

# Chapter 5.

## Monitoring and Adaptive Management

### Monitoring and Adaptive Management Framework

Minnesota’s Wildlife Action Plan monitoring framework uses multiple scales to assess the effectiveness of the Wildlife Action Network and conservation actions and to identify broad trends in species populations and habitats. This chapter describes the plan’s monitoring approach. See chapter 4, “Goals, Objectives, Conservation Actions, and Performance Measures,” for specific performance measures.

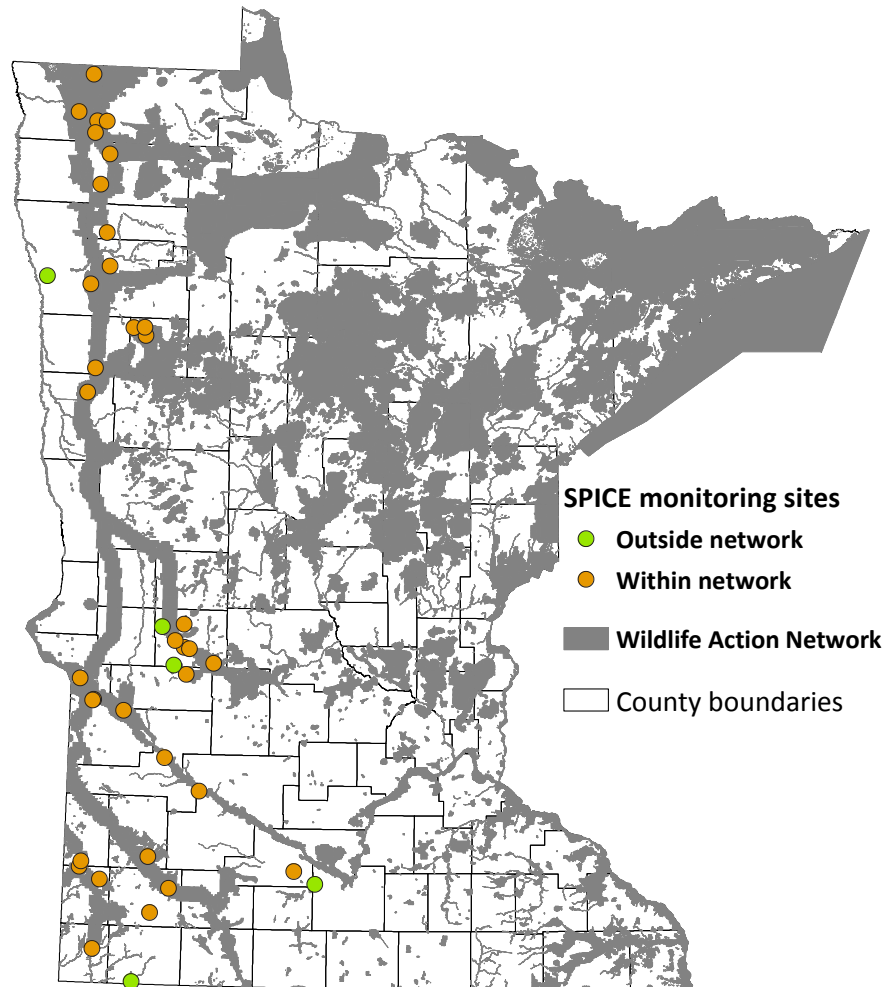
At the broadest scale, existing and new monitoring efforts will be analyzed and structured to assess the status of habitats and focal species both within and outside of the Wildlife Action Network. In addition, new efforts and approaches aimed at assessing ecosystem resiliency will be developed over the next 10 years. At the next scale, monitoring within Conservation Focus Areas will be designed to answer the questions: What actions did we take? Were our actions effective? and What do we need to do differently? Species monitoring will be used to address questions at both the Wildlife Action Network and Conservation Focus Area scales, as well as to provide information related to individual species performance measures identified in chapter 4. The monitoring approach is informed by Measuring the Effectiveness of State Wildlife Grants, Final Report (Association of Fish and Wildlife Agencies, April 2011).

### Monitoring Approach

#### Wildlife Action Network Monitoring

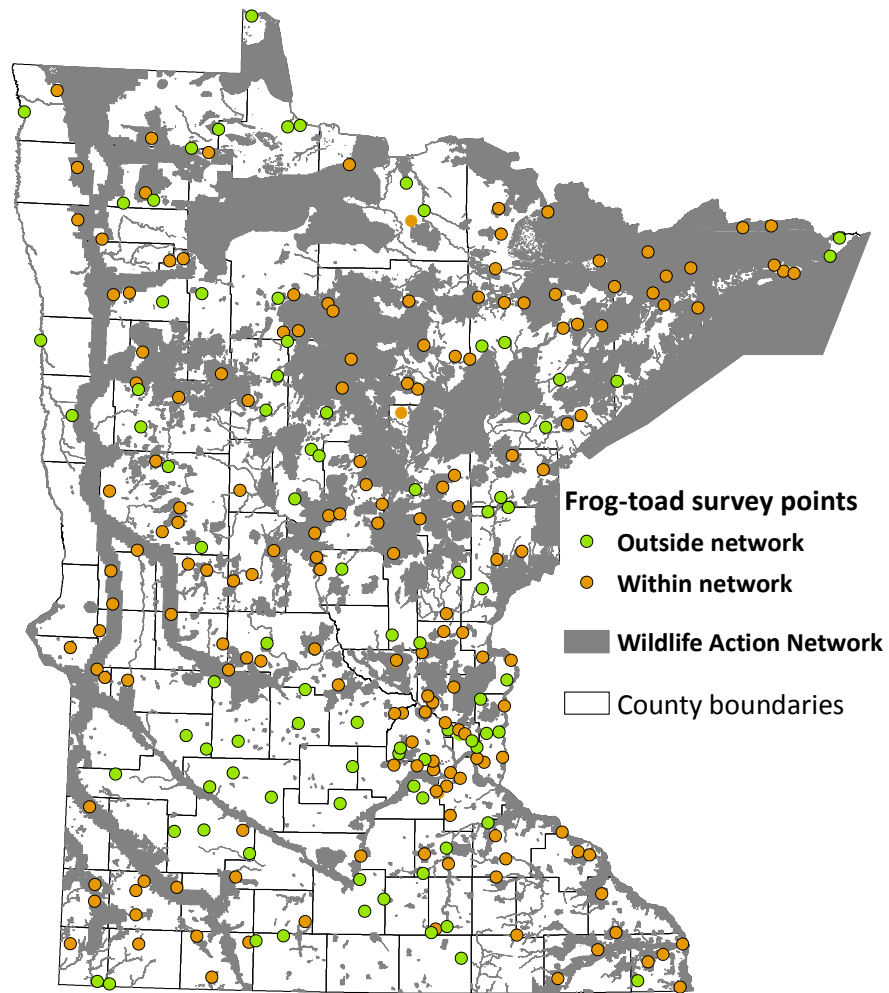
Monitoring will be used to assess if areas within the Wildlife Action Network continue to support viable SGCN populations, greater biological diversity, and higher-quality habitat than areas outside the Wildlife Action Network. Monitoring will occur both within (with emphasis on higher scoring areas where feasible) and outside of the Wildlife Action Network to make these comparisons. Existing habitat monitoring efforts such as the Prairie Status and Trend Monitoring Project (SPICE: Sustaining Prairies in a Changing Environment) will be assessed, analyzed, and modified if possible to allow comparisons between areas within and outside the Wildlife Action Network. Currently, 5 of the 40 prairie monitoring sites are located outside of the Wildlife Action Network (Figure 5.1). Examples of other existing broad-scale habitat monitoring efforts that could be used to evaluate the Wildlife Action Network include the Minnesota Pollution Control Agency’s (MPCA) and Minnesota DNR’s Wetland Status and Trend Monitoring Program, the MPCA’s Stream Index of Biological Integrity (IBI) monitoring, the DNR’s Lake IBI monitoring, and Minnesota Biological Survey relevés.

In addition to habitat monitoring efforts, several existing wildlife species monitoring efforts to determine status and trends could serve as indicators of habitat quality and provide information on biological diversity. For example, the Minnesota Frog and Toad Calling Survey includes monitoring points both within and outside of the Wildlife Action Network (Figure 5.2). Several other existing species monitoring efforts that could be used to evaluate the effectiveness of the Wildlife Action Network are listed in the species monitoring section below.



**Figure 5.1.** Sustaining Prairies in a Changing Environment (SPICE) monitoring sites that are located within (orange) and outside of (green) the Wildlife Action Network. Five of the 40 prairie monitoring sites are located outside of the Wildlife Action Network. The area in northeastern Minnesota delineating a portion of Lake Superior represents Minnesota’s managed area of the lake.

Additional monitoring efforts needed for assessing the Wildlife Action Network should include assessing major habitat types for which there currently is not a coordinated monitoring program of status and trends. Forest habitats, for example, have specific monitoring efforts but are generally lacking broader information about status and trends sufficient to evaluate the effectiveness of the Wildlife Action Network. Efforts such as High Conservation Value Forest monitoring and the DNR Forestry ECS program’s Case Studies in Ecological Silviculture monitoring of native plant communities are examples of the type of information needed. A biodiversity monitoring initiative being started by



**Figure 5.2.** Minnesota Frog and Toad Calling Survey points that are located within (orange) and outside of (green) the Wildlife Action Network. The calling survey contains approximately 240 active routes and over 2,400 survey points across the state; 66% of the routes have at least one survey point within the network, and 33% of the total survey points fall within the network boundaries. The area in northeastern Minnesota delineating a portion of Lake Superior represents Minnesota’s managed area of the lake.

the Minnesota DNR’s Division of Ecological and Water Resources will help identify gaps in monitoring efforts. In addition, measures of ecosystem resilience will be defined and developed where possible. This an emerging concept that needs additional research and refinement, but current literature identifies measures that focus on functional richness, diversity, evenness, and redundancy; cross-scale redundancy; structural diversity; ecosystem services; and human social connections (Allen et al. 2011; Angeler et al. 2015).

## **Conservation Focus Area Monitoring**

Specific monitoring within Conservation Focus Areas will be defined during implementation following the identification of SMART (Specific, Measureable, Attainable, Relevant, Time-Oriented) objectives and conservation actions for specific targets by partnership teams (for more information on the process, see chapter 6). Targets are generally defined as particular habitats, a group of species, or an individual SGCN but could also include an ecosystem function, such as groundwater recharge or water quality.

In general, monitoring for Conservation Focus Areas will be used to answer these questions:

- What actions did we take?
- Were our actions effective?
- What do we need to do differently?

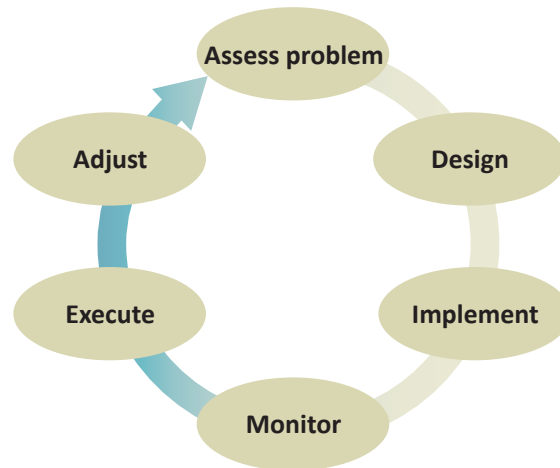
To answer the question “What actions did we take?” monitoring will include measures of conservation actions, such as the number of acres protected by conservation easements, the number of acres burned, or the number of demonstration or research projects. Much of this information can be tracked using the Adaptive Management Spatial Database developed by the DNR that spatially tracks conservation actions using a consistent naming convention for actions.

To answer the question “Were our actions effective?” monitoring will include measures to evaluate if a conservation action or suite of actions achieved the desired results for a specific target. Desired results are described using SMART objectives. For example, if the target is native prairie, a SMART objective could be to increase native plant richness by 25 percent over the next 10 years. Conservation actions to achieve those results could be to remove woody vegetation, spot-spray invasive plants with herbicide, and conduct prescribed burns every 3 years. Monitoring should measure the number of native plants and cover of invasive and woody plants. Often, it is not sufficient to measure if a single conservation action is effective because results are achieved by the cumulative effect of many actions over several years. Further, ecological responses to conservation actions are often slow and/or highly variable due to external factors, such as climate variability. As a result, longer-term monitoring of status and trends is usually necessary to evaluate results. Since this kind of monitoring requires considerable financial and staff resources, these efforts should be undertaken judiciously and structured so as to provide information beyond a particular Conservation Focus Area, allowing for evaluation of the broader Wildlife Action Network. This can be accomplished by carefully choosing indicators and using standardized protocols. The multi-organization Grassland Monitoring Team (GMT) is a successful example of this approach.

Finally, to answer the question “What do we need to do differently?” requires the use of adaptive management. There are various definitions of adaptive management with different standards for applying them. While there is not necessarily a right way of applying adaptive management, as it depends on the specific situation at hand, some general principles apply.

The adaptive management framework consists of assessing the problem, designing strategies to address the problem, implementing selected strategies, monitoring results, evaluating what those results mean, and adjusting management if monitoring suggests that changes are needed (Figure 5.3). The assessment and design stages should involve the identification of SMART objectives, potential

management alternatives, and the development of statistically valid monitoring designs. This stage should also incorporate the use of prediction and modeling (at least using conceptual models) to develop hypotheses based on potential management strategies, current understanding of the system, and expected response to conservation actions to test if the assumptions and objectives are valid (validation monitoring).



**Figure 5.3.** Adaptive management process

The Grassland Monitoring Team (GMT) and the MN DNR Adaptive Forest Management Projects are examples of adaptive management projects that can be used as guides for future endeavors. All Conservation Focus Areas implemented in the years 2015–25 should have some level of adaptive management capacity built into implementation, especially given the unknowns presented by climate change. Particular Conservation Focus Areas that have a high degree of uncertainty regarding the effects of current management practices on SGCN may necessitate more rigorous adaptive management methods.

### **Species Monitoring**

The ability to monitor changes in populations of SGCN is critical to the success of the Wildlife Action Plan. However, because we cannot monitor all 346 SGCN, targeted monitoring efforts are essential to evaluate whether our conservation actions are effective in maintaining or increasing SGCN populations.

### ***Effectiveness Monitoring***

Performance measures for Goal 1, Objective 1.1 (chapter 4) include monitoring populations of the monarch butterfly and golden-winged warbler to evaluate the effectiveness of implementing best management practices for these species. The performance measures for Goal 1, Objective 2 include monitoring of at least three of the following species for which conservation actions are implemented over the next 10 years:

- northern long-eared bat
- freshwater mussels

- wood turtle
- brook trout, southeastern Minnesota heritage strain
- mudpuppy
- hornyhead chub

SGCN monitoring for effectiveness will be based on scientifically sound protocols as defined through literature, expert knowledge, and collaboration with existing monitoring projects. Existing sources of status and trends monitoring data will be used when available, or new monitoring efforts will be initiated as needed to evaluate the effectiveness of conservation actions and inform adaptive management (see Table 5.1).

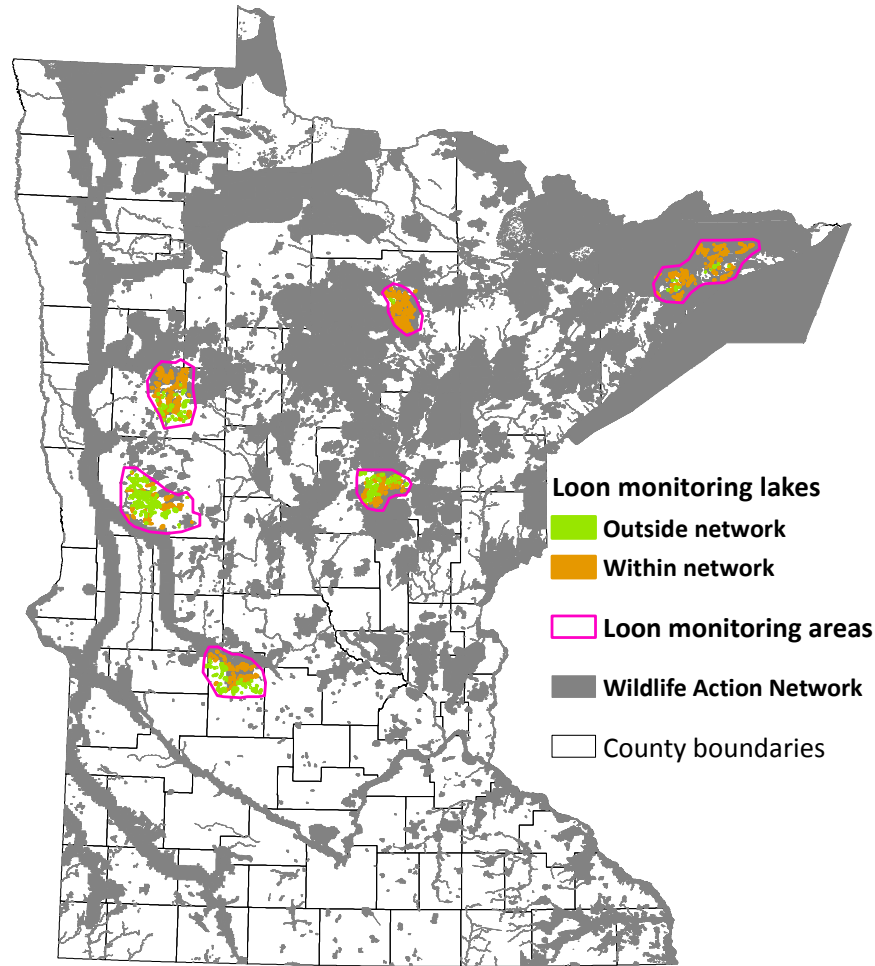
**Table 5.1.** SGCN for which population monitoring data are available or needed to evaluate the effectiveness of conservation actions under a species approach.

Species or group	Type of monitoring data available or needed	Data source (if applicable)
northern long-eared bat	population assessment to be developed by DNR Ecological and Water Resources	
freshwater mussels	16 monitoring sites established in 4 watersheds to track mussel communities and SGCN population demography	DNR Ecological & Water Resources
wood turtle	population assessment to be developed by DNR Ecological and Water Resources	
brook trout, southeastern Minnesota heritage strain	population assessment to be developed by DNR Fisheries	
mudpuppy	permits and monthly reports submitted to DNR Fisheries could be used to track commercial harvest data as part of legislative initiative to regulate collection	
hornyhead chub	population structure and nest count surveys to be developed by DNR Ecological and Water Resources	
monarch butterfly	population status and trend data	University of Minnesota Monarch Lab
golden-winged warbler	North American Breeding Bird Survey status and trend data	USGS Patuxent Wildlife Research Center
	Long-term Breeding Bird Monitoring, Superior and Chippewa National Forests	University of Minnesota, Natural Resources Research Institute

### ***Long-Term Species Population Monitoring***

A number of current DNR long-term species monitoring projects will continue as part of the Minnesota Wildlife Action Plan. These projects include

- statewide frog and toad call monitoring (Figure 5.2)
- statewide mussel monitoring
- common loon monitoring (Figure 5.4)

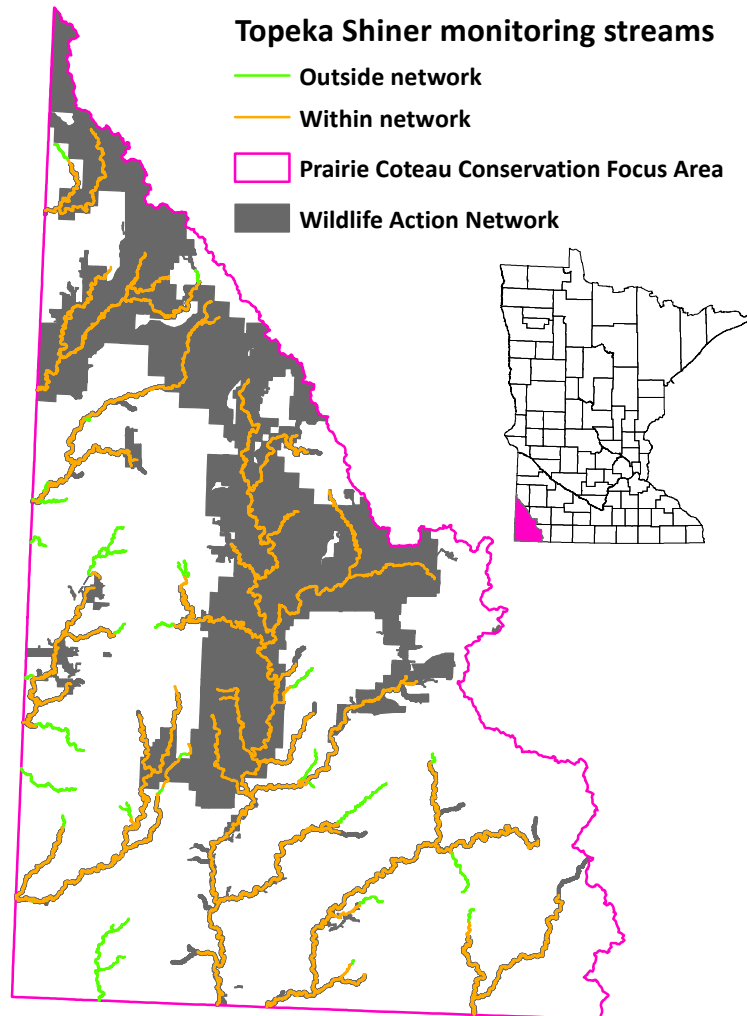


**Figure 5.4.** Minnesota loon monitoring lakes that are located within (orange) and outside of (green) the Wildlife Action Network. Out of approximately 600 lakes that are monitored annually for loons, 60% fall partially or entirely within the network boundary. The area in northeastern Minnesota delineating a portion of Lake Superior represents Minnesota’s managed area of the lake.

- northern goshawk monitoring
- Topeka shiner monitoring (Figure 5.5)

These monitoring projects not only contribute to our understanding of SGCN population status and trends but also serve as an indicator of the health of the habitats on which they depend. Therefore, information collected from these projects can potentially be used to evaluate aspects of the Wildlife Action Network and/or Conservation Focus Area approach. However, the design of these existing monitoring projects must be assessed to determine their robustness at different scales. Monitoring will be implemented by DNR staff, through contracts with universities and colleges, by volunteers, and by staff from other agencies and organizations as expertise and resources allow.

In addition, the DNR, other wildlife agencies, and many partner organizations are involved with long-term species population monitoring. For example, a few of the monitoring initiatives that will help assess the status of SGCN and the Wildlife Action Network include breeding waterfowl population



**Figure 5.5.** Minnesota Topeka shiner monitoring streams that are located within (orange) and outside of (green) the Wildlife Action Network. The orange lines indicate that the majority of streams within the Topeka shiner monitoring area are included in the network. Note: The gray coloration of the network is obscured in places where it closely follows the stream boundaries.

surveys, breeding bird surveys, monitoring of the annual furbearer harvest, and ecosystem measures in the Minnesota Prairie Conservation Plan (e.g., greater prairie-chicken, several prairie butterflies). Surveys for two of the stewardship species, American white pelican and trumpeter swan, will continue at approximately five-year intervals to assess distribution and abundance and to evaluate any changes in population status.

#### **Data Management and Analysis**

Successful monitoring requires initial development of statistically valid designs, databases accessible by all partners involved, timely analysis and evaluation of results, and reporting of results to inform conservation actions. Issues such as data to be collected, data organization, metadata, quality

assurance measures, and data storage should also be addressed during the initial development of monitoring efforts. Addressing these aspects of data management up front will be useful for long-term consistency, comparisons, and compliance with current and presumably future data management requirements. See chapter 4 for specific data management objectives and actions. Statisticians familiar with developing conservation-related monitoring will be consulted early on in the process. Several existing systems that can facilitate data management and analysis are described below.

#### *Minnesota's Natural Heritage Information System (NHIS)*

Information on SGCN and native plant communities is stored in the Minnesota's Natural Heritage Information System (NHIS). This information system is considered to be the most current and comprehensive source of information on the state's rare wildlife resources and their habitats. Survey and observation information for Minnesota's wildlife species and the ecological communities that support wildlife populations is available to land managers, state and federal agency staff, local governments, planners, researchers, and others as they make decisions that will affect Minnesota's wildlife resources. However, the capabilities of the current system need to be expanded to adequately incorporate species and habitat monitoring information.

#### *The Adaptive Management Spatial Database (AMSD)*

The Adaptive Management Spatial Database is a web-based database developed by the DNR that spatially tracks conservation actions using a consistent naming convention for actions. It is currently used by the DNR Scientific and Natural Areas Program and could be expanded to other sites or ownerships. In addition, design specifications for a second phase of AMSD that will link monitoring data with conservation objectives and management actions is completed but the database still needs to be developed.

#### *Grassland Monitoring Team (GMT)*

The Grassland Monitoring Team is a multi-organization collaborative made up of the Minnesota DNR, the US Fish and Wildlife Service, and The Nature Conservancy. This adaptive management effort relies on a standardized set of hierarchical protocols to address common objectives to maintain or improve the quality of native prairie. The hierarchical protocols allow partners to collect more detail if desired while ensuring that all partners collect the same core set of data. Monitoring data are stored in a web-based SharePoint database accessible by all partners. Core monitoring data are used in a state and transition model to evaluate the response of habitat indicators to fire, grazing, rest, and management intensity. Monitoring data are collected on a three-year time frame, but since partners are on different schedules, management recommendations from model results are updated and provided to managers annually. The strength of this effort is the broad partnership using common protocols and data storage. In this way, the monitoring requirements for any individual manager are minimal, yet learning occurs from collective involvement.

#### *Minnesota DNR Data Governance and Decision Support Program*

The goal of this program is to ensure that the DNR's data will function as an information foundation that is reliable, usable, and accessible to staff, partners, and the public. This will help staff, decision

makers, and the public have the best information possible as they work together to address complex challenges to sustain Minnesota’s natural resources. The program addresses data policies, processes and procedures, data systems, and the use of various methods and software tools to improve decision making.

## References

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