

M.L. 2019, First Special Session, Chp. 4, Art. 2, Sec. 2, Subd. 03a as extended by M.L. 2022, Chp. 94, Sec. 2, Subd. 19 (c.1) [to June 30, 2023]

Project Abstract

For the Period Ending June 30, 2023

PROJECT TITLE: Minnesota Biological Survey - Continuation

PROJECT MANAGER: Bruce Carlson

AFFILIATION: MN DNR

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FUNDING SOURCE: Environment and Natural Resources Trust Fund

LEGAL CITATION: M.L. 2019, First Special Session, Chp. 4, Art. 2, Sec. 2, Subd. 03a as extended by M.L. 2022, Chp. 94, Sec. 2, Subd. 19 (c.1) [to June 30, 2023]

APPROPRIATION AMOUNT: \$ 1,500,000

AMOUNT SPENT: \$1,500,000

AMOUNT REMAINING: \$0

Sound bite of Project Outcomes and Results

The Minnesota Biological Survey (MBS) collects, interprets, and delivers foundational data on native and rare 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

Minnesota Biological Survey (MBS) baseline terrestrial plant field surveys in Lake of the Woods, St. Louis, and Koochiching counties were finished under this appropriation. This brings to completion baseline biological field surveys in each of MN's 87 counties, an effort that began in 1987.

Lake surveys for aquatic plants occurred in eastern Minnesota with significant rare plant discoveries including new state record locations. Baseline surveys for native and rare moths in northern and eastern counties revealed numerous notable rare species including state records and species new to science.

Work continued with DNR Division of Fish & Wildlife in northwest Minnesota to update and expand on 1980-90s era MBS surveys of native prairie and savannah and associated rare species in 34 sites.

Major progress continued from previous ENRTF MBS appropriations to enter MBS field data from this long-term project into databases of the Natural Heritage Information System, preparing biological specimens for accession to the University of Minnesota Bell Museum and Entomology collections, and digitizing and archiving MBS county survey records.

Mapping and classification of native plant communities based on MBS field surveys continued in several northern counties. Over 46,000 polygons were mapped and classified for nearly 2 million acres.

The completed manuscript of the book "Ferns and Lycophytes of Minnesota" was completed and delivered to the UMN Press for publishing.

The [DNR Rare Species Guide](#) was updated with new data from field work accomplished under this and previous ENRTF MBS appropriations. A public online biodiversity data viewing and delivery platform, [MN Conservation Explorer](#), was developed and launched.

MBS provided technical guidance to a wide range of audiences related to outcomes of this project. MBS contributed social media posts (posted to the DNR, SNA, or Nongame Wildlife Program Facebook pages) and updated its website regarding MBS survey activity and highlights.

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. 2019 ENRTF Work Plan (Main Document)

Today's Date: 08/15/2023

Final Report

Date of Work Plan Approval: June 5, 2019

Project Completion Date: June 30, 2023

PROJECT TITLE: Minnesota Biological Survey - Continuation

Project Manager: Bruce Carlson

Organization: MN DNR

College/Department/Division: Division of Ecological & Water Resources, MN Biological Survey Unit

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Location: Aitkin, Anoka, Becker, Beltrami, Big Stone, Carlton, Chippewa, Chisago, Clay, Cook, Crow Wing, Fillmore, Houston, Isanti, Itasca, Kittson, Koochiching, Lake, Lake of the Woods, Lincoln, Mahnommen, Marshall, Meekeer, Mille Lacs, Norman, Olmsted, Otter Tail, Pennington, Pine, Polk, Pope, Ramsey, Redwood, Roseau, St. Louis, Stearns, Stevens, Swift, Todd, Wabasha, Wadena, Washington, Winona, and Wright counties.

Total Project Budget: \$1,500,000

Amount Spent: \$1,500,000

Balance: \$0

Legal Citation: M.L. 2019, First Special Session, Chp. 4, Art. 2, Sec. 2, Subd. 03a as extended by M.L. 2022, Chp. 94, Sec. 2, Subd. 19 (c.1) [to June 30, 2023]

Appropriation Language: \$1,500,000 the first year is from the trust fund to the commissioner of natural resources for the Minnesota biological survey to complete the statewide field surveys begun in 1987 to provide a foundation for conserving biological diversity by systematically collecting, interpreting, and delivering data on native and rare species, pollinators, and native plant communities throughout Minnesota. Any revenues generated through the publication of books or other resources created through this appropriation may be reinvested as described in the work plan approved by the Legislative-Citizen Commission on Minnesota Resources according to Minnesota Statutes, section 116P.10.

M.L. 2022 - Sec. 2. ENVIRONMENT AND NATURAL RESOURCES TRUST FUND; EXTENSIONS. [to June 30, 2023]

I. PROJECT STATEMENT:

The Minnesota Biological Survey (MBS) proposes to collect and deliver foundational natural resource data and information on native and rare species, pollinators, and native plant communities. This work will deliver new data and products that help guide and prioritize biodiversity and water conservation and management throughout Minnesota.

This proposal will 1) bring to completion field surveys in all of Lake of the Woods County, St. Louis County, and Koochiching County thereby completing field work for the statewide, baseline county-by-county survey started in 1987 for native terrestrial plants, plant communities, birds, amphibians, reptiles, and small mammals; 2) continue towards statewide completion of aquatic (lake) plant surveys; 3) update and enhance 1980s–90s field surveys and monitoring data in select native prairies, wetlands, and forests that are important to current collaborative planning and management initiatives or of imminent conservation attention; and 4) provide new biological reports, a new book, technical guidance, and outreach resulting from 1-3 above.

Recent examples of delivery and interpretation of MBS data 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; delivery of biological specimens for the UMN Bell Museum’s Minnesota Biodiversity Atlas (ENRTF ML18 004-A); and technical support tools for stream and watershed management. MBS has particular ENRTF-invested expertise and capacity to efficiently and effectively deliver the stated outcomes.

II. OVERALL PROJECT STATUS UPDATES:

First Update March 1, 2020

Per phone call on 2/28/2020 with LCCMR staff, we did not need to complete this update due to this project not started yet. Spending on this appropriation is not intended to begin until July 1, 2020.

Second Update September 1, 2020

Work started on this work plan on July 1, 2020. Field-related Outcomes were typically less than expected or cancelled due to COVID-related reasons and associated Governor Executive Orders. Much of this work plan is a continuation of the ML17 ENRTF MBS work plan.

Progress continued from previous ENRTF MBS appropriations to enter MBS field data from this long-term project into databases of the Natural Heritage Information System and preparing biological 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 80,000 acres of native plant communities were mapped during the reporting period.

Lake surveys for aquatic plants occurred in July and August in east central Minnesota with surveys occurring in six lakes with several significant rare plant discoveries – details forthcoming at the next update. 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 in NW Minnesota. Over 1,000 specimens were collected with many noteworthy discoveries to be reported at the next update report.

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 contributed to Facebook posts (posted to the DNR, SNA, or Nongame Wildlife Program Facebook pages) 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 and previous ENRTF MBS appropriations.

Third Update March 1, 2021

Field-related Outcomes were typically less than expected or cancelled due to COVID-related reasons and associated Governor Executive Orders. Outcomes related to office or desktop work were typically greater than expected.

Progress continued from previous ENRTF MBS appropriations to enter MBS field data from this long-term project into databases of the Natural Heritage Information System and preparing biological specimens for accession to the University of Minnesota Bell Museum and Entomology collections. Processing data and results from 2020 field surveys and developing priorities and preparing for 2021 field work occupied much of the 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 delays due to COVID, 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 several counties. Mapping of native plant communities involves considerable amounts of collaboration with DNR Forestry, Fish & Wildlife, and Parks & Trails. Over 470,000 acres of native plant communities were mapped during the reporting period.

Lake surveys for aquatic plants occurred in July and August in east central Minnesota with surveys occurring in 32 lakes. Many surveys resulted in documentation of significant rare plant discoveries including a new state record of aquatic plant. 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 in NW Minnesota. Over 2,500 specimens were collected with many noteworthy discoveries including numerous county and regional records and at least a few new state records.

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 contributed to Facebook posts (posted to the DNR, SNA, or Nongame Wildlife Program Facebook pages) and updated its website regarding MBS survey activity during 2020 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 and previous ENRTF MBS appropriations.

Fourth Update September 1, 2021

Accomplishments and budgets reported are through June 30, 2021. Some field-related Outcomes were less than expected or cancelled due to COVID-related travel restrictions, the state hiring freeze, and associated Governor Executive Orders. For example, field surveys planned for the Northwest Angle in Lake of the Woods County that require travel through Canada were cancelled for the second year in a row due to travel restrictions at the US-Canada border. Outcomes related to office or desktop work were typically greater than expected.

Field surveys in St. Louis County resumed with 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 and ecological monitoring plots) distribution. Much of the field work during this reporting period focused on pairing vegetation plots with detailed NRCS soil descriptions.

Lake surveys for aquatic plants occurred in 19 lakes in Chisago and Ramsey counties in May and June. At each lake a meander survey and/or a nearshore plot survey is completed to document all native aquatic plants present. Additional targeted searches are completed for rare plant species. New rare species locations were documented including a few new locations for the recent state-record species, *Wolffia brasiliensis*.

Pollinator surveys in MBS sites of biodiversity significance focused on baseline surveys for native and rare moths in Goodhue and Washington counties in eastern Minnesota. Unusually warm spring conditions resulted in surprisingly high species diversity and notably early phenological records. Over 200 specimens were collected with many noteworthy discoveries.

MBS plant ecologists collected new relevés (vegetation plots) in northern Minnesota that help describe and classify native plant communities. MBS also installed permanent vegetation monitoring plots in MBS sites of biodiversity significance in several eastern Minnesota counties. These plots are designed to track long-term changes in plant community composition and condition.

Progress continues on the manuscript for a new book publication on the ferns and fern allies of Minnesota. Field work occurred at various sites throughout the state to address manuscript questions, fill species distribution gaps, and follow up on tips for new locations of high priority species. Additional work focused on processing specimens, processing and editing recently acquired photos, updating map data, and consultation with taxa experts and various other specialists in specific parts of the manuscript.

Desktop GIS mapping of native plant communities based on MBS field surveys continued in Itasca, Cass, Beltrami, Koochiching, Lake of the Woods, St. Louis, Winona, Fillmore, and Olmstead counties. Mapping of native plant communities involves considerable amounts of collaboration with DNR Forestry, Fish & Wildlife, and Parks & Trails. Over 13,000 polygons were created covering over 490,000 acres of native plant communities were mapped during the reporting period.

Progress continued from previous ENRTF MBS appropriations to enter MBS field data from this long-term project into databases of the Natural Heritage Information System and preparing biological specimens for accession to the University of Minnesota Bell Museum and Entomology collections. Processing data and results from 2019 and 2020 field surveys and developing priorities and preparing for 2021 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.

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 contributed to Facebook posts (posted to the DNR, SNA, or Nongame Wildlife Program Facebook pages) and updated its website regarding MBS survey activity during 2020 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 and previous ENRTF MBS appropriations. MBS continues a collaboration with NatureServe and 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.

Amendment Request as of September 1, 2021

Budget amendment requests:

1. Within Professional/Technical/Service Contracts add a new category, "Contracts with biologists," and establish a \$5,000 budget for that line by moving \$5,000 from "MN.IT for embedded GIS services." This is needed for a contract with a field botanist with professional plant photography skills for Activity 3 Outcome 1, the Ferns and Fern Allies book publication. MN.IT GIS Services has been coming in under budget.
2. Move \$50,000 from Travel Expenses for Activity 1 to Personnel for Activity 2. Travel Expenses have been coming in well under budget and those dollars can be used to increase %FTE to Activity 2 Outcome 1.

Amendment Approved by LCCMR 10/14/2021.

Fifth Update March 1, 2022

Accomplishments and budgets reported are through December 31, 2021. Some field-related Outcomes were less than expected as our program is still in the process of normalizing operations after the state hiring freeze was lifted and we are still subject to some COVID-related restrictions.

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 and ecological monitoring plots) distribution. Much of the field work during this reporting period focused on collecting vegetation plot data paired to locations with ongoing NRCS soil mapping.

Survey work in the eastern portion of Voyageurs National Park, including both upland and aquatic habitats, was completed. New populations of nine rare plant species were found.

Lakes surveys for aquatic plants occurred in in St. Louis, Chisago, Ramsey and Washington counties in 31 lakes and one river backwater. At each lake a meander survey and/or a nearshore plot survey is completed to document all native aquatic plants present. Additional targeted searches are completed for rare plant species. New rare species locations were documented including a few new locations for the recent state-record species, *Wolffia brasiliensis*.

Pollinator surveys in MBS sites of biodiversity significance focused on baseline surveys for native and rare moths in occurred at 22 site across 18 counties. New reports were documented of seven rarely encountered moth species. *Lithophane georgii* was documented far south of its previously known range, indicating the ecology of this species is more complex than first thought.

Progress on the manuscript for a new book publication on the ferns and fern allies of Minnesota is on schedule to be delivered to the publisher by March 31, 2022, for a book release date in spring 2023. All last field visits are complete, and all the major components of the manuscript are complete and currently being assembled and formatted.

Desktop GIS mapping of native plant communities based on MBS field surveys continued in several counties. A notable accomplishment this reporting period; The final quality control and certification of Beltrami County, 441,135 acres of mapped NPCs, was completed. MBS staff completed a project to update and enhance NPC information in MBS Sites of Biodiversity Significance first mapped in the 1990s that overlap with lands administer by DNRs Division of Forestry in the southeast part of the state. MBS staff also created and refined a new geoprocessing tool that more efficiently discovers errors in draft NPC classification maps. This tool will allow for quicker review and certification of NPC maps and ultimately result in higher quality NPC products.

Progress continued from previous ENRTF MBS appropriations to enter MBS field data from this long-term project into databases of the Natural Heritage Information System and preparing biological specimens for accession to the University of Minnesota Bell Museum and Entomology collections. Processing data and results from 2020 and 2021 field surveys and developing priorities and preparing for 2022 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.

MBS staff provided technical guidance and advice to a wide range of audiences related to outcomes of this project and previous MBS ENRTF appropriations. 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 and previous ENRTF MBS appropriations. MBS continues a collaboration with NatureServe and 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.

Update as of June 30, 2022:

Project extended to June 30, 2023 by LCCMR 6/30/22 as a result of M.L. 2022, Chp.94, Sec. 2, Subd. 19, legislative extension criteria being met.

Sixth Update as of September 1, 2022:

Accomplishments and budgets reported are through June 30, 2022.

With field work under Activity 1 now considered complete, major progress has been made processing specimens, entering field data into electronic databases, creating native plant community maps, and interpreting those data for Lake of the Woods, St. Louis and Koochiching Counties. For example, initial digitizing and NPC classifications for all Lake of the Woods County is complete, and substantial progress on NPC mapping was made on over 49,000 acres in St. Louis County.

Lakes surveys for aquatic plants continued in Chisago County and began in Anoka, Le Sueur and Rice Counties across 15 lakes. Four new county records for three species were documented, and one new population of the

rare *Decodon verticillatus* was discovered. Also, in collaboration with work being done to update and enhance rare species data, two calcareous fens were searched for charophytes (*Chara* species). A rare charophyte is known to occur in fens but has not yet been documented in MN. *Chara* species were found at one site; their identification still needs to be verified.

The completed manuscript, including text and images, of the book “Ferns and Lycophytes of Minnesota” was delivered to the publisher, the University of Minnesota Press, in March 2022. The expected book release date is spring 2023.

Desktop GIS mapping of native plant communities based on MBS field surveys continued in Cass, Clearwater and Itasca counties. In total, progress was made on over 200,000 acres. MBS staff completed an internal review and began resolving discrepancies for a project to update and enhance NPC information in MBS Sites of Biodiversity Significance first mapped in the 1990s that overlap with lands administered by DNR's Division of Forestry in the southeast part of the state.

MBS continues a collaboration with NatureServe and DNR Environmental Review to launch an online geographic data viewing and delivery platform. User acceptance testing was completed for the MN Conservation Explorer and the final preparations to launch the site to the public by August 2022 began. This will fill a major gap in our current data delivery options by providing GIS-based data to non-GIS users using standard internet browsers.

Progress continued to enter MBS field data from this long-term project into databases of the Natural Heritage Information System and preparing biological specimens for accession to the University of Minnesota Bell Museum and Entomology collections.

MBS staff provided technical guidance and advice to a wide range of audiences related to outcomes of this project and previous MBS ENRTF appropriations. 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 and previous ENRTF MBS appropriations. Notably, MBS staff contributed to several trainings and workshops including: a Forest Grasses Workshop, a Bee Identification and Monitoring Workshop in collaboration with the Xerces Society, and online trainings on the Ecological Classification System and NPCs for staff of the Superior National Forest.

Seventh Update as of March 1, 2023:

Progress continued processing specimens, entering field data into electronic databases, creating native plant community maps, and interpreting those data for Lake of the Woods, St. Louis, and Koochiching Counties. Substantial progress on NPC mapping was made with over 320,000 acres mapped and added to our publicly available NPC map datasets.

Field work for Lake aquatic plant and Lepidopteran surveys under this appropriation are now complete, with data and specimen processing in-progress. In total, over 3,000 Lepidopteran specimens were collected during the summer of 2022. Lakes surveys in Ramsey County were completed, documenting three new rare aquatic species records.

Work continued on a collaborative project with DNR Division of Fish & Wildlife in Kittson, Roseau, and Marshall Counties to update and expand on 1980-90s era MBS surveys of native prairie and savannah. Data and specimen processing resulting from previously reported surveys of prairie and savanna native plant communities and associated rare plant species on 34 sites, are in-progress.

The completed manuscript of the book “Ferns and Lycophytes of Minnesota” was delivered to the publisher prior to this reporting period. The expected book release date is spring 2023. 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 and previous ENRTF MBS appropriations.

[MN Conservation Explorer](https://mce.dnr.state.mn.us/) was fully launched to the public during this reporting period. It can be found at: <https://mce.dnr.state.mn.us/>.

MBS staff provided technical guidance and advice to a wide range of audiences related to outcomes of this project and previous MBS ENRTF appropriations.

Amendment Request as of March 1, 2023

Increase Contracts with biologists by \$20,000 by moving

- \$5,000 from Joint Powers Agreement with the UMN Press,
- \$7,951 from Travel Expenses,
- \$952 from Equipment/Tools/Supplies,
- \$6,097 from Personnel

This is done to achieve field work under Activity 2, Milestone 2 for which we lack staff capacity. We instead intend to offer a competitive RFP for contracting this work. Money can be moved from the budget lines listed because the book published by UMN Press came in \$5000 under budget and the remaining balances for travel expenses and equipment/supplies are not needed with no additional staff-led field work planned for this appropriation.

Amendment Approved by LCCMR 4/12/23.

Amendment Request as of June 30, 2023

Increase Contracts – MN.IT for embedded GIS services by \$36,319 by moving the same amount from Personnel. This is done to reflect final budget close numbers to balance the final project budget. The increase in MN.IT embedded GIS services is due to the additional attention put to GIS mapping and data processing in this appropriation and a commensurate decrease in field surveys.

Amendment Approved by LCCMR 10/3/23.

Final Report as of June 30, 2023 (to be submitted before August 15, 2023):

MBS baseline terrestrial plant field surveys in Lake of the Woods, St. Louis and Koochiching counties were finished under this appropriation. This brings to completion baseline biological field surveys in each of MN's 87 counties, an effort that began in 1987.

Lake surveys for aquatic plants occurred in eastern Minnesota with significant rare plant discoveries including new state record locations. Baseline surveys for native and rare moths in northern and eastern counties revealed numerous notable rare species including state records and species new to science.

Work continued with DNR Division of Fish & Wildlife in NW MN to update and expand on 1980-90s era MBS surveys of native prairie and savannah and associated rare species in 34 sites.

Major progress continued from previous ENRTF MBS appropriations to enter MBS field data from this long-term project into databases of the Natural Heritage Information System, preparing biological specimens for accession to the University of Minnesota Bell Museum and Entomology collections, and digitizing and archiving MBS county survey records.

Mapping and classification of native plant communities (NPC) based on MBS field surveys continued in several northern counties. Over 46,000 polygons were mapped and classified for nearly 2 million acres.

The completed manuscript of the book “Ferns and Lycophytes of Minnesota” was completed and delivered to the UMN Press for publishing.

The [DNR Rare Species Guide](#) (RSG) was updated with new data from field work accomplished under this and previous ENRTF MBS appropriations. A public online biodiversity data viewing and delivery platform, [MN Conservation Explorer](#) was developed and launched.

MBS provided technical guidance to a wide range of audiences related to outcomes of this project. MBS contributed social media posts (posted to the DNR, SNA, or Nongame Wildlife Program Facebook pages) and updated its website regarding MBS survey activity and highlights.

III. PROJECT ACTIVITIES AND OUTCOMES:

ACTIVITY 1: County Biological Surveys – complete Lake of the Woods, St. Louis, and Koochiching Counties

Description: MBS will bring to completion, in the three remaining counties, statewide county-by-county baseline field surveys begun in 1987 on the distribution and ecology of native terrestrial plants, plant communities, birds, amphibians, reptiles, and small mammals.

ACTIVITY 1 ENRTF BUDGET: \$741,538

Outcome	Completion Date
1. Baseline field survey completed for Northwest Angle, Lake of the Woods County	June 2022
2. Baseline field survey completed for St. Louis County	June 2022
3. Baseline field survey completed for Koochiching County	June 2022
4. Field data entered into DNR databases; specimens delivered to MN repositories.	Ongoing

First Update March 1, 2020

See overall project status updates above.

Second Update September 1, 2020

Work started on this work plan on July 1, 2020. Field-related Outcomes were typically less than expected or cancelled due to COVID-related reasons and associated Governor Executive Orders.

1. Northwest Angle, Lake of the Woods County
No updates at this time.
2. St. Louis County
Collaborative work with the Superior National Forest and the Natural Resources Conservation Service continued from the ML17 MBS work plan. This work combines mutual priorities among MBS, SNF and NRCS to fill gaps in vegetation plot (relevé) distribution and understanding soil-vegetation relationships. Filling these data gaps is important to MBS efforts to complete St. Louis County on this work plan and to 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.
3. Koochiching County
No updates at this time.
4. Field data entered into DNR databases; specimens delivered to MN repositories.
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 here is a continuation from the ML17 ENRTF MBS appropriation. Accomplishments include:
 - Completed identification of 2019 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 2019 rare species collections.
 - Completed data entry, quality-control, and editing of relevés from the 2019 field season.
 - Completed quality control of native plant community condition ranking field forms from 2019 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 northern MN 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.
- Continued digitizing and updating of older MBS amphibian and reptile datasets to modern standards for submission to the MBS Observation Database.
- 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.

Third Update March 1, 2021

1. Northwest Angle, Lake of the Woods County
No updates at this time.
2. St. Louis County
Collaborative work with the Superior National Forest and the Natural Resources Conservation Service continued. This work combines mutual priorities among MBS, SNF and NRCS to fill gaps in vegetation plot (relevé) distribution and understanding soil-vegetation relationships. Filling these data gaps is important to MBS efforts to complete St. Louis County on this work plan and to classify and map native plant communities in the state and the SNF's similar goal within their boundaries. During the reporting period project staff analyzed and interpreted project data to-date (2016 to present) and completed 36 (85% of total) of the Land Type Phase (USFS classification) to Native Plant Community (DNR classification) crosswalk. Evaluated all current relevés that intersect each LTP on the SNF – ensured relevé NPC was classified correctly and that LTP mapping conformed to soil concept of LTP designation.
3. Koochiching County
No updates at this time.
4. Field data entered into DNR databases; specimens delivered to MN repositories.
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 here is a continuation from the ML17 ENRTF MBS appropriation. Accomplishments include:
 - Completed identification of 2019-20 plant and insect specimen collections from Lake of the Woods, Koochiching and St. Louis counties, prepared labels for specimens to be accessioned to

Bell Museum herbarium and UMN Entomology Insect collection, and completed Biotics submissions for 2020 rare species collections.

- Completed data entry, quality-control, and editing of relevés from the 2020 field season.
- Completed quality control of native plant community condition ranking field forms from 2020 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 northern MN 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.
- Continued digitizing and updating of MBS amphibian and reptile datasets to modern standards for submission to the MBS Observation Database. For example, adding “negative” data i.e. surveys in suitable habitat for a specific species or group that did not result in documenting presence of that species or group. In the past only “positive” data has been recorded and added to the MBS Observation Database.
- 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: Kittson, Roseau, Clay, Wilkin, Traverse and Big Stone. Volunteers provide most of the work hours to this effort.

Fourth Update September 1, 2021

1. Northwest Angle, Lake of the Woods County

Due to COVID-19 travel restrictions, field survey for the Northwest Angle, Lake of the Woods County did not occur. Lake of the Woods County is considered complete for MBS plant survey work. Work here now focuses on entering field data into DNR databases, mapping, and processing specimens.

2. St. Louis County

Collaborative work with the Superior National Forest and the Natural Resources Conservation Service continued. This work combines mutual priorities among MBS, SNF and NRCS to fill gaps in vegetation plot (relevé) distribution and understanding soil-vegetation relationships. Filling these data gaps is important to MBS efforts to complete St. Louis County on this work plan and to classify and map native plant communities in the state and the SNF’s similar goal within their boundaries.

During the reporting period scientists completed a preliminary crosswalk of USFS Land Type Phases to DNR native plant communities (one LTP remaining, see below). MBS plant ecologists identified and prepared 15 relevé re-visits to collect soil information in 2021 and identified plot locations for relevés and backhoe soil pits with NRCS soil scientists. These plots occur where Superior National Forest LTP mapping and NRCS soil mapping is deficient. The plots will occur on the Isabella Moraine, Phantom Lake Peatland, and Cabin Lake Till Plain LTAs.

Coordination with Voyageurs National Park in St. Louis County continued to plan for survey work in the Park that will occur in later summer 2021. Voyageurs is among the last remaining places in St. Louis County for MBS to survey.

Rare plant surveys occurred in southern St. Louis County along the St. Louis River where over 50 individuals of the rare *Allium schoenoprasum* were discovered.

3. Koochiching County

No updates at this time. Plant field survey for Koochiching County is considered complete. Work here now focuses on entering field data into DNR databases, mapping, and processing specimens.

4. Field data entered into DNR databases; specimens delivered to MN repositories.

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 vegetation plots, GPS waypoints, and digital photographs and video. Work here is a continuation from previous reporting periods. Accomplishments at the individual staff level are similar to last reporting period and include:

- Completed identification of 2019-20 plant and insect specimen collections from Lake of the Woods, Koochiching and St. Louis counties, prepared labels for specimens to be accessioned to Bell Museum herbarium and UMN Entomology Insect collection, and completed Biotics submissions for 2020 rare species collections.
- Completed data entry, quality-control, and editing of relevés from the 2020 field season.
- Completed quality control of native plant community condition ranking field forms from 2020 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 northern MN 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.
- Continued digitizing and updating of MBS amphibian and reptile datasets to modern standards for submission to the MBS Observation Database including:
 - 2013 Southeast MN data totaling 1,537 records in Dakota, Houston, Wabasha, and Winona counties. This dataset includes drift fence and radio telemetry of targeted snake species including bullsnakes.
 - 2013 Lac qui Parle data totaling 575 records in Chippewa and Swift counties. This dataset includes frog, toad, salamander, and plains hog-nosed snake surveys conducted in prairie sites that are subject to conservation grazing. This telemetry effort identified important overwintering and nesting sites for plains hog-nosed snakes, and provided insight as to how they cope with and respond to both cattle grazing and prescribed fire.

- 2015 Southeast MN data totaling 1724 records in Fillmore and Wabasha counties. This dataset includes drift fence and radio telemetry of targeted snake species including bullsnakes and hog-nosed snakes.
- 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: Pine, Kittson, Roseau, Clay, Wilkin, Traverse and Big Stone. Volunteers provide most of the work hours to this effort.

Fifth Update March 1, 2022

1. Northwest Angle, Lake of the Woods County

Field surveys for Lake of the Woods County were considered complete as of the prior reporting period. Work here now focuses on entering field data into DNR databases, mapping, and processing specimens.

2. St. Louis County

Collaborative work with the Superior National Forest and the Natural Resources Conservation Service (NRCS) continued. This work combines mutual priorities among MBS, Superior National Forest (SNF) and NRCS to fill gaps in vegetation plot (relevé) distribution and understanding soil-vegetation relationships. Filling these data gaps is important to MBS efforts to complete St. Louis County on this work plan and to classify and map native plant communities in the state and the SNF's similar goal within their boundaries. During this reporting period, 11 relevé plots were sampled within the SNF (Isabella Moraine and Cabin Lake Till Plain LTAs) in conjunction with backhoe soil pits dug by NRCS and SNF soil scientists in areas where NRCS soil mapping was deficient.

A newly discovered population of the state endangered floating marsh marigold, *Caltha natans*, was documented on private property.

Survey work in the eastern portion of Voyageurs National Park was completed. The survey area included aquatic (see Activity 2, Outcome 1 for detail) and upland environments of Sand Point Lake, Namakan Lake, Crane Lake, and Little Vermillion Lake (BWCAW).

Notable discoveries include new populations nine of rare plant species:

Utricularia geminiscapa
Caltha natans
Subularia aquatica

Crassula aquatica
Elatine triandra
Littorella uniflora

Sceptridium rugulosum
Myriophyllum tenellum
Ophioglossum pusillum

Several of the above rare species had not previously been documented in VNP. We also newly documented six other more common native species:

Huperzia selago
Lipocarpa micrantha

Sceptridium dissectum
Lycopodiella inundata

Spinulum canadense
Carex viridula

Lastly, we updated existing rare plant records with VNP, including *Crassula aquatica* and *Littorella uniflora*.

3. Koochiching County

Field surveys for Koochiching County are considered complete. Work here now focuses on entering field data into DNR databases, mapping, and processing specimens.

4. Field data entered into DNR databases; specimens delivered to MN repositories.

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 vegetation plots, GPS waypoints, and digital photographs and video. Work here is a continuation from previous reporting periods. Accomplishments at the individual staff level are similar to last reporting period and include:

- Completed data entry, quality-control, and editing of relevés and transects from the 2021 field season at SNF
- Completed identification of unknown plant, moss, and lichen species from 2021 SNF sampling; prepared labels for specimens to be accessioned to Bell Museum herbarium and completed BIOTICS submissions for 2021 rare species collections
- Prepared and submitted a report of 2021 field season to NRCS and SNF
- Began data entry and specimen identification of unknown specimens from 2021 VNP sampling; prioritized *Elatine* specimens which required external expert verification
- 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.
- Incorporated new field data into the defining and continued development of MBS Sites of Biodiversity Significance in northern MN counties.
- Wrote field-survey-site summaries and vegetation descriptions in the MBS Site Database for sites in northern MN 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.
- 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. Accomplishments centered on southeast and northwest MN counties and Pine County. . Volunteers provide most of the work hours to this effort.

Update as of June 30, 2022:

Project extended to June 30, 2023 by LCCMR 6/30/22 as a result of M.L. 2022, Chp.94, Sec. 2, Subd. 19, legislative extension criteria being met.

Sixth Update as of September 1, 2022:

Accomplishments through June 30, 2022.

1. Northwest Angle, Lake of the Woods County

Field surveys for Lake of the Woods County were considered complete as of the prior reporting period. Work here now focuses on entering field data into DNR databases, mapping, and processing specimens.

2. St. Louis County

Field surveys for St. Louis County are considered complete. Work here now focuses on entering field data into DNR databases, mapping, and processing specimens.

3. Koochiching County

Field surveys for Koochiching County were considered complete as of the prior reporting period. Work here now focuses on entering field data into DNR databases, mapping, and processing specimens.

4. Field data entered into DNR databases; specimens delivered to MN repositories.

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 vegetation plots, GPS waypoints, and digital photographs and video. Work here is a continuation from previous reporting periods. Accomplishments at the individual staff level are similar to last reporting period and include:

- Initial digitizing and NPC classifications for all Lake of the Woods County sites are complete.
- Final digitizing and NPC classifications for six Koochiching County sites are complete and those sites are ready for certification.
- Completed data entry, quality-control, and editing of nine relevés from collaborative MBS, SNF and NRCS work in St. Louis County.
- A large site,
- Substantial mapping progress was made in MBS sites in St. Louis county including Bear Head Lake (35,181 acres; 1,104 polygons), with approx. 4,000 of those acres also classified to native plant community; Loon Echo site[14,209 acres; 783 polygons]; and progress was also made in Giants Ridge site, and Pike Peatlands sites
- 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: Lake of the Woods, Stevens, Grant, Marshall, Douglass. Volunteers provide most of the work hours to this effort.

Seventh Update as of March 1, 2023:

1. Northwest Angle, Lake of the Woods County

Field surveys for Lake of the Woods County were considered complete as of the prior reporting period. Work here now focuses on entering field data into DNR databases, mapping, and processing specimens.

2. St. Louis County

Field surveys for St. Louis County were considered complete as of the prior reporting period. Work here now focuses on entering field data into DNR databases, mapping, and processing specimens.

3. Koochiching County

Field surveys for Koochiching County were considered complete as of the prior reporting period. Work here now focuses on entering field data into DNR databases, mapping, and processing specimens.

4. Field data entered into DNR databases; specimens delivered to MN repositories.

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 vegetation plots, GPS waypoints, and digital photographs and video. Work here is a continuation from previous reporting periods. Accomplishments at the individual staff level are similar to last reporting period. Of note during this reporting period is 320,000 acres of Native Plant Communities mapped within 11 Sites of Biodiversity Significance ranked High or Outstanding. Volunteers substantially contribute to these accomplishments.

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. Volunteers contribute to much of this work, together they addressed items from over a dozen counties during this reporting period.

Final Report as of June 30, 2023 (to be submitted before August 15, 2023):

Northwest Angle, Lake of the Woods County

Due to COVID-19 travel restrictions, field survey for the Northwest Angle, Lake of the Woods County did not occur on this appropriation. Lake of the Woods County is considered complete for MBS plant survey work. Work here now focuses on entering field data into DNR databases, mapping, and processing specimens that continues on the ML21 ENRTF MBS appropriation.

St. Louis County

Collaborative work with the Superior National Forest and the Natural Resources Conservation Service continued from the ML17 MBS work plan. This work combines mutual priorities among MBS, SNF and NRCS to fill gaps in vegetation plot (relevé) distribution and understanding soil-vegetation relationships. Filling these data gaps is important to MBS efforts to complete St. Louis County on this work plan and to classify and map native plant communities in the state and the SNF's similar goal within their boundaries.

Survey work in the eastern portion of Voyageurs National Park was completed. The survey area included aquatic (see Activity 2, Outcome 1 for detail) and upland environments of Sand Point Lake, Namakan Lake, Crane Lake, and Little Vermillion Lake (BWCAW).

Koochiching County

Plant field survey for Koochiching County is considered complete. Work here now focuses on entering field data into DNR databases, mapping, and processing specimens that continues on the ML21 ENRTF MBS appropriation..

Field data entered into DNR databases; specimens delivered to MN repositories.

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 here is a continuation from the ML17 ENRTF MBS appropriation and continues on the ML21 ENRTF MBS appropriation.

Accomplishments include:

- Completed identification of plant specimen collections from Lake of the Woods, Koochiching and St. Louis counties, prepared labels for plant specimens to be submitted to the Bell Museum herbarium.
- Completed Biotics submissions for rare species collections.
- Completed data entry, quality-control, and editing of relevés.
- Completed quality control of native plant community condition ranking field forms.
- 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 northern MN counties.
- 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.
- Continued digitizing and updating of older MBS amphibian and reptile datasets to modern standards for submission to the MBS Observation Database.
- Completed identification of insect specimen collections from Lake of the Woods, Koochiching and St. Louis counties, prepared labels for specimens to be accessioned to the UMN Entomology Insect collection, and completed Biotics submissions for rare species collections.

- Completed identification of unknown plant, moss, and lichen species from SNF and Voyageur National Park sampling.
- Significant progress continued 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.

ACTIVITY 2: Enhance Surveys and Monitoring in High Priority Sites and Ecological Systems

Description: Collect and deliver field survey data and provide analysis on targeted lakes, high-quality native plant communities, sensitive species, and pollinators that either 1) expand upon existing or previous ENRTF investments in data collection and analysis or 2) address foundational needs in Minnesota science and collaborative plans and projects.

ACTIVITY 2 ENRTF BUDGET: \$368,462

Outcome	Completion Date
1. Statewide lake surveys continued for native and rare aquatic plants. ~125 lakes in 8 counties.	June 2022
2. Field surveys completed of newly documented prairie vegetation and rare species in northwestern Minnesota. ~200 sites in 16 counties.	June 2022
3. 1980s–90s field surveys updated and enhanced for rare species, pollinators, or native vegetation in eastern Minnesota. >10 sites TBD from ~26 counties.	June 2022
4. Field data entered into DNR databases; specimens delivered to MN repositories.	Ongoing

First Update March 1, 2020

See overall project status updates above.

Second Update September 1, 2020

Work started on this work plan on July 1, 2020. Field-related Outcomes were typically less than expected or cancelled due to COVID-related reasons and associated Governor Executive Orders.

1. Lake surveys for aquatic plants

This work is a continuation from the ML17 ENRTF MBS appropriation that ended for this Outcome on June 30, 2020. The 2020 field season started later than normally planned due to COVID-related restrictions on travel, field work, etc. Field work and data and specimen processing are in-progress at the time of this report. A more thorough update will be provided for this work in the next update. Field work has been focused on lakes in east-central MN. Field work included coordination with the DNR Lake Ecology Unit on collecting plant material for a genetic study on *Nelumbo* and *Sagittaria* populations as encountered incidentally through planned field work. This project is also in collaboration with the New York Botanical Garden and the DNR Lake Unit on research into charophyte (an aquatic algae that looks like an aquatic plant) distribution in MN.

2. Field surveys in northwest MN

Lepidoptera surveys: sites were surveyed in Beltrami, Koochiching, Lake of the Woods, and Roseau 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). High intensity surveys (multiple methods including nocturnal surveys which yield large number of species) were conducted. 2020 field surveys thus far have yielded well over 1,000 moth and butterfly specimens, including numerous new county records and possibly at least one new state record. Field work and data and specimen processing are all in-progress at the time of this report.

3. Field surveys in eastern MN

No updates at this time.

Third Update March 1, 2021

1. Lake surveys for aquatic plants

MBS Conducted aquatic plant surveys on 32 lakes in Chisago, Washington, and Ramsey counties. At each lake a meander survey and/or a nearshore plot survey is completed to document all native aquatic plants present. Additional targeted searches are completed for rare plant species. Field work included coordination with the DNR Lake Ecology Unit on collecting plant material for a genetic study on *Nelumbo* and *Sagittaria* populations as encountered incidentally through planned field work. This project is also in collaboration with the New York Botanical Garden and the DNR Lake Unit on research into charophyte (an aquatic algae that looks like an aquatic plant) distribution in MN. The lakes surveyed and highlights for each lake are provided in the tables below. A very significant highlight being a discovery of an aquatic plant not previously documented in Minnesota, *Wolffia brasiliensis*, a species of watermeal.

Chisago County lake	MBS aquatic plant survey highlight
Kroon Lake	Collected <i>Sagittaria rigida</i> at the public water access.
East Rush Lake, West Rush Lake	New documentation of <i>Decodon verticillatus</i>
West Rush Lake	New documentation of <i>Decodon verticillatus</i> , County record of <i>Elodea canadensis</i>
North Lindstrom Lake	County record of <i>Heteranthera dubia</i> , watchlist update of <i>Wolffia brasiliensis</i>
South Lindstrom Lake	Nearshore plot survey completed. No rare species documented.
Chisago Lake	County record of <i>Nelumbo lutea</i> .
Comfort Lake, Little Green Lake, Spider Lake	Conducted field visits to lakes in priority areas to search for and collect charophytes.
Washington County	
Colby Lake	Potential new state record of <i>Wolffia brasiliensis</i>
Lost Lake	Meander plant survey, no rare species documented.
Powers Lake, Lily Lake, DeMontreville Lake	Meander plant survey, documented the rare <i>Wolffia brasiliensis</i>
Bone Lake	Nearshore plot survey, no rare species documented.
Olson Lake	Meander plant survey, documented the rare <i>Wolffia brasiliensis</i> and <i>Lychnothamnus barbatus</i> , county record of <i>Potamogeton nodosus</i> ,
Big Carnelian Lake	Documentation of the rare <i>Alisma gramineum</i>
Jane Lake	Watchlist record of <i>Lychnothamnus barbatus</i>
Battle Creek Lake	Documentation of the rare <i>Wolffia brasiliensis</i> , <i>Nelumbo lutea</i>
Big Marine Lake	County record of <i>Schoenoplectus subterminalis</i> , documentation for <i>Alisma gramineum</i>

Ramsey County	
Beaver Lake, McCarron Lake, Wakefield Lake, Island Lake, Bennett Lake, Langton Lake, Keller Lake, Silver Lake (ID 62008300), Josephine Lake	Watchlist record of <i>Wolffia brasiliensis</i>
Silver Lake (ID 62000100), Spoon Lake	Meander plant survey, no rare species documented.
Kohlman Lake	New EO of <i>Decodon verticillatus</i> and <i>Wolffia brasiliensis</i>

A significant part of MBS aquatic botanist's time in late fall, winter, and early spring is spent processing specimens, entering field data into electronic databases, and interpreting those data. Field data include specimens, notes, standardized data sheets for rare species and vegetation plots, GPS waypoints, and digital photographs and video. Accomplishments include:

- Continued creating herbarium labels for my 2020 aquatic vascular plant specimens. This included creation of labels and associated collection forms for *Nelumbo* and *Sagittaria* that contribute to a genetic study and efforts to better document known populations in the state. Genetic study is being conducted by Dr. Jinming Chen, Wuhan Botanical Garden, Chinese Academy of Sciences.
- Consulted with the taxonomic authority and received verification on the identity of the state record discovery, *Wolffia brasiliensis*.
- Integrated 2020 field survey waypoints from GPS and iPad with field photos;
- Verified identity of aquatic plant specimens collected during the 2020 field season. Of note is 52 aquatic macroalgae specimens in the family *Characeae*. This is a group that has been under-collected in the state; its diversity and distribution in MN is not well known. Most have duplicates and will be sent to an expert at New York Botanical Garden for ID verification and genetic analyses.

2. Field surveys in northwest MN

See also Activity 1, Outcome 3.

Lepidoptera surveys: a total of 64 sites were surveyed within the Agassiz Lowlands (34 sites) and Littlefork-Vermillion Uplands (16 sites) ecological subsection portion of the following counties: Beltrami (16 sites), Clearwater (4 sites), Itasca, (2 sites), Koochiching (19 sites), Lake of the Woods (10 sites), Roseau (3 sites), and St. Louis (4 sites) 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). High intensity surveys (multiple methods including nocturnal surveys which yield large number of species) were conducted. 2020 field surveys yielded well over 2,500 moth and butterfly specimens, including numerous new county, regional, and state records. Significant moth discoveries include:

<i>Chaetoglaea cerata</i>	new state record from 3 sites in Roseau, Lake of the Woods, and Koochiching counties
<i>Depressaria alienella</i>	new state record from 4 sites in Roseau and Lake of the Woods counties

<i>Palpita quadristigmalis</i>	new state record from 1 site in Koochiching Co.
<i>Catocala whitneyi</i>	Special Concern species – very unexpected new county record in Lake of the Woods Co.
<i>Boloria chariclea</i>	A Species of Greatest Conservation Need (SGCN)– 3 new sites in Koochiching and St. Louis counties
<i>Xestia mixta</i>	SGCN – 1 new site in Koochiching Co.
Countless other notable species including:	
<i>Acleris maximana, Eupsilia tristigmata, Alsophila pometaria, Homoglaea hircina, Operophtera bruceata, and Lithophane baileyi</i>	Seldom-encountered species, Norris Camp WMA, Lake of the Woods County.
<i>Ufeus satyricus</i> and <i>Nycteola cinereana</i>	Seldom-encountered species, Franz-Jevne State Park, Koochiching County
<i>Acleris oxycoccana, Xylena curvimacula, Hypena scabra, Eupsilia morrisoni, Dolomedes tenebrosus</i>	Seldom-encountered species, Red Lake Peatland, Beltrami County

The number of new species added for the Agassiz Lowlands was remarkable given past survey efforts. For example, 12 species of the genus *Papaipema* (a fairly well-studied group of distinctive moths) were previously documented, but efforts this September yielded an incredible 8 new *Papaipema* species not previously documented in the Agassiz Lowlands.

Lepidoptera surveys often involve as much attention to plants as they do insects. A few notable plant discoveries were documented with specimens from Roseau Co. – *Amorpha canescens* (herbarium records apparently lacking from Agassiz Lowlands), *Ceanothus herbaceous* (new county record and northwest range extension in MN), and *Vaccinium caespitosum* (a rarely encountered dwarf shrub which supports *Plebejus idas*, a Special Concern butterfly).

3. Field surveys in eastern MN

Nemadji State Forest, Carlton and Pine Counties: completed targeted rare plant surveys in MBS Sites of Outstanding and High Biodiversity Significance last surveyed about 20 years ago. The focus was on rare *Botrychium* species. This involved collaboration and coordination with DNR regional ecologists and DNR forestry staff. Rare species observations (nearly 40 in total) included:

- *Botrychium oneidense* (T)– 20 new observations
- *Botrychium mormo* (T)– 3 new observations
- *Botrychium lanceolatum* (T)– 15 new observations
- *Botrychium simplex* var. *tenebrosus* (SPC)– 1 new observation.

Generated spatial data for *Botrychium* source features of the NSF observed 2016-2020 (total of 65 observations). Worked on species identification/verification of 2020 small *Botrychium* collections (primarily *B. mormo* and *B. simplex* var. *tenebrosus*). Reviewed and compiled MBS data for a data request related to the Nemadji River watershed area. Created a document that highlights site attributes and work done by MBS and shared it with other EWR staff involved with the data request (e.g. R2 EWR and SNA).

Fourth Update September 1, 2021

1. Statewide lake surveys continued for native and rare aquatic plants. ~125 lakes in 8 counties.

A significant part of MBS aquatic botanist’s time in late fall, winter, and early spring is spent processing specimens, entering field data into electronic databases, and interpreting those data. Field data include specimens, notes, standardized data sheets for rare species and vegetation plots, GPS waypoints, and digital photographs and video. Accomplishments include:

- Finished typing *Characeae* herbarium labels for 130 specimens collected in 2020. This taxa group has been under-collected in the state; its diversity and distribution in MN is not well known. Specimens were sent to an expert at New York Botanical Garden (NYBG) for ID verification and genetic analyses. Once verified, specimens will be accessioned at the Bell Museum with duplicates retained at NYBG, as is common practice when receiving verification from a taxa group expert.
- Processed *Wolffia brasiliensis* specimens collected in 2020. This species was previously not known to occur in the state and was first documented in Minnesota in 2020 during aquatic plant surveys funded by this and previous ENRTF MBS appropriations. This work included review of literature on preservation techniques and identification of *Wolffia*, a genus that can be difficult to identify from dried material. Specimens were accessioned to the UMN Bell Museum Herbarium.
- Mapped 2020 rare plant observations (EOs) in ArcMap for submission to the Natural Heritage Information System, Biotics database. This included submitting historic records of *Lychnothamnus barbatus*, a macroalga recently added to the State watchlist.
- In collaboration with the DNR Lake Ecology Unit, created a tool in ArcGIS that will generate taxa list reports for MBS aquatic plant surveys. These reports would be placed on the DNR LakeFinder website. This tool will also be available to use by other programs conducting aquatic plant surveys.

MBS conducted aquatic plant surveys on 19 lakes in Chisago and Ramsey counties in May and June 2021. At each lake a meander survey and/or a nearshore plot survey is completed to document all native aquatic plants present. Additional targeted searches are completed for rare plant species. Botanical specimens were collected and pressed during 2021 aquatic plant surveys for later herbaria submission. Much of collecting focused on rare/watchlist species, county records, and charophytes (part of a collaborative project with NYBG). The lakes surveyed and highlights for each lake are provided in the tables below. A very significant highlight is additional discoveries of *Wolffia brasiliensis*, a species of watermeal first documented in Minnesota in 2020 by MBS.

Chisago County lake	MBS aquatic plant survey highlight
Green Lake	New EO of <i>Decodon verticillatus</i> ; watchlist record of <i>Wolffia brasiliensis</i> ; and county record of <i>Utricularia gibba</i> ; Aquatic plant list.
Chisago Lake, Bull Lake, North Center Lake, South Center Lake	Watchlist record of <i>Wolffia brasiliensis</i> ; Aquatic plant list.
Little Green Lake, Goose Lakes, Linn Lake, Spider Lake, Little Lake, School Lake, Mattson Lake, Martha Lake, North Sunrise Pool, Kost Dam Pool, Sunrise River, Tanners Lake	Aquatic plant list
Ramsey County	
Johanna Lake	Watchlist record of <i>Wolffia brasiliensis</i> ; Aquatic plant list.
Turtle Lake	County record of <i>Schoenoplectus acutus</i> ; Aquatic plant list.

2. Field surveys completed of newly documented prairie vegetation and rare species in northwestern Minnesota. ~200 sites in 16 counties.

No update at this time. Very little progress was made on this Outcome due to the state hiring freeze.

3. 1980s–90s field surveys updated and enhanced for rare species, pollinators, or native vegetation in eastern Minnesota. >10 sites TBD from ~26 counties.

Limited update for this reporting period due to state hiring freeze and the unexpected three-month leave-of-absence of a key staff member contributing to this Outcome.

Lepidoptera surveys

Three sites were surveyed for native and rare moths in Goodhue (2 sites) and Washington (1 site) counties. These lie within the Blufflands and St. Paul-Baldwin Plains ecological subsections, respectively. Sites were surveyed April 4-5 using mercury vapor (MV) lighted sheets, ultraviolet (UV) light traps, fermenting banana/sugar bait, and random meander diurnal searches. All three sites yielded significant results with Spring Creek Prairie in Goodhue County standing out as a priority for more intensive insect inventories due to its high potential for myriad species of conservation interest. Unusually warm spring conditions resulted in surprising diversity (over 60 species of moths at one sheet on the best night) and notable early phenological records. Most species collected are likely new county records. Seldom-encountered species included the undescribed *Lithophane* sp. (similar to *L. disposita*) and *Lobocleta plemyraria* (the latter appears to be a dune/sand prairie specialist in Minnesota, and worthy of SGCN consideration in future revisions of the State Wildlife Action Plan). Other records of local interest include *Lithophane amanda*, a moth more typical of northerly parts of the state. Over 200 specimens from these field surveys were prepared, dried, and sorted into boxes for labeling this coming winter. Additionally, over 1,000 moth and butterfly specimens from the 2020 field season were labeled and data entered into electronic spreadsheets.

Nemadji State Forest, Carlton and Pine Counties

Field survey planning: evaluated baseline survey gaps in and the Nemadji SF of Carlton/Pine counties including undersampled rare native plant communities. Worked on identifying rare species targets within survey gaps and initiated coordination conversations with other DNR staff and volunteers to establish a field survey plan. Rare species of interest include *Botrychium oneidense* (T), *Botrychium mormo* (T), *Botrychium lanceolatum* (T), *Botrychium simplex* var. *tenebrosus* (SPC).

Vegetation Monitoring Plots

MBS plant ecologists installed permanent vegetation monitoring plots in MBS sites in several eastern Minnesota counties including Dakota, Carver, Anoka, Rice, Steele, Houston, Winona, Fillmore, Lake, and St. Louis (St. Louis County could also be reported under Activity 1, Outcome 2). The purpose of this work is to establish monitoring plots designed to track long-term status and trends in specific native plant communities. A total of 11 plots were installed in several different native plant communities. In the course of this work, a number of rare plant species were documented: *Botrychium campestre*, *Pellaea cf atropurpurea*, *Taenidia integerrima*, and *Dodecatheon amethystinum*, *Sullivantia sullivantii*, *Hybanthus concolor*, *Carex jamesii*, *Carex woodii*, *Arnoglossum reniforme*, *Dryopteris goldiana*, *Ophioglossum pusillum*, and *Dodecatheon amethystinum*.

Fifth Update March 1, 2022

1. Statewide lake surveys continued for native and rare aquatic plants

MBS conducted aquatic plant surveys in St. Louis, Chisago, Ramsey and Washington counties on 31 lakes and one river backwater in July and August 2021, including four in Voyageurs National Park in conjunction with completing the County Biological survey of St. Louis County. At each lake a meander survey and/or a nearshore plot survey is completed to document all native aquatic plants present. Additional targeted searches are completed for rare plant species. Botanical specimens were collected and pressed during aquatic plant surveys

for later herbaria submission. Much of collecting focused on rare/watchlist species, county records, and charophytes as part of a collaborative project with New York Botanical Garden (NYBG). The lakes surveyed and highlights for each lake are provided in the tables below. A very significant highlight is additional discoveries of *Wolffia brasiliensis*, a species of watermeal first documented in Minnesota in 2020 by MBS with support from this appropriation.

Voyageurs National Park, St. Louis County	MBS aquatic plant survey highlight
Little Trout Lake	New element occurrence (EO) of <i>Littorella americana</i> , Potential new EO of <i>Utricularia resupinate</i> , <i>Elatine</i> sp., Aquatic plant list
Namakan Lake	New EO of <i>Littorella americana</i> , EO update of <i>Crassula aquatica</i> , EO update of <i>Subularia aquatica</i> , Aquatic plant list
Sand Point Lake	New EO of <i>Crassula aquatica</i> , New EO of <i>Subularia aquatica</i> , New EO of <i>Littorella americana</i> , <i>Elatine</i> sp., Aquatic plant list
Mukooda Lake	New EO of <i>Subularia aquatica</i> , Update EO of <i>Littorella americana</i> , <i>Elatine</i> sp., Aquatic plant list
St. Louis County	
Crane Lake	New EO of <i>Crassula aquatica</i> , Aquatic plant list
White Iron Lake	EO update of <i>Littorella americana</i> , Aquatic plant list and assisted Lake Ecology Program with nearshore, point intercept, and rare plant surveys
Chisago County	
Little Comfort Lake	Aquatic plant list
Ramsey County	
Gervais Lake	New EO of <i>Decodon verticillatus</i> , Watchlist record of <i>Wolffia brasiliensis</i> , County record of <i>Potamogeton nodosus</i> , Aquatic plant list
Owasso Lake	Watchlist record of <i>Wolffia brasiliensis</i> , Aquatic plant list
Snail Lake	Watchlist record of <i>Lychnothamnus barbatus</i> , Watchlist record of <i>Wolffia brasiliensis</i> , Potential EO update of <i>Najas guadalupensis</i> subsp. <i>Olivaceae</i> , Aquatic plant list
Wabasso Lake, North Long Lake, South Long Lake	Aquatic plant list
Washington County	
Goose Lake	<i>Elatine</i> sp., Aquatic plant list
Clear Lake	New EO of <i>Decodon verticillatus</i> , Aquatic plant list
Mud Lake	New EO of <i>Decodon verticillatus</i> , Watchlist record of <i>Lychnothamnus barbatus</i> , Aquatic plant list
Howard Lake, Anoka County (connected to Mud Lake in Washington County)	Watchlist record of <i>Lychnothamnus barbatus</i> , EO update of <i>Decodon verticillatus</i> , Aquatic plant list
Oneka Lake	New EO of <i>Decodon verticillatus</i> , New EO of <i>Najas gracillima</i> , Aquatic plant list
West Boot Lake	Watchlist record of <i>Lychnothamnus barbatus</i> , Aquatic plant list
East Boot Lake	Watchlist record of <i>Wolffia brasiliensis</i> , Aquatic plant list
Little Carnelian Lake	Watchlist record of <i>Lychnothamnus barbatus</i> , Watchlist record of <i>Wolffia brasiliensis</i> , Aquatic plant list
Forest Lake, Keewahtin Lake	New EO of <i>Decodon verticillatus</i> , Aquatic plant list
Mays Lake, Terrapin Lake, Alice Lake & St. Croix River backwater near Alice Lake, Rice Lake, Hedge's Pond, Big Marine NE basin, German Lake	Aquatic plant list

An additional two lakes in Washington County were re-visited to verify and enhance rare plant species documentation: Jane Lake (EO update of *Lychnothamnus barbatus* & *Elatine* sp.) and Big Carnelian Lake (New EO of *Lychnothamnus barbatus*).

2. Field surveys completed of newly documented prairie vegetation and rare species in northwestern Minnesota

A total of 25 prairie sites across Becker, Mahnomon, and Norman counties were visited to document new discoveries of native prairie vegetation and rare species data during the 2021 field season.

MBS has been in collaboration with the State of Minnesota School Trust Land Office (STO) to survey State Trust Lands (STL) sites in northwest and western MN. This work combines mutual priorities among MBS and STO to update and enhance existing 1990s-era MBS data and to expand surveys into new sites that address significant gaps in rare species and native prairie documentation. These modern and expanded MBS data will deliver intended outcomes of this appropriation while also lending support to the STO's mission to adaptively manage natural resources based on both economic and environmental conditions. Sites of mutual interest are those STLs in existing MBS Sites of Biodiversity Significance or in undocumented sites with high potential for native prairie and rare species that are also classified by STO as having high mineral (gravel, sand) potential and potentially subject to mining. MBS staff reviewed STL parcels against current native prairie and rare species records to determine the need for field evaluation, resulting in 321 priority sites. MBS and STL staff are currently engaged in conversations to further refine site priorities for the 2022 field season.

3. 1980s–90s field surveys updated and enhanced for rare species, pollinators, or native vegetation in eastern Minnesota

Lepidoptera surveys

A total of 22 sites across 18 counties were surveyed within the Anoka Sandplain, Blufflands, St. Paul-Baldwin Plains and Moraines, Coteau Moraines, Inner Coteau, and Minnesota River Prairie ecological subsections. Species were surveyed using mercury vapor (MV) and ultraviolet (UV) lighted sheets, UV light traps, fermenting banana/sugar bait, and random meander diurnal searches.

Surveys yielded numerous county and regional records. Some notable highlights are:

- Leonard's Skipper (*Hesperia leonardus*), SPC, was documented at three sites in three different counties, with over 145 individuals observed at the latter. This is very encouraging to see for a regionally declining species.
- Regal Fritillary (*Speyeria idalia*), SPC, was found at two sites in in two different counties.

Rarely encountered moths, mostly prairie associated species, were also documented. Some notable highlights from species with few if any prior records include:

- *Apamea burgessi* (1 county)
- *Apamea relicina* (2 counties)
- *Chaetagnaea cerata* (5 counties)
- *Euxoa niveilinea* (1 county)
- *Mimoschinia rufofascialis* (1 county)
- *Papaipema sciata* (1 county)
- *Pyrausta volupialis* (1 county)

Notably, *Lithophane georgii* was found further south than ever documented before. This species was formerly known in MN only from a handful of sites across the northern tier of counties, with northern Hubbard Co. as a southerly outlier. This indicates the ecology of this species is more complex than first thought.

Nemadji State Forest, Carlton and Pine Counties

Field surveys conducted to update rare *Botrychium* species records in MBS Sites of Biodiversity Significance, the Holyoke Hardwoods High Conservation Value Forest unit in Carlton and Pine counties and a ‘salamander set-aside’ area in the Nemadji State Forest (NSF) in Pine County. Rare species observations included:

- *B. oneidense* (T) – 10 new observations
- *B. lanceolatum* (T) – 3 new observations
- *B. simplex var. tenebrosum* (SPC) – 4 new observations

Field surveys were conducted to update NPC maps at one site in Rice County (by MBS staff) and numerous sites in Freeborn and Waseca counties in collaboration with local natural resource and conservation managers.

4. Field data entered into DNR databases; specimens delivered to MN repositories.

A significant part of MBS ecologist’s and botanist’s time in late fall, winter, and early spring is spent processing specimens, entering field data into electronic databases, and interpreting those data. Field data include specimens, notes, standardized data sheets for rare species and vegetation plots, GPS waypoints, and digital photographs and video. Accomplishments at the individual staff level include:

- Integrated 2021 field survey waypoints from GPS and iPad with field photos
- Quality control of rare species 2021 EOs and prepare for inclusion into Natural Heritage Information Database/BIOTICS
- *Specific to aquatic surveys:*
 - Identified of 82 aquatic macroalgae specimens in the family Characeae collected during the 2021 field season prior to pressing. This a group that has been under-collected in the state; its diversity and distribution in MN is not well known. Created herbarium labels for all 2021 aquatic macroalgae specimens to be sent off to NYBG for verification and genetic analyses. Once verified, specimens will be accessioned at the Bell Museum with duplicates retained at NYBG, as is common practice when receiving verification from a taxa group expert.
 - Continued identification and herbarium label creation of vascular aquatic plant specimens, with prioritization on 2021 rare aquatic plant collections.
 - Prepared *Elatine sp.* specimens for shipment to experts for identification at Eastern Illinois University

Update as of June 30, 2022:

Project extended to June 30, 2023 by LCCMR 6/30/22 as a result of M.L. 2022, Chp.94, Sec. 2, Subd. 19, legislative extension criteria being met.

Sixth Update as of September 1, 2022:

1. Lake surveys for aquatic plants

Taxa lists of aquatic plant surveys from 2021 lakes surveys were completed, and planning work for summer 2022 field work began. MBS conducted aquatic plant surveys in Chisago, Anoka, Le Sueur and Rice counties on 15 lakes in June 2022. At each lake a meander survey and/or a nearshore plot survey was completed to document all native aquatic plant species present. Additional targeted searches were completed for rare plant species. Botanical specimens were collected and pressed during aquatic plant surveys for later herbaria submission. Much of collecting focused on rare/watchlist species, county records, and charophytes (*Chara* species) as part of a collaborative project with New York Botanical Garden (NYBG). The lakes surveyed and highlights for each lake are provided in the tables below.

Chisago County lake	MBS aquatic plant survey highlight
Little Green Lake	<i>Iris pseudacorus</i> collected (county record)
North Center Lake	Aquatic plant list
Anoka County lake	

East Twin Lake	Charophytes collected
West Twin Lake	<i>Utricularia minor</i> collected (county record)
East Moore Lake	<i>Iris pseudacorus</i> collected (county record) <i>Chara globularis</i> collected
Crooked Lake	<i>Chara contraria</i> collected
Round Lake	<i>Decodon verticillatus</i> collected (new EO) <i>Chara globularis</i> collected <i>Chara contraria</i> collected
Le Sueur County lake	
Clear Lake	<i>Chara globularis</i> collected
Pepin Lake & Sandborn Lake	<i>Chara braunii</i> collected <i>Chara globularis</i> collected
Rice Lake	<i>Sparganium eurycarpum</i> (county record)
Green Leaf Lake	Aquatic plant list
Rice County lake	
Cody Lake	<i>Chara braunii</i> collected
Caron Lake	<i>Chara braunii</i> collected <i>Chara globularis</i> collected <i>Chara contraria</i> collected
Phelps Lake	Aquatic plant list

2. Field surveys completed of newly documented prairie vegetation and rare species in northwestern Minnesota

Native Plant Community mapping was completed for the 25 prairie sites in Becker, Mahnommen, and Norman counties previously reported (2,578 acres total). Mapping included 411 acres of newly identified prairie and more precise mapping for six calcareous fens.

Surveys to document native plant communities and rare plant species were conducted on 34 sites administered by DNR's Division of Fish & Wildlife in Kittson, Roseau, and Marshall Counties. This work is being supported in part by DNR's Division of Fish & Wildlife.

3. 1980s–90s field surveys updated and enhanced for rare species, pollinators, or native vegetation in eastern Minnesota

Lepidoptera surveys

Work during this period focused on completing identification and processing of over a 1,000 specimens collected in the summer of 2021 from sites and surveys reported previously.

Field surveys focused in southeast and east-central counties with many significant discoveries including numerous prairie moth Species of Greatest Conservation (SGCNs) and species that will be proposed as SGCN during the next revision to the State Wildlife Action Plan and MN list of SGCNs. The most significant discovery was the globally mysterious *Capis archaia* in the wetlands at the Arden Hills Ammunition Testing Site in the north metro. Previous to this discovery, the only known occurrences of the species in the world were from two patterned peatlands in northwestern MN and a cluster of sites in southern Quebec.

Native Vegetation

Surveys to document native plant communities and rare plant species were conducted at four calcareous fen sites. At two sites, these searches included looking for charophytes (*Chara* species) in collaboration with our aquatic work. A rare charophyte is known to occur in fens but has not yet documented in MN. *Chara* species were found at one site; its identification still needs to be verified. Voucher specimens of all state-listed plant species were collected and preserved from all four sites. Other targeted rare species searches also took place in Washington, Anoka, Isanti, Pine and Mille Lacs Counties.

4. Field data entered into DNR databases; specimens delivered to MN repositories.

A significant part of MBS ecologist's and botanist's time in late fall, winter, and early spring is spent processing specimens, entering field data into electronic databases, and interpreting those data. Field data include specimens, notes, standardized data sheets for rare species and vegetation plots, GPS waypoints, and digital photographs and video. Accomplishments at the individual staff level include:

- Deposited approx. 500 plant specimens to the Minnesota Bell Herbarium for accession including 250 rare terrestrial plants, county records, or important habitat indicator species; 150 rare or county record aquatic plants (including: *Alisma gramineum*, *Decodon verticillatus*, *Najas gracillima*, *Najas marina*, *Ruppia cirrhosa*, and *Utricularia purpurea*); and 100 undercollected aquatic plant species (many sedges) including 6 county records.
- MN Taxa (the statewide checklist of plant occurrences by county) was updated with 30 new county records of vascular plant species.
- Observations and accompanying data received from contractors and extracted from iNaturalist for *Sagittaria calycina* (state threatened), were prepared for submission to the NHIS rare species database; those observations included new county records.
- Aquatic plant specimens were sent to collaborators for expert identification (*Elatine* specimens and aquatic moss specimens).

Seventh Update as of March 1, 2023:

1. Lake surveys for aquatic plants

Surveys were completed in Ramsey County for Pleasant Lake and Wilkinson Lake. Three new populations of rare aquatic plant species were discovered. Data and specimen processing is in-progress.

2. Field surveys completed of newly documented prairie vegetation and rare species in northwestern Minnesota

MBS and UMN Bell Museum botanists conducted rare prairie plant surveys in northwestern MN in June 2022. Over four days and across five counties, approximately 450 plant specimens were collected and numerous new or updated rare species locations were recorded.

MBS continued a project to document prairie and savanna native plant communities and associated rare plant species on sites administered by DNR's Division of Fish & Wildlife in Kittson, Roseau, and Marshall Counties. This work is being supported in part by DNR's Division of Fish & Wildlife. No further field work was completed during this reporting period. Data processing, including Native Plant Community mapping, specimen preparation and data management from sites previously reported continues.

3. 1980s–90s field surveys updated and enhanced for rare species, pollinators, or native vegetation in eastern Minnesota

Lepidoptera surveys

Work during this period focused on completing identification and processing of over a 1,000 specimens collected in the summer of 2022 from sites and surveys reported previously. Lepidopteran surveys were completed at six sites in the Prairie Parkland Province.

4. Field data entered into DNR databases; specimens delivered to MN repositories.

A significant part of MBS ecologist's and botanist's time in late fall, winter, and early spring is spent processing specimens, entering field data into electronic databases, and interpreting those data. Field data include specimens, notes, standardized data sheets for rare species and vegetation plots, GPS waypoints, and digital photographs and videos. Accomplishments at the individual staff level include:

- Completed identification and processing of 250 aquatic plant specimens.
- Work continued to create taxa lists for lakes surveyed under this appropriation.
- Continued work to extract, review, and add iNaturalist records for rare aquatic plant species to the DNR Natural Heritage Information System.

Final Report as of June 30, 2023 (to be submitted before August 15, 2023):

1. Lake surveys for aquatic plants

This work is a continuation from the ML17 ENRTF MBS appropriation and continues on the ML21 appropriation.

Field work was focused on lakes in Chisago, Washington, Ramsey, Anoka, Le Sueur, and Rice counties. At each lake a meander survey and/or a nearshore plot survey was completed to document all native aquatic plants present. Additional targeted searches are completed for rare plant species. Field work included coordination with the DNR Lake Ecology Unit on collecting plant material for a genetic study on *Nelumbo* and *Sagittaria* populations. MBS is also in collaboration with the New York Botanical Garden and the DNR Lake Unit on research into charophyte (an aquatic algae that looks like an aquatic plant) distribution in MN. The lakes surveyed and highlights from each lake are provided in the work plan update reports. A very significant highlight was the discovery in Washington County of an aquatic plant not previously documented in Minnesota, *Wolffia brasiliensis*, a species of watermeal.

2. Field surveys completed of newly documented prairie vegetation and rare species in northwestern Minnesota

Prairie Vegetation

A total of 59 prairie sites across Becker, Mahnomen, Norman, Kittson, Roseau, and Marshall counties were visited to document new discoveries of native prairie vegetation and rare species data. Native Plant Community mapping was completed for these sites totaling 2,578 acres.

MBS and UMN Bell Museum botanists conducted rare prairie plant surveys in northwestern MN in June 2022. Over four days and across five counties, approximately 450 plant specimens were collected and numerous new and updated rare species locations were recorded.

MBS completed a project to document prairie and savanna native plant communities and associated rare plant species on sites administered by DNR's Division of Fish & Wildlife in Kittson, Roseau, and Marshall Counties. This work is being supported in part by DNR's Division of Fish & Wildlife and in collaboration with the State of Minnesota School Trust Land (STL) Office (STO). Sites of mutual interest were identified as those STLs on DNR Wildlife lands and in MBS Sites of Biodiversity Significance, or in undocumented sites with high potential for native prairie and rare species, that are also classified by STO as having high mineral (gravel, sand) potential and potentially subject to mining.

MBS completed a contracted project to document prairie and savanna native plant communities and associated rare plant species on two large sites in northwestern Minnesota administered by DNR's Division of Fish & Wildlife. In May and June 2023, contractors mapped four different prairie community types, the largest of which was 974 acres of Dry Sand - Gravel Oak Savanna (Northern), an S1 or Critically Imperiled community in Minnesota. They also documented 17 rare species at 74 different locations within those communities.

Rare Species - Lepidoptera

See also Activity 1, Outcome 3.

Lepidoptera surveys were completed in Beltrami, Koochiching, Lake of the Woods, and Roseau 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). High intensity surveys (multiple methods including nocturnal surveys which yield large number of species) were conducted.

A total of 64 sites were surveyed within the Agassiz Lowlands and Littlefork-Vermillion Uplands ecological subsection in Beltrami, Clearwater, Itasca, Koochiching, Lake of the Woods, Roseau, and St. Louis counties. Field surveys yielded well over 3,500 moth and butterfly specimens, including numerous new county, regional, and state records. Significant moth discoveries included in the work plan update reports.

3. 1980s–90s field surveys updated and enhanced for rare species, pollinators, or native vegetation in eastern Minnesota

Rare Species - Plants

MBS completed targeted rare plant surveys in MBS Sites of Outstanding and High Biodiversity Significance last surveyed about 20 years ago in the Nemadji State Forest in Carlton and Pine Counties. The focus was on rare *Botrychium* species. This involved collaboration and coordination with DNR regional ecologists and DNR forestry staff. 57 new rare *Botrychium* populations were documented.

Rare Species/Pollinators - Lepidoptera

Sites were surveyed for native and rare moths in Goodhue and Washington counties within the Blufflands and St. Paul-Baldwin Plains ecological subsections, respectively. A total of 22 sites across 18 counties were surveyed within the Anoka Sandplain, Blufflands, St. Paul-Baldwin Plains and Moraines, Coteau Moraines, Inner Coteau, and Minnesota River Prairie ecological subsections.

Surveys yielded numerous county and regional records, and potentially a few state records including numerous prairie moth Species of Greatest Conservation (SGCNs) and species that will be proposed as SGCN during the next revision to the State Wildlife Action Plan and MN list of SGCNs. Notable highlights are included in the work plan update reports.

Native Plant Communities

Surveys to document native plant communities and rare plant species were conducted at four calcareous fen sites. At two sites, these searches included looking for charophytes (*Chara* species) in collaboration with our aquatic work. A rare charophyte is known to occur in fens but has not yet documented in MN. *Chara* species were found at one site; its identification still needs to be verified. Voucher specimens of all state-listed plant species were collected and preserved from all four sites. Other targeted rare species searches also took place in Washington, Anoka, Isanti, Pine and Mille Lacs Counties.

MBS plant ecologists installed permanent vegetation monitoring plots in MBS sites in in several eastern Minnesota counties including Dakota, Carver, Anoka, Rice, Steele, Houston, Winona, Fillmore, Lake, and St. Louis (St. Louis County could also be reported under Activity 1, Outcome 2). The purpose of this work is to establish monitoring plots designed to track long-term status and trends in specific native plant communities. A total of 11 plots were installed in several different native plant communities.

4. Field data entered into DNR databases; specimens delivered to MN repositories.

No further work was supported by this appropriation. Activities have continued as appropriate on ML21. A significant part of MBS aquatic botanist's time in late fall, winter, and early spring is spent processing specimens, entering field data into electronic databases, and interpreting those data. Field data include specimens, notes, standardized data sheets for rare species and vegetation plots, GPS waypoints, and digital photographs and video. Specific accomplishments are included in the work plan update reports:

- Continued creating herbarium labels for aquatic vascular plant specimens.
- Consulted with the taxonomic authority and received verification on the identity of the state record discovery, *Wolffia brasiliensis*.
- Integrated field survey waypoints from GPS and iPad with field photos;

- Verified identity of aquatic plant specimens. Of note is 52 aquatic macroalgae specimens in the family *Characeae*. This is a group that has been under-collected in the state; its diversity and distribution in MN is not well known.
- Finished typing *Characeae* herbarium labels for 130 specimens. Mapped 2020 rare plant observations (EOs) in ArcMap for submission to the Natural Heritage Information System, Biotics database.
- Deposited approx. 500 plant specimens to the Minnesota Bell Herbarium for accession including 250 rare terrestrial plants, county records, or important habitat indicator species; 150 rare or county record aquatic plants.
- MN Taxa (the statewide checklist of plant occurrences by county) was updated with new county records of vascular plant species.
- Identification and processing of over a 2,000 moth and butterfly specimens for accession to the UMN Entomology Insect Collection.

ACTIVITY 3: Deliver survey results

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).

ACTIVITY 3 ENRTF BUDGET: \$390,000

Outcome	Completion Date
1. Final draft delivered for publication of new book on ferns and fern allies of Minnesota.	June 2022
2. Digital maps (GIS polygon data) created for native plant communities and sites. Targeted field surveys to address mapping questions and quality control.	Ongoing
3. DNR's website and social media updated with current survey results; biological reports, technical guidance, presentations, and trainings delivered.	Ongoing

First Update March 1, 2020

See overall project status updates above.

Second Update September 1, 2020

Work started on this work plan on July 1, 2020.

1. Ferns of MN manuscript

Field and lab work continued from the ML17 ENRTF MBS appropriation towards the development and publishing of a new Ferns of Minnesota book to be published by the MN Press. The lead author is making significant progress towards that end. Most time is spent at the UMN Bell Museum Herbarium to gather data for dichotomous keys and descriptions; reconcile recent literature with specimens; producing draft species distribution maps; and specimen annotations. Field work is targeted at either 1) revisiting certain species or locations to address questions arising from manuscript development, 2) to discover new locations of species that help improve distribution knowledge, or 3) to capture photographs of certain species at particular points in their development. Time in the office is spent editing and processing photos, maps, and the manuscript text.

2. Mapping and associated field surveys

This work continued from the ML 17 ENRTF MBS appropriation. 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 82,190 acres in MBS Sites of High or Outstanding Biodiversity Significance in Cass, Clearwater, Crow Wing, Beltrami, Koochiching, Lake, St. Louis, and Goodhue counties. Field surveys to sites in Crow Wing and Clearwater counties targeted transition zones between wet-mesic and mesic forests that can be difficult to map without field-level data.

3. Website and social media updated with current survey results;

See also Section IV of this report.

DNR Online 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. Progress this reporting period on updating and editing over 10 species profiles and uploading over 50 new and improved photographs and writing associated captions.

DNR online MN Conservation Explorer: MBS continues (from the ML17 ENRTF MBS appropriation) a 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.

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

The technical guidance reported here 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 ML19 LCCMR MBS work plan and budget.

MBS staff funded by this appropriation for 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 ML19 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.

Third Update March 1, 2021

1. Final draft delivered for publication of new book on ferns and fern allies of Minnesota.

A considerable amount of progress was made on the fern book including processing specimens, reviewing and processing recently acquired photos, acquiring newly published literature and reconciling against herbarium specimens, revising and editing text, updating map data, and correspondence with taxa experts and various other specialists. A draft of the text of the book has been completed in its entirety. The draft is not final, but is on schedule to be finalized by March 2022.

Maps for the book are being continually updated as additional specimens are being submitted. The number of specimens that are mapped currently numbers about 13,000.

About 80 percent of the photos for the book have been acquired (both field and lab photos), although many of the acquired photos still need a fair amount of work to prepare them for final submission. The remaining 20 percent of the needed photos will be identified this winter so they can be targeted for the 2021 field season. Overall, the graphic portion of the submission is on schedule for completion by March 2022.

Field work continued into fall 2020 at various sites throughout the state to address manuscript questions, fill species distribution gaps, and follow up on tips for new locations of high priority species. Particular attention was given to Lycophytes (fern allies) and ferns in the genus *Sceptridium*s which are both evergreen, making them ideal targets of autumn searches.

2. Digital maps (GIS polygon data) created for native plant communities and sites. Targeted field surveys to address mapping questions and quality control.

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. A significant amount of mapping occurred during the reporting period (in part due to COVID restrictions on field survey and travel that resulted in more office/desk work) with the creation of over 10,000 polygons classified to native plant community covering over 470,000 acres in MBS Sites of High or Outstanding Biodiversity Significance in Cass, Clearwater, Crow Wing, Beltrami, Koochiching, Lake, St. Louis, and Goodhue counties. Field surveys to sites in Crow Wing County to address mapping questions, in particular transitions between upland forest types.

A native plant community mapping project in southeast Minnesota focused on resolving NPC polygons created by Division of Forestry overlapping older MBS polygons that were created and classified using a NPC classification system that is now outdated. Work focused on making adjustments based on latest available resources such as recent photography, Lidar, USGS 24k topo, EO records and MBS Site notes from scans for each county. Geometry and classification work for this quarter has been applied to over 1,000 polygons (60,000+ acres) in Wabasha, Winona, Houston, Olmstead, and Goodhue Counties.

3. DNR and MBS Website updated with current survey results;

See also Section IV of this report.

DNR Online 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 the RSG. 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. Progress this reporting period on updating and editing over 32 plant species profiles.

DNR online MN Conservation Explorer: MBS continues a collaboration with NatureServe and 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. During the reporting period work focused on developing the legends for each of the GIS layers, beta-testing of the platform, reviewing and troubleshooting data layer loading and viewing, and standard report templates.

4. Biological reports

MBS completed the biological report, ***Documenting Long-term Change in Native Plant Communities in East-Central and Southeast Minnesota State Parks and SNAs through Resampling Relevé Plots.***

Brief Summary: A relevé is a standard vegetation plot, which captures species occurrence, and cover estimates within stratified height classes (Minnesota DNR 2013). Relevés are used to document and classify the native plant communities in Minnesota. Since 1964, 11,200 relevés have been recorded in the MNDNR Relevé Database. This provides one of the largest long-term datasets available for measuring change in the state's native vegetation. We resampled 78 historical relevés to document changes that have occurred over

the last 20+ years in State Parks and Scientific and Natural Areas (SNAs) in the southern portion of the Eastern Broadleaf Forest Province of Minnesota. The resampled plots were permanently marked in the field to facilitate future resampling. We expect these results to be useful indicators of the overall health of our native plant communities through time.

The relevés used in this analysis represent Upland Prairie, Dry Barrens Prairie and Savanna, Mesic Hardwood Forest and Fire-Dependent Woodlands. We detected significant changes over the last decades in Upland Prairie, Mesic Hardwood Forests, and Fire-Dependent Woodlands. Although it is hard to directly compare the change across these groups, our results indicate that larger compositional changes have occurred in Fire-Dependent Woodlands (10.1% change), followed by wetter Mesic Hardwood Forests (7.3%), drier Mesic Hardwood Forests (5.1% change) and Upland Prairie without fire management (5.1% change). Fire-managed Prairie (1.2%) and Dry Barrens Prairie and Savanna (2.5%) had only slight changes over the last decades.

Much of the MBS data supporting this report and analysis was collected under the ML17 and previous ENRTF MBS appropriation with additional funding contributions from the stated partners.

MN Conservation Volunteer magazine: during the reporting period MBS work was completed on a story about the very rare plant, *Polemonium occidentale*, scheduled for the March-April 2021 issue.

5. Technical guidance

The technical guidance reported here 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 ML19 LCCMR MBS work plan and budget.

MBS staff funded by this appropriation are among the second line of technical guidance communication or outreach behind DNR Regional Plant Ecologists, Regional Nongame Ecologists, other DNR positions, and MBS staff who are not funded by ML19 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.

Specific examples of technical guidance delivered during the reporting include:

- St. Louis County Lands & Minerals Department – SLC Wetland Preservation Bank project at the Polemonium Bog site. Delivery of MBS vegetation and soils data and ecological interpretation of data. Review of preliminary wetland delineation and Floristic Quality Index assessment points and provided feedback related to planned survey efforts.

- MN Point, Duluth – ongoing topics related to T&E species, dune erosion, human use and development, and coordination between various entities (and within DNR) in an area with exceptional natural resource values.
- Nemadji River Watershed, Carlton County – Summarized MBS survey data and site attributes for “areas of interest” for designation as SNAs.
- Provided MBS survey results and updates to DNR Sauk Rapids Invasive Species Specialist on select lakes in their work area.
- MBS botanists contributed subject matter expertise to the development of a DNR rare plant identification exam for consultants who apply to be on the DNR list of qualified surveyors for endangered and threatened species.
- DNR Information Center – MBS subject matter experts address questions from the public regarding rare species, native plant communities and sites of biodiversity significance.
- Boulder Lake Environmental Learning Center, Duluth – provided subject matter expertise about the property’s peatland communities for their development of new peatland educational programs.
- Provided plant data and subject matter expertise to DNR partners related to calcareous fen classification and protection.

Fourth Update September 1, 2021

1. Final draft delivered for publication of new book on ferns and fern allies of Minnesota.

Progress continues on processing specimens, reviewing and processing recently acquired photos, acquiring newly published literature and reconciling against herbarium specimens, revising and editing text, updating map data, and correspondence with taxa experts and various other specialists. A draft of the text of the book has been completed in its entirety. The draft is not final, but is on schedule to be finalized by March 2022.

Maps for the book are being continually updated as additional specimens are being submitted. The number of specimens that are mapped increased by about 300 during this reporting period, putting total numbers at about 13,300.

All of the photos for the book have been acquired (both field and lab photos), although many of the acquired photos still need a fair amount of work to prepare them for final submission.

Field work continued into spring 2021 at various sites throughout the state to address manuscript questions, fill species distribution gaps, and follow up on tips for new locations of high priority species. Particular attention was given to Lycophytes (fern allies) with a highlight including the documentation of *Dendrolycopodium obscurum*, a new county record for Pine County.

2. Digital maps (GIS polygon data) created for native plant communities and sites. Targeted field surveys to address mapping questions and quality control.

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. A significant amount of mapping occurred during the reporting period with the creation of over 13,000 polygons classified to native plant community covering over 490,000 acres in MBS Sites of High or Outstanding Biodiversity Significance in Itasca, Cass, Beltrami, Koochiching, Lake of the Woods, and St. Louis counties. Targeted field surveys were conducted in Cass County to address mapping and NPC classification questions. In the course of that work two vegetation monitoring plots were established and a new location for the rare *Botrychium matricariifolium* was documented.

A native plant community mapping project in southeast Minnesota focused on resolving issues with NPC polygons created by Division of Forestry overlapping older MBS polygons that were created and classified using a NPC classification system that is now outdated. Work focused on making adjustments based on latest available

resources such as recent photography, Lidar, USGS 24k topo, EO records and MBS Site notes from scans for each county. Geometry and classification work for this quarter has been applied to over 63 MBS Sites of Biodiversity Significance in Winona, Fillmore, and Olmstead counties.

3. DNR's website and social media updated with current survey results; biological reports, technical guidance, presentations, and trainings delivered.

See also Section IV of this report.

Social Media

MBS aquatic botanist wrote a brief article on *Wolffia brasiliensis* along with a few images for inclusion on the DNR's SNA Facebook page.

DNR Online Rare Species Guide

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 the RSG content and the driving need for continuous updating. Current work on the RSG is funded in part by Federal State-Wildlife-Grant dollars that cover animal species while plants, bryophytes, and fungi are funded by this ENRTF appropriation.

Progress this reporting period included:

- updated and copy-edited over 100 plant species profiles that involves adding or updating information on phenology, habitat, management recommendations and general descriptions to reflect the latest information.
- worked with MN.IT GIS staff to produce two new features: 1) an automated system that provides live data for each rare species by number of occurrences in each subsection, section, and province and 2) a new photo application that ensures all photos in the RSG meet accessibility standards complete with captions and that simplifies uploading new photos and replacing or removing photos in the profile.

DNR online MN Conservation Explorer

MBS continues a collaboration with NatureServe and 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 that the platform will provide are in large part generated by MBS from this and all previous ENRTF appropriations. During the reporting period work focused on standard report templates, addressing State of MN accessibility standards, establishing and testing standard buffers applied to certain groups of rare species, and final updates to the system's underlying mapcore.

Biological reports

Completed "Final Report" for MBS Sites of Biodiversity Significance in SE Carlton County, Nemadji River Watershed. The report summarized MBS data for 10 MBS Sites of Biodiversity Significance covering ~75,000 acres across multiple public and private ownerships and highlighting areas for conservation consideration. The report was shared with a public requestor as well as regional SNA DNR staff and external partners. The areas of interest included numerous stretches of streams/rivers in SE Carlton County.

Technical guidance

The technical guidance reported here 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 ML19 LCCMR MBS work plan and budget.

MBS staff funded by this appropriation are among the second line of technical guidance communication or outreach behind DNR Regional Plant Ecologists, Regional Nongame Ecologists, other DNR positions, and MBS

staff who are not funded by ML19 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.

Specific examples of technical guidance delivered during the reporting include:

- Aquatic plant webinar: MBS aquatic plant botanist collaborated with the DNR Lake Ecology Unit to create PowerPoint presentations with written scripts that were used in a public webinar hosted by MBS and LEU that over 100 people attended. Topics included collecting aquatic plants, pressing/preserving aquatic plants, and photographing aquatic plants for identification and documentation purposes. This webinar approach was developed in response to COVID-19 restrictions on in-person gatherings such as our annual aquatic plant identification workshops for internal and external stakeholders.
- Provided *Wolffia brasiliensis* (new state record species) locations and observation information to Minnesota Wildflowers for addition to their website.
- Provided a brief presentation on *Wolffia brasiliensis* to the Minnesota Native Plant Society during the 'Plant of the Month' section of their virtual meeting.
- Evaluated and provided feedback on a proposal to conduct searches for *Utricularia purpurea*, a state endangered aquatic plant; request made by MN Endangered Species Consultant.
- Provided MBS aquatic plant survey data (1995-2016) to the University of Minnesota Bell Museum for inclusion in the Minnesota Biodiversity Atlas.
- Provided information about the Lakes of Biological Significance layer to a Park's and Trails Area Resource Specialist inquiring about the layer and lakes in Region 2.
- Assisted a DNR Wildlife lake specialist in the Shallow Lakes Program and an aquatic biologist in the Lake Ecology Unit with filling out a rare species observation and specimen submission paperwork.
- Provided *Typha* locations to University of MN Aquatic Invasive Species Research Center graduate student for a project they're leading.
- Provided vegetation and plant technical guidance related to field survey suggestions for the MBS bee survey
- Provided information on Eastern Hemlock to Environmental Review concerning seedling propagation and distribution
- Provided information about DNR native plant community mapping to Leech Lake Band of Ojibwe foresters
- Provided editorial and technical review for new signs for 2 Scientific and Natural Areas
- Provided subject matter expertise in *Lepodoptera*, moths in particular, to the the Regional Species of Greatest Conservation Need (RSGCN) Midwest Lepidoptera team. This was a multi-state initiative to identify species of conservation interest between states and foster collaboration. Hundreds of

species were reviewed for conservation status. The resulting list (currently in final review stages) will inform our next list revisions for T/E/SPC/SGCN in Minnesota.

- Provided technical guidance related to rare species, rare species habitat, and plant identification to various partners including the SNA program, R2 Regional Ecologist, Grand Portage Band of Ojibwe, and MPCA.
- Provided subject matter expertise to MPCA and DNR R2 ecologist regarding the Scanlon remediation site in St. Louis County to assess and discuss potential project impacts to the state-endangered wild chives (*Allium schoenoprasum*).

Fifth Update March 1, 2022

1. Final draft delivered for publication of new book on ferns and fern allies of Minnesota.

A few last site visits were completed at the end of the 2021 field season to address manuscript questions, fill species distribution gaps, and follow up on tips for new locations of high priority species.

All the major components of the manuscript are complete and currently being assembled and formatted. The maps (approximately 100, representing over 14,000 data points) are complete. All photos (147 pages) are complete. The language is also completely drafted (approximately 60,000 words, 385 pages). These components are on schedule to be delivered to the publisher by March 31, 2022, for a book release date in spring 2023.

2. Digital maps (GIS polygon data) created for native plant communities and sites. Targeted field surveys to address mapping questions and quality control.

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.

A significant amount of mapping occurred during the reporting period with the creation of over 9,703 polygons classified to NPC covering over 441,135 acres in MBS Sites of High or Outstanding Biodiversity Significance in Beltrami County.

MBS increased native plant community mapping efforts by recruiting, interviewing, and training three new volunteers to digitize NPCs in MBS Sites of Biodiversity Significance. MBS staff also created and refined a new geoprocessing tool that more efficiently discovers errors in draft NPC classification maps. This tool will allow for quicker review and certification of NPC maps, and ultimately result in higher quality NPC products.

Southeast MBS and DNR Forestry Overlap Mapping

MBS is collaborating and cost-sharing with DNR Division of Forestry to update and expand NPC mapping in Goodhue, Wabasha, Fillmore, Houston and Olmsted counties. The project focuses on updating and enhancing 1990s-era NPC map data in MBS Sites of Biodiversity Significance that intersect DNR Forestry administered lands. Both MBS and Forestry have collected more recent vegetation data that the original 1990s data does not reflect and both parties are interested in integrating these data into new and enhanced NPC maps.

MBS staff reviewed and re-aligned mapped areas using best available data (e.g. LIDAR, aerial photography). MBS added NPC condition ranks, MBS site attributes, and EO information. This process and the resulting new dataset was documented with metadata indicating that the new maps are comprised of some old and some new data and geometry. The new mapping is currently under review by MBS and Forestry staff.

3. DNR's website and social media updated with current survey results; biological reports, technical guidance, presentations, and trainings delivered.

DNR Online Rare Species Guide

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 the RSG content and the driving need for continuous updating. Current work on the RSG is funded in part by Federal State-Wildlife-Grant dollars that cover animal species while plants, bryophytes, and fungi are funded by this ENRTF appropriation.

Progress this reporting period included work with MNIT to develop a "RSG Managed Area Analysis" report. The report provides a managed area occurrence list for each species profile. This is especially useful as a proxy to indicate the level of protection afforded a rare species. Work was also focused on the conservation management section of the rare species to address necessary text and reference updates.

DNR online MN Conservation Explorer

MBS continues a collaboration with NatureServe and 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 that the platform will provide are in large part generated by MBS from this and all previous ENRTF appropriations. During the reporting period work focused final development and delivery of the platform for a limited user acceptance testing process that is scheduled to wrap up by mid-March 2022.

Technical guidance

The technical guidance reported here 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 ML19 LCCMR MBS work plan and budget.

MBS staff funded by this appropriation are among the second line of technical guidance communication or outreach behind DNR Regional Plant Ecologists, Regional Nongame Ecologists, other DNR positions, and MBS staff who are not funded by ML19 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 Scientific and Natural Areas Program, DNR Hydrologists, DNR Fisheries, 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 of technical guidance delivered during the reporting period include:

- Continued to distribute Aquatic Plant Webinars to partners
- Wrote evaluation reports for restoration work at McCarthy Beach and Lake Vermilion State Parks and presented findings to restoration committee
- Several MBS staff contributed editorial reviews of the 'North Shore Relevé Resampling' report

- Virtual field day presentation on MBS research projects at Hole in the Mountain given to the Prairie Restoration Initiative.
- Continued to contribute information on Eastern Hemlock to Environmental Review concerning a permit to collect seeds for propagation and distribution
- Contributed to DNR's ash tree management policy revisions
- Provided technical guidance to Lake Superior Binational Program on revisions to a map of conservation areas used to prioritize project funding
- Provided technical guidance to the St. Louis River Restoration Team on their pilot project involving the planting of dune vegetation on Interstate Island
- Provided technical guidance to the Minnesota Landscape Arboretum regarding *Polemonium* seed collection at the Leander *Polemonium* Site
- Developed and led a field training for permittee related to beachgrass ecotype morphology/phenology, approved collection zones and methodology, and considerations for other rare and/or invasive species present in area
- Provided technical guidance to a student group from Miami University in Ohio working on development of a Species Status Assessment Report for Western Jacob's Ladder (*Polemonium occidentale* ssp. *lacustre*).
- Provided review and feedback to EWR staff regarding two pending *Ammophila breviligulata* seed/propagule permits

Update as of June 30, 2022:

Project extended to June 30, 2023 by LCCMR 6/30/22 as a result of M.L. 2022, Chp.94, Sec. 2, Subd. 19, legislative extension criteria being met.

Sixth Update as of September 1, 2022:

1. Final draft delivered for publication of new book on ferns and fern allies of Minnesota.

The completed manuscript, including text and images, of the book "Ferns and Lycophytes of Minnesota" and delivered to the publisher, the University of Minnesota Press, in March 2022. The expected book release date is spring 2023.

2. Digital maps (GIS polygon data) created for native plant communities and sites. Targeted field surveys to address mapping questions and quality control.

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.

See Activity 1 Outcome 4 for accomplishments within Lake of the Woods, St. Louis and Koochiching counties.

Native Plant Community mapping and classification continued in Clearwater County, with a total of 76,085 acres (18 sites) ready for quality control and certification. An additional 7,456 acres of mapping was completed in a Cass County. Quite a bit of initial polygon delineation was completed by volunteers for Cass and Itasca Counties. A total of 120,618 acres [5,737 polygons] were quality controlled across multiple counties in preparation for certification.

Southeast MBS and DNR Forestry Overlap Mapping

MBS is collaborating and cost-sharing with DNR Division of Forestry to update and expand NPC mapping in Goodhue, Wabasha, Fillmore, Houston and Olmsted counties. The project focuses on updating and enhancing 1990s-era NPC map data in MBS Sites of Biodiversity Significance that intersect DNR Forestry administered

lands. Both MBS and Forestry have collected more recent vegetation data that the original 1990s data does not reflect and both parties are interested in integrating these data into new and enhanced NPC maps. Work was done during this period focused on finalizing Houston County. With that complete, MBS and Forestry staff completed internal reviews and resolving discrepancies in delineation and classification determinations for all overlaps within the 133 total MBS sites that are the focus of this work in SE MN.

3. DNR's website and social media updated with current survey results; biological reports, technical guidance, presentations, and trainings delivered.

DNR Online Rare Species Guide

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 the RSG content and the driving need for continuous updating. Current work on the RSG is funded in part by Federal State-Wildlife-Grant dollars that cover animal species while plants, bryophytes, and fungi are funded by this ENRTF appropriation. Twenty-five plant species profiles for the DNR's Rare Species Guide on the DNR website were fully reviewed and revised, with progress made on the revisions of several more.

DNR online MN Conservation Explorer

MBS continues a collaboration with NatureServe and 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 that the platform will provide are in large part generated by MBS from this and all previous ENRTF appropriations. During the reporting period, acceptance testing was completed and the final preparations to launch the site in August 2022 to the public are currently underway.

Technical guidance

The technical guidance reported here 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 ML19 LCCMR MBS work plan and budget.

MBS staff funded by this appropriation are among the second line of technical guidance communication or outreach behind DNR Regional Plant Ecologists, Regional Nongame Ecologists, other DNR positions, and MBS staff who are not funded by ML19 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 Scientific and Natural Areas Program, DNR Hydrologists, DNR Fisheries, 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 of technical guidance delivered during the reporting period include:

- Delivered site specific data for bee surveys planning in NE MN, including flowering plant locations for target plant species (e.g. *Polemonium* species)
- Contributed guidance to the St. Louis River Restoration Team on a pilot project involving planting dune vegetation on Interstate Island
- Reviewed permit to conduct tree chronology research on the MN Point Pine Forest SNA
- Provided technical guidance and MBS data to a Hibbing Area forester related to a mixed NPC forestry stand within a High Site of Biodiversity Significance.
- Ongoing guidance for EWR staff related to MN Point related to listed plant species, dune ecology, human use and development, and coordination between various entities (and within DNR) in an area with exceptional natural resource values.
- Reviewed “Plant Recommendations for Minnesota Point Homeowners” draft document and provided input related to native plant communities and appropriate planting options by native habitats.
- Contributed technical information to a Forest Grasses Workshop and a Bee Identification and Monitoring Workshop (MBS and Xerces Society)
- Coordinated with NatureServe to discuss revision of a crosswalk between MN NPCs and their National Vegetation Classification System.
- Provided the Minnesota Land Trust with MBS site information in Cass County in support of preparing a management plan for a private property.
- Updated the Forestry Director of the Leech Lake Band of Ojibwe on the status of DNR’s NPC mapping.
- Provided recommendations to the Bell Museum on locations for plant collecting forays.
- Provided comments to the US Forest Service on proposed changes to the map of Land Type Associations in northeast Minnesota.
- Reviewed six peatland Ecological Site Descriptions and suggested edits for the NRCS.
- Participated in a series of online trainings on the Ecological Classification System and NPCs for staff of the Superior National Forest.
- Provided Lakes of Biological Significance data and NHIS rare species information for a local watershed for an Area Hydrologist.
- Advised colleagues in the Long Term Resource Management survey program on the Mississippi River about the need for a *Sagittaria calycina* rare species search in a proposed management area.
- Contributed a story about Shagbark Hickory to the Minnesota Conservation Volunteer.
- Reviewed numerous plant specimens collected by other contributors to verify their identifications of rare and difficult plant taxa.

Seventh Update as of March 1, 2023:

1. Final draft delivered for publication of new book on ferns and fern allies of Minnesota.

The completed manuscript, including text and images, of the book “Ferns and Lycophytes of Minnesota” was delivered to the publisher prior to this reporting period. Occasional work continues coordinating with the publisher in anticipation of the expected book release date of spring 2023.

2. Digital maps (GIS polygon data) created for native plant communities and sites. Targeted field surveys to address mapping questions and quality control.

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 numerous references including MBS field ecologist notes, relevés, rare species records, color-infrared aerial imagery, LiDAR, National Wetlands Inventory, soils data, and forestry inventories. Approximately 320,000 acres were delineated and classified during this reporting period.

See Activity 1 Outcome 4 for accomplishments within Lake of the Woods, St. Louis, and Koochiching counties.

Southeast MBS and DNR Forestry Overlap Mapping

This project is complete.

3. DNR's website and social media updated with current survey results; biological reports, technical guidance, presentations, and trainings delivered.

DNR Online Rare Species Guide

Progress continued 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 the RSG content and the driving need for continuous updating. Current work on the RSG is funded in part by Federal State-Wildlife-Grant dollars that cover animal species while plants, bryophytes, and fungi are funded by this ENRTF appropriation. Combined, draft reports for most of Minnesota's Threatened and Endangered plant species were completed.

DNR online MN Conservation Explorer

Through a collaboration among MBS, NatureServe and DNR Environmental Review, the [MN Conservation Explorer](https://mce.dnr.state.mn.us/) (<https://mce.dnr.state.mn.us/>) was fully launched to the public during this reporting period.. This is an online map and data delivery platform. It fills a major gap in our past data delivery options by providing GIS-based data to non-GIS users using standard internet browsers. A lot of the biodiversity data that the platform provides are generated by MBS from this and all previous ENRTF appropriations.

Technical guidance

The technical guidance reported here 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 ML19 LCCMR MBS work plan and budget.

MBS staff funded by this appropriation are among the second line of technical guidance communication or outreach behind DNR Regional Plant Ecologists, Regional Nongame Ecologists, other DNR positions, and MBS staff who are not funded by ML19 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 Scientific and Natural Areas Program, DNR Hydrologists, DNR Fisheries, 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 of technical guidance delivered during the reporting period include:

- Delivered subject matter expert review for MN Lake Superior Coastal Program annual grant proposals,
- Delivered technical guidance to Regional DNR staff related to landscape context, native plant communities, rare species, and other unique features of the Pike Mountain Area in St. Louis County.

- Delivered technical guidance and resources to DNR staff related to ecology and distribution of a rare species on MN Point coastal dune systems, including distribution details of local genotypes.

Final Report as of June 30, 2023 (to be submitted before August 15, 2023):

1. Final draft delivered for publication of new book on ferns and fern allies of Minnesota.

The completed manuscript, including text and images, of the book “Ferns and Lycophytes of Minnesota” was delivered to the publisher, the University of Minnesota Press, in March 2022. The expected book release date is summer 2023.

2. Digital maps (GIS polygon data) created for native plant communities and sites. Targeted field surveys to address mapping questions and quality control.

This work continued from the ML 17 ENRTF MBS appropriation. 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 several references including MBS field ecologist notes, relevés, rare species records, color infrared aerial imagery, LiDAR, National Wetlands Inventory, SSURGO soils data, and forestry inventories. Over 46,000 polygons were mapped and classified for nearly 2 million acres. MBS increased native plant community mapping efforts by recruiting and training volunteers to digitize NPCs in MBS Sites of Biodiversity Significance. Targeted field surveys were conducted in Cass County to address mapping and NPC classification questions.

A native plant community mapping project in southeast Minnesota focused on resolving NPC polygons created by Division of Forestry overlapping older MBS polygons that were created and classified using a NPC classification system that is now outdated. Work focused on adjusting based on latest available resources such as recent photography, Lidar, USGS 24k topo, EO records and MBS Site notes from scans for each county. Over 100,000 acres of NPC mapping was corrected and improved because of this work.

3a. Website and social media updated with current survey results;

See also Section IV of this report.

The [DNR Rare Species Guide](#) (RSG) was updated with new data from field work accomplished under this and previous ENRTF MBS appropriations. 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. Over 200 RSG plant profiles were updated and improved as a result of this appropriation.

Through a collaboration among MBS, NatureServe and DNR Environmental Review, the [MN Conservation Explorer](#) (MCE) was launched to the public. MCE is an online map and data delivery platform. It fills a major gap in our past data delivery options by providing GIS-based data to non-GIS users using standard internet browsers. A lot of the biodiversity data that the platform provides are generated by MBS from this and all previous ENRTF appropriations.

In collaboration with the DNR Lake Ecology Unit, MBS created a tool in ArcGIS that will generate taxa list reports for MBS aquatic plant surveys. These reports would be placed on the [DNR LakeFinder website](#). This tool will also be available to use by other programs conducting aquatic plant surveys.

3b. Biological reports, technical guidance, presentations, and trainings delivered.

The technical guidance reported here 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 ML19 LCCMR MBS work plan and budget.

MBS staff funded by this appropriation for 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 ML19 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.

Specific examples of technical guidance, biological reports, social media, and publications delivered during this appropriation are included in the work plan update reports.

IV. DISSEMINATION:

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

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

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

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

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

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

The Minnesota Environment and Natural Resources Trust Fund (ENRTF) will be acknowledged through use of the trust fund logo or attribution language on project print and electronic media, publications, signage, and other communications per the [ENRTF Acknowledgement Guidelines](#).

First Update March 1, 2020

See overall project status updates above.

Second Update September 1, 2021

Work started on this work plan on July 1, 2020.

See Activity 3, Outcome 3 update.

Third Update March 1, 2021

See Activity 3, Outcome 3 update.

Fourth Update September 1, 2022

See Activity 3, Outcome 3 update.

Fifth Update March 1, 2022

See Activity 3, Outcome 3 update.

Update as of June 30, 2022:

Project extended to June 30, 2023 by LCCMR 6/30/22 as a result of M.L. 2022, Chp.94, Sec. 2, Subd. 19, legislative extension criteria being met.

Sixth Update as of September 1, 2022:

See Activity 3, Outcome 3 update.

Seventh Update as of March 1, 2023:

See Activity 3, Outcome 3 update.

Final Report as of June 30, 2023 (to be submitted before August 15, 2023):

See Activity 3, Outcome 3 final report.

V. ADDITIONAL BUDGET INFORMATION:

A. Personnel and Capital Expenditures

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

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 entomologist (0.5 FTE for one year) is directed to pollinator field

surveys and data management in Activity 2. Due to extensive entomological field and data analysis experience, this entomologist brings knowledge and perspectives that will result in high quality results.

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

Enter Total Estimated Personnel Hours for entire duration of project: 28,912	Divide total personnel hours by 2,080 hours in 1 yr = TOTAL FTE: 13.9
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Total Number of Full-time Equivalents (FTE) Estimated to Be Funded through Contracts with this ENRTF Appropriation:

Enter Total Estimated Contract Personnel Hours for entire duration of project: 1664	Divide total contract hours by 2,080 hours in 1 yr = TOTAL FTE: 0.8
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VI. PROJECT PARTNERS:

A. Partners outside of project manager’s organization receiving ENRTF funding

University of Minnesota Press, costs for publishing of Activity 3, Outcome 1: a new book on ferns and fern allies of Minnesota.

B. Partners outside of project manager’s organization NOT receiving ENRTF funding

Name	Title	Affiliation	Role
George Weiblen	Professor and Science Director	UMN Bell Museum	Biological specimen curation; MN Biodiversity Atlas
Ralph Holzenthal	Professor	UMN Dpt. Of Entomology	Biological specimen curation.
Phil Delphy	Endangered Species Coordinator	US Fish & Wildlife Service	Listed species coordination and collaboration.

VII. LONG-TERM- IMPLEMENTATION AND FUNDING:

MBS data, analysis, products, and technical guidance have proven critical and foundational to countless societal and scientific applications. MBS is funded by ENRTF, State General Fund, State Fish & Game Fund, State Heritage Enhancement Fund, and Federal State Wildlife Action Plan dollars. DNR is developing new strategies to sustainably fund MBS. MBS has developed a 10-year strategic plan to guide work and funding priorities through 2018. MBS will continue to offer LCCMR proposals that address relevant needs and add value to existing ENRTF investments, including completion of statewide baseline biological surveys; species and ecosystem monitoring; product development (e.g., books, maps); targeted field surveys to inform conservation and management planning and decisions; and field surveys for under-surveyed taxa and ecological systems.

VIII. REPORTING REQUIREMENTS:

- Project status update reports will be submitted March 1 and September 1 each year of the project
- A final report and associated products will be submitted between June 30 and August 31, 2023

IX. SEE ADDITIONAL WORK PLAN COMPONENTS:

- A. Budget Spreadsheet** – attached
- B. Visual Component or Map** – attached
- C. Parcel List Spreadsheet** – N/A
- D. Acquisition, Easements, and Restoration Requirements** – N/A
- E. Research Addendum** – N/A

Attachment A:

Environment and Natural Resources Trust Fund

M.L. 2019 Budget Spreadsheet Final

Legal Citation: M.L. 2019, First Special Session, Chp. 4, Art. 2, Sec. 2, Subd. 03a

Project Manager: Bruce Carlson

Project Title: Minnesota Biological Survey

Organization: Minnesota Department of Natural Resources

Project Budget: \$1,500,000

Project Length and Completion Date: 4 years, June 30, 2023

Today's Date: 8/10/2023



ENVIRONMENT AND NATURAL RESOURCES TRUST FUND BUDGET	Revised Budget 6/30/2023 Final	Amount Spent	Balance
BUDGET ITEM			
Personnel (Wages and Benefits)	\$ 1,261,860	\$ 1,261,860	\$ -
Botanist \$133,691 (82% salary, 18% benefits) 0.75 FTE for two years WS			
Plant Ecologists \$918,733 (position #1 72% salary, 28% benefits; positions #2 and #3 66% salary, 34% benefits; position # 4 76% salary, 24% benefits; positions #5 71% salary, 29% benefits) 5.0 FTEs for two years FH JJ			
Entomologist/Pollination Specialist \$35,387 (71% salary, 29% benefits) 0.25 FTE for two years KJ			
Data/Specimen Assistant \$38,189 (63% salary, 37% benefits) 0.2 FTE for two years			
Project/Data Coordinator \$80,026 (59% salary, 41% benefits) 1.0 FTE for one year BJ			
Information officer \$98,251 (64% salary 36% benefits) 0.5 FTE for two years.			
Professional/Technical/Service Contracts			
MN.IT for embedded GIS services (equivalent to 0.4FTE for each of 2 years)	\$ 91,319	\$ 91,319	\$ -
Joint Powers Agreement with University of Minnesota Press for book publication	\$ 10,000	\$ 10,000	\$ -
Contracts with biologists	\$ 25,000	\$ 25,000	\$ -
Equipment/Tools/Supplies			
Equipment is used from previous survey periods when at all possible (e.g. GPS units, cameras, canoes, communication equipment, etc.) but replaced, repaired, or updated as necessary. Items such as batteries, specimen collecting materials, aerial photography need to be replaced or updated each field season.	\$ 4,048	\$ 4,048	\$ -
Travel expenses in Minnesota			
Travel expenses for MN travel related to field survey in Activities 1 & 2. Travel expenses are subject to State of MN labor agreements and DNR policy. Food (\$15,000), transportation in seasonal DNR fleet vehicles (\$35,000), and lodging (\$25,000).	\$ 17,049	\$ 17,049	\$ -
Other			
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 (~\$20,537), Safety Support (~\$4,254), Financial Support (~\$17,110), Communication Support (~\$1,251), IT Support (~\$46,513), and Planning Support (~\$1,050).	\$ 90,724	\$ 90,724	\$ -
COLUMN TOTAL	\$ 1,500,000	\$ 1,500,000	\$ -

OTHER FUNDS CONTRIBUTED TO THE PROJECT	Status (secured or pending)	Spent	Balance
Non-State:			
Federal - State Wildlife Grants FY20, FY21, FY22	Secured	\$ 450,000	\$ -
State:			
General Fund FY20, FY21, FY22	Secured	\$ 450,000	\$ -
Heritage Enhancement FY20, FY21, FY22	Secured	\$ 500,000	\$ -
In kind: N/A		\$ -	\$ -

PAST AND CURRENT ENRTF APPROPRIATIONS	Amount legally obligated but not yet spent	Spent	Balance
Current appropriation:			
ML2017 - MN Biological Survey	\$ -	\$ 2,900,000	\$ -
Past appropriations:			
ML2015 - MN Biological Survey	\$ -	\$ 2,450,000	\$ -
ML2013 - MN County Biological Survey	\$ -	\$ 2,650,000	\$ -
ML2011 - MN County Biological Survey	\$ -	\$ 2,250,000	\$ -
ML2009 - MN County Biological Survey	\$ -	\$ 2,100,000	\$ -
ML2007 - MN County Biological Survey	\$ -	\$ 1,500,000	\$ -
ML2005 - MN County Biological Survey	\$ -	\$ 1,000,000	\$ -
ML2003 - MN County Biological Survey	\$ -	\$ 900,000	\$ -
ML2001 - MN County Biological Survey	\$ -	\$ 800,000	\$ -
ML1999 - MN County Biological Survey	\$ -	\$ 1,600,000	\$ -
ML1997 - MN County Biological Survey	\$ -	\$ 1,200,000	\$ -
ML1995 - MN County Biological Survey	\$ -	\$ 900,000	\$ -
ML1993 - MN County Biological Survey	\$ -	\$ 900,000	\$ -
ML1991 - MN County Biological Survey	\$ -	\$ 1,000,000	\$ -