 4 update.

Status as of January 31, 2020
See above dissemination description and the Activity 4 update.

Status as of July 31, 2020:
See above dissemination description and the Activity 4 update.

Status as of January 31, 2021:
See above dissemination description and the Activity 4 update.

Final Report Summary: Submitted between June 30 and August 1, 2021.
See above dissemination description and the Activity 4 Final Report Summary.

VI. PROJECT BUDGET SUMMARY:
A. Final ENRTF Budget Overview:
***This section represents an overview of the preliminary budget at the start of the project. It will be reconciled with actual expenditures at the time of the final report.**

Budget Category	$ Amount	Overview Explanation
Personnel:	$ 2,390,707	Botanists, Plant Ecologists, Research Ecologist, Zoologist, Mammologist, Entomologists, Data Manager, Data Assistant, Information Officer for baseline surveys, targeted field survey, data entry and management, map development, book development, technical guidance and outreach. 3 Botanists (2 classified 1.8 FTE for two years; 1 unclassified 0.5 FTE for two years) position# 1 1.0 FTE, 81% salary, 21% benefits; position #2 0.8 FTE, 79% salary 21% benefits;

		position #3 0.5 FTE, 80% salary, 20% benefits). 9 Plant Ecologists (9 unclassified 6.3 FTE for two years) position #1 80% salary, 20% benefits; positions #2 71% salary, 29% benefits; position #3 70% salary, 30% benefits; position # 4 67% salary, 33% benefits; position #5 67% salary, 33% benefits; positions #6 77% salary, 23% benefits; position #7 78% salary, 22% benefits; position #8 61% salary, 39% benefits; position #9 70% salary, 30% benefits. 1 Research Ecologist (1 classified 0.5 FTE for two years) 72% salary, 28% benefits. 1 Zoologist (1 unclassified 0.5 FTE for two years) 70% salary 30% benefits. 1 Mammologist (1 classified 0.2 FTE for one year) 82% salary 18% benefits. 2 Entomologists (2 unclassified 2.0 FTE for two years) positions TBD per DNR competitive hiring process. 1 Data Manager (1 classified 0.2 FTE for two years) 68% salary, 32% benefits. 1 Data Assistant (1 unclassified 1.0 FTE for two years) position TBD per DNR competitive hiring process. 1 Information officer (1 unclassified 1.0 FTE for two years) 69% salary 21% benefits.
Professional/Technical/Service Contracts:	$ 220,042	Sole-source contract with MN.IT for GIS and database services. Contracts TBD with biologists, MN.IT service-level agreements, MN Press book development/publishing. Work orders with Conservation Corps Minnesota for project assistance.
Equipment/Tools/Supplies:	$ 16,695	Equipment, tools, and supplies necessary to complete baseline and targeted field surveys. Examples include GPS units, digital cameras, watercraft (non-motorized), communication equipment, increment borers, soil probes, collections materials, notebooks, compasses, hand lenses, data recorders, taxonomic references, batteries, aerial photography, etc. Equipment is used from previous survey periods when at all possible but each year some of this equipment needs replacing or updating.
Travel Expenses in MN:	$ 95,157	Travel expenses for MN travel only. This is related to field survey in Activities 1 & 2. Travel expenses are subject to State of MN labor agreements and DNR policy. Most travel expenses are related to the 4-6 months of time when staff are conducting field work that requires food, transportation in seasonal DNR fleet vehicles, and lodging. Also includes travel expense reimbursement to volunteers.
Other: DNR Direct & Necessary	$ 177,398	DNR's direct and necessary costs pay for activities that are directly related to and

		necessary for accomplishing appropriated projects. HR Support (~$41,997), Safety Support (~$11,763), Financial Support (~$36,436), Communication Support (~$1,316), IT Support (~$84,794), Planning Support (~$912), and Procurement Support (~$197).
TOTAL ENRTF BUDGET:	**$ 2,900,000**	

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 four classified staff are directly related to this work program.

A portion of the time of one research ecologist (0.5 FTE for two years) is directed to targeted field survey (Activity 2), data analysis, and technical guidance. Due to decades of field experience and ecological analysis work in the prairie, this ecologist brings knowledge and perspectives that will result in high quality results.

A portion of the time of one mammologist (0.2 FTE for one year) is directed to writing a draft of a new mammals of Minnesota book to be published by the Minnesota Press. Due to decades of field experience, data analysis, technical writing, outreach, and technical guidance, this mammologist brings expertise, experience, and perspectives not available elsewhere.

2 botanists (1.8 FTE for two years) are needed for plant baseline field survey, rare orchid monitoring, verification of MBS plant collections, coordination with collections repositories (e.g. herbaria), data management, outreach and technical guidance. Due to many years of experience, these botanists bring unparalleled expertise, experience, and perspectives to this project.

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

Total Number of Full-time Equivalents (FTE) Directly Funded with this ENRTF Appropriation: 28.3

Total Number of Full-time Equivalents (FTE) Estimated to Be Funded through Contracts with this ENRTF Appropriation: 0.5

B. Other Funds:

Source of Funds	$ Amount Proposed	$ Amount Spent	Use of Other Funds
Non-state			
State Wildlife Grant (Federal)	$550,000	$716,730	Animal surveys and monitoring, data management, outreach, technical guidance
Federal Endangered Species	$70,000	$86,835	Monitoring, analysis, volunteer coordination for federally listed plant species in Minnesota.
State			
General Fund	$750,000	$778,000	A portion of MBS program management and supervision; office space; program operations.
Game & Fish Fund	$120,000	$128,656	Field survey to monitor prairie management effects on native plants and plant communities.

Heritage Enhancement	$1,225,000	$1,505,703	Fund senior ecologists and zoologists who lead and provide oversight to field survey efforts and associated analysis. Associated operations budget.
TOTAL OTHER FUNDS:	**$ 2,715,000**	**$3,211,924**	

VII. PROJECT STRATEGY:

A. Project Partners:

Partners receiving ENRTF funding: N/A

Partners NOT receiving ENRTF funding

- The Bell Museum, University of Minnesota, plant and animal collections
- The Science Museum, animal collections
- University of Minnesota, Entomology Department, insect collections
- Superior National Forest, US Forest Service, vegetation plot (relevé) collection
- NatureServe, data management, database structure, data distribution, data standards

B. Project Impact and Long-term Strategy: MBS will pursue future funding proposals to address priority needs such as field survey to fill data gaps and improve scientific understanding; field survey under-surveyed species groups and ecological systems; field survey of MBS sites and other priority areas to add precision or depth to ecological data; update priority areas first surveyed in the 1980-90s or before with new ecological data; monitor ecological response to policies and management on ecological sites, native plant communities, and species populations; and provide new data and analysis in response to advances to technology, data collection, analysis, modeling, and information delivery.

C. Funding History:

Below is the most recent summary of significant MBS funding. General Fund is used for MBS supervisors, office space for all staff, and most non-field operations. State Wildlife Grant dollars fund most of the MBS animal survey. Heritage Enhancement is used to fund senior ecologists and zoologists who lead field survey efforts and associated analysis. Game and Fish Fund is used to fund field operations for a senior prairie Research Scientist and assistants co-leading (with DNR Wildlife) a field study assessing the effects of prairie management on native plants and plant communities. The ENRTF dollars listed are previous allocations for the ongoing project entitled, Minnesota (County) Biological Survey.

Funding Source and Use of Funds	Funding Timeframe	$ Amount
ENRTF M.L. 2015, Chp. 76, Sec. 2, Subd. 03c	July 1, 2015 - June 30, 2017	$2,450,000
General Fund	July 1, 2015 - June 30, 2017	$ 773,273
State Wildlife Grant (Federal dollars)	July 1, 2015 - June 30, 2017	$ 568,103
Heritage Enhancement	July 1, 2015 - June 30, 2017	$ 1,237,920
Game & Fish Fund	July 1, 2015 - June 30, 2017	$ 140,549
ENRTF M.L. 2013, Chp. 52, Sec. 2, Subd. 03a	July 1, 2013 - June 30, 2015	$2,650,000
General Fund	July 1, 2013 - June 30, 2015	$ 420,000
State Wildlife Grant	July 1, 2013 - June 30, 2015	$ 450,000
Heritage Enhancement	July 1, 2013 - June 30, 2015	$1,162,000
ENRTF M.L. 2011, First Special Session, Chp. 2, Art.3, Sec. 2, Subd. 03a	July 1, 2011 - June 30, 2013	$2,250,000
General Fund	July 1, 2011 - June 30, 2013	$ 520,000
State Wildlife Grant	July 1, 2011 - June 30, 2013	$ 500,000
Heritage Enhancement	July 1, 2011 - June 30, 2013	$ 934,000
RIM Critical Habitat	July 1, 2011 - June 30, 2013	$ 226,500

VIII. REPORTING REQUIREMENTS:

- **The project is for 4 years, will begin on 07/01/17, and end on 6/30/2021.**
- **Periodic project status update reports will be submitted December 31, 2017, June 30, 2018, January 31, 2018, July 31, 2019, January 31, 2020, July 31, 2020, and January 31, 2021.**
- **Final Report Summary: Submitted between June 30 and August 1, 2021.**

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

Environment and Natural Resources Trust Fund
M.L. 2017 Final Project Budget

Project Title: Minnesota Biological Survey
Legal Citation: M.L. 2017, Chp. 96, Sec. 2, Subd. 03d
Project Manager: Bruce Carlson
Organization: Department of Natural Resources
M.L. 2017 ENRTF Appropriation: **$** 2,900,000
Project Length and Completion Date: *4* Years, June 30, 2021
Date of Report: August 16, 2021

ENVIRONMENT AND NATURAL RESOURCES TRUST FUND BUDGET	Revised Activity 1 Budget 8/24/2020	Amount Spent	Activity 1 Balance	Revised Activity 2 Budget 8/24/2020	Amount Spent	Activity 2 Balance	Revised Activity 3 Budget 8/24/2020	Amount Spent	Activity 3 Balance	Reised Activity 4 Budget 8/24/2020	Amount Spent	Activity 4 Balance	TOTAL BUDGET	TOTAL BALANCE
BUDGET ITEM														
Personnel (Wages and Benefits)	426,067	426,067	0	366,580	366,580	0	1,191,189	1,191,189	0	406,871	406,871	0	2,390,707	0
3 Botanists (2.3 FTE for two years: 2 classified 1.8 FTE for two years; 1 unclassified 0.5 FTE for two years) position# 1 1.0 FTE, 81% salary, 21% benefits; position #2 0.8 FTE, 79% salary 21% benefits; position #3 0.5 FTE, 80% salary, 20% benefits). Total estimated $389,697.														
9 Plant Ecologists (9 unclassified 6.3 FTE for two years) position #1 80% salary, 20% benefits; positions #2 71% salary, 29% benefits; position #3 70% salary, 30% benefits; position # 4 67% salary, 33% benefits; position #5 67% salary, 33% benefits; positions #6 77% salary, 23% benefits; position #7 78% salary, 22% benefits; position #8 61% salary, 39% benefits; position #9 70% salary, 30% benefits. Total estimated $1,077,764														
1 Research Ecologist (1 classified 0.5 FTE for two years) 72% salary, 28% benefits. Total estimated $109,109.														
1 Zoologist (1 unclassified 0.5 FTE for two years) 70% salary, 30% benefits). Totoal estimated $70,000														
1 Mammologist (1 classified 0.5 FTE for two years) 82% salary 18% benefits. Total estimated $106,255.														
2 Entomologists (2 unclassified 2.0 FTE for two years) positions TBD per DNR competitive hiring process. Total estimated $269,717.														
1 Data Manager (1 classified 0.2 FTE for two years) 68% salary, 32% benefits. Total estimated $34,798.														
1 Data Assistant (1 unclassified 1.0 FTE for two years) position TBD per DNR competitive hiring process. $115,388.														
1 Information officer (1 unclassified 1.0 FTE for two years) 69% salary 21% benefits. Total estimated $181,938.														
Professional/Technical/Service Contracts														
MN.IT for day-to-day GIS and IT services. MN.IT staff embedded in DNR 0.5 FTE. 411951	33,367	33,367	0	33,367	33,367	0	33,367	33,367	0	33,367	33,367	0	133,468	0
Contract biologists to be selected competitively per State contract rules for biological field survey.	1,617	1,617	0	4,446	4,446	0	5,140	5,140	0	22,832	22,832	0	34,035	0
Joint Powers Agreement with University of Minnesota Press for book publication. (NW book only in WP; $2,500 spent for Sedges & Rushes final product payment) 430011	0	0	0	0	0	0	0	0	0	17,500	17,500	0	17,500	0
Service Level Agreements with MN.IT for specific database, GIS, and map projects. 411960	0						324	324	0				324	0
Work Order with Conservation Corps Minnesota for program support purposes per DNR-CCM Master Contract Agreement. 411310										34,716	34,716	0	34,716	0
Equipment/Tools/Supplies													0	
Equipment, tools, and supplies for ~14 FTEs necessary to complete baseline and targeted field surveys. Equipment is used from previous survey periods when at all possible but each year some of this equipment needs replacing or updating. Examples include GPS units, digital cameras, communication equipment, increment borers, soil probes, biological specimen materials, notebooks, compasses, hand lenses, data recorders, taxonomic references, batteries, aerial photography, etc.	11,272	11,272	0	3,754	3,754	0							15,026	0
Entomology-specifc field survey equipment, lures/baits/traps, and collections materials and storage cabinets.	0	0	0	1,669	1,669	0							1,669	0

Travel expenses in Minnesota													0	
Travel expenses for MN travel only. This is related to field survey in Activities 1 & 2. Travel expenses covered per Commissioner's Plan. Travel expenses are for ~12 FTEs for ~6 months of field work each year. Most travel occurs between St. Paul or Duluth and field work locations in northern, western, central, and SE MN. This includes food, transportation in DNR fleet vehicles, and lodging. Also includes travel expense reimbursement to volunteers	71,784	71,784	0	23,373	23,373	0							95,157	0
Other													0	
Direct and Necessary: DNR's direct and necessary costs pay for activities that are directly related to and necessary for accomplishing appropriated projects. HR Support (~$41,997), Safety Support (~$11,763), Financial Support (~$36,436), Communication Support (~$1,316), IT Support (~$84,794), Planning Support (~$912), and Porcurement Support (~$197)	49,671	49,671	0	39,028	39,028	0	65,637	65,637	0	23,062	23,062	0	177,398	0
COLUMN TOTAL	**593,778**	**593,778**	**0**	**472,217**	**472,217**	**0**	**1,295,657**	**1,295,657**	**0**	**538,348**	**538,348**	**0**	**2,900,000**	**0**