



MINNESOTA BIOLOGICAL SURVEY **PLANT OPERATIONAL PLAN**

Appendix to the Minnesota Biological Survey Strategic Plan

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PURPOSE and SCOPE

The Minnesota Biological Survey (MBS) Plant Operational Plan (POP) is an actionable guide for MBS Plants (defined as the staff and/or projects focused on botany, plant ecology and related data management) to implement the goals, strategies, and priority actions outlined in the MBS Strategic Plan.

MBS's Mission is to collect, analyze, and deliver data and information to support conservation and management of biological diversity. That mission is embodied within the MBS Strategic Plan as three broad goals.

1. Collect biological data and information.
2. Manage and deliver biological information.
3. Exemplify operational excellence in our work.



Goals 1 and parts of 2 and 3 are addressed specific to MBS Plants in this document. The remainder of Goals 2 and 3 are somewhat inherent within the work described and will be addressed more specifically at the MBS Program level. Although the MBS POP is specific to MBS Plants, it has relevance for broader Ecological and Water Resources (EWR) and Department of Natural Resources (DNR) conservation and planning priorities. A few examples include:

- Much of the work outlined in the POP is collaborative involving staff across the DNR.
- Much of the data and information MBS Plants produces is used widely by EWR, other DNR Divisions and external partners.
- The POP can contribute to developing an EWR or State-wide Biodiversity Action Plan as recommended by EWR's Biodiversity Work Assessment Project. This document also operationalizes MBS's Vision, Healthy and resilient biological diversity throughout Minnesota, through two guiding principles:
- To inform and improve conservation, protection, and management outcomes for native plants, and
- To enhance our understanding of the State's natural botanical and ecological resources.

These guiding principles were applied when evaluating all current and proposed MBS Plants' work, partnerships and staffing priorities. We intend to use this Plan to guide MBS Plants' short- and long-term workplans, and we hope it increases awareness of MBS Plants and fosters greater communication and collaboration broadly.

ACCOMPLISHMENTS

The MBS Strategic Plan was implemented in 2019. This document was finalized in 2024. MBS Plants has already undertaken numerous activities in support of MBS's strategic goals. Examples of key accomplishments, listed by strategic plan goal are:

Goal 1: Collect Biological Data and Information

- The Minnesota County Biological Survey (MCBS) field work for native plant species and communities was completed in all 87 counties.
- 2,338 MCBS lake surveys were conducted across 52 counties, resulting in the collection of over 5,000 aquatic plant specimens.
- A 10-year MBS Sustainable Plant Survey Framework was developed.
- The MN PlantWatch program was initiated in collaboration with the University of Minnesota's Landscape Arboretum (UMLA).
- Over 100 Species Habitat Models were created for State-listed Endangered, Threatened and Special Concern (ETS) plant species.
- The first MBS Botany Foray was conducted and has expanded into a Biodiversity Foray.
- MBS assumed co-management of the Wetland Quantity Monitoring Project with DNR's Conservation and Management of Rare Resources Unit.
- A third grant funded through the Environmental Natural Resources Trust Fund (ENRTF) was awarded to MBS Plants to complete the Ecological Monitoring Network (EMN) project.
- MBS Plants expanded work conducting effectiveness monitoring of conservation grazing as a disturbance management tool in native prairies.
- MBS Plants initiated research studying the effectiveness of different disturbance management regimes in reducing invasive smooth brome grass in native prairies.

Goal 2: Manage and deliver biological information

- A grant was awarded to MBS Plants funded through the ENRTF to revise the DNR's native plant community (NPC) classification system.

Goal 3: Exemplify operational excellence in our work

- Full stable funding was secured to create a combined MBS biometrician and wetland scientist position.
- Partial stable funding and permanent classification status were secured for the MBS aquatic botanist position.
- Partial stable funding and permanent classification status were secured for two natural resource specialist senior positions to support survey, monitoring and research.





MBS Plants within the DNR

MBS Plants regularly collaborates with other DNR Units and Divisions on inter-disciplinary projects. MBS Plants most frequent and on-going collaborations occur with EWR's Conservation Assistance and Regulation and Environmental Management and Protection sections and with associated EWR regional staff. Collaborative projects often include work with multiple types of data, work at multiple ecological scales, and reach beyond DNR to include a variety of other entities.

While each project is unique, MBS plant staff typically serve in two roles. They can act as technical advisors, providing recommendations and guidance to decisions makers. And they can be project team members, with responsibilities for study design, data collection, data management, processing and analysis, or project reporting. Although less common, MBS plant staff can serve as project managers when an effort is fully encompassed within study design, data collection, analysis and reporting responsibilities.

For example, the DNR, through the Office of School Trust (OST), administers School Trust Lands (STL), which are public lands used to provide a continual source of funding in support of education. From 2021-2023 MBS engaged with the OST and the Division of Fish and

Wildlife (FAW) to identify and protect remaining native prairies on STLs that contain aggregate resources that are administered by FAW. MBS staff conducted surveys on select STL parcels in Northwestern Minnesota to 1) locate, survey and map Upland Prairie and Wetland Prairie native plant communities; and 2) locate populations of State-Listed plant species in those systems. MBS project managed two Professional/Technical contracts to accomplish parts of the work.

Disciplines within MBS Plants

MBS Plants conducts a wide variety of activities that fall under two main disciplines, botany and plant ecology

Botany, technically defined is the scientific study of plants, including all aspects of their physiology, morphology, genetics, ecology, distribution, economic importance and more. MBS typically uses a narrower definition of the word botany, focusing on aspects of species distribution, taxonomy, and population-level ecology.

Plant Ecology, technically defined is the scientific study of the relationships among plants and their biotic and abiotic environment. Again, MBS uses a narrower definition, typically referring to community- and landscape-level ecological processes when using the term.



SUSTAINABILITY

- Long-term sustainability is foundational to achieving the goals of the MBS Strategic Plan, particularly Goal 3, Exemplify operational excellence in our work. Operational excellence requires MBS maintain a diverse and adaptable portfolio of work to address the varied needs, challenges and changes that face Minnesota’s natural resources. Achieving operational excellence sustainably will require MBS to create and maintain staff and funding portfolios that are equally diverse and adaptable. The Plant Operational Plan embodies MBS Plants’ efforts toward sustainability in the following ways:
- This document was created assuming a steady, manageable, and fundable staffing level as described under Goal 3, which outlines a staff structure that balances breadth of expertise (e.g., maintains state-wide coverage) with depth of experience (e.g., promotes long-term staff retention) and encourages innovation.
- This document was created to be adaptable to variations in funding availability and limitations, and work priorities driven by Division or Department needs.
- It is MBS Plants’ intention to only seek grant funding (typically through the Legislative-Citizen Commission on Minnesota Resource’s (LCCMR) and the ENRTF) and for short-term or special projects as enhancements to essential MBS plant work, such that permanent plant staff do not rely heavily on transitory funding.
- Special attention is given to how partnerships can maximize the benefit of MBS Plants for conservation, protection and management.
- Special attention is given to promoting strong collaboration and teamwork among MBS staff.
- Special attention is given to balancing data collection with product creation to improve timeliness in data processing and dissemination.
- Special attention is given to the use of community science and volunteers to increase the overall capacity of MBS Plants.



MBS Plants Biological Data

The **MBS Strategic Plan** categorizes MBS biological data collection activities into three broad types: **survey**, **monitoring** and **research**.

Biological Surveys are efforts to collect data on the presence, distribution, abundance, ecological integrity, or natural history of a defined biological feature, resource or within a defined geographic area. MBS plant staff make a distinction between new surveys, efforts to collection foundational or baseline data, and re-surveys, efforts to update pre-existing data or information.

Biological Monitoring is a more systematic process of collecting data than re-surveys. Monitoring is done with the purpose of detecting long-term trends or predicting future trajectories of the presence, distribution, abundance, or ecological integrity of a define biological feature.

Research is a designed activity to test a hypothesis about the effects of one or more variables over a specified time frame. Both survey and monitoring efforts can be research projects if designed to be so. Research is defined by how a scientific question is asked. Survey and monitoring are defined by how scientific data are collected.



GOAL 1 Collect Biological Data and Information

Strategy 1.1:

Conduct surveys to determine the distribution and abundance of native and rare plants, animals, and plant communities

Priority actions:

- 1.1A Complete statewide, baseline surveys of Minnesota's native terrestrial plants, plant communities, birds, amphibians, reptiles, and small mammals (i.e., complete the MCBS).
- 1.1B Continue progress in statewide baseline surveys of aquatic plants, bees, moths and butterflies, and nongame fish.
- 1.1C Conduct systematic return-surveys to update statewide survey data >20 years old.
- 1.1D Conduct statewide surveys on under-sampled sites, species, and plant communities.

MBS Plants' activities that primarily address priority actions in Strategy 1.1 are presented in this section within six categories:

- 1) completing the Minnesota County Biological Survey (MCBS),
- 2) transitioning MBS Plants' survey work to a long-term, sustainable framework,
- 3) aquatic plant survey projects,
- 4) landscape-scale terrestrial plant survey projects,
- 5) community-scale terrestrial plant survey projects and
- 6) species and population-scale terrestrial plant survey projects.

MBS Plants' activities that secondarily address priority actions in Strategy 1.1 are described elsewhere in the document and included in Table 1.1.

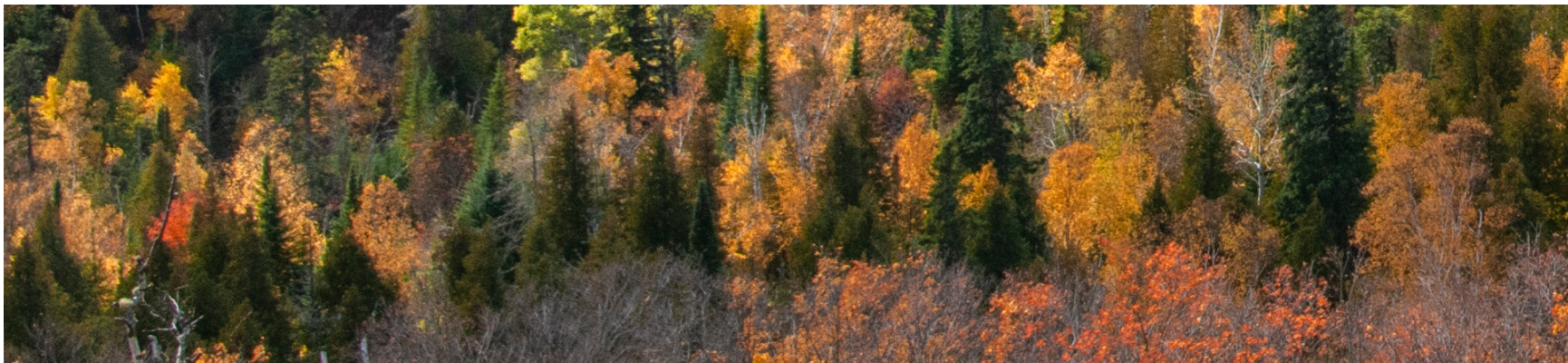
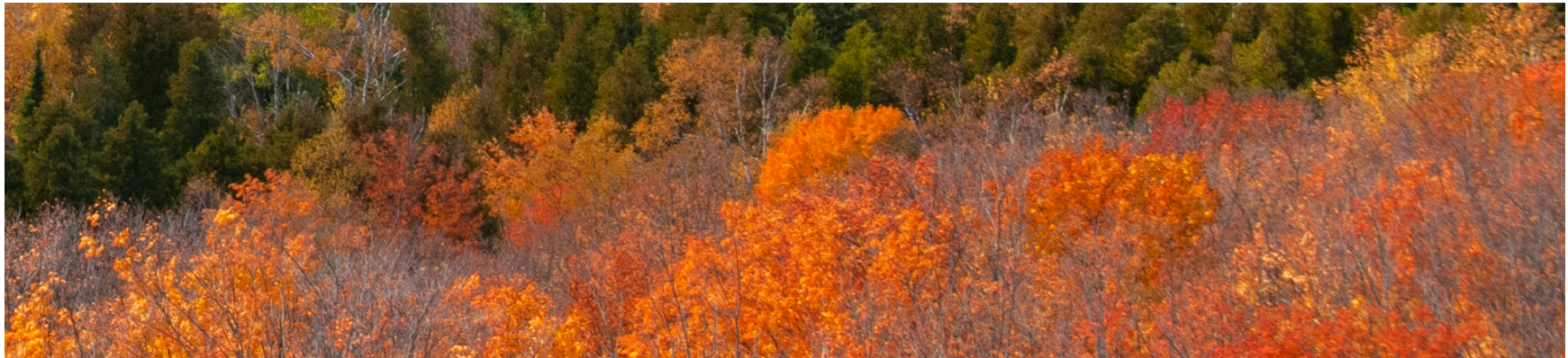


Table 1.1: Primary and secondary MBS Plants' activities linked to the priority action(s) (PA) they contribute to within Strategy 1.1.

Focus on Strategy	Activities and Projects	Priority Action 1.1
Primary	Completing the MCBS	A
Primary	Sustainable Plant Survey Framework	C, D
Primary	MBS Aquatic Plant Surveys	B, C, D
Primary	Landscape Scale Surveys	C, D
Primary	Community Scale Surveys: Targeted Relevé Sampling	C, D
Primary	Community Scale Surveys: NPC-LTP Crosswalks	D
Primary	Community Scale Surveys: Ephemeral Pond Surveys	D
Primary	Species and Population Scale Surveys: Re-survey in High and Outstanding SBS (Rare)	C
Primary	Species and Population Scale Surveys: Species Habitat Modeling (Rare)	D
Primary	Species and Population Scale Surveys: MN Plant Watch (Rare)	C
Primary	Species and Population Scale Surveys: Re-surveying SNAs Statewide (Rare)	C
Primary	Species and Population Scale Surveys: Statewide Lichen Survey (Flora)	D
Primary	Species and Population Scale Surveys: Botany Foray (Flora)	C, D
Secondary	Update and Modernize the v2.0 Native Plant Community Classification System	C, D
Secondary	Wetland Hydrology Network	D



Complete the Minnesota County Biological Survey (MCBS)

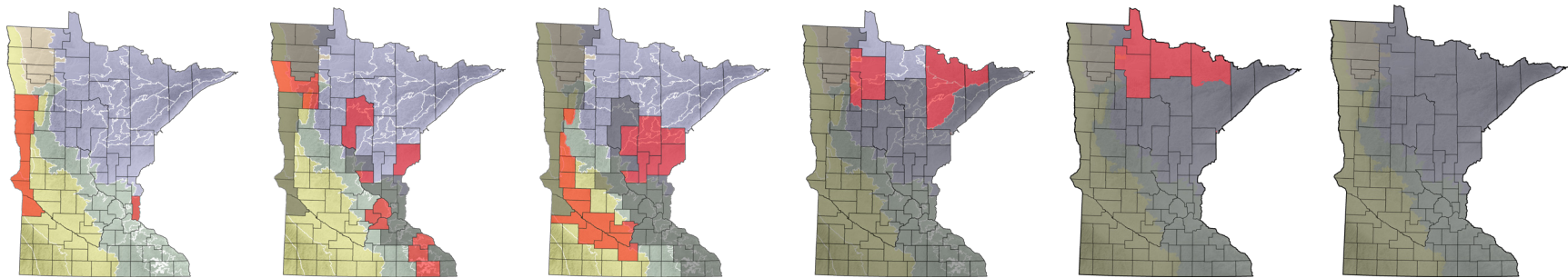
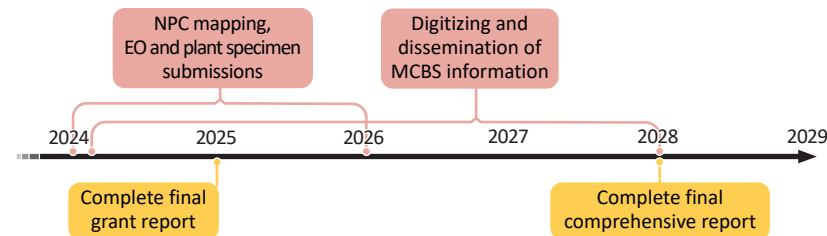
The MCBS project is a one-time, baseline biological survey of Minnesota, carried out county-by-county, funded in large part by the Environmental and Natural Resources Trust Fund (ENRTF) as recommended by the Legislative-Citizen Commission on Minnesota Resource's (LCCMR). MCBS field survey work for terrestrial plants and plant communities was completed from 1987–2022.

Statewide baseline surveys for aquatic plants began as part of the MCBS project in 1995. Aquatic work completed through 2022 will be included in the MCBS final products. However, the statewide aquatic plant survey is not scheduled for completion until 2029. Continued

work on aquatic plants after 2022 will fall under MBS Aquatic Plant Surveys.

The work remaining for the MCBS project includes: 1) entering, processing, storing, and making available the data collected during terrestrial and aquatic field surveys through 2022, 2) creating final documentation for all survey methods, and 3) creating a final summation report documenting the entirety of the project. Finalizing data processing from the MCBS not stored and available by 2025 will continue to be a priority for MBS stable funds and staff time after the expiration of LCCMR/ENRTF support.

Figure 1: Timeline to Complete the Minnesota County Biological Survey.



Sustainable Plant Survey Framework

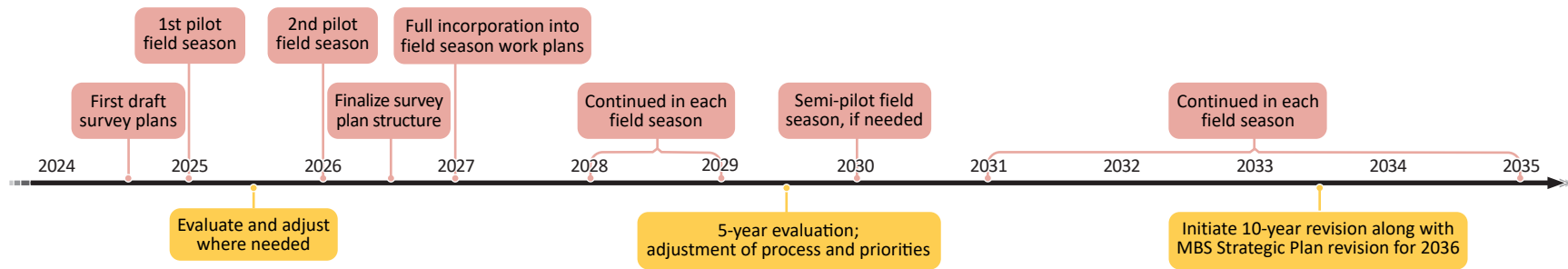
With the completion of the MCBS, MBS Plants' survey work will transition to a statewide, systematic approach that will: 1) maintain the currency of plant data by regularly updating and enhancing terrestrial plant species and community data (PA 1.1C); and 2) expand the scope of plant data by prioritizing new surveys to fill knowledge gaps in terrestrial under-sampled sites, species and communities (PA 1.1D). Maintaining and expanding MBS data are critical to continuously improving the value of the information MBS provides for conservation, protection and management. The priorities outlined here will be reevaluated and a new plant survey framework will be created every 10-years in conjunction with revisions to the MBS Strategic Plan.

The guiding principles driving MBS Plants' priorities in this framework are to:

- inform and improve conservation, protection, and management outcomes, and
- enhance our understanding of the State's natural botanical and ecological resources.
The most critical conservation needs that MBS Plants' data should inform are:
 - protection opportunities, which vary widely from land acquisition, to informing species' Listing status, to aiding the enforcement of legal protections and more,
 - natural resource management,
 - documenting threats and stressors to natural resources, and
 - documenting status and trends of natural resources, particularly where habitat degradation or population decline is occurring or suspected.

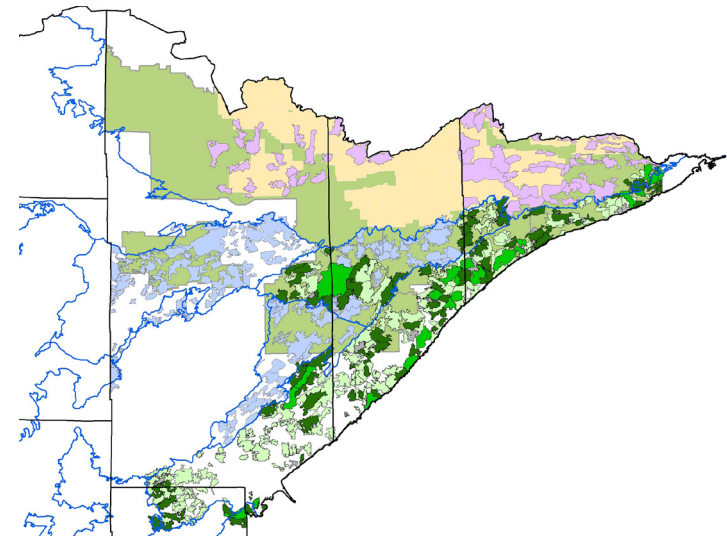


Figure 2: Timeline for implementing the Sustainable Plant Survey Framework.



i Methods: Sustainable Plant Survey Framework

MBS Plants developed statewide 10-year survey priorities by combining data summarizations and expert opinion at the ecological subsection level. Example metrics used to assess data currency within each subsection are mean age of mapped rare NPCs and the proportion of the EO records greater than 20 years old. An example metric used to assess knowledge gaps is the proportion of rare NPCs that were mapped using only photo interpretation within a subsection. Knowledge gaps were also assessed through expert opinion on topics such as the potential for new discoveries of rare features in a subsection. Known conservation needs, such as the rate of habitat loss or alteration in a subsection, were considered throughout the whole process of determining survey priorities.



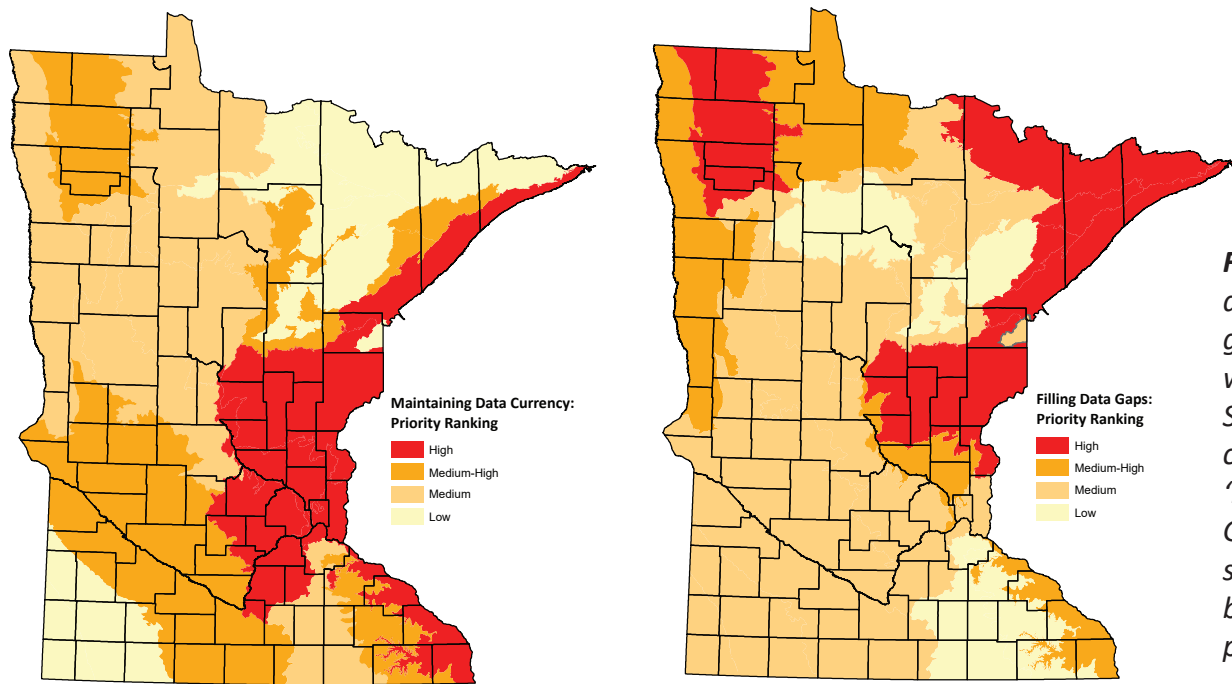
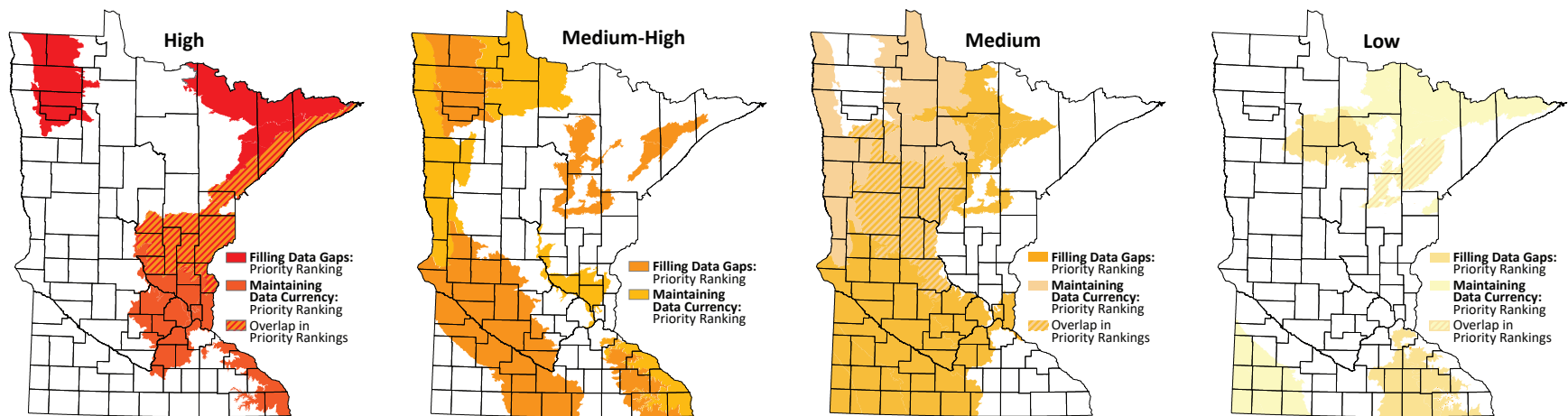


Figure 3: Maps showing maintaining data currency and filling knowledge gaps priorities statewide developed within the Sustainable Plant Survey Framework. Priorities were categorized as 'High,' 'Medium-High,' 'Medium,' 'Medium-Low,' or 'Low.' Generally, we expect MBS Plants' survey work for the next 10-years to be greatest where both categories are prioritized at higher ranks.



Aquatic Plant Surveys

Project: MBS Plants will complete a statewide survey of aquatic plants in lakes by 2029. As of 2023, approximately one-third of the state remains to be surveyed. Aquatic surveys to-date have consisted of creating a species list for each lake and documenting rare species via meander surveys of submerged, free-floating, floating-leaved, and emergent plant species. Rare species populations are typically documented by presence only, without estimates of population size. These data have been a major contributor in defining and mapping Lakes of Biological Significance (LOB) in collaboration with DNR's Lake Ecology Unit.

Project: MBS Plants will begin limited re-surveys of rare aquatic plant species to map populations in more detail and estimate population size and conservation status. These enhanced population survey techniques will also be incorporated into the remaining statewide

surveys. Priority will be given to areas of the State with a high concentration of Element Occurrences (EOs) great than 20 years old and to expand surveys into rivers and permanent and seasonal wetlands that harbor aquatic and semi-aquatic plant species.

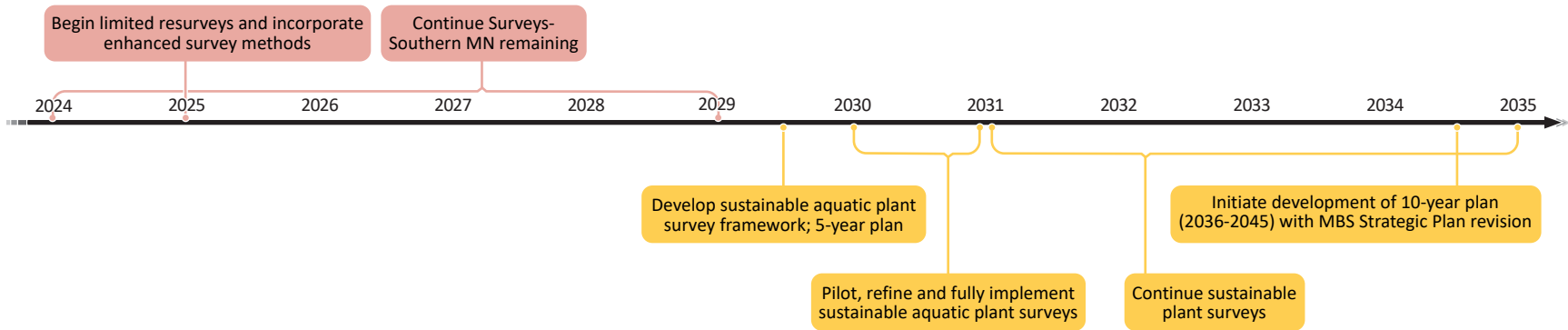
Intention: As data become sufficient, MBS Plants will develop methods for creating species habitat models for rare aquatic plant species.

Intention: As part of the work to revise the DNR's terrestrial native plant community (NPC) classification system, MBS Plants will collaborate with the Lake Ecology Unit to develop methods for classifying aquatic NPCs.

Intention: Aquatic plant survey work will be incorporated into the overall Sustainable Plant Survey Framework after the completion of the statewide aquatic plant survey.



Figure 4: Timeline for implementing Aquatic Plant Surveys.



i Collaborator: DNR’s Lake Ecology Unit 

The DNR’s Lake Ecology Unit is a key MBS partner in aquatic plant work through botanical expertise, and data management and distribution. Our collaborations include:

- Taxonomic expertise for Charophytes through the Lake Ecology Unit’s partnership with the New York Botanical Garden.
- Data management and distribution of plant species lists, survey spatial data, and LOB designations.
- Annual aquatic plant identification workshops. Statewide aquatic plant surveys.

With only a single MBS position devoted to aquatic plant species and ecology, this partnership is critical to the success of MBS’s aquatic plant work.



Landscape-scale Surveys

MBS Plants landscape-scale survey efforts during the MCBS focused on intact, ecologically functional natural areas that were defined and mapped as Sites of Biodiversity Significance (SBS). The delineation, survey and mapping of SBS was a major endeavor. MBS cannot commit to regular return surveys for updated or enhanced data within all SBS.

Intention: Areas within existing SBS that have had no on-the-ground data collection will be prioritized for surveys, especially in Northeast MN.

Intention: Areas with protection opportunities or that create connectivity across a fragmented landscape will be prioritized for surveys, especially within prairie dominated landscapes.

Intention: SBS information will be updated when data are collected on site for other purposes (e.g., EO updates).



Ecology Scales

MBS Plants works at three ecological scales:

A Biological Population is a group of organisms of a species that live in the same place, at the same time, interact and can interbreed.

A Biological Community is a group of organisms including members of the same and different species that share a common habitat and often interact through trophic and spatial relationships; or the living (biotic) populations that exist in the same place, at the same time.

An Ecological Landscape is a geographic unit containing a mosaic of different biological communities, physical characteristics, and land uses.

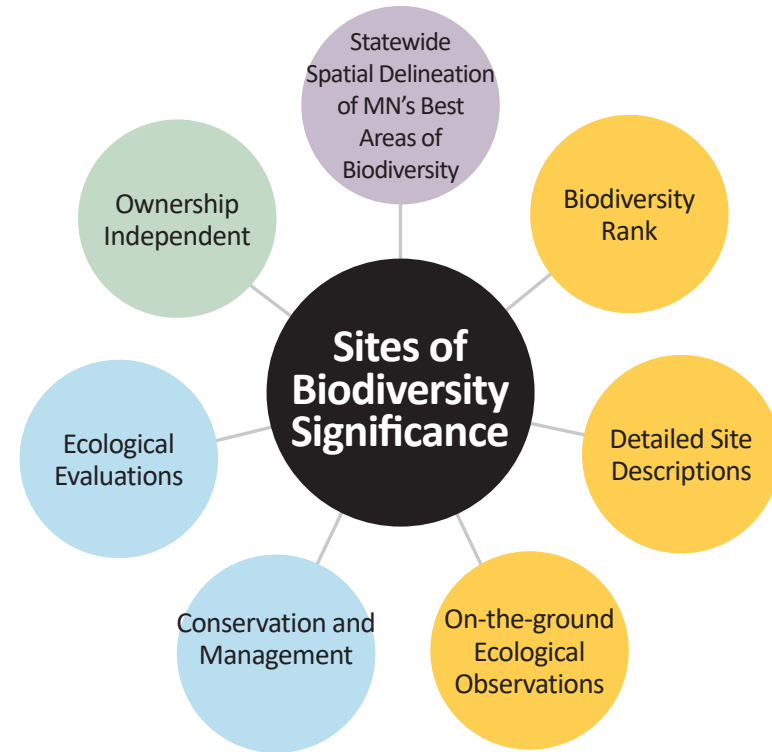


Figure 5: Information map showing the types of information the SBS dataset contributes.



Community-scale Surveys

MBS Plants community survey efforts during the MCBS centered on native plant community (NPC) survey, classification, and mapping. MBS mostly uses vegetation plots (relevés), meander surveys (referred to as site surveys in the MCBS), and aerial photo interpretation to gather the necessary information to document, map, and classify NPCs. The existing NPC classification system (v2.0) was developed with data collected from 1996–2003. In the twenty years since, MBS has accumulated a more ecologically complete and representative relevé dataset statewide, and extensive user feedback from two decades of application.

Given the large user base of the NPC classification system, MBS must continuously improve and streamline its applications, expand coverage within and across ecological systems, improve access to the data and products, and increase connections to evolving climate and vegetation trends.

Aspirational Goal: MBS Plants will continue exploring needs for larger relevé sampling projects targeted at specific community types or areas of interest. MBS will prioritize re-sampling plots last surveyed more than 20 years ago opportunistically with the goal of maintaining this long-term dataset of plant species' abundance and structure statewide.

Project: Targeted relevé sampling is planned for two field seasons as part of the larger project, Update and modernize the v2.0 NPC Classification System. Priorities will include:

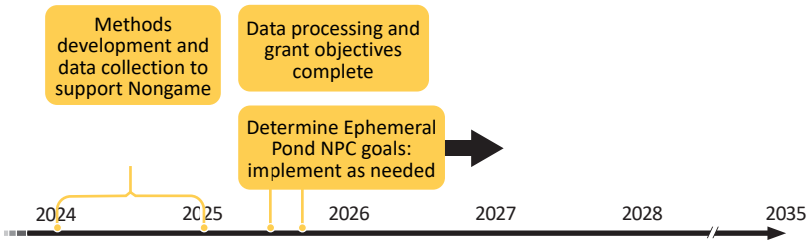
- Rare NPCs, especially those that have been mapped and classified via aerial photo interpretation only,
- Ecological systems that still have inadequate data to define NPCs (e.g., Lakeshores, River Shores, Marshes, and Rock Outcrops), and
- Standardized collection of detailed soil data at new and previously sampled relevé plot locations.

Project: MBS Plants and the Nongame Program are conducting a collaborative project to characterize rare salamander habitat needed for the upcoming revision of the MN State Wildlife Action Plan (SWAP). MBS Plants is developing sampling methods to document the variation in vegetation in ephemeral pond habitats important for salamanders, with the hope of eventually defining a formal native plant community classification.

Intention: MBS Plants recently completed a crosswalk of NPCs to Land Type Phases (LTPs) in collaboration with the Superior National Forest (SNF). The Chippewa National Forest (CNF) has expressed a similar interest. MBS Plants intends to expand the LTP-NPC crosswalk work to include the CNF if opportunity arises.

Intention: Additional community scale survey projects will be developed in accordance with the Sustainable Plant Survey Framework.

Figure 6: Timeline for Ephemeral Pond Surveys.



The term *Vegetation*, when used in an ecological sense, refers to all the plant life found in an area, typically a small area such as a specific community type.

Compared to the term *Flora*, which is typically used at a broader scale to mean all plant life in a whole region, period of time, or environment.

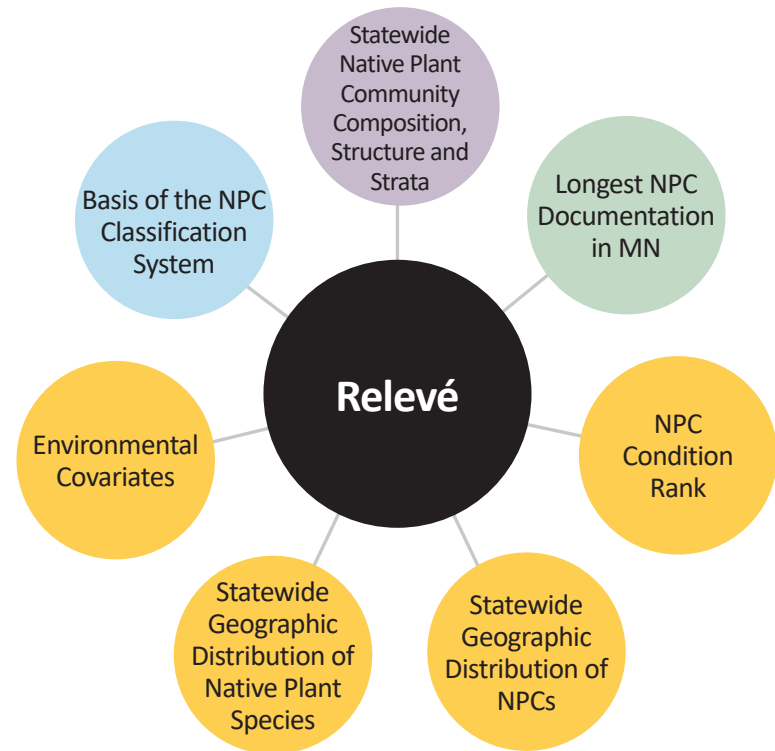


Figure 7: Relevé data is foundational to our understanding of native plant community structure, distribution and health. It is the primary data source drawn upon for the Native Plant Community Classification System. This graphic is a depiction of the key attributes and uses for this data set.



Collaborators: National Forests

MBS Plants has a broad partnership with SNF, including the LTP-NPC crosswalk, as well as regularly advising each other and collaborating on items of mutual interest. For example, SNF staff also provide their expertise in soil science and geomorphology in the broader ecology of Northeast MN. MBS Plants is exploring expanding our formal partnership with SNF to also include the CNF.

MBS Plants collaborates with the NRCS via our partnership with the SNF. MBS Plants assists with NRCS soil surveys when working on the SNF. However, if this partnership is expanded to include the CNF, it may also be possible to form a more integrated State/Federal partnership with all three entities. This would be best accomplished via a dedicated position focused on integrating plant and soil ecology.

Collaborators: Nongame Program

Collaborations between the Nongame Program and MBS Plants will increase as plant species are incorporated into the next SWAP. MBS Plants intends to build a portfolio of collaborative work with Nongame as needs arise, much like what has been produced for animal species through ongoing collaborations with MBS Zoology staff.



Species and Population Scale Surveys

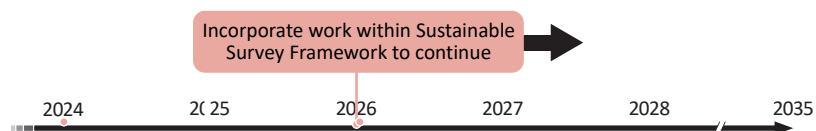
Rare Plant Surveys

Element Occurrence (EO) records of rare or State-listed Endangered, Threatened and Special Concern (ETS) species are essential for plant biodiversity conservation, protection and management, updating species' Listing status, and environmental review. These data are obtained from a variety of internal (e.g., MCBS) and external (e.g., private consultants) sources. DNR's Environmental Review Unit is a key consumer of rare and ETS species observation data.

Aspirational Goals: The metrics collected during rare species surveys have varied over time due to the field time available, specifics of the species' biology, and the survey objectives. This variation is problematic for species conservation, especially for the environmental review process. MBS Plants intends to improve the standardization of rare species survey data as much as possible across all the projects described by:

- continued effort to assign standardized EO condition ranks,
- increased effort to estimate population size and spatial extent,
- increased effort at documenting site-level threats observed where rare and ETS species are found, and
- developing a standardized documentation process for non-detection data.

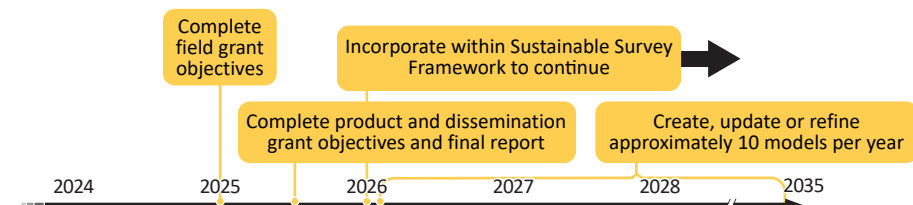
Figure 7: Timeline for completing Re-Survey in MBS High-and-Outstanding Sites.



Project: MBS has been revisiting High and Outstanding SBS in the Southeast Blufflands since 2013, and before that in Northwestern and Western MN. While the focus of this work has been re-survey of rare species with EOs greater than 20 years old, a significant number of new rare plant populations have been discovered. This work partially focuses on High Conservation Value Forests (HCVF) as part of the State's sustainable forest certification. Continued revisits in High and Outstanding SBS will be conducted in accordance with the Sustainable Plant Survey Framework.

Project: Species habitat models (SHM) identify potential habitat for a species by correlating environmental variables with occurrence data and then predicting where areas of similar (potentially occupied) habitat occur. Incorporating these models as a site selection tool for rare species surveys will increase the efficiency, speed and precision of locating new populations. They can also be used to develop vulnerability models, conduct threats assessment and predict rare species' potential future trends under climate change. Population-level survey work supported by the LCCMR/ENRTF is ongoing in both new and previously surveyed locations to field validate SHM results. MBS Plants will continue this work after ENRTF funds expire June 30, 2025 by incorporating SHM results and continuous improvement into the Sustainable Plant Survey Framework.

Figure 8: Timeline for completing Species Habitat Modeling.



Project: The MN PlantWatch project began in 2023 in collaboration with the University of Minnesota Landscape Arboretum (UMLA), funded by the ENRTF. This project will establish and oversee a group of community scientists to re-survey EOs greater than 20-years old and bank seed from State-listed plant populations. Re-survey data are being collected in accordance with MBS Plants’ enhanced data standards, and will include population size, distribution, demographics, phenology, and threats. Incorporating community scientists in rare species surveys will greatly increase MBS Plants’ capacity, efficiency and speed.

Project: In 2021, MBS Plants began a collaborative project to re-survey rare plant species on Scientific and Natural Areas (SNAs). The goal of the field surveys is to revisit all rare plant EOs, collecting up-to-date data in accordance with MBS’ Plants’ enhanced data standards on priority SNAs, Native Prairie Bank (NPB) easements, and adjacent lands. MBS Plants is also providing brief management recommendations where applicable.

Intention: MBS Plants would like to use the SNA collaboration as a model for implementing similar re-survey work in partnership with DNRs other major land administrators (e.g., State Parks).



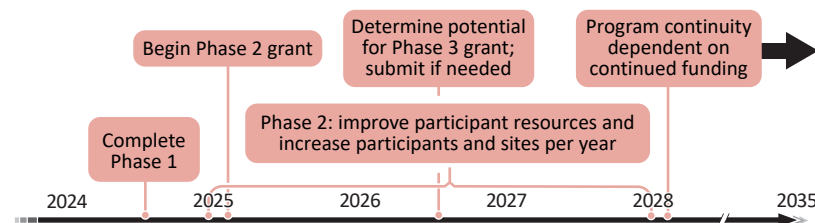
Collaborator: Minnesota Landscape Arboretum (UMLA) 🔑

The UMLA is a key conservation partner with MBS Plants. UMLA specializes in active In Situ and Ex Situ rare plant conservation efforts that both inform and are informed by the foundational data MBS Plants collects and distributes. MBS Plants recently strengthened this relationship through the initiation of our joint project, MN PlantWatch. This collaboration will continue to strengthen as MN PlantWatch grows, and as both partners seek out new ways to enhance the complimentary nature of their work.

Collaboration: DNR’s Forest Coordination 🔑

Broadly, the data that MBS Plants collects, manages and disseminates play a key role in the Department-wide Forest Coordination process, particularly SBSs and rare plant species EOs. MBS plant staff collaborate in a variety of Forest Coordination related initiatives as both technical advisors and team members.

Figures 9: Timelines for completing MNPlant Watch projects.





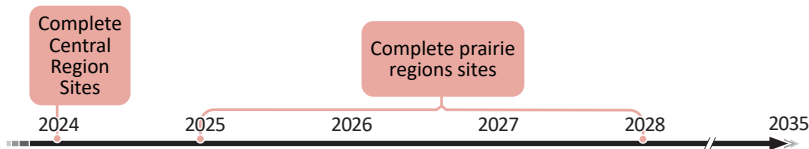
Collaborator: DNR's Scientific and Natural Areas (SNA) Program

SNA administered lands (SNAs and NPBs) are often 'the best of the best' in terms of habitat quality and occurrences of rare and ETS species. SNAs also have the highest level of land protection awarded by the State of MN. Thus, the DNR has a special responsibility for their conservation and management, and MBS has a special responsibility for providing data to support those efforts. Most collaborations with the SNA Program are project specific. Broadly, MBS Plants collaborates with the SNA program on:

- Surveys for rare and ETS plant species,
- Site evaluations,
- Both MBS- and SNA-initiated short- and long-term monitoring projects, and
- Experimental research examining various management techniques.

MBS Plants intends to maintain this close relationship through continually seeking out new opportunities and addressing new needs in support of protection, conservation and management on SNA administered lands.

Figures 10: Timelines for completing SNA and Native Prairie Bank projects.



Species & Population-scale Surveys - Statewide Flora

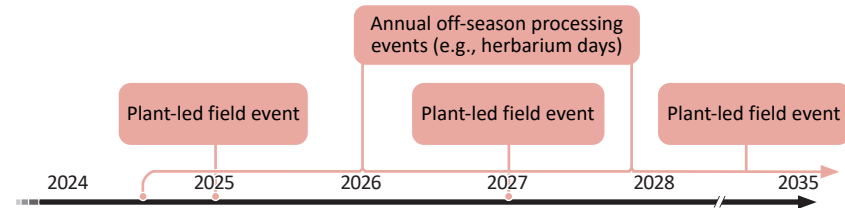
A large portion of MBS Plants' work to document Minnesota's native flora has been through voucher specimens accessioned into herbaria. Over 60% of the Minnesota vouchers held at the Bell Museum Herbarium were submitted by MBS or its predecessor, the DNR's Natural Heritage program. The uses of herbarium collection data are far reaching. For example, they are foundational data to determine a species' geographic range and habitat associations, as well as shifts in those over time. They are a critical resource for botanical education. They have been used to detect phenological shifts as the climate has warmed. And more recently, they have been recognized for the vast, long-term genetic data they store.

Aspirational Goals: MBS Plants will continue to include the collection of plant voucher specimens within appropriate projects outlined in this document. MBS Plants intends to improve upon the historical base specimen collection priorities (which were new County records and rare species occurrences) by incorporating wider ecological and genetic variation. MBS Plants' priorities for herbarium quality voucher specimens are:

- Contributing to vouchered documentation of native species' full ranges in Minnesota at minimum the County level, but at a finer scale where a species is found in variable ecological conditions (e.g., multiple ecological subsections within a County or where Counties are particularly large).
- Contributing to vouchered documentation of all rare, watchlist, State ETS and Federally Listed species at the population level (where those populations can sustain a collection without harm and MBS is permitted to Take Listed species).
- Contributing to keeping MN's flora documented as a 'living collection' that can be used to assess genetic and other changes over time by re-vouchering, where practical, across a species' distribution at minimum the County level, and a finer scale where appropriate as stated above when the most recent voucher is greater than 20 years old.

Project: MBS Plants initiated a Botany Foray project in 2021. This project's purpose and goals have changed through time. MBS is now viewing this initiative as a Biodiversity Foray; a joint plant/animal event, aimed at creating connection and collaboration among MBS staff while collecting data on under surveyed species, systems, or areas throughout the State. MBS plant or animal staff will hold a field event every-other year, respectively. The MBS Plants-led events conducted within this project will be planned in accordance with the Sustainable Plant Survey Framework and emphasize collaboration with regional DNR staff.

Figure 11: Timeline for completing Biodiversity Forays.



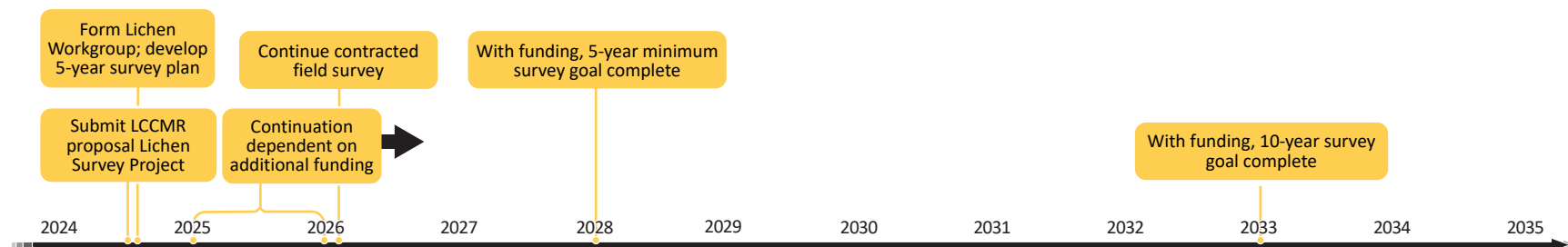
Project: MBS Plants piloted a statewide lichen survey in 2024. The first field surveys were conducted via contract in Southeast MN. This work targeted Southern Algific Talus and Southern Maderate Cliff communities and other unique settings where rare lichens are likely to occur or where lichens are a dominant taxonomic group within the community. This work has future support via the Update and modernize the v2.0 NPC Classification System project through 2026. MBS Plants will seek continued grant support to continue surveys through at least 2028 to complete five-seasons of survey targeted at communities where lichens are known to be particularly diverse or abundant.

Intention: Non-vascular plants (Bryophytes and Algae) and fungi have not had focused statewide survey effort. The commitment of stable funds to work in aquatic systems will, in part, ensure botanical work with Algae continues. MBS Plants intends to continue to seek external funding sources as a means of continuing to expand our knowledge of non-vascular plants and fungi.

Intention: MBS Plants cannot commit to continuing to publish hardbound taxa-focused floras as in the past. However, MBS Plants does intend to continue producing similar content, likely distributed online. While not a priority within the timeframe of this POP, aquatic systems have been identified as the likely next target for a comprehensive statewide flora.



Figure 12: Timeline for completing Statewide Lichen Survey projects.





Collaborator: Natural Resource Contractors

MBS Plants executes numerous natural resource contracts every year. Contracts range from a few days and a few hundred dollars to multiple years totaling \$100,000 dollars or more. MBS Plants contracts both internally (e.g. DNR’s Forest Resource Assessment Unit), and externally in both the public and private sector. These relationships are critical to enhancing our capacity for data collection, accessing specialized skills, and allowing MBS Plants to quickly adapt to emerging needs.

Collaborator: The University of Minnesota’s Bell Museum Herbarium

MBS Plants has a special relationship with the Bell Museum’s Herbarium. Multiple staff and MBS leadership engage in regular, in-depth coordination on a variety of matters. Two MBS plant staff have Museum Associate appointments through the University. They are responsible for maintaining and enhancing our collaborations, advocating for joint MBS Plants/Bell priorities, and enhancing MBS’s mission by maintaining relevant expertise in scientific collections.

Collaborator: DNR’s Regional Plant Ecologists

MBS Plants has a unique relationship to the Regional Plant Ecologist (RPE) staff. Collaborations occur within Department, Division and Unit-level projects. MBS leadership and plant staff intend to grow this program-to-program relationship for more comprehensive and timely coordination within shared projects and on topics of mutual interest. For example, the Northeast Region arranged surveys of Spring Fens only accessible by helicopter in 2023. MBS plant staff participated in several days of surveys collecting, processing and submitting native plant community and rare plant species data. Ultimately, those data will be used to inform the designation of Spring Fens within the Calcareous Fen designation process.



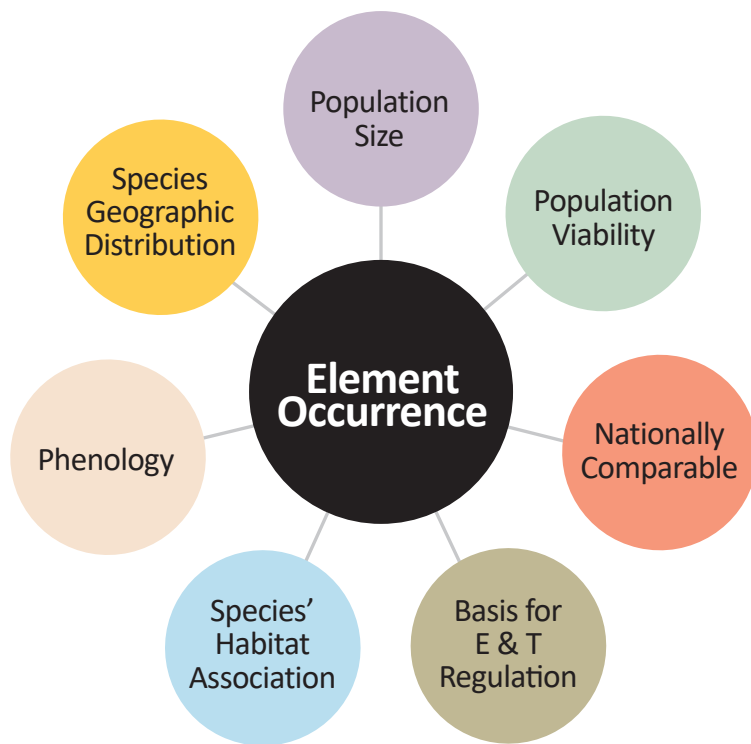


Figure 13: Element Occurrences (EO) provide a variety of information about rare species' populations. This graphic is a depiction of the key attributes and uses for this dataset.

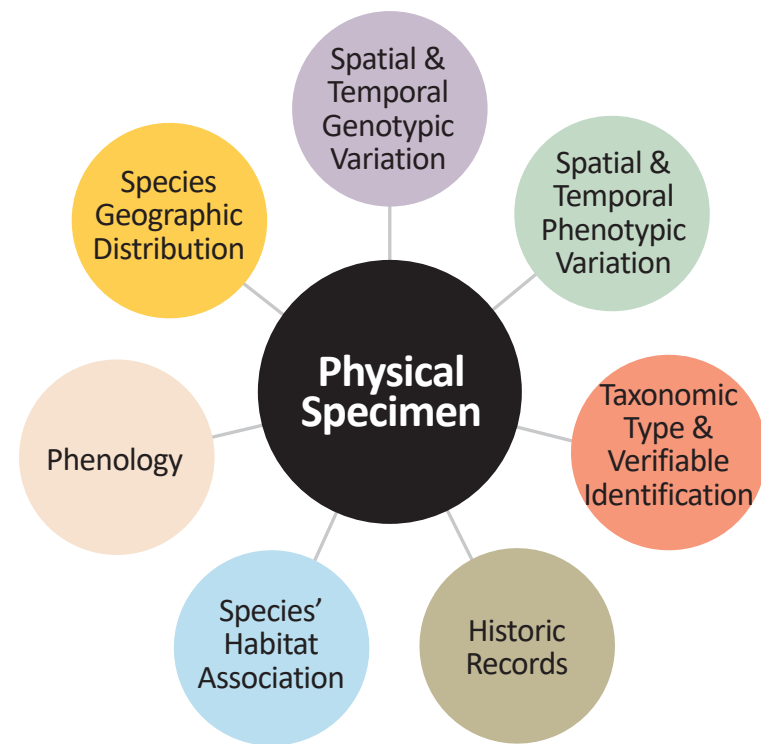


Figure 14: Physical specimens are the main source of verifiable evidence about native species' in MN. This graphic is a depiction of the key attributes and uses for this dataset.

Strategy 1.2:

Monitor native and rare plant and animal populations, plant communities, and landscapes to detect and measure change through time.

Priority actions:

- 1.2A Monitor status and trends of native plant communities and sites of biodiversity significance.
- 1.2B Continue to monitor status and trends of state- and federally listed plants and animals.
- 1.2C Monitor the response of plant communities and species to land and water management.
- 1.2D Conduct surveillance monitoring of species and ecosystems under threat from emerging diseases and pests
- 1.2E Enhance program capacities in statistics and monitoring design and analysis.

MBS Plants activities that primarily address priority actions in Strategy 1.2 are presented in this section by ecological scale:

- 1) landscape,
- 2) community, and
- 3) species and population combined.

MBS Plants activities that secondarily address priority actions in Strategy 1.2 are described elsewhere and included in Table 1.2.



Table 1.2: Primary and secondary MBS Plants' activities linked to the priority action(s) (PA) they contribute to within Strategy 1.2.

Focus on Strategy	Activities and Projects	Priority Action 1.2
Primary	Landscape-scale Monitoring: Wetland Quantity Monitoring	A, C, E
Primary	Community-scale Monitoring: Ecological Monitoring Network	A, C, D, E
Primary	Community-scale Monitoring: Determining Priorities for non-EMN Community Monitoring	A
Primary	Population-scale Monitoring: Federally-listed species	B, C
Primary	Population-scale Monitoring: Federally-listed species	B, C
Secondary	Wetland Research	A, C
Secondary	Disturbance Management: Upland Prairie	A, C
Secondary	Disturbance Management: Small White Lady's Slipper	B, C
Secondary	Invasive Species Control: Goat Grazing to Control Woody Species	C
Secondary	Invasive Species Control: Smooth Brome Control	C



Landscape-Scale Monitoring

Landscape scale MBS Plants work has mostly been survey via the MCBS. Those survey data cannot determine if natural landscapes have been or will continue to be stable through time. MBS Plants' landscape-scale projects will focus on research and development of landscape-monitoring methods and approaches and the continuation of EWR's statewide Wetland Quantity Monitoring.

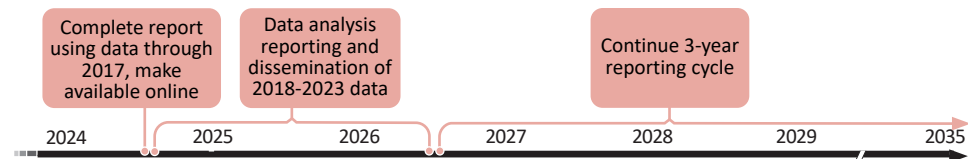
Aspirational Goal: MBS Plants intends to engage in landscape-scale monitoring whenever feasible. The metrics of interest we will seek include in those efforts are:

- change in the size and quality of terrestrial and aquatic natural areas,
- change in the connectivity among terrestrial natural areas, and
- change in the spatial distribution of land conversions, specifically to identify areas with the largest increases in the rate of land conversion from natural or semi-natural to non-natural land uses.

Project: MBS Plants assumed co-management of the Wetland Quantity Monitoring Project with EWR's Wetlands Program in 2021. Monitoring of wetland quantity by EWR started in 2006, with aerial photos currently taken on a three-year rotation. Along with the MN Pollution Control Agency's monitoring of wetland quality throughout the State, these projects are a critical source of information used by State policymakers and agencies to enact and implement wetland policy and statutes. This project is critical to understanding long-term trends in Minnesota's wetlands.

Intention: MBS Plants will continue to explore advances in technologies and statistics that would make landscape-scale monitoring efforts more feasible under current staff and resource levels. For example, MBS Plants intends to establish methods to remotely monitor changes to non-wetland NPCs and SBSs using aerial photos currently taken for EWR's Wetland Quantity Monitoring. The LCCMR has recommended funding a grant proposal for this work.

Figures 14: Timeline for completing Wetland Quantity Monitoring projects.



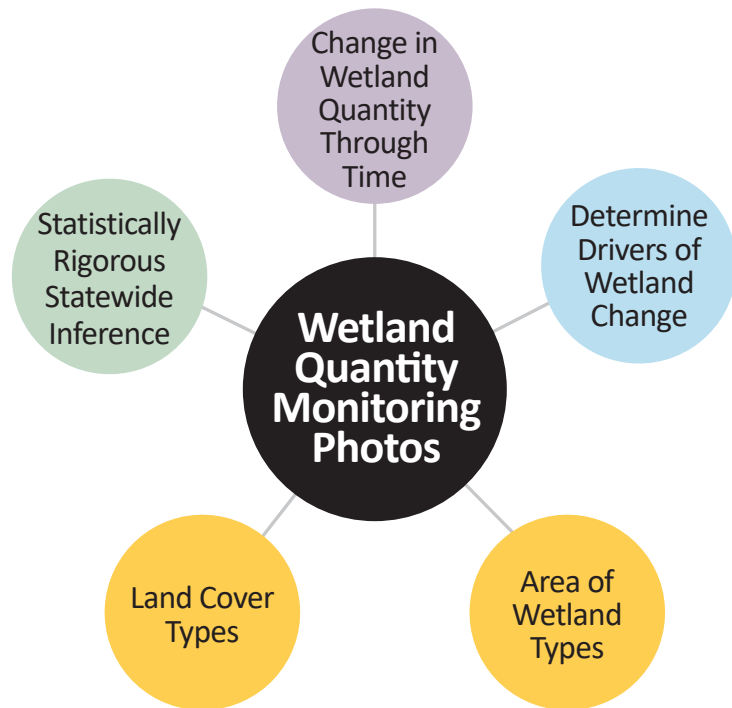


Figure 15: Information map showing the types of information the Wetland Quantity Monitoring photo dataset contributes to, along with connections to other datasets that also contribute similar types of information. This graphic is a depiction of the key attributes and uses for this data set.





Community-Scale Monitoring

Community scale MBS Plants' work has mostly been NPC surveys via the MCBS. Again, those survey data cannot determine if NPCs have been or will continue to be stable through time. In the future, MBS Plants' community-scale monitoring work will heavily focus on the Ecological Monitoring Network (EMN). However, we recognize that EMN cannot address all community monitoring needs.

Aspirational Goal: MBS Plants intends to engage in community-scale monitoring beyond the EMN whenever feasible. The variables of interest we will seek examine in those efforts are:

- change in native plant community richness, evenness, quality, and alpha, beta, or gamma diversity within and among NPC classes or other units,
- change in the relative abundance of plant species within NPCs, for example a change in the ratio of native to non-native species or in regional floristic indicators,
- correlations between threats and metrics of native plant biodiversity, and
- correlations between habitat management and metrics of native plant biodiversity (e.g., habitat management effectiveness monitoring).

Project: The Ecological Monitoring Network is a long-term, State-wide monitoring project quantifying native plant biodiversity within NPCs. Once fully established, EMN data will be capable of addressing all the community-scale metrics and correlations of interest to MBS Plants noted above, assuming adequate resampling. As of 2023, MBS Plants does not have sufficient dedicated stable funding or permanent positions to ensure a full network resampling within a reasonable time interval. MBS has dedicated the biometrician position as a long-standing member of the EMN team to provide high-level design, statistical and analytical support to

continually apply the dataset in new and creative ways to understand how Minnesota’s native plant communities are changing.

Intention: The EMN will provide a network of permanently marked and monitored sites for researchers or other collaborators to expand upon over time, and MBS Plants will actively outreach to these potential partners to promote broader use of the network.

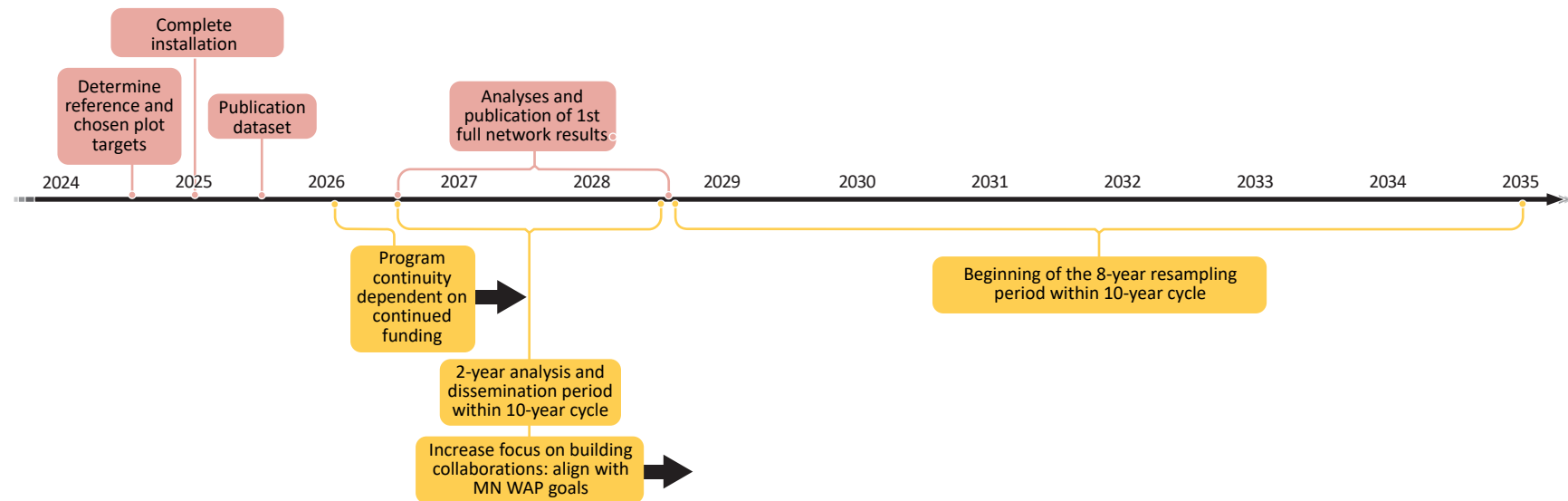
Intention: MBS leadership will continue to advocate for stable resources and continue to seek grant support to expand the application of the EMN.

Intention: The EMN method can be used broadly across community-scale monitoring efforts, and MBS Plants will engage in the planning of external efforts using the EMN method as much as is feasible.

Intention: Again, the EMN cannot address all community-scale monitoring needs. MBS Plants will undertake a planning project to determine the rare NPCs and targeted areas of the State where NPCs should be prioritized for long-term monitoring outside of the EMN. The methods for each project will vary based on specific needs and goals. For example, relevé plots may be appropriate in some systems and could capitalize on the extensive network of relevé plots already established throughout the State.

Intention: Upon completion of the statewide survey of aquatic systems, MBS Plants will initiate a planning project to determine needs and goals for aquatic community monitoring, but cannot commit to initiating in-field monitoring efforts within the timeframe of this POP.

Figure 16: Timelines for completing the EMN project.



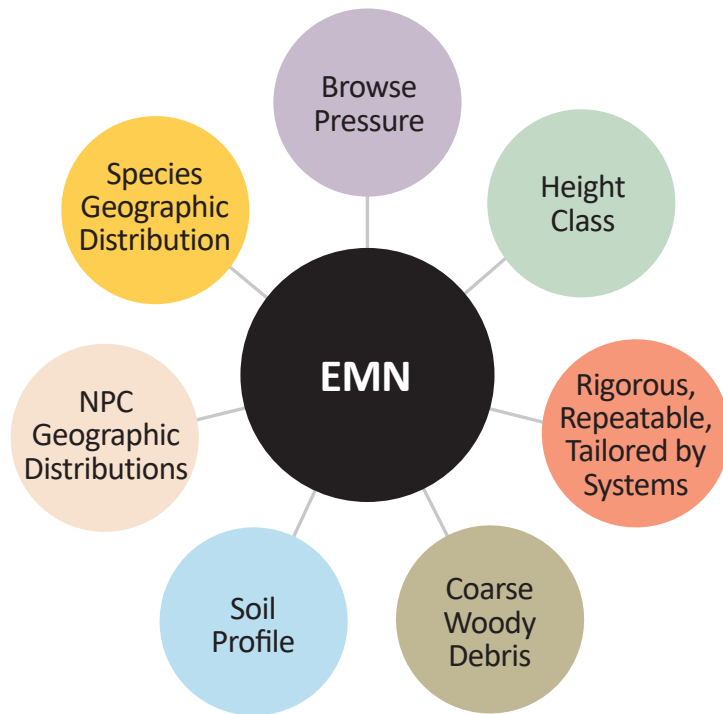


Figure 17: The Ecological Monitoring Network (EMN) provides a variety of information types about native plant communities using a repeatable, rigorous sampling design. This graphic is a depiction of the key attributes and uses for this dataset.

i Collaborations: Ecological Monitoring Network 

The development of the EMN project was a highly collaborative process involving outreach to numerous stakeholders and formal support from eight internal and external partners. Plot establishment has created a wide variety of connections with Tribes, counties, cities, and private landowners. Through the EMN, MBS Plants will continue to seek out new and enhance current partnerships to encourage the use of current data and expansions of data collection and scientific opportunities within the network. For example, a current effort is underway to align the resampling strategy for the network with stated landscape priority areas within the Minnesota’s State Wildlife Action Plan.



Population-Scale Monitoring

Population-scale monitoring within MBS Plants has largely focused on species listed as Threatened or Endangered at the Federal level. MBS Plants cannot currently commit resources to expanding rigorous, statistically designed quantitative monitoring at the population-scale. This work is time and resource intensive. It is often best done with a

specific, short-term motivation that guides study design and analysis. Recurring population-level work in both terrestrial and aquatic systems will continue to largely be re-survey efforts guided by the Sustainable Plant Survey Framework.



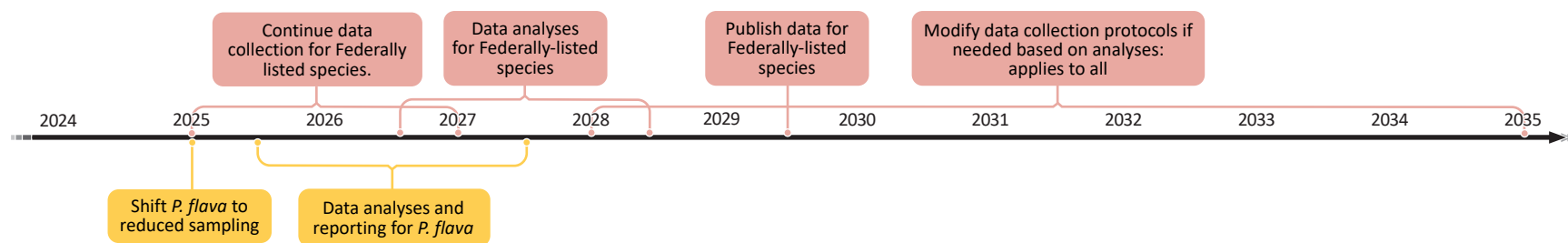
Aspirational Goal: MBS Plants intends to develop short-term species level monitoring projects when needs arise and resources allow. It is likely these projects will be done in collaboration with the MN PlantWatch project, although monitoring will not be that project’s focus. Where MBS Plants can engage in population-scale monitoring, the variables of interest we will seek examine are:

- change in population size (total number of individuals),
- change in demographic structure (the ratios of individuals at different life stages),
- change in population vital rates (growth, survival, and reproduction),
- correlations between threats and metrics of population viability, and
- correlations between habitat management and metrics of population viability (e.g., habitat management effectiveness monitoring).

Project: MBS Plants has conducted annual population monitoring of the state’s federally listed plant species (*Erythronium propullans*, *Platanthera praeclara*, *Lespedeza leptostachya* and *Rhodiola integrifolium* ssp. *leedyi*) since the late 1980s and early 1990s. Data collected include population size, distribution, demographics, and phenology. Collection of these data is expected to be continuous and ongoing. Data are summarized annually and used to aid site management and threat detection. Monitoring results are shared with partners across species’ ranges, and MBS Plants engages in range-wide collaborations, such as research studies, on these species when opportunities arise.

Project: MBS Plants is conducting demographic monitoring of *Platanthera flava*, a State-Listed Threatened plant species. This project was motivated by a need to better understand the species basic biology and response to habitat management. The period of intensive annual sampling concluded in 2023. MBS Plants intends to transition this project to the MN PlantWatch project to enlist volunteer support for continued data collection.

Figure 18: Timeline for Rare Plant Monitoring projects.



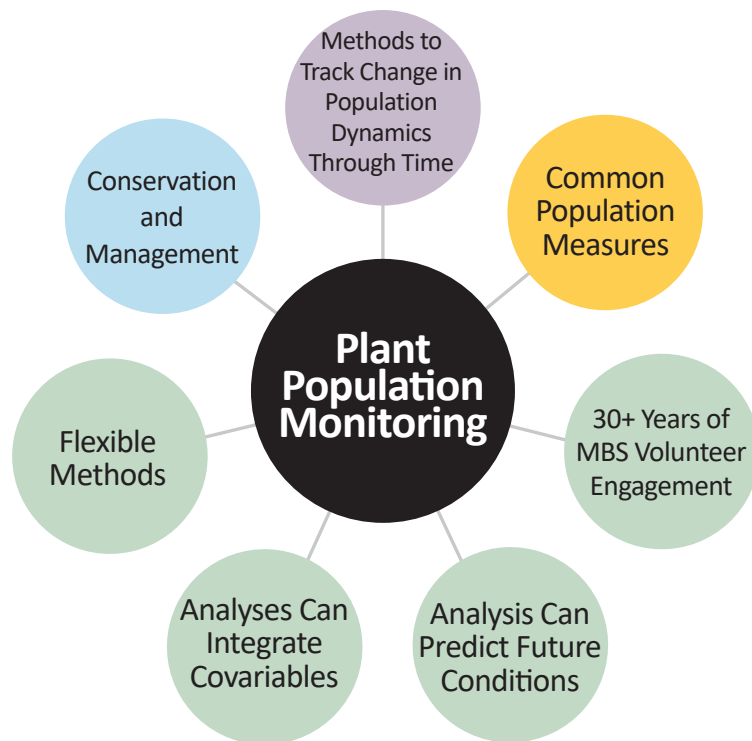


Figure 19. Info map showing general population monitoring datasets. This graphic is a depiction of the key attributes and uses for this dataset.

i Collaborations: Federally Listed Species 🔑

- *Erythronium propullans*: Collaboration with private and public entities in the species range has resulted in several EO updates that provide population spatial distribution information that minimizes impacts from on site management.
- *Platanthera praeclara*: Minnesota is a leader for monitoring and research with this species. MBS Plants collaborates with partners from several research institutions looking at fungal associates, pollinators, population trends and management impacts.
- *Lespedeza leptostachya*: MBS Plants has worked with university partners and collaborators exploring population trends with the species.
- *Rhodiola integrifolia* subsp. *leedyi*: MBS Plants engages with researchers from Northeastern Illinois University who have maintained a positive working relationship with the private landowners where this species occurs. They have collected population data going back to the early 1990s.
- MBS Plants frequently collaborates, provides technical information, data, and species information to the USFWS that is used in their online products and for range-wide species efforts.
- The Nature Conservancy, US Fish and Wildlife Service and the National Park Service and numerous volunteers make MBS Plants’ annual monitoring efforts possible.

Strategy 1.3:

Research native and rare biological diversity to address specific questions, detect patterns, and test alternatives.

Priority actions:

- 1.3A MBS proposes to lead or help others lead research relationships of native species and plant communities to climate change.
- 1.3B Research relationships among biological diversity and water quantity and quality.
- 1.3C Research relationships among plants and pollinators
- 1.3D Continue systematic collection of quantitative data on native plant communities (e.g., relevés).
- 1.3E Research the effects of resource management on native species and plant communities and ecological systems.
- 1.3F Enhance program capacities in statistics and research design and analysis.

MBS Plants' activities that primarily address priority actions in Strategy 1.3 are presented broadly by ecological system then research focus:

- 1) Wetland Research
- 2) Prairie Research
 - a. Disturbance Management
 - b. Invasive Species Control

MBS Plants' activities that secondarily address priority actions in Strategy 1.3 are described elsewhere and included in Table 1.3.



Table 1.3: Primary and secondary MBS Plants' activities linked to the priority action(s) (PA) they contribute to within Strategy 1.3.

Focus on Strategy	Activities and Projects	Priority Action 1.2
Primary	Wetland Hydrology Network	B
Primary	Disturbance Management: Upland Prairie	A, C, E
Primary	Disturbance Management: Mesic Prairie	A, C, E
Primary	Disturbance Management: Small White Lady's Slipper	E
Primary	Invasive Species Control: Goat Grazing for Woody Species Control	E
Primary	Invasive Species Control: Smooth Brome Control	E
Secondary	Species Habitat Modeling	F
Secondary	Aspirational Goal: Contributing to a Living Botanical Collection	A
Secondary	Wetland Quantity Monitoring	B
Secondary	Ecological Monitoring Network	A
Secondary	Staffing: Creation of the MBS Biometrician Position	F
Secondary	Targeted relevé sampling	D



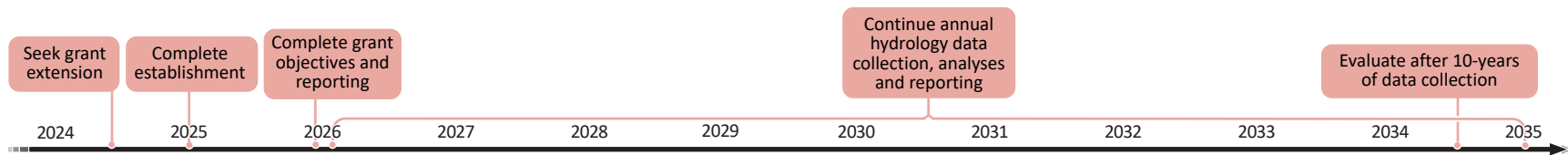
Wetland Research

Project: The Minnesota Wetland Hydrology Network is a collaboration between MBS Plants, EWR's Conservation Management and Rare Resources (CMRR) Unit and EWR's Water Monitoring and Surveys Unit. This project began in 2018 and will describe the hydrologic regimes of different types of wetlands across the State. MBS Plants conducts an initial vegetation and soil survey at each site and CMRR contracts with the Water Monitoring and Surveys Unit to conduct hydrological monitoring using shallow wells. The results will provide reference conditions for wetland restoration projects and inform groundwater

use thresholds. Hydrological monitoring is planned to be ongoing, but there is currently only financial support to conduct vegetation sampling once.

Intention: MBS Plants has already identified these systems as high priority for community monitoring outside of the EMN and intends to seek support for long-term vegetation monitoring at established Wetland Hydrology Network sites.

Figure 20: Timeline for completing Wetland Research projects.





Methods: Wetland Hydrology Network

The Minnesota Wetland Hydrology Network collects data in eight types of wetlands: wet prairies, fresh meadows, fens/sedge mats, shallow marshes, deep marshes, shrub swamps, wooded swamps, and bogs. Wetlands are on public lands, chosen to represent sites with low anthropogenic impact, and located across the State, roughly stratified by ecological province. MBS Plants conducts an initial vegetation and soil survey at each site for a baseline condition. Vegetation data are collected with 15 randomly placed

1-square-meter quadrats and, for woody vegetation, with 3 replicates of 2- and 5-m fixed radius plots. Soils are described down to 1.5 meters and include measurements of horizon designation, color, texture, structure, consistence, redoximorphic features, organic decomposition state, coarse fragments, and roots. The Water Monitoring and Surveys Unit leads hydrological monitoring using shallow wells. Water level is surveyed to a reference marker and measured every 15 minutes with a logger.



Prairie Management Research

A key strategy of the Minnesota Prairie Conservation Plan is to identify safe, effective, and cost-efficient habitat management practices that can enhance the quality of native prairie. Disrupted disturbance regimes, habitat loss, invasive species, fragmentation, and climate change are just a few of the threats that have destroyed or degraded native prairie and will continue to do so without sustained and directed management.

MBS Plants is engaged in several research projects focused on prairie management and intend to continue such studies as needs arise. Some research projects may also be categorized as effectiveness monitoring. The prairie research projects are done in collaboration with many

internal and external partners, and generally fall into two main categories:

1. projects designed to determine the impact of a disturbance management practices on native plant diversity or native plant community condition, or
2. projects designed to determine the impact of a specific threat, such as an invasive species, and measure the effectiveness of one more control techniques.

Community scale or population-scale metrics can be used to quantify the effects of management or impacts of threats depending on the focal system of interest.





Collaborator: Conservation and Management of Rare Resources (CMRR) Unit

Collaborations between MBS and the Conservation Management and Rare Resources Unit (CMRR) include most CMRR staff and a wide variety of work. MBS leadership is committed to maintaining and continuously seeking to enhance these partnerships. For example, MBS Plants devoted a portion of an increase to stable funding to allow an expert in Calcareous Fen plant species and communities to be permanently classified on staff. MBS Plants is committed to proving at least one plant staff member to

continuously serve on the Calcareous Fen Technical Team. MBS Plant staff engaged in a multi-year project to revise the criteria used to designate a Calcareous Fen for protection status, in which MBS Plant staff performed the bulk of the vegetation data analyses and interpretation. MBS Plants’ other collaborative work areas with CMRR include forest coordination, pollinator concerns, State-Listed species status assessments and Takings permits, and Wetland conservation.

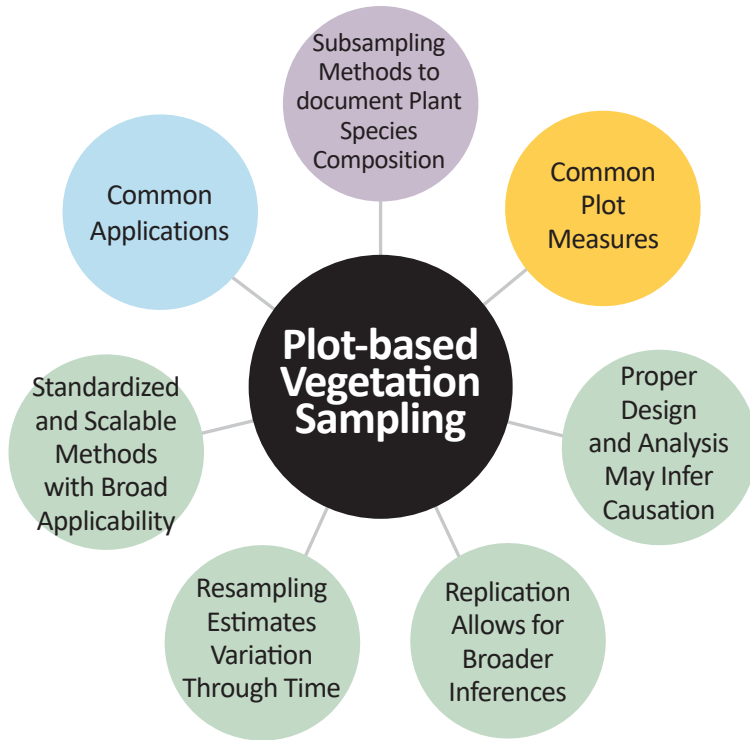


Figure 21: A generalized information map for quadrat-based datasets.

Disturbance Management

Conservation grazing uses cattle to mimic historic grazing disturbance regimes in native prairie. It is a fairly new management tool to Minnesota and can be implemented in a variety of ways (i.e., patch-burn grazing, rotational grazing, adaptive management grazing). Most conservation grazing research has been conducted in large, expansive prairie systems in Kansas, Oklahoma, and Nebraska, making it important to assess grazing management locally before using it widely in the small, fragmented prairies of Minnesota. The projects described below are being done by MBS Plants and the DNR's Division of Fish and Wildlife (FAW) to provide evidence-based data and information on these techniques at the request of land managers and decision-makers.

Project: MBS Plants is conducting a long-term study to document the effects of patch-burn grazing techniques in upland prairie plant communities. The data being collected will be directly applicable to how patch-burn grazing functions in small remnant prairie, and its potential for being a viable disturbance management tool in Minnesota's prairies. Results to-date are being prepared for peer-reviewed publication. Thus far, the data show that cattle stocking rates have a large effect on the outcomes of conservation grazing in upland prairies.

Intention: The continuation of this project is dependent on adaptive changes to stocking rates at the study locations. MBS Plants intends

to discontinue monitoring if no changes to management occur after an initial 10-years of study.

Project: MBS Plants also conducts research on conservation grazing in wet prairies and prairie wetlands collaboratively with the U.S. Fish and Wildlife Service (USFWS) and the DNR's SNA Program. The impact of cattle grazing often differs between upland and wetter portions of a prairie landscape, as cattle tend to concentrate near standing water. The increased activity in mesic microhabitats can cause substantial soil disturbance. The goal of this project is to document the effect of conservation grazing on native plant diversity and the occurrence of key invasive species in high-quality mesic prairie plant communities. This grazing research is being conducted at six sites and varies slightly in methodology by site.

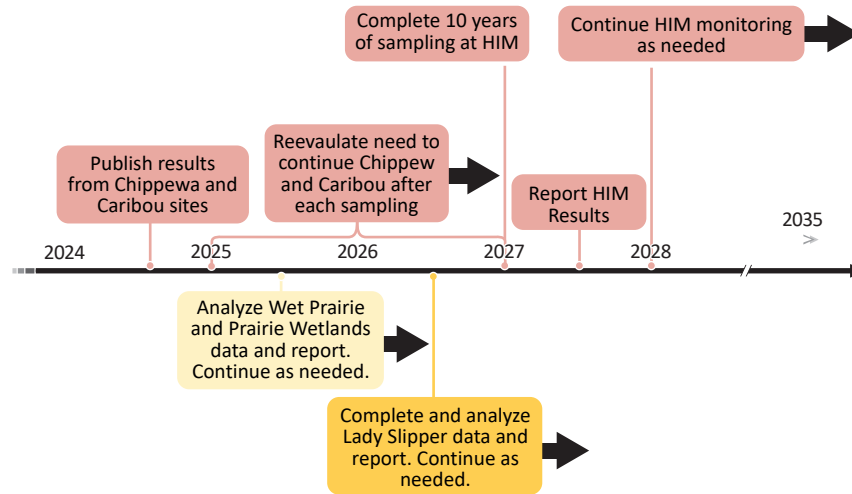
Project: A population-level monitoring study is being conducted to determine the impact of rotational conservation grazing on small white lady's slipper. Small white lady's slippers are often located in high-quality mesic to wet prairie microhabitats most disturbed by cattle grazing. The study will monitor plant population size and relate changes in size to soil compaction.



Collaborations: Conservation Grazing Projects

In total, these projects are cooperative efforts between DNR's EWR and FAW Divisions and The Nature Conservancy, as well as partners in the Federal Government, at multiple Universities, the private sector and local cattle grazers. For example, a comprehensive network of partners was recently established for the long-term adaptive management at HIM, led by EWR's Regional Ecologist in the Southwest. Maintaining these partnerships is essential to the continued success of these projects in support of maintaining healthy, diverse native prairie in Minnesota.

Figure 22: Timeline for completing Grazing Management Projects.



Invasive Species Control

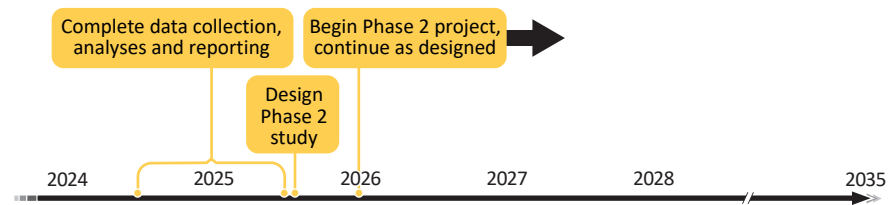
Project: MBS Plants began a collaborative project with the SNA program in 2020 to document the effects of goat grazing as a tool for woody species control on a bluff prairie community in southeastern Minnesota at Rushford Sand Barrens SNA. The use of goat grazing is a relatively new management tool in Minnesota. Goat grazing is implemented much like cattle grazing, with goats concentrated in paddocks at set stocking rates for different amounts of time. It is being used in Minnesota on very steep terrain where other methods of woody control, such as brush mowing, are not possible. MBS Plants will measure rates of decline in the abundance of woody vegetation, and relate that to plant species richness, evenness, and diversity. The results will help guide goat grazing management at Rushford Sand Barrens SNA and contribute to general understanding of goats as a management tool.

Project: The smooth brome management project is also being conducted in collaboration with the SNA program. This project seeks

to compare the effectiveness of different disturbance management regimes (various combinations of fire and haying) in reducing smooth brome. Smooth brome is a widespread and aggressive invasive in prairies in Minnesota that can drastically reduce native plant species diversity. To date, both spring fire and fall haying seem to slow smooth brome invasion and increase the vigor of native plant species after multiple years of management. Plans are currently underway to expand this study with a second phase to incorporate varying management frequencies.

Intention: MBS Plants intends to prioritize opportunities to expand the number of sites studied for short-term invasive species control studies to broaden the applicability and inferences that can be made with the data, especially where pre-management or control group data can be incorporated.

Figure 23: Timeline for Smooth Brome Research.





Methods: Goat Grazing to Control Woody Species

This project will compare pre-grazing data and post-grazing data blocked by grazing paddock in a Before-After-Control-Impact design. Plots were placed across the entire grazed area stratified by the three main vegetation types on site: bedrock bluff prairie (40 plots), open dry sand barrens prairie (20 plots), and dry black oak woodland (20 plots). Data characterizing the plant species composition and foliar woody cover were collected.

Methods: Smooth Brome Control

The project compares three management regimes aimed at controlling the invasive species smooth brome. The treatments, spring haying, spring burning, fall haying, and a no management control are spread across four moderately to heavily infested mesic to dry-mesic prairies in southwestern Minnesota in a partially factorial design. Data characterizing the plant species composition and level of smooth brome infestation were collected.



GOAL 2 Manage and Deliver Biological Information

Much of MBS Plants' work towards Goal 2 items are inherently addressed within the projects, partnerships and other content within the POP, and so are not addressed individually. All Goal 2 Strategy 2.1 (data governance) items are incorporated into the everyday work of MBS Plants. Many of these items are evident in aspirational goals and project milestones. Goal 2 Strategy 2.2 (dissemination) items are also mostly addressed within MBS Plants project plans. Actions

and accomplishments can be seen in relation to individual projects, except for Priority Action 2.2D which is addressed specifically below. MBS Plants' activities that secondarily address priority actions within Strategies 2.1 and 2.2 are recognized in Table 2.2. Lastly, MBS Plants' activities addressing Goal 2 Strategy 2.3 (partnerships) are embodied in descriptions of collaborations throughout and are not specifically addressed by each priority action.

Strategy 2.2:

Make our data understandable and available through analysis, interpretation and outreach.

Priority action:

2.2D Continue refinement of the DNR statewide native plant community classification and development of related products.

MBS Plants' activities that primarily address priority action 2.2D of Strategy 2.2 are presented here under the umbrella project Update and modernize the v2.0 NPC Classification System

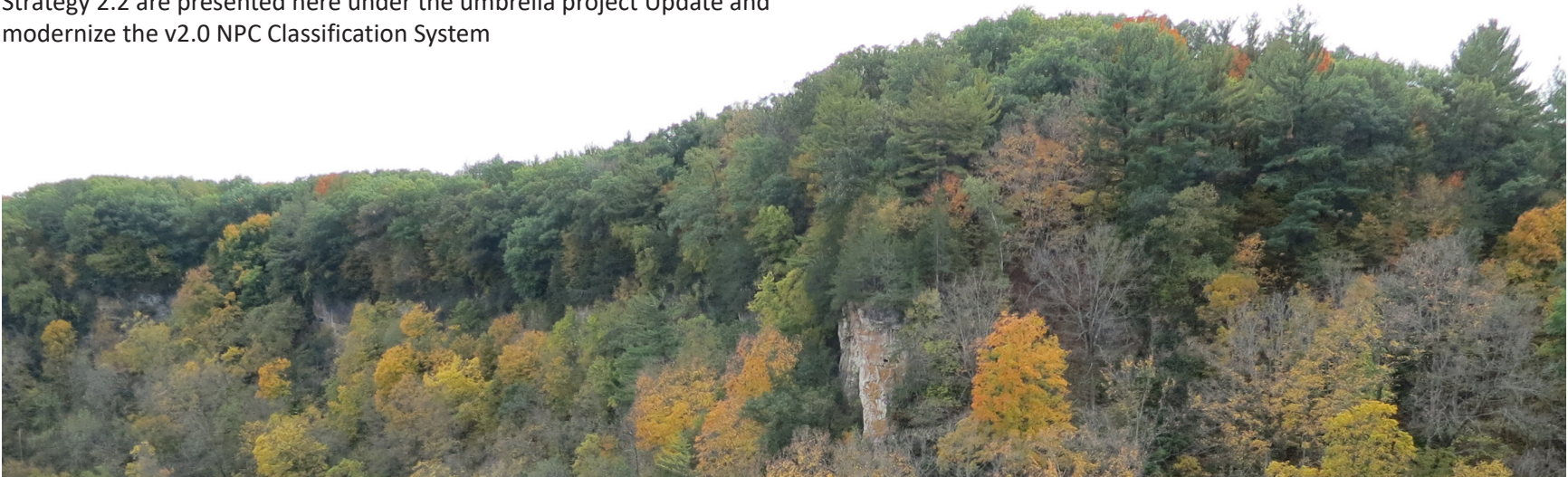


Table 2.2: Primary and secondary MBS Plants' activities linked to the priority action(s) (PA) they contribute to within Strategy 2.1 & 2.2 of Goal 2.

Focus on Strategy	Activities and Projects	Priority Action
Primary	Update and modernize the v2.0 NPC Classification System: Data Analysis	2.2D, 2.1B, 2.2A
Primary	Update and modernize the v2.0 NPC Classification System: Field Projects	
Primary	Update and modernize the v2.0 NPC Classification System: Product Development	2.2, 2.1B, 2.1E, 2.2A
Primary	Update and modernize the v2.0 NPC Classification System: Partner Engagement	2.2D
Secondary	Statewide Lichen Survey	2.2D
Secondary	Targeted Relevé Sampling	2.2D
Secondary	Ephemeral Pond Surveys	2.2D
Secondary	Key Collaboration: Native Plant Community Database	2.1A, 2.1B
Secondary	Aspirational Goal: Improve Standardization of Rare Plant Survey Data	2.1A, 2.1B
Secondary	Key Collaboration: Bell Herbarium	2.1A, 2.1E
Secondary	Aspirational Goal: Contributing to a Living Botanical Collection	2.1A, 2.1E
Secondary	Federally Listed Species Monitoring	2.2A
Secondary	Wetland Quantity Monitoring	2.2A, 2.2C
Secondary	Ecological Monitoring Network	2.2C
Secondary	Wetland Hydrology Network	2.2C
Secondary	Disturbance Management: Upland Prairies	2.2C
Secondary	Disturbance Management: Wet Prairies	2.2C
Secondary	Invasive Species Control: Smooth Brome	2.2A, 2.2C



Update and Modernize the v2.0 NPC Classification System

The existing NPC classification system (v2.0) was developed with data collected from 1996-2003. MBS Plants now has two decades of additional data, making the current relevé dataset far more ecologically complete and representative of the entire State of Minnesota. MBS Plants also has extensive user feedback on the v2.0 NPC classification system from almost two decades of application. The projects proposed here are being funded by a grant from the Environmental and Natural Resources Trust Fund (ENRTF) that began July 1, 2024.

Project: Data analyses will refine current classifications (classes and types), expand understanding of poorly documented communities, and inform the creation of new classifications (via lumping or splitting). The analyses will also provide an opportunity for exploring climate trends with the addition of abiotic data.

Project: Targeted field data collection will focus on coarsely defined or undefined NPCs, largely through relevé sampling. Data targets will be under sampled taxa and communities, representations of early successional NPC Classes, floristic transition zones, and highly variable NPCs such as ephemeral ponds, Barrens and Saline communities. Field work will largely overlap with the overall NPC survey goals for targeted relevé sampling described in Section 1.1.

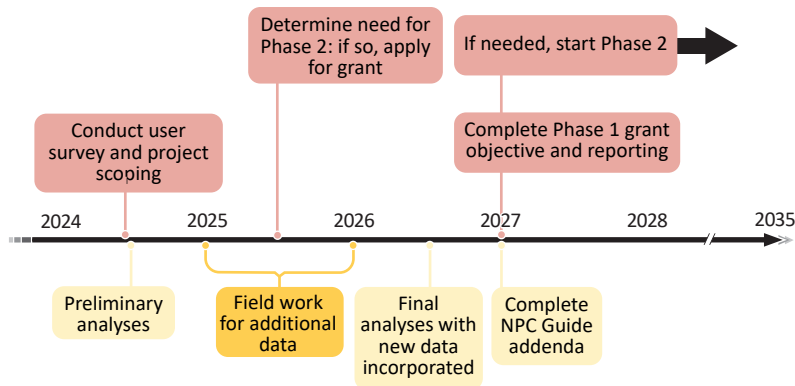
Project: Products developed will include digital versions of updated factsheets, printable and tablet-ready, and addenda for all three volumes of the Field Guides to the Native Plant Communities of Minnesota. Updated data or descriptions may be produced for NPC condition ranking, forest growth stages, soils and surficial geology, wetland water chemistry and hydrology, climate change relationships, and pollinator relationships. MBS Plants will explore options for creating an online relevé classification tool that assigns an NPC to individual relevé, or similar vegetation data provided by users. This application would provide immediate user feedback to increase consistency among surveyors.

Project: Partner engagement is a crucial part of this initiative. MBS Plants will seek user feedback and develop collaborative projects with internal (e.g., DNR's Forestry Division) and external (e.g., USFS, NRCS and NatureServe) partners. A mixture of online surveys and targeted interviews will be used to capture user experiences with the various components of v2.0 NPC classification system. For example, collaborations will be developed to explore new data collection methods for unique habitats and focus groups will be used to iteratively review and test revised NPC system tools.

Intention: MBS Plants will assess the need for new printed versions of the Field Guides to the Native Plant Communities of Minnesota series after the scope of revisions and additions becomes clear.

Intention: MBS Plants will continue to collaborate with the Lake Ecology Unit to explore needs for new field keys and new methods for classifying aquatic NPCs.

Figure 24: Timeline for NPC Revision Project.



i Methods: Update and Modernize the v2.0 NPC Classification System Projects

First, by forming an inter-agency project team of partners, MBS Plants will gather user and stakeholder feedback on their needs for improvement to the NPC Guide information. That team will also identify additional sources of vegetation plot data, advise on the use of and needs for incorporating environmental, climate and soils data. Next, a preliminary assessment and summary of vegetation and environmental data will refine priorities for data collection of additional vegetation data and environmental data over two field seasons. Ultimately, these projects will involve iterative analyses of vegetation plot data using a suite of classification tools (e.g., ordinations, indicator species analysis, cluster analysis, and others) to identify plant community distribution and classification patterns that are not currently defined in the NPC Guides and add understanding of the factors driving those patterns.



GOAL 3 Exemplify Operational Excellence in Our Work

Strategy 3.1:

Enhance funding diversity and sustainability

This document was created assuming a steady, manageable, and fundable staff structure that incorporates all the priorities actions within Goal 3. Rather than describe individual activities, MBS leadership intends to pursue all available opportunities to achieve the 10-year MBS plant staff structure described here. The 10-year staff structure goals are roughly organized by position type or function.

Priority Actions:

- 3.1A Be adaptive in budgeting, project and funding initiatives, and partnerships to maintain program continuity.
- 3.1B Seek increased funding from long-term state funding sources to adequately support essential program positions and functions.
- 3.1C Pursue new or innovative funding sources such as Outdoor Heritage Fund, Parks and Trails Fund, and private foundations.
- 3.1D Develop funding proposals that address priorities identified in Minnesota's State Wildlife Action Plan and LCCMR's Minnesota Statewide Conservation and Preservation Plan.

Strategy 3.2:

Foster a program with a diverse, skilled, and adaptable staff

Priority Actions:

- 3.2A Promote a workplace where staff learn new skills, share knowledge with one-another, and achieve excellence in their field.
- 3.2B Develop practical succession plans to weather retirements and staff turnover.
- 3.2C Locate staff geographically to provide expertise and services in all parts of the state.
- 3.2D Promote safe and respectful workplace practices.
- 3.2E Promote diversity, equity and inclusion.
- 3.2F Enhance our use of and relationships with community scientists and volunteers.

Numerous MBS plant staff positions fully or partially rely on transitory funding, typically LCCMR/ENRTF grants. MBS leadership will continue to pursue grant funding for short-term or special projects that enhance essential MBS Plants work. However, reliance on those sources for essential program positions, functions and long-term initiatives is not sustainable. This section outlines goals for creating a sustainable MBS Plants staff structure that meets all basic functions and balances the use of stable and short-term funding sources.

Statewide Natural Heritage Positions

MBS Plants provides statewide botanical expertise for all native terrestrial and aquatic plant species with special emphasis on species with protected status at State or Federal levels. This includes extensive support for DNR's Environmental Review Unit, for the DNR Endangered Species Consultant, and for Ginseng harvest regulation. This includes coordination with the national and Midwest region's natural heritage networks. Field-based work includes monitoring and research for Federally Threatened and Endangered plant species, coordination with the USFWS on these species and documenting all native plant species' distributions statewide. Plus, many other forms of technical support and guidance.

Status as of 2024: MBS Plants has 2.5 full-time equivalent (FTE) classified Statewide Natural Heritage positions. Stable state funds support 1.5-FTE, and stable Federal grant funds (non-competitive Federal Section 6) support 0.5-FTE. Currently, ENRTF funds support 0.5-FTE of the MBS Aquatic Botanist position. Stable funds are needed by 2027 to continue to support this classified position.

Botanical/Ecological Research Scientists

MBS Plants research scientist-level positions have expertise for a wide array of botanical and ecologically focused survey, monitoring and research projects statewide. Each MBS Plants' Research Scientist maintains in-depth knowledge within their geographic and topical areas of expertise. They serve as primary technical experts on the identification of native plants, and on the ecology and conservation of native plant species and communities, and functional landscapes across Minnesota.

Status as of 2024: MBS has 3-FTE permanently classified positions funded with stable state sources.

Botanical/Ecological Specialists

MBS Plants Natural Resource Specialist Senior positions conduct botanical and ecologically focused survey, monitoring and research projects with an emphasis on special projects and maximizing local opportunities for native plant conservation. These positions also maintain in-depth knowledge within their areas of expertise and serve as technical experts on the ecology and conservation of native plant species and communities.

Status as of 2024: MBS has 2-FTE permanently classified positions (one focused on the prairie provinces, the other on the Laurentian Mixed Forest). Stable state funds support 1-FTE, half of each position. ENRTF funds support the other half of each position. MBS leadership expects to continue to support these positions at 0.5-FTE each with grants funds focused on special projects for the remainder of this 10-year plan. MBS Plants lacks this position type focused on the Eastern Broadleaf Forest Province and will seek to secure 0.5-FTE of stable state funds, matched with 0.5-FTE of grants funds, to add one permanently classified Natural Resource Specialist Senior to fill this need.



Ecological Soil Specialist

MBS Plants seeks to provide stable soil science expertise, particularly on the ecology of the plant-soil interface. Needs for soils-based data and technical guidance have risen in recent years, as has the recognition of soil dynamics as a critical piece of ecological systems (e.g., carbon storage in peat-based systems).

Status as of 2024: MBS Plants has an unclassified staff member with advanced soils expertise supported at approximately 0.15-FTE through a cost share agreement with the Superior National Forest. That agreement ends in 2026. After that, MBS will have no dedicated support to continue plant-soil specific work. MBS leadership will seek to secure 0.5-FTE of stable state funds, matched with 0.5-FTE of grants funds to permanently classify this Natural Resource Specialist Senior position to support soil information needs.

Biometrician

The MBS Biometrician position provides support in statistics and data analysis for botanical and ecologically focused survey, monitoring, and research projects statewide. This research scientist-level position leads DNR's statewide wetland quantity monitoring and serves as a technical expert in study design and data analyses.

Status as of 2024: MBS Plants has a 1-FTE classified position funded with stable state sources.

Long-Term Program Coordination

MN PlantWatch

MBS leadership will seek 1-FTE long-term stable funding to maintain the current MBS Plants Community Science Coordinator position to administer the MN PlantWatch program. This program has vastly increased MBS Plants' capacity for field surveys of ETS, rare and watchlist plant species. It has also enhanced MBS Plants' partnership with the University of Minnesota's Landscape Arboretum (UMLA).

Status as of 2024: A current phase two grant proposal for MN PlantWatch has been recommended for funding by the LCCMR, likely securing this as an unclassified position for through June 30, 2028.



Ecological Monitoring Network

MBS Plants is committed to maintaining the Ecological Monitoring Network (EMN). The goal of this DNR-wide initiative is to quantitatively track change in native plant communities statewide. The EMN is being established with support from three LCCMR/ENRTF grants that started in 2017, with the last grant funds expiring in 2026. Long-term maintenance of the EMN will require, at minimum, a 1-FTE program lead position, two 0.5-FTE field crew lead positions, plus an 1-3 seasonal field staff each year.

Status as of 2024: MBS Plants currently has no classified positions or stable funding devoted to the EMN. MBS leadership will seek long-term stable funding to replace the 1-FTE unclassified Natural Resource Specialist Senior position currently leading the EMN establishment with a classified Natural Resource Coordinator position to lead the program long-term. MBS leadership will also seek to combine 1-FTE of stable funding for the EMN crew lead positions with the grant support for the botanical/ecological specialist and the ecological soil specialist positions. Each position would be permanently classified, devoted at half-time to EMN using stable funding and half-time to its other specialty using grant funding. Lastly, MBS leadership will seek 0.5-FTE stable funding to support seasonal field staff positions for EMN plot resampling.

Aspirational Goal: There is a growing DNR-wide need for native plant community monitoring projects, particularly to assess the effectiveness of land management techniques. The skills needed to coordinate the EMN overlap with the skills needed to establish and coordinate an array of native plant community monitoring projects statewide. The creation of a classified Natural Resource Coordinator as a part of MBS Plants could meet this need. If adequate field staff support for EMN plot resampling could be assured, the EMN Coordinator could be devoted at approximately 0.25-FTE to supporting DNR-wide native plant community monitoring projects.

Data Management

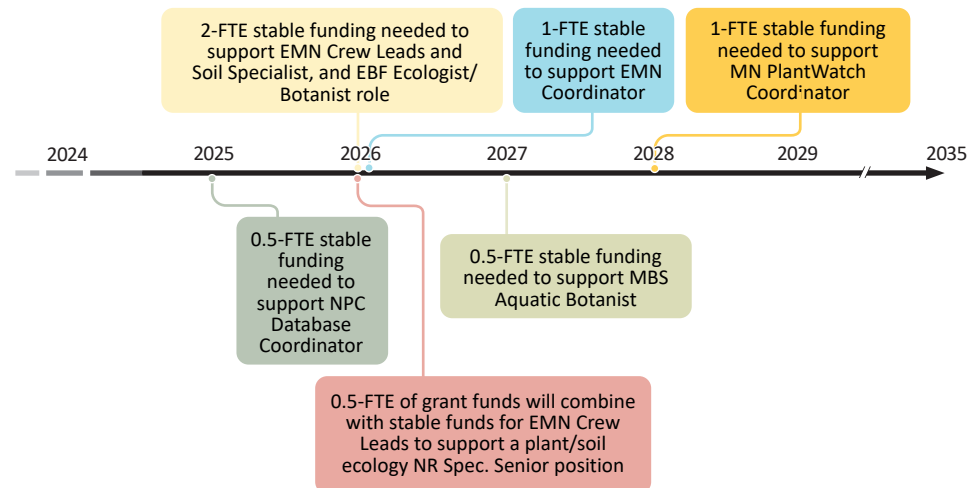
MBS maintains the DNR's Natural Heritage Information System (NHIS). MBS Plants provides business data stewards for several plant-focused databases within the NHIS, including MNTaxa, ETS plant species occurrence records (EOs), the NPC database, and the Relevé database. Data stewardship needs will increase as the NHIS Modernization project is implemented.

Status as of 2024: MBS Plants has 1.5-FTE classified and 1-FTE unclassified positions devoted to data management and stewardship. Stable state funds support 2-FTE. Currently, ENRTF funds support 0.5-FTE of the unclassified MBS NPC Database Coordinator position. MBS leadership will seek 0.5-FTE stable funding to convert this position to permanently classified.

Grant Funded Positions

While portions of several MBS Plants classified positions will be devoted to grant-funded projects, MBS Plants will likely still require the addition of unclassified, fully grant funded staff. As needs arise, MBS Plants will seek special project lead positions (e.g., unclassified project coordinators), unclassified field support positions (both year-round and seasonal), unclassified general project management positions, and unclassified data stewardship positions. MBS leadership will look to current unclassified staff to fill these needs first. Additional classified staff, beyond those described above, are not part of a sustainable MBS Plants staff structure within the next 10-years.

Figure 25: Timeline for Staffing Needs.





Collaborator: DNR’s Environmental Review (ER) Unit

The Heritage Botanist position within MBS Plants is 50% devoted to technical guidance for plant-related regulatory and permitting matters in collaboration with the Division of Enforcement, the Environmental Review Unit, and the Endangered Species Consultant within the Conservation and Management of Rare Resources Unit.

Collaboration: Native Plant Community Database

MBS Plants partners with DNR Forestry, Fish and Wildlife, and Parks and Trails to maintain DNR-wide NPC database and Ecological Classification System information, tools and applications. DNR Forestry has a strong interest in NPCs for silvicultural applications. MBS Plants intends to continue to collaborate with Forestry in relevé (or similar) data collection and management to enhance the NPC database and support shared tools for NPC classification.

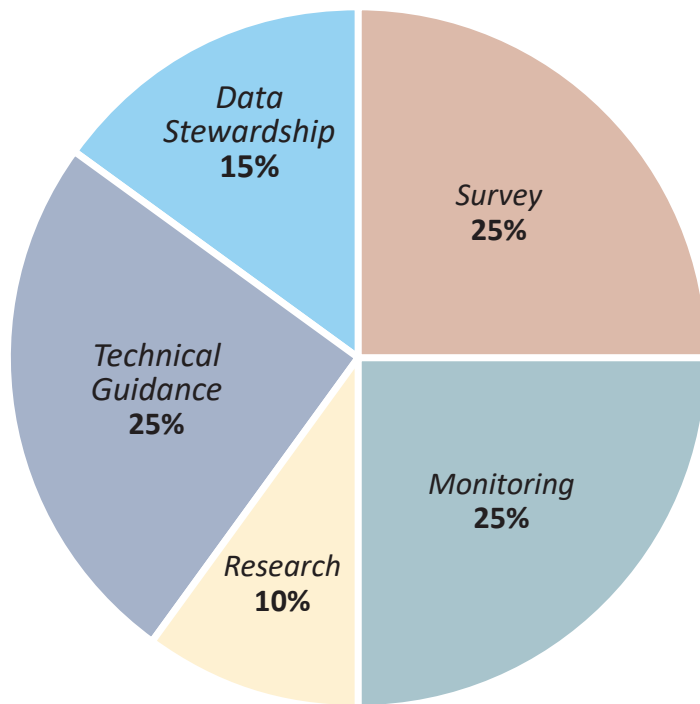


Figure 26: Planned Allocation of MBS Plant Staff Time.

Estimated allocation of MBS Plant staff time grouped into five major functions.

Survey, monitoring and research include all field and non-field activities supporting those efforts, including program coordination activities. Technical guidance includes a wide variety of activities including product creation, advising as a subject matter expert, and serving on work groups or committees in a technical role. Data management includes all data stewardship or database support activities, except for annual data processing for field-based staff. That time is grouped appropriately into survey, monitoring or research. As planned, MBS Plants will maintain 16 classified staff. Four of those will be partially grant supported. In addition, MBS Plants expects to regularly employ 1-3 unclassified, fully grant supported roles in data management or project coordination. MBS plants will also regularly employ seasonal field support staff, which are not included in these estimates. In total, MBS Plants expects to range between 16 and 19 year round staff, with an additional 1 to 4 seasonal staff at any given time.

CALL US

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