

Minnesota's Wildlife Action Plan

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working with partners for
*Wildlife
Conservation*

Acknowledgments

The Wildlife Action Plan Management Team would like to thank the many people who have contributed to the completion of this project through their participation on teams or by providing thoughtful comments and review. In addition to the people mentioned in Appendix B, we would like to acknowledge the numerous people who provided input during the public comment period during preparation of this plan.

We would also like to acknowledge the efforts of four people who provided valuable support during the planning process: Ann Pierce, for her leadership and guidance; Brian Stenquist and April Rust for planning and facilitation, and Tom Klein for his creativity in the graphic design and production of the plan document.

Funding Support

Development of the 2015-25 Minnesota Wildlife Action Plan was supported by the State Wildlife Grant Program, administered by US Fish and Wildlife Service, and the MN DNR Nongame Wildlife Program.

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How to cite this document

Minnesota Department of Natural Resources. 2016. Minnesota's Wildlife Action Plan 2015-2025. Division of Ecological and Water Resources, Minnesota Department of Natural Resources.

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2015 - 2025

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Foreword

Minnesota is home to diverse and abundant wildlife, due in part to the four major biomes that occur in the state. Prairie grassland, deciduous forest, tallgrass aspen parkland and coniferous forest are interspersed with 69,000 miles of rivers and streams, 11,800 lakes and millions of acres of wetlands. However, over the past centuries, the habitat that wildlife depends upon has been dramatically altered. Only 1 percent, or less than 200,000 acres, of Minnesota's once expansive prairie grasslands remain. Portions of our once vast deciduous forests have become fragmented, increasing their susceptibility to invasive species and reducing their suitability for wildlife that depend on large unbroken tracts of forests. Millions of acres of wetlands have been lost, many of our rivers and streams have been altered and polluted, and our lakes and shorelands are being "loved" to death.

Despite what occurred in the past, there are steps we can take to secure the future for wildlife and the habitat on which it depends. Numerous efforts across the state are attempting to maintain the habitat that remains and restore some of what has been lost. Minnesota's Wildlife Action Plan 2015-2025, which focuses on wildlife species in greatest need of conservation, is one such effort. This plan focuses conservation actions at three levels: a Wildlife Action Network, where landscape level action is called for; Conservation Focus Areas, which include target species and habitats; and actions focused on individual species to address specific issues. The Wildlife Action Plan complements a number of other conservation plans developed for Minnesota. In implementing the plan, the Minnesota Department of Natural Resources will work in collaboration with other conservationists to maintain and enhance wildlife populations and habitats.

The plan also addresses the need to adequately fund the conservation of rare wildlife. The State Wildlife Grants program has provided federal funding for the implementation of state Wildlife Action Plans since 2001. However, this funding is unpredictable and supports only a small portion of the needs identified in the state plans. Minnesotans have shown their support for conservation and willingness to fund it as evidenced by the passage of the 2008 Clean Water, Land and Legacy Amendment to the Minnesota Constitution. This amendment invests in Minnesota's cultural and natural resources through a three-eighths of one percent increase in the state sales tax. Reaching our goal of healthy wildlife populations and habitats depends on the collaboration of the various natural resource conservation agencies and organizations and the support of citizens that value and support these efforts. Minnesota's Wildlife Action Plan takes us a step closer to reaching that goal.



Tom Landwehr
Commissioner
Minnesota Department of Natural Resources

Introduction

MINNESOTA'S WILDLIFE ACTION PLAN (2015–25):

PLANNING FOR 10 YEARS OF WILDLIFE CONSERVATION IN MINNESOTA

Forty-two years ago I was hired by the Minnesota Department of Natural Resources as the assistant manager of the Lac qui Parle Wildlife Refuge. While managing Canada geese, white-tailed deer, mallards, and wood ducks, I was constantly drawn to the sight of migrating golden plovers over the western Minnesota prairies, upland sandpipers, marbled godwits, and the summer feast of prairie wildflowers that bloomed on the Lac qui Parle countryside. It was a wonderful place to begin my wildlife conservation career. Three years later, in 1977, I was hired to create the state's Nongame Wildlife Program with an annual budget of \$25,000, which included my salary.

That is when I learned the value of having a vision. I envisioned a statewide program of wildlife specialists with expertise in wildlife species that had previously drawn little financial or scientific attention by state government and game managers. I envisioned thousands of Minnesotans—both adults and children—appreciating, protecting, and enhancing all wildlife species across the state.

The seeds of growth for the Nongame Wildlife Program came from Dr. John B. Moyle, the DNR wildlife research supervisor who published a keystone publication in 1975 titled "The Uncommon Ones". The booklet provided an overview of Minnesota's flora and fauna, a discussion of the value of preserving biological diversity, and a preliminary list of 64 endangered, threatened, and special interest species. Bald eagles were still uncommon then, and peregrine falcons and trumpeter swans were extirpated from the state. When Dr. Moyle retired, Section of Wildlife Chief Roger Holmes used Dr. Moyle's vacant position to create the Nongame Wildlife Program supervisor position because he felt that the DNR had a responsibility to manage and protect all wildlife, not just game species. When I was hired for that position, I had no idea that I would still occupy that same position 39 years later!

Over the years I have seen a remarkable growth and evolution in our conservation efforts for wildlife species that are not traditionally hunted or harvested. Funding for our statewide Nongame Wildlife Program has grown from \$25,000 per year to nearly \$3 million per year thanks to the Nongame Wildlife Checkoff, matching funds from the Reinvest in Minnesota Critical Habitat Matching fund, and federal State Wildlife Grants. Those funds are complemented by the conservation efforts and investments of many wildlife managers and other conservation partners, supplemental funding from state Legacy funding from sales tax revenue, and lottery proceeds to the Environment and Natural Resources Trust Fund. Staffing for our program has grown from 1 to 16, and additional biologists work for closely related programs like the DNR's Minnesota Biological Survey, Mussel Recovery, and Scientific and Natural Areas programs.

Perhaps one of the most impressive changes over the past 39 years has been the ever-widening definition of the term nongame. The Nongame Wildlife Program initially dealt with vertebrates such as birds, mammals, reptiles, amphibians, and some fish. Over the years its focus expanded to include invertebrate fauna, including surveys and research on dragonflies, butterflies, moths, snails, caddisflies, and native bees. We have truly become a program focused on the collective diversity of wildlife in Minnesota.

Another important change over the years has been the transition from costly single-species projects, like restoration of peregrine falcons and trumpeter swans, to more habitat-based efforts to benefit multiple species. Minnesota's changing climate may also make it more difficult to effectively implement single-species management and is driving a greater focus on landscape-scale conservation. These changes are requiring conservation programs to prioritize work within connected habitat networks to facilitate species movement and adaptation, such as Minnesota 2015 Wildlife Actions Plan's mapping of a Wildlife Action Network and Conservation Focus Areas.

As our Nongame Wildlife Program has matured, it has metamorphosed through three strategic planning cycles. This document represents the fourth plan, Minnesota's Wildlife Action Plan (2015–25), which serves to ensure the long-term health and viability of Minnesota's native wildlife, with a focus on species that are rare, declining, or vulnerable to decline.

However, the more things change, the more some things stay the same. We need to maintain some level of work on high-profile species such as the monarch butterfly if our work is to resonate with the public, and expand and diversify our funding sources. We need to continue to connect with the public to communicate our conservation success stories, though our communication approaches now include social media and other technologies. We also need to ensure that we advocate for the preservation of biological diversity through the acquisition, preservation, and management of important wildlife habitats, including habitat for the lesser known and seldom appreciated species. And finally, it is important to demonstrate our commitment to wildlife education for our youth and our citizens by providing them with both educational and outreach programs that provide information on how they can personally help Minnesota's wildlife as a volunteer, through citizen science activities, or by attracting and helping wildlife on their own property.

I would like to extend my sincere appreciation to our Nongame Wildlife Program staff, Wildlife Action Plan staff, and associated planning teams for their assistance in completing this plan. We are committed to making this a working document that will be useful to planners, wildlife managers, biologists, land managers, and other conservationists over the next 10 years as they utilize this information for setting their priorities, budgets, and actions for protecting and enhancing Minnesota's priceless wildlife resources.

Carrol L. Henderson
Nongame Wildlife Program supervisor
Division of Ecological and Water Resources
Minnesota Department of Natural Resources
June 2015

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Chapter 1.

Wildlife Action Plan Foundation

"We are drowning in information, while starving for wisdom. The world henceforth will be run by synthesizers, people able to put together the right information at the right time, think critically about it, and make important choices wisely."

E. O. Wilson

In 2005, the Minnesota Department of Natural Resources (DNR) in collaboration with over 100 individuals and more than 40 organizations developed Minnesota's Wildlife Action Plan, *Tomorrow's Habitat for the Wild and Rare*. The plan was completed in September 2005 and approved by the US Fish and Wildlife Service. Approval of the plan allowed Minnesota to continue to participate in the State Wildlife Grant Program, which has provided about \$1 million per year to implement the plan.

The US Fish and Wildlife Service requires that the Wildlife Action Plans address eight elements (Appendix A) and be reviewed and updated every 10 years. From 2013 to 2015 conservation partners came together again to update Minnesota's plan. This document is the result of that work. A list of partners who participated in the process can be found in Appendix B.

Minnesota's first Wildlife Action Plan included 292 Species in Greatest Conservation Need (SGCN). The updated plan includes 346 SGCN and includes bees, which were not addressed in the original plan. The 2015 list of SGCN can be found in Appendix C.

Since 2005, Minnesota has received over \$10 million in State Wildlife Grant funds to invest directly in the implementation of the Wildlife Action Plan. Many successful projects and partnerships have been funded through this program. Here are a few highlights:

- Releasing more than 5,200 captive-reared mussels, including the federally endangered Higgins eye, into the Mississippi River gorge and discovering two juvenile Higgins eye mussels. This represents the first verification of successful natural reproduction from a population of reintroduced endangered mussels!
- Identifying shoreline areas most critical for the conservation of Species in Greatest Conservation Need. This information was used by counties to inform revisions to their land-use standards and identify important areas for protection and restoration.
- Restoring over 687 acres of bluff prairie habitat on 45 parcels of privately owned lands in southeastern Minnesota to complement habitat improvement work being done on public lands with state funds.

- Identifying golden-winged warbler¹ habitat preferences throughout its breeding season to enable better management of forests for this Minnesota stewardship species.
- Systematically surveying rare animals throughout the state, resulting in thousands of new records that can be used proactively by business and industry to minimize impacts to SGCN.
- Initiating a long-term prairie status and trends monitoring project for vegetation and bird communities with links to a multi-organization adaptive management effort.
- Conducting a statewide dragonfly and damselfly survey, which identified 19 new species in Minnesota.
- Working with Audubon Minnesota and other partners to identify 20 additional Important Bird Areas throughout the state.
- Acquiring over 700 acres of habitat supporting SGCN.

The results from these and many other projects implemented under the Wildlife Action Plan have provided a wealth of information that has been integrated into the 2015-25 plan. The plan also incorporates information from other conservation plans that have been developed over the past 10 years.

The 2015-25 Wildlife Action Plan builds upon the foundation established in the 2005 plan. One of the first steps in updating the plan was to survey users of the plan to determine additional information or products that would make the plan more useful. Increased prioritization, collaboration with other planning efforts that have taken place in recent years, and providing information in Geographic Information System (GIS) format were the recurring recommendations we received, and have been addressed in the plan.

Addressing Climate Change

Minnesota's climate is changing (see Appendix D), effecting both how the DNR and our conservation partners operate and the natural resources we protect. Although climate change was mentioned in the 2005 plan, updating the plan involved conducting a habitat climate change vulnerability assessment and reviewing habitat and species vulnerability assessments and other information about the changing climate. The Wildlife Action Plan addresses many of the strategies recommended in the *National Fish, Wildlife and Plants Climate Adaptation Strategy* (2012).

Audiences

The primary audiences for the plan are the same as in 2005 and include the following:

- conservation practitioners who manage conservation lands or work with regional or local governments or private citizens on conservation issues;
- researchers who seek to improve our knowledge of SGCN, their habitats, and conservation issues, including emerging issues that could affect common species;

¹ Stewardship species are those species for which populations in Minnesota represent a significant portion of their North American breeding, migrating, or wintering population, or species whose Minnesota populations are stable, but whose populations outside of Minnesota have declined or are declining in a substantial part of their range.

- governmental agencies and private organizations that make land use, land management, or policy decisions that may affect SGCN and their habitats;
- members of the public who enjoy and appreciate wildlife and want to participate in its conservation; and
- managers of public and private conservation funds and other funding decision makers.

Goals

The goals of the 2005 Wildlife Action Plan have been updated to better reflect our understanding of wildlife conservation needs and the approaches needed to address them. The goals of the 2015-25 plan are to:

- 1) Ensure the long-term health and viability of Minnesota's wildlife, with a focus on species that are rare, declining, or vulnerable to decline;
- 2) Enhance opportunities to enjoy Species in Greatest Conservation Need and other wildlife and to participate in conservation; and
- 3) Acquire the resources necessary to successfully implement the Minnesota Wildlife Action Plan.

Wildlife Action Plan Approach

Minnesota is home to over 2,000 known native wildlife species. Approximately 16 percent (346) of these species have been identified as Species in Greatest Conservation Need (SGCN) because they are rare, their populations are declining, or they face serious threats that may cause them to decline. Minnesota's Wildlife Action Plan takes a three-pronged approach to ensuring the long-term health and viability of Minnesota's wildlife (Figure 1.1). The first and most comprehensive is the habitat approach. In identifying Minnesota's 2015 list of SGCN, experts considered a number of causes for decline, including habitat loss, habitat degradation and fragmentation, disease, pollution, and exploitation. They also considered life-history traits of species that could increase their vulnerability to threats. The primary causes of decline are habitat-related (see Table 3.1). The habitat approach focuses on sustaining and enhancing terrestrial and aquatic habitats for SGCN in the context of the larger landscapes. To facilitate the implementation of this approach, the plan identifies a preliminary Wildlife Action Network that represents quality habitats for terrestrial and aquatic SGCN. To further prioritize the implementation of on-the-ground, partner-based conservation projects, Conservation Focus Areas have been identified within the network.

The second approach focuses on specific SGCN or groups of species that are affected by non-habitat-related issues. The species approach identifies a prioritized group of species whose needs cannot be sufficiently addressed by the habitat approach, and suggests specific conservation actions. The plan also identifies species for which more information is needed to assess their conservation status or the factors contributing to population declines.

Goal 1: Ensure the long-term health and viability of Minnesota's wildlife with a focus on species that are rare, declining, or vulnerable to decline

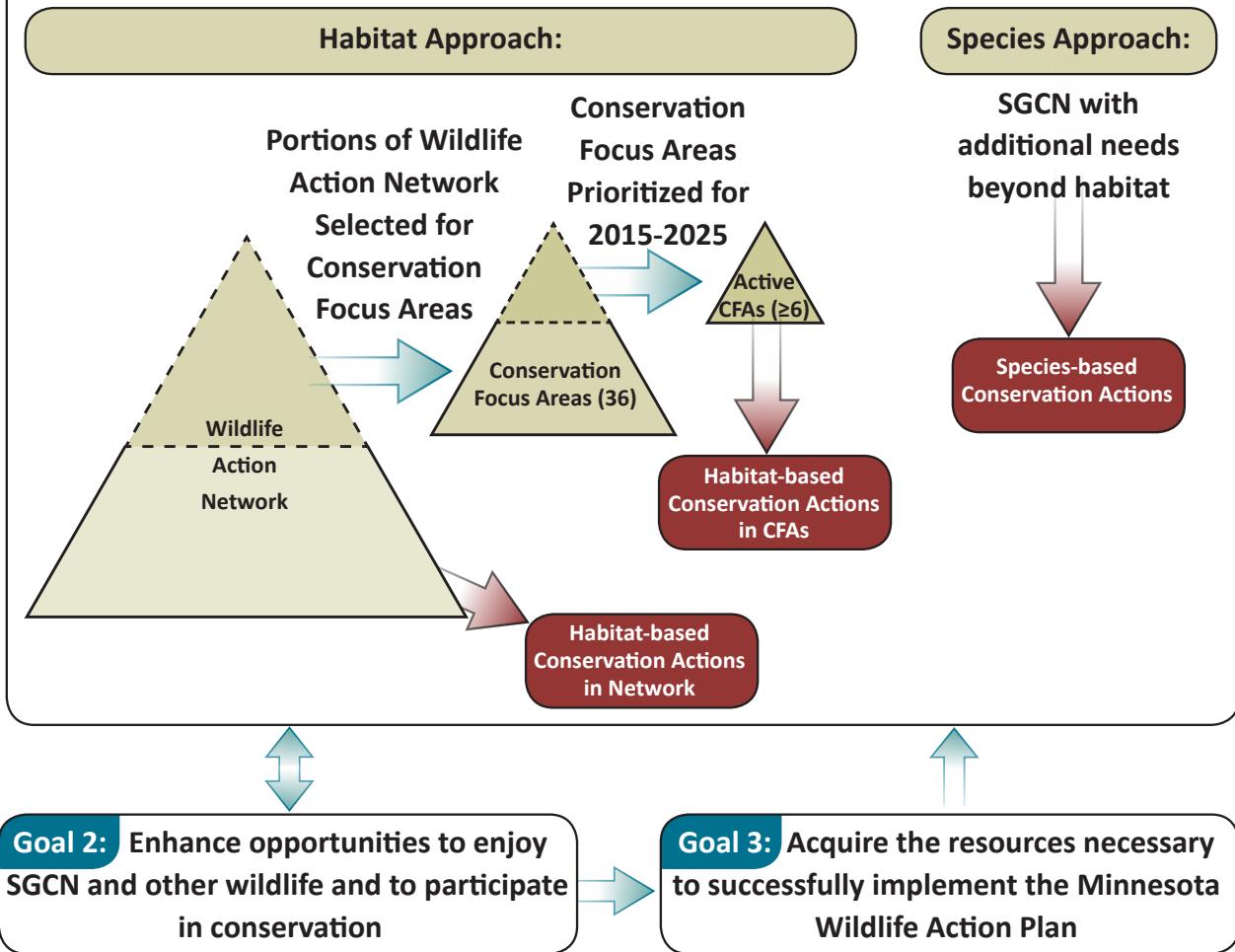


Figure 1.1. Wildlife Action Plan Approach.

The third approach recognizes that providing people with opportunities to enjoy wildlife and habitats and to actively participate in their conservation helps to ensure an engaged conservation community now and into the future that supports conservation funding and contributes to Minnesota's outdoor recreation-based economies.

The Habitat Approach

The habitat approach emphasizes sustaining and enhancing terrestrial and aquatic habitats for SGCN in the context of the larger landscapes (including watersheds). Local habitat is considered part of a larger habitat system across the landscape. The goals for managing local habitat should include sustaining or enhancing landscape-scale biological diversity, improving the functions of conservation lands and waters, and supporting ecosystem resilience. Resilience, as it applies to Minnesota's Wildlife Action

Plan, is the capacity of an ecological system to absorb some level of disturbance and reorganize while still retaining essential functions, structures, and feedbacks. The focus of the habitat approach is to implement conservation actions that will maintain or enhance the conditions that increase a system's resilience. Examples of such actions include protecting large habitat areas from fragmentation, restoring natural levels of connectivity while maintaining natural barriers, reducing invasive species, an emphasis on managing habitats for biological and functional diversity (vs. single-species needs), minimizing pollution and impervious surfaces, restoring watershed hydrology, and reintroducing disturbance when appropriate. Measuring ecosystem resilience is an emerging concept that needs additional research and refinement but includes developing ways to assess functional groups (e.g., decomposers, producers, predators), redundancy of functional groups at multiple scales, structural diversity, ecosystem services, and human social/ecological connections. Measures of changes in resilience will be defined and used as possible over the next 10 years.

To implement this habitat approach, the Wildlife Action Plan lays out the basis for the long-term vision of a Wildlife Action Network composed of terrestrial and aquatic habitat cores and corridors to support biological diversity and ecosystem resilience with a focus on SGCN. To begin development of this network, the Wildlife Action Plan's management team convened groups of taxonomic experts to analyze the distribution of SGCN. This analysis was combined with expert opinion and GIS data to map habitats containing viable or persistent populations and "richness hotspots" of SGCN (Figure 1.2). Added to this information are other data on the relative condition of habitat. Sites with quality habitat or ecosystem function such as spatially prioritized Sites of Biodiversity Significance, Lakes of Biological Significance, and Stream Indices of Biological Integrity combined with the information on species viability and richness form the base of the Wildlife Action Network (Figure 1.3). The network, largely based on ground-truthed, mapped habitats, represents a diversity of quality habitats that contain populations of SGCN. See Appendix E for detailed methodology.

Purposes of the Wildlife Action Network

The Wildlife Action Network serves three purposes:

- 1) addresses large-scale habitat stressors such as climate change, fragmentation, and invasive species;
- 2) increases the effectiveness and efficiency of actions by the conservation community; and
- 3) prioritizes and focuses conservation work over the next ten years by identifying Conservation Focus Areas (CFAs).

Addressing Large-Scale Stressors

As climate change becomes more pronounced, its effects will be both direct and indirect. Impacts from climate change in addition to those from other large-scale drivers will be synergistic; that is, multiple stressors will have an effect that is greater than what may be considered simply additive. Species are already moving in response to climate change, and it is expected that the ranges of many more plant and animal species will shift and habitats will change. The Wildlife Action Network will facilitate adaptation to these changes by identifying core areas large enough to contain a diversity of ecotones and habitats to allow for local shifts (e.g., dry to mesic prairie), and connections to allow for species movements and the flow of energy and materials. These conditions will support the biological diversity already present in the Wildlife Action Network and make it more likely that ecosystem resilience can be

maintained in response to climate change and other stressors, such as invasive species and other forms of habitat degradation. Current research finds little evidence of the potential negative consequences of connections, such as the spread of predators and pathogens (Haddad et al. 2014), and strong evidence of positive effects, such as increased biological diversity (Gilbert-Norton et al. 2010). Connectivity of habitats is not appropriate, however, for naturally unconnected systems such as certain wetlands. Increased native biological diversity has generally been found to decrease the invasability of invasive plants (Levine and D'Antonio 1999; Hooper et al. 2005; Fridley et al. 2007; Yan et al. 2015).

Increasing the Effectiveness and Efficiency of Conservation Actions

Focusing habitat management, restoration, and protection within the Wildlife Action Network will enhance core areas of habitat and connections between habitats. Existing habitat within the network will provide source populations of plants and animals to colonize newly protected and restored areas. A network focus will increase efficiency by facilitating coordination of management, prioritizing outreach efforts, and targeting technical assistance. Coordination of management will also increase its effectiveness. For example, coordinating activities across multiple ownerships within the network can benefit species that require large areas of habitat in a certain successional stage (i.e., time since disturbance). Limited resources for monitoring activities can be targeted within the Wildlife Action Network. Long-term status and trend monitoring will likely target areas both inside and outside of the network to evaluate the effectiveness of the network and adapt management over time (see “Wildlife Action Network Monitoring,” in chapter 5).

Prioritizing the Work of the Wildlife Action Plan: Conservation Focus Areas

Given the extent of the Wildlife Action Network and limited resources, the Wildlife Action Plan further prioritizes work by identifying Conservation Focus Areas (CFAs) within the network. While the Wildlife Action Network is a broad system to guide conservation efforts, the Conservation Focus Areas are where on-the-ground action will be focused to directly benefit SGCN and their habitat. These are priority areas for working with partners to identify, design, and implement conservation actions and report on the effectiveness toward achieving the goals and objectives defined in Wildlife Action Plan. (See Appendix E for information on how the network and CFAs were identified and for information on the CFAs.) Identifying Conservation Focus Areas is intended to focus conservation efforts over the next 10 years to maintain and enhance the resiliency of the Wildlife Action Network.

Conservation Focus Areas do not represent all of the important areas in the Wildlife Action Network for SGCN. Conservation Focus Areas are areas with conservation value for which there are resources, such as organized and willing partners or funding, to address conservation needs, making it more likely that results are achievable within the next 10 years. Some important areas have received a great deal of attention in the past so that relatively little additional conservation work needs to be done; for other important areas, there may be limited opportunity to address their needs over the next 10 years.

To identify Conservation Focus Areas, the Wildlife Action Network was first scored using the following scalable metrics: SGCN population viability scores, SGCN richness, spatially prioritized Sites of Biodiversity Significance, ranks of Lakes of Biological Significance, and Stream Indices of Biological Integrity (Figure 1.4; see Appendix E for more information on scoring methods). The scored network was then used as a guide for regional DNR Nongame Wildlife staff and others to identify a set of potential Conservation Focus Areas, concentrating on areas with conservation needs and opportunities.

Additional input on the draft focus areas was then solicited in day-long workshops with regional staff from several DNR divisions. Following these meetings, staff from the Wildlife Action Plan management team further prioritized the draft proposed Conservation Focus Areas by evaluating them primarily based on conservation needs and opportunities, as well as investment required to address the needs, and return on investment in terms of species or habitats benefited. This evaluation resulted in 36 Conservation Focus Areas, of which at least 6 will be targeted for specific projects over the next 10 years (Figures 1.5 and 1.6).

The boundaries of some Conservation Focus Areas extend outside the Wildlife Action Network. In general, the boundary was extended if the target of the Conservation Focus Area was an aquatic habitat that necessitates a watershed approach. In these cases, actions may be necessary in highly degraded areas in order to maintain or enhance the quality of downstream areas. In other cases Conservation Focus Areas include areas outside the Wildlife Action Network that can enhance connectivity.

Please see Conservation Focus Area overviews (starting at page 73) for descriptions of individual Conservation Focus Areas. Successful implementation of projects within Conservation Focus Areas will require broad partnerships. During implementation of the Wildlife Action Plan, teams of partners will be established to develop specific objectives, actions, effectiveness measures, and monitoring plans for Conservation Focus Areas. See chapter 6 for more details on implementation.

Caveats about the Wildlife Action Network

Identification of the Wildlife Action Network is based on a rich set of species occurrence data and biodiversity rankings from several decades of intensive survey efforts by Minnesota Biological Survey staff; surveys and public reports collected by Nongame Wildlife Program, Scientific and Natural Areas, and Parks and Trails staff; intensive sampling efforts by the Minnesota Pollution Control Agency for stream Indices of Biological Integrity; and other sources of information (habitat modeling data were used for some species). The Wildlife Action Network does not capture potentially important areas lacking survey information. Over the next 10 years, the network should be further refined to include new information on rare species occurrences and Sites of Biodiversity Significance.

In addition, while some spatial prioritization and landscape connectivity data were incorporated from existing planning efforts (the Scientific and Natural Areas Strategic Plan and the Minnesota Prairie Conservation Plan), the current Wildlife Action Network should be considered as the initial building blocks to define a network of cores and corridors across the state. Using spatial tools to facilitate decision making, the network should be further refined over the next 10 years to better define the size and configuration of the network. Also, knowledge of the appropriate amount and size of core area and connections needed for ecosystem resiliency is still evolving, and the Wildlife Action Network should evolve with that understanding.

Finally, the development of the Wildlife Action Network is largely based on populations of SGCN and habitat. Working with others to broaden the network to include consideration of other features, such as rare plant populations and recreation opportunities, will increase the effectiveness and utility of the network. We envision an ultimate goal of a “Conservation” Action Network of which wildlife is a component.

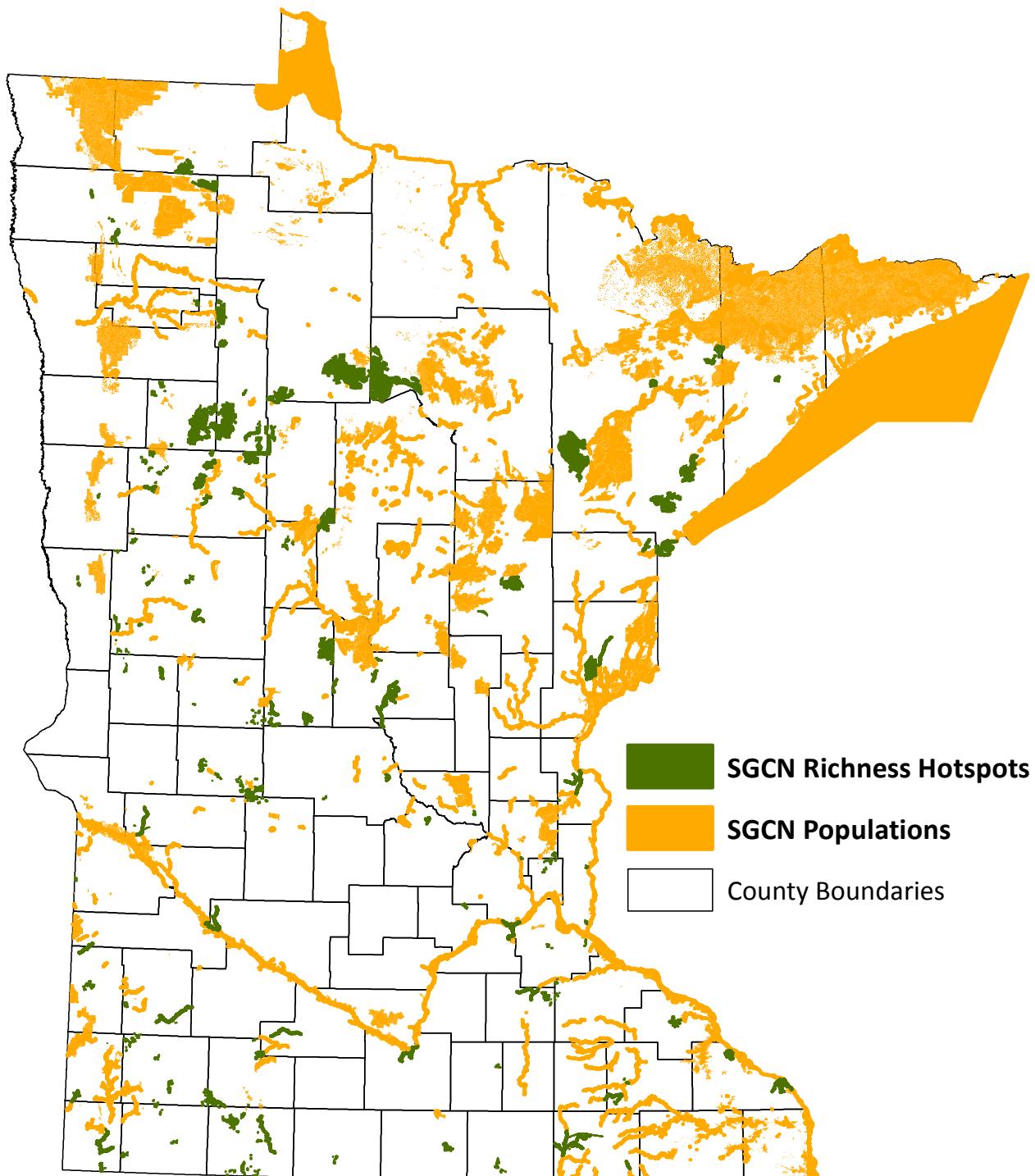


Figure 1.2. Mapped populations (orange) and richness hotspots (dark green) of Species in Greatest Conservation Need (SGCN). The SGCN populations here are the same top 95% score of mapped SGCN that was included in the Wildlife Action Network (see Appendix E). The SGCN richness hotspots represent areas of high SGCN richness that were not mapped as SGCN populations and do not represent all SGCN richness hotspot areas in Minnesota. The area in northeastern Minnesota delineating a portion of Lake Superior represents Minnesota's managed area of the lake.

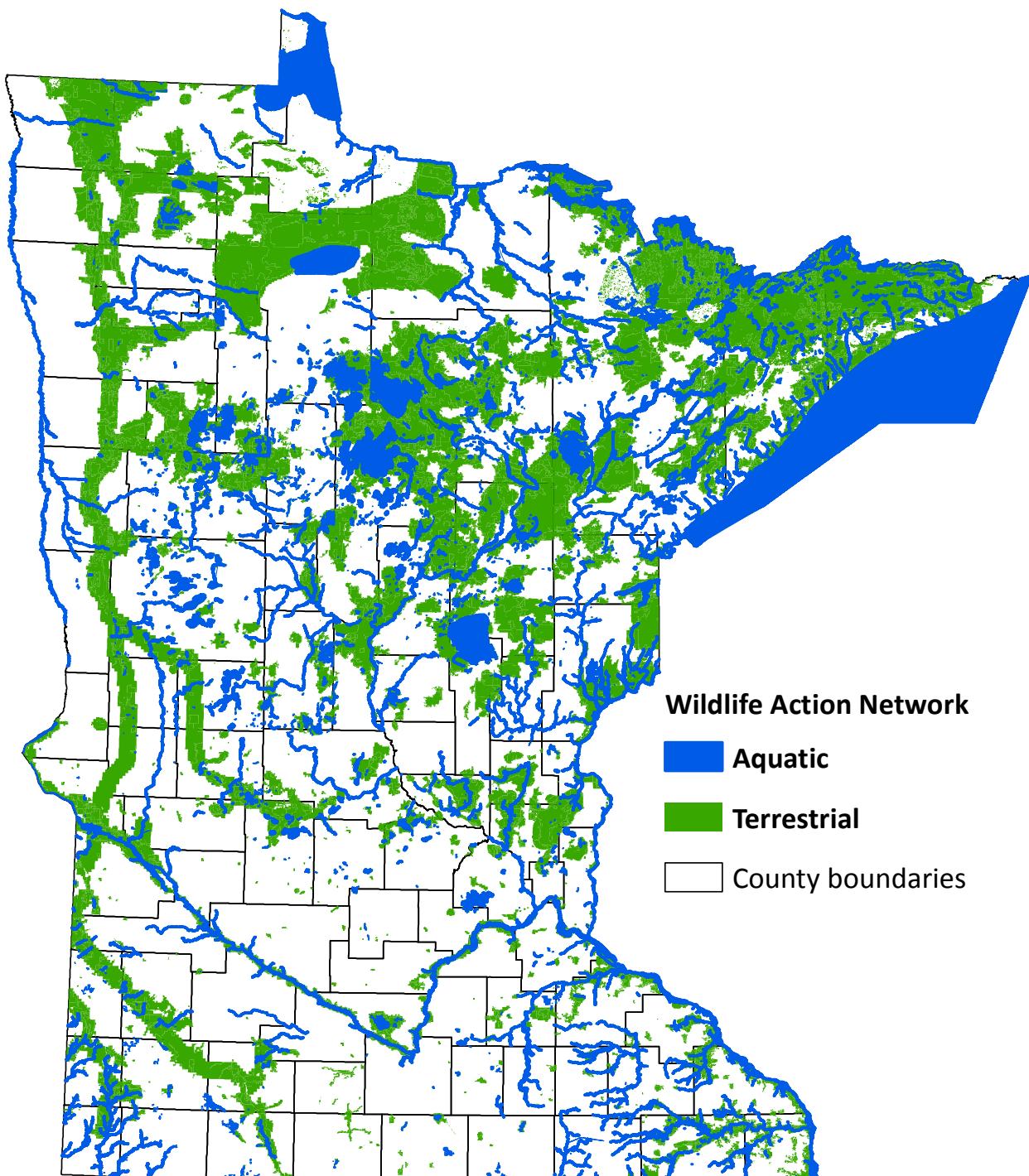


Figure 1.3. The Wildlife Action Network with differentiation of aquatic (lakes and rivers, blue) and terrestrial (including wetlands, green) habitats. The area in northeastern Minnesota delineating a portion of Lake Superior represents Minnesota's managed area of the lake.

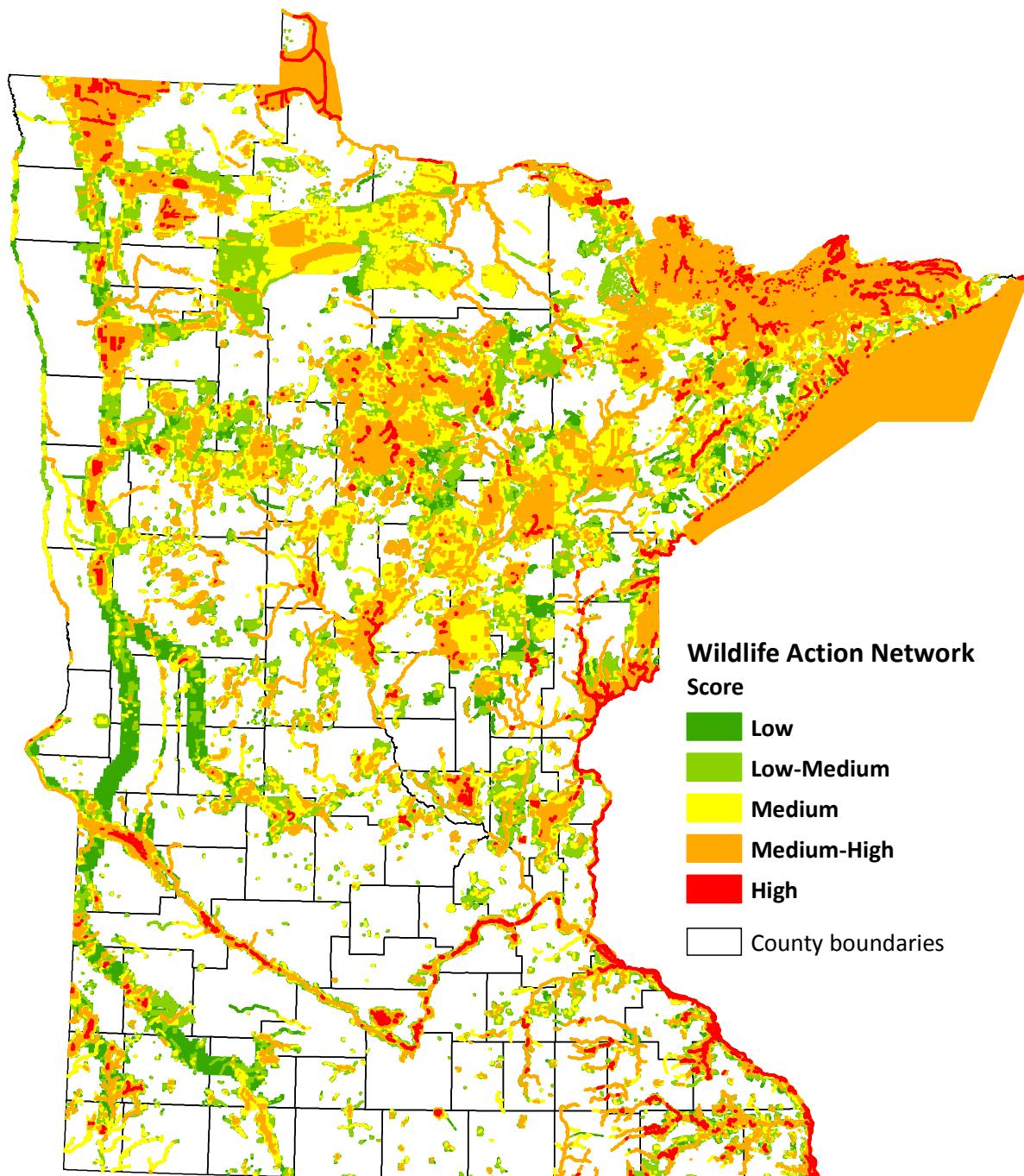


Figure 1.4. The Wildlife Action Network scored. Scores are based on five scalable metrics: SGCN population viability scores, SGCN richness, spatially prioritized Sites of Biodiversity Significance, ranks of Lakes of Biological Significance, and Stream Indices of Biological Integrity (IBI). Lower scores (green) in a given area indicate the metric scores for any of these five components were either relatively low or zero, while high scores (red) indicate that multiple metrics of high scores overlap. For example, a red area could indicate several good or outstanding SGCN populations and/or high SGCN richness (including species that did not have population maps available) along with a high score from another prioritization layer. See Appendix E for more details. The area in northeastern Minnesota delineating a portion of Lake Superior represents Minnesota's managed area of the lake.

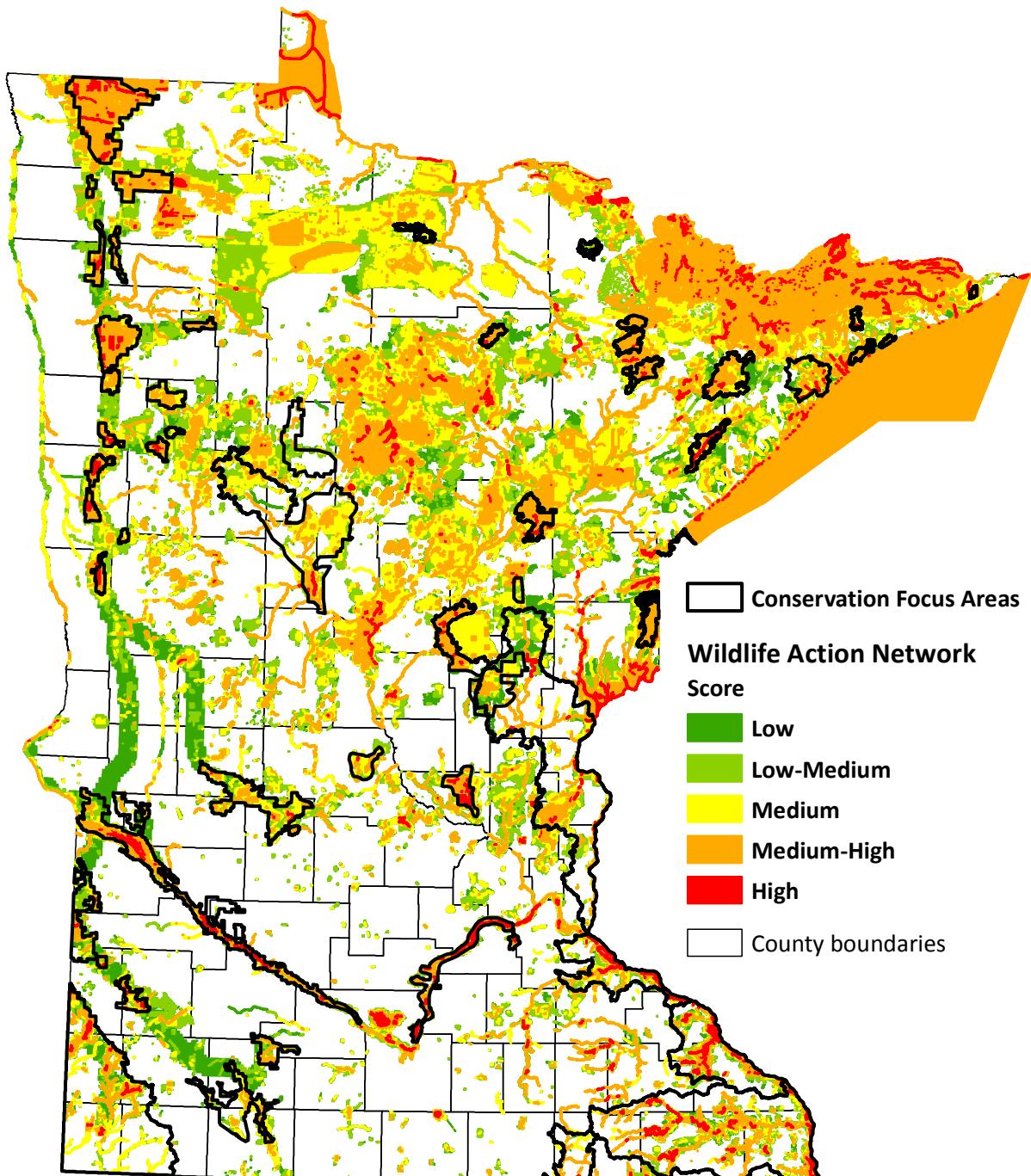


Figure 1.5. Conservation Focus Areas (outlined in black) in relation to the Wildlife Action Network (green to red shading). See Figure 1.4 and/or Appendix E for an explanation of the Wildlife Action Network scores. The area in northeastern Minnesota delineating a portion of Lake Superior represents Minnesota's managed area of the lake.

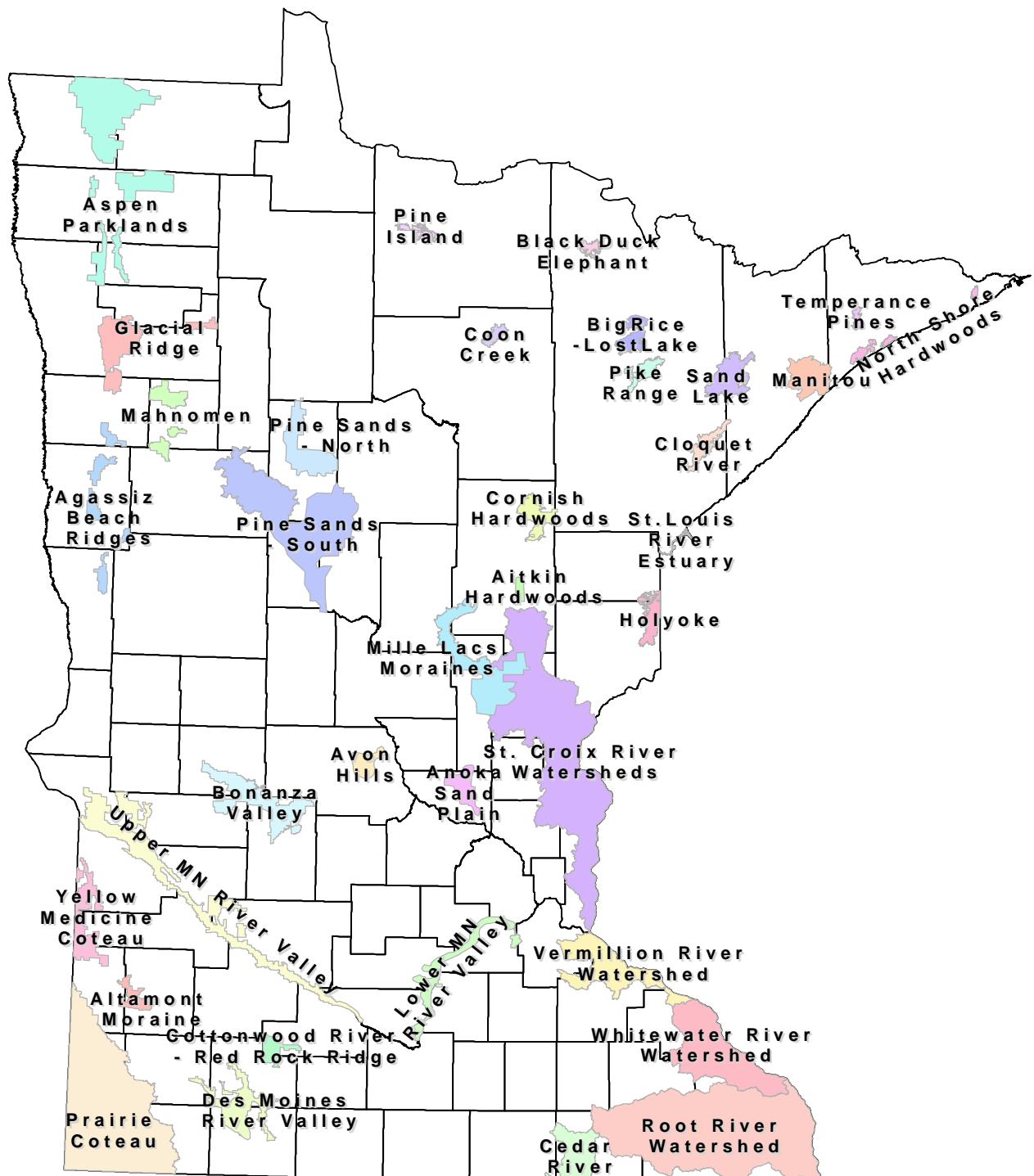


Figure 1.6. Conservation Focus Areas

The Species Approach

The Wildlife Action Plan recognizes that we cannot conserve Minnesota's 346 SGCN by managing on a species by species basis. The habitat approach described above used species occurrence data to map viable or persistent populations and richness "hotspots" of SGCN, and that approach serves as the foundation to conserve the majority of the state's SGCN. The species approach addresses the needs of species for which the habitat approach is not sufficient.

Addressing Non-Habitat-Related Issues Limiting SGCN Populations

The species approach in the Wildlife Action Plan identifies species or groups of species that are affected by specific threats or life-history traits that may contribute to their rarity or make them more vulnerable to decline. For these species, a habitat approach alone is not enough to maintain or increase the species' population, and specific conservation actions are required (chapter 4, Goal 1, Objective 2).

We evaluated the list of SGCN for populations that may be rare, have declined, or may decline within the next 10 years and identified four categories of issues to focus conservation actions around: (1) disease, (2) limited ability to recover, (3) stewardship species with a limited distribution, and (4) deliberate killing or overexploitation. The priority species that are targeted under these categories met the following criteria:

- a habitat approach alone is not sufficient for maintaining or increasing populations,
- specific conservation issues were identified,
- specific conservation actions (other than survey, research, or monitoring) can be implemented to address those issues,
- the conservation actions have a high likelihood of maintaining or increasing populations, and
- the populations can be monitored to report on the effectiveness of conservation actions.

Improving Knowledge

The species approach also targets species for which more information is needed to assess their conservation status or the factors contributing to population declines. To prioritize these species, we compiled information used in amending Minnesota's list of Endangered, Threatened, and Special Concern Species in 2013 (MN DNR 2012), notes from Species Technical Advisory Team meetings, and all feedback received on the teams' recommendations. The following three categories are the prioritized gaps in species information that were identified as a result of this evaluation:

- 1) State-listed SGCN for which more data are needed to assess their current conservation status (endangered, threatened, or special concern) (chapter 4, Goal 1, Objective 3.1). The list is provided in Appendix F, section 3a.
- 2) Species or groups of species for which Species Technical Advisory Teams lacked sufficient information to determine if the species met the criteria for SGCN (chapter 4, Goal 1, Objective 3.2). The list is provided in Appendix F, section 3b.
- 3) SGCN for which Species Technical Advisory Teams members were unable to identify a cause of population decline (chapter 4, Goal 1, Objective 3.3). The list is provided in Appendix F, section 3c.

The latter two categories were distributed to the Species Technical Advisory Team members for priority ranking based on criteria that included urgency, importance, feasibility, and likelihood of obtaining actionable results. The full list of species evaluated under each category and the selection process can be found in the methodology section in Appendix F.

Additionally, there are several species groups or areas of the state that are undersurveyed and areas of the state for which data on SGCN are quite old. The plan includes objectives to address these needs (chapter 4, Goal 1, Objectives 3.4–3.6).

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Chapter 2.

Minnesota Species in Greatest Conservation Need

Definition

States were required in the development of their 2005 Wildlife Action Plans to identify species in greatest conservation need and to review and update this list as part of the required 10-year review process. Minnesota defines Species in Greatest Conservation Need (SGCN) as native animals, nongame and game, whose populations are rare, declining, or vulnerable to decline and are below levels desirable to ensure their long-term health and stability. Also included are species for which Minnesota has a stewardship responsibility.

Methodology for Updating the List of SGCN

Nine Species Technical Advisory Teams (STATs) composed of DNR staff and external taxon experts were formed to review and update the 2005 SGCN list for the following taxa: mammals, birds, amphibians and reptiles, fish, mussels, butterflies and moths, dragonflies and damselflies, tiger beetles, and bees. The list of team members can be found in Appendix B.

Species Technical Advisory Teams were not organized for snails, caddisflies, leafhoppers, and jumping spiders due to the lack of known, available experts. Given the lack of current expertise and data for these groups, and after consultation with the Minnesota Endangered Species Coordinator, the only species from these groups designated as SGCN are those included on the 2013 state list of endangered, threatened, and special concern species. Strategies to review these taxonomic groups will be implemented during the next 10 years so that more information is available for the 2025 update of the Wildlife Action Plan.

Criteria for Assessing Species as SGCN

The criteria used to assess species as SGCN were those criteria, with minor revisions, originally developed by a technical team for the 2005 Wildlife Action Plan. The most significant change in criteria was to not automatically include as SGCN species on “watch” lists other than the Minnesota and federal lists of endangered, threatened, and special concern species. The exception is the gray wolf. When the mammal STAT reviewed the SGCN list, the gray wolf was not a listed species and did not meet the criteria. Because the Minnesota population has met the federal recovery goal for Minnesota since the 1970’s and the subsequent federal listing has been challenged, we have decided not to list the wolf as a SGCN at this time.

Climate change vulnerability was not considered as an independent criterion for evaluating a species as a SGCN. Species Technical Advisory Teams discussed species or groups of SGCN that could be affected by climate change but concluded that data were insufficient to conduct a species climate change vulnerability assessment. However, when assessing a species, the teams frequently considered how changes in temperature, precipitation, and the frequency and severity of storm events could interact with the criteria listed here to reduce a population’s long-term health and stability.

Criteria Used by Experts to Assess SGCN:

1. *Listed Species*

Species on Minnesota's list of endangered, threatened, and special concern species and species on the federal list of endangered and threatened species found in Minnesota, including proposed and candidate species, are automatically included on Minnesota's list of SGCN.

2. *Rare or Declining Species¹*

This criterion is used to evaluate native species that do not meet criterion 1 for inclusion on Minnesota's list of SGCN as rare or declining species. Species considered extirpated,² occasional,³ abundant,⁴ or migratory in Minnesota should not be evaluated under criterion 2. Migratory species should be evaluated under criterion 3C.

- A. Species for which a statistically valid decline throughout Minnesota has been documented.
- B. Species for which populations in Minnesota may be rare, have declined, or may decline within the next decade due to factors such as the following:
 - 1. terrestrial and aquatic habitat concerns
 - a. dependence on a rare, vulnerable, or declining habitat⁵
 - b. habitat loss
 - c. habitat degradation
 - d. habitat fragmentation
 - 2. specific threats
 - a. overexploitation, collecting, bounty killing
 - b. invasive species
 - c. disease
 - d. contaminants
 - e. deliberate killing
 - f. predation beyond normal levels
 - 3. life-history characteristics
 - a. require large home ranges or multiple habitats as part of their life cycle (i.e., herps)
 - b. depend on large habitat patch sizes
 - c. need special resources, such as host species, or have narrow thermal preferences
 - d. depend on an ecological process, such as fire, that no longer operates within the natural range of variation
 - e. are limited in their ability to recover on their own due to low dispersal ability or low reproductive rate
 - f. have a highly localized or restricted distribution
 - g. aggregate their populations during some time of the year

- C. Survey efforts indicate a decline, but there is uncertainty as to the cause of the decline.
3. *Stewardship Species*
- This criterion is used to evaluate native species not identified by criterion 1 or 2 for inclusion on Minnesota's list of SGCN as stewardship species.
- A. Species for which populations in Minnesota represent a significant portion of their North American breeding or wintering population, or
 - B. Species whose Minnesota populations are stable, but whose populations outside of Minnesota have declined or are declining in a substantial part of their range.
 - C. Species for which migrating populations congregating in Minnesota represent a significant portion of the North American population.
-

Definitions

- ¹ Rare species are those species whose low population densities, few occurrences, or restricted distributions warrant concern about their viability in Minnesota. Species that have always been rare in Minnesota are not considered SGCN. Declining species are those species whose populations have substantially declined within the past decade, and these declines are not part of a recognized population cycle or the result of management activities.
- ² A species is presumed extirpated from Minnesota if there is no expectation of it returning as a resident or being reintroduced in the next decade.
- ³ A species occurrence is occasional as a result of wandering behavior of individuals and when no breeding populations are established or likely to become established in the next 10 years. Regular migrating or overwintering species that depend on habitat within Minnesota are not included in this group.
- ⁴ A species is abundant when it is abundant both in Minnesota and throughout its range.
- ⁵ Rare habitats are those with few occurrences or restricted distributions in Minnesota whose rarity may impact the viability of species that depend on them. Declining habitats are those whose acreage or overall quality of habitat has substantially declined within the past decade. Vulnerable habitats are those most likely to be altered or degraded within the foreseeable future.

Assessing the Status of Each Species

Species Technical Advisory Teams met separately by taxon. Each team followed the same process described below and used the same set of criteria listed above for evaluating a species as a SGCN.

- State-listed animal species: The DNR updated Minnesota's list of endangered, threatened, and special concern species in 2013. All state-listed species are automatically SGCN. The following actions were taken to account for changes in the state list in 2013:
 - Animals added to the 2013 state list that were not included in the 2005 SGCN list were automatically added to the proposed 2015 SGCN list. Even though these species are automatically SGCN, Species Technical Advisory Teams did evaluate each species to determine the criterion (in addition to criterion 1) the species met.

- Animals on the 2005 list of SGCN due to their state-listed status at that time but no longer state-listed as of 2013 were evaluated using the criteria listed above to determine if the species was eligible for the proposed 2015 SGCN list. If the species met at least one of the criteria, they were added to the proposed list.
- Evaluating the remaining species on the 2005 SGCN list:
 - The remaining 2005 SGCN were each evaluated using the criteria listed above.
 - If none of the criteria were applicable to a species, then the species was removed from the revised SGCN list. A “strong” majority (all but one team member agreeing) was needed for a species to remain on the list or be removed.
- Recommending and evaluating new species (species not identified as SGCN in 2005):
 - Species Technical Advisory Team members recommended species not currently on the 2005 SGCN list that they thought met the SGCN criteria. These species were vetted by the team using the best data and expert opinion available.
 - The Species Technical Advisory Team members voted on adding species to the 2015 SGCN list. A “strong” majority (all but one team member agreeing) was needed to add a species.

Incorporating changes to the federal and state species lists, and initial recommendation by Species Technical Advisory Teams resulted in 111 species being recommended for addition to the SGCN list and 59 recommended for removal from the list.

The proposed changes were distributed for comments to key partners within all DNR divisions, 17 conservation partner agencies, 25 nongovernmental organizations, and 11 tribal nations. Eleven comments were received and evaluated against the criteria, resulting in the addition of the monarch butterfly and dusky skipper, and the removal of the deertoe mussel. It was also noted that the American white pelican met the criterion of a stewardship species. Additionally the rufa red knot was listed as threatened by the US Fish and Wildlife Service after the review period, so it was added to the SGCN list. The final tally of changes to the list of SGCN was 60 species removed (Appendix G) and 114 species added (Appendix H).

Minnesota’s 2015–25 SGCN List

Minnesota’s 2005 Wildlife Action Plan identified 292 species as SGCN. The 2015 list revision resulted in a total of 346 SGCN (Appendix C).

Minnesota’s 346 SGCN include species from all major animal taxonomic groups (Table 2.1). Five taxonomic groups have one-third or more of the total species listed as SGCN: mussels (60%), reptiles (50%), tiger beetles (46%), mammals (38%), and amphibians (36%). These values reflect both the fact that these groups are well studied in Minnesota and that they appear to be the most imperiled based on current knowledge.

With the exception of mussels, which are relatively well studied, the estimated number of invertebrate species in Minnesota and the number identified on the list is most certainly underrepresented (Table 2.1). While we have reasonable estimates for the number of species in some of the lesser-studied

invertebrate groups, we know very little about their rarity or population status. For example, we estimate that there are approximately 400 species of bees in Minnesota, but the small percentage that are designated as SGCN is based on a lack of information about this taxon and not an accurate reflection of their true conservation status. The total number of other insect and spider species that have been documented in Minnesota is probably one or more orders of magnitude less than what actually lives here, and we have little understanding of those that are rare, declining, or vulnerable to decline. More survey and research are clearly needed for these taxonomic groups, and we prioritize filling some of these knowledge gaps in our goals and objectives (chapter 4).

In conformance with criterion 1 (above), if species are added to the federal list of endangered and threatened species or the state list of endangered, threatened, or special concern species during the period covered by the plan, those species will automatically be added to the SGCN list. Information obtained about the status of unlisted species will be used to inform the updating of the SGCN list in 2025.

Table 2.1. Summary of the number of SGCN compared to all species in Minnesota by taxonomic group

Taxonomic group	Number of species in Minnesota ¹	Number of state or federally listed species	Number of SGCN	Percentage of species that are SGCN
Vertebrates				
mammals	72	21	27	38%
birds	320	33	92	28%
amphibians	22	5	8	36%
reptiles	30	11	15	50%
fish	143	34	43	30%
Total vertebrates	587	104	185	32%
Invertebrates				
mussels	50	28	30	60%
snails ^{2,4}	100	5	5	5%
bees ²	400	0	5	1%
butterflies ³	163	15	22	13%
moths	unknown	4	11	unknown
caddisflies ^{3,4}	277	24	24	9%
dragonflies & damselflies ³	149	8	40	27%
jumping spiders ^{2,4}	74	10	10	14%
leafhoppers ^{2,4}	300	3	3	1%
tiger beetles ²	24	9	11	46%
Total invertebrates	> 1537	106	161	10%
Totals	> 2124	210	346	16%

¹ Appendix I explains how the number of species was calculated for each taxon

² Expert estimate of the number of species likely to occur in the state

³ Number of species documented to date

⁴ Taxon not assessed by STAT; only state-listed species were considered SGCN

Occurrence and Distribution of SGCN Populations and Richness Hotspots

As stated in chapter 1, focusing on particular species or habitats will likely not be sufficient to ensure biological diversity and ecosystem resilience in the future given the dynamic shifts that are unfolding as a result of climate change. The Wildlife Action Network is the 2015 Wildlife Action Plan's approach to address this dynamism. As the impacts of climate change become more pronounced, the importance of maintaining the presence of certain species or habitats in a particular area may wane. Of greater importance will be the need to facilitate changes in species and habitat that retain sufficient biological diversity to sustain ecological functions and ensure ecological resiliency. It is likely that future functional and biological diversity will be made up of both existing native species and newly immigrated species, and the intent of the Wildlife Action Network is to allow for that dynamic to unfold as sustainably as possible. That being said, the viable population mapping provides a useful benchmark to track changes over time and evaluate functional and biological diversity.

The Wildlife Action Plan addresses information about the distribution and abundance of wildlife species and location and condition of habitats primarily by mapping “viable/persistent” populations and richness hotspots of SGCN, as well as other habitat or animal community information used to develop the Wildlife Action Network. Since information on population viability is virtually nonexistent for most species in a given location, populations of individual SGCN species were ranked through an expert review of species occurrence and other GIS data based on evidence of abundance, recruitment, and persistence, the presence of suitable habitat, and expert opinion. The ranking guidelines below were used for specific locations, so while the population of a particular SGCN may be declining overall in Minnesota populations in certain locations may be relatively viable or stable.

Populations were mapped using a variety of sources of information to delineate habitat used by the species (see Appendix E for detailed information on the mapping process). In regards to habitat condition, this mapping exercise focused on mapping habitat of high enough quality to support viable populations of one or more SGCN.

The mapping exercise used as much field-verified data as possible and limited reliance on modeled habitat. This was done because of two main challenges with species-habitat modeling: (1) Most of the SGCN do not have sufficient information to model their habitat, and (2) habitat models are only as good as the available land-cover data, which in general is insufficient for accurate models. Models were used for five bird species where team members determined that the modelers had sufficiently addressed both challenges.

Ranking guidelines for SGCN populations

Excellent (strong evidence for viability/persistence):

- The population shows indications (abundance, age class distribution, persistence) of recruitment or immigration, or
- The population represents the only population in the region (ECS section or HUC 4 watershed) or one of three or fewer populations in the state regardless of viability/persistence.
- An additional consideration is that the habitat is known to be of good quality for supporting outstanding viable populations.

Good (evidence for viability/persistence):

- Species has persisted in the area over time.
- Evidence of abundance, recruitment, or persistence either indicates the population is not as viable as a population ranked as outstanding, or
- Data and professional judgment are insufficient to rank the population as excellent.
- An additional consideration can be the quality of the habitat.

Poor (little to no evidence for viability/persistence):

- Species is present but in low numbers.
- Evidence shows lack of persistence, or limited or no reproduction indicates the population is likely not viable.
- An additional consideration is that the habitat quality is known to be poor to the point of limiting population viability.

Viable/persistent SGCN populations were mapped for 156 of the 346 SGCN and included mammals, birds, reptiles, amphibians, fish, and mussels (Table 2.2). Invertebrate species other than mussels were not mapped due to insufficient occurrence information. Of the taxa that were mapped, several species within the taxa could not be mapped because they occurred over a wide range with no distinct population centers, or they used habitats that were not readily mappable (e.g., purple martin, a species that centers its populations near artificial nesting compartments). This occurred most often with birds (51% mapped) and mammals (67% mapped) (Table 2.2). Examples of individual species maps are shown in Figures 2.1 a–f.

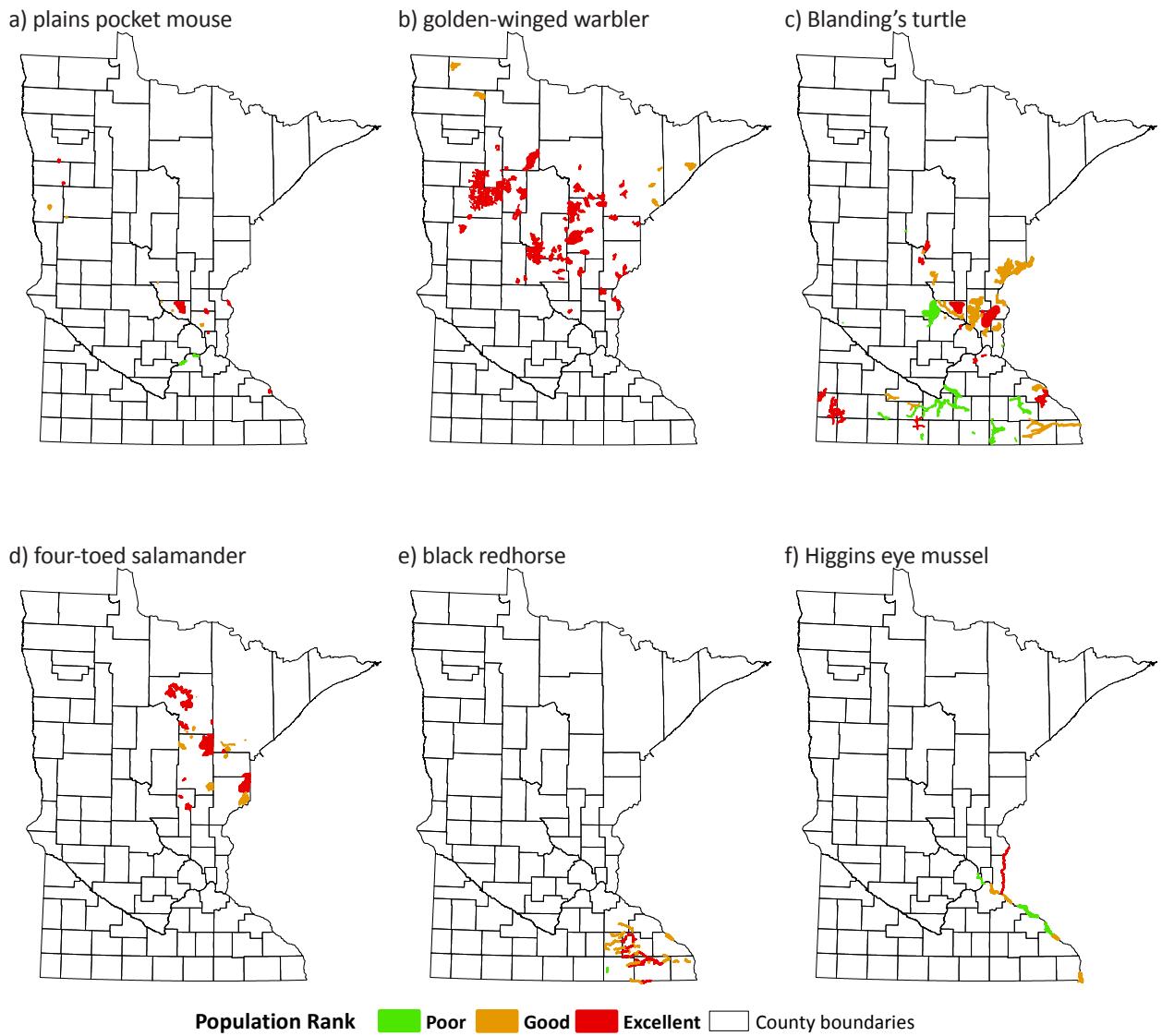
Richness Hotspots

Since about half of the SGCN species' populations could not be mapped, a SGCN richness hotspot analysis was also performed to identify additional areas in the Wildlife Action Network with high concentrations of SGCN species. To complete this process, observation records of all SGCN species, including invertebrates, were used to sum the number of species in approximately 2.5-square-mile blocks across the state. A set of rules was used to identify areas with high concentrations of SGCN species that had not been mapped as part of the population mapping exercise (see Appendix E for more information on the mapping process). Once these high concentration areas, or "hotspots," were

identified, habitat that represented the species present was delineated for inclusion in the Wildlife Action Network (see Figure 1.2, chapter 1). In addition to identifying these hotspots for the Wildlife Action Network, the statewide map of the number of SGCN species per 2.5-square-mile block is valuable for showing concentrations of SGCN species and was also used as a scoring metric for the Wildlife Action Network (Figures 2.2, 2.3). It should be noted that the map also reflects where species survey information is lacking, such as the vast peatland areas of northern Minnesota.

Table 2.2. Number of SGCN with mapped populations by taxa.

Taxon	Total number of SGCN	Mapped		% of SGCN mapped
		Yes	No	
mammals	27	18	9	67
birds	92	47	45	51
amphibians	8	7	1	88
reptiles	15	14	1	93
fish	43	42	1	98
mussels	30	28	2	93
snails	5	0	5	0
bees	5	0	5	0
butterflies	22	0	22	0
caddisflies	24	0	24	0
dragonflies & damselflies	40	0	40	0
jumping spiders	10	0	10	0
leafhoppers	3	0	3	0
moths	11	0	11	0
tiger beetles	11	0	11	0
Total	346	156	190	45%



Figures 2.1 a–f. A sample of species population maps for (a) plains pocket mouse, (b) golden-winged warbler, (c) Blanding's turtle, (d) four-toed salamander, (e) black redhorse (fish species), and (f) Higgins eye mussel. Colors correspond to the population viability/persistence rank of the species in a given area, and were assigned one of three rank categories of poor (green), good (orange), or excellent (red). See Appendix E for more information.

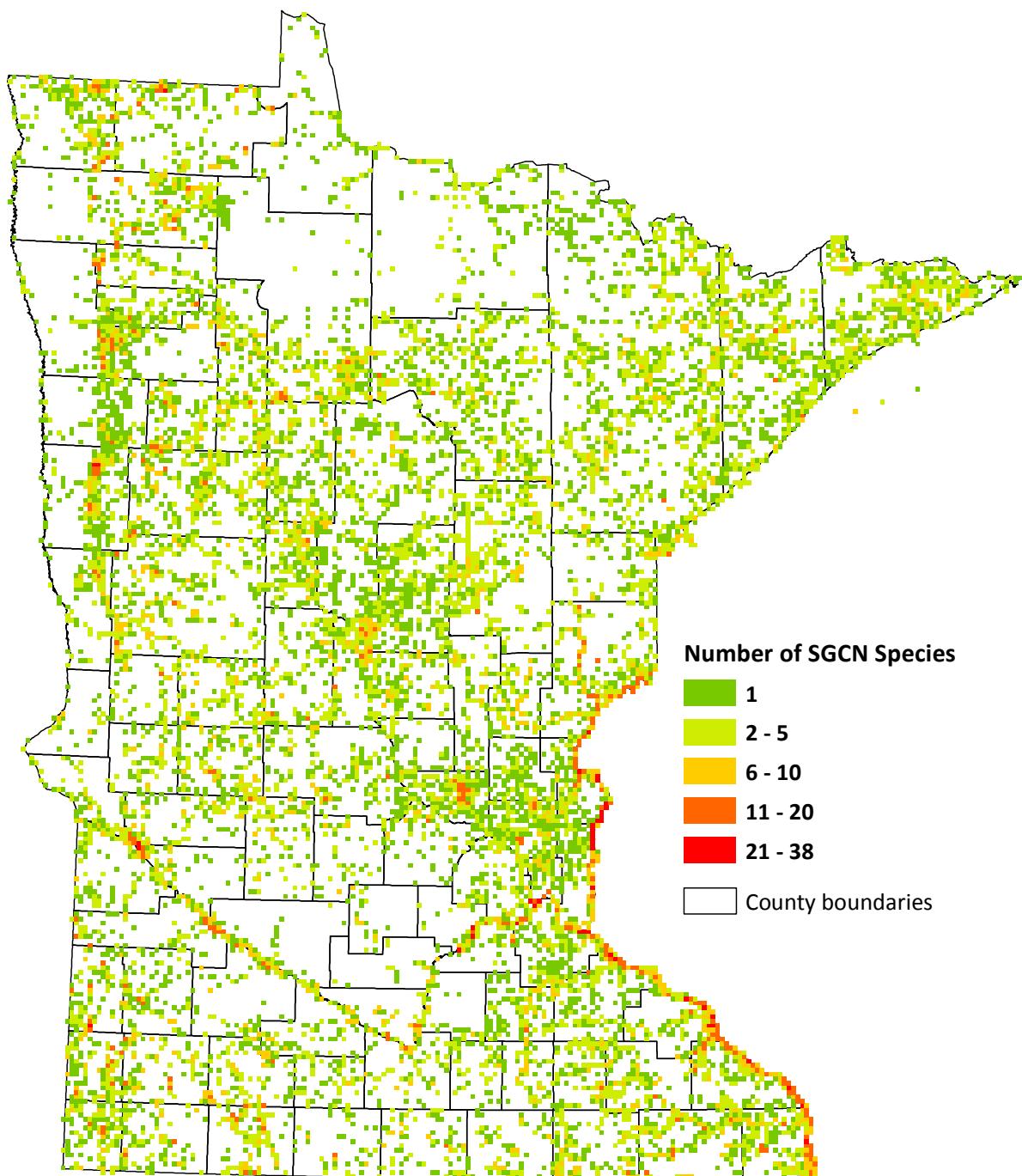


Figure 2.2. Species in Greatest Conservation Need (SGCN) richness by 2.5-square-mile grid block. Scale is from the lowest number of species per grid block (green) to the highest number of species per grid block (red).

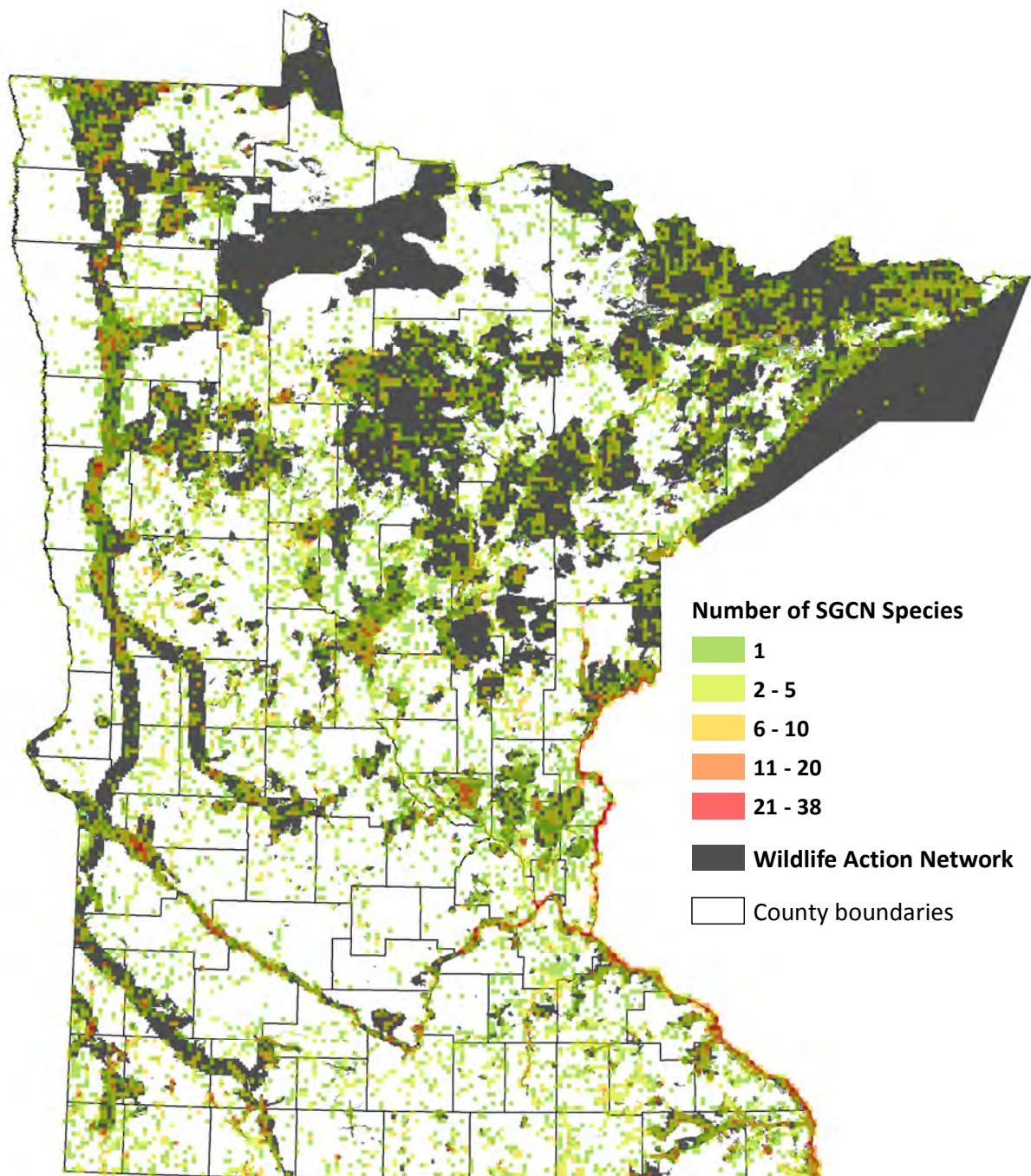


Figure 2.3. Species in Greatest Conservation Need (SGCN) richness by 2.5-square-mile grid block overlaid on the Wildlife Action Network. See Figure 2.2 for an explanation of the SGCN richness map, chapter 1 for an explanation of the Wildlife Action Network, and Appendix E for methods. The area in northeastern Minnesota delimiting a portion of Lake Superior represents Minnesota's managed area of the lake.

Chapter 3.

The Identification of Stressors Contributing to Population Declines of Species in Greatest Conservation Need

A stressor is a condition that directly or indirectly negatively impacts a habitat or species. Conservation actions are implemented to reduce the impact of stressors. Many of the criteria used to evaluate a species as a Species in Greatest Conservation Need also represent stressors associated with population declines. In addition to stressors, life-history traits, which were also included in the criteria for identifying SGCN, can increase a species' vulnerability to stressors. The list of SGCN and the stressors and life-history traits identified for each species can be found in Appendix C. The stressors and life-history traits were used to identify the objectives and possible conservation actions (chapter 4) that will be implemented over the next 10 years to reduce the impacts of stressors on SGCN and their habitats.

Stressors

Habitat-related stressors were considered a predominant stressor for 70 percent of SGCN (241 of 346 species), indicating that loss, degradation (including from contaminants), and fragmentation of habitats are the most serious challenges facing SGCN populations (see Table 3.1). Stressors not related to habitat also contribute to SGCN declines but do not impact as many species (see Table 3.1). However, stressors of all types may interact with each other and exert a cumulative impact on a species.

Table 3.1. Stressors affecting SGCN populations

Stressors	Percentage of SGCN for which stressor was considered a predominant factor
Habitat stressors	70%
Habitat degradation	38%
Habitat is rare, vulnerable, or declining	35%
Habitat loss	31%
Habitat fragmentation	23%
Depends on natural processes that are no longer within natural range of variation	10%
Contaminants	9%
Requires large home range or multiple habitats as part of their life cycle	4%
Depends on large habitat patch	4%
Other stressors: specific threats	13%
Invasive animal species	9%
Disease	3%
Overexploitation, collecting, bounty killing	2%
Deliberate killing	1%

Life-History Traits

Table 3.2 lists the life-history traits that were considered during the SGCN identification process. These traits may increase the vulnerability of species to stressors, including climate change, contributing to population declines.

Table 3.2. Life-history traits increasing species' vulnerability

Life-history traits	Percentage of SGCN for which this trait was identified
Highly localized or restricted distribution	32%
Needs special resources such as host species; has narrow thermal preference	24%
Aggregate their populations during some time of the year	7%
Limited ability to recover on their own due to low dispersal ability or low reproductive rate	5%

Note: Because a given species may have multiple stressors and/or life-history traits, the totals in Tables 3.1 and 3.2 do not equal 100%.

A sortable spreadsheet of stressors and life history traits identified for each Species in Greatest Conservation Need is available for online: <http://files.dnr.state.mn.us/assistance/nrplanning/bigpicture/mnwap/species-stressor-spreadsheet-2015-08-27.xlsx>

Addressing Stressors at the Species Level

Minnesota's Wildlife Action Plan identifies a subset of species that are being affected by specific threats or have life-history traits for which a habitat approach alone is not sufficient to maintain or increase populations. For these species, the plan identifies specific conservation actions (e.g., best management practices, restoration, and propagation) that have a high likelihood of being implemented, and conservation actions that are believed to be effective in maintaining or increasing populations (see "The Species Approach," chapter 1). These species and the associated issues to be addressed through conservation actions are listed in Table 3.3.

Table 3.3. SGCN in need of specific conservation actions.

Species	Issues
northern long-eared bat, little brown myotis, big brown bat, tri-colored bat	white-nose syndrome http://www.dnr.state.mn.us/wns/index.html
freshwater mussels	limited ability to recolonize historic sites without assistance
wood turtle	low reproductive rate, concentrated populations, and high nest predation exacerbated by habitat loss and degradation
brook trout, southeastern Minnesota heritage strain	stewardship species; limited distribution
gophersnake	deliberate killing, overexploitation, and unregulated take; requires large home range and multiple habitat types
plains hog-nosed snake	overexploitation and unregulated take exacerbated by habitat loss, degradation, and fragmentation
mudpuppy	overexploitation and unregulated take
hornyhead chub	overexploitation and unregulated take
monarch butterfly and other pollinators	pesticides, larval dependence on a host plant (milkweed), and possible climate change impacts
golden-winged warbler	stewardship species; Minnesota provides habitat for at least 40% of the global population of golden-winged warblers
four-toed salamander	low ability to disperse and is dependent on forested wetlands as breeding habitat (habitat that could be vulnerable to climate change)
Blanding's turtle	low reproductive rate and high nest predation exacerbated by habitat loss and degradation

Summary of Climate Change Impacts on Minnesota's Habitats

Minnesota's wildlife and their habitats are impacted by a number of human activities that contribute to the stressors identified in Table 3.1, including habitat loss, fragmentation, and degradation, and the introduction of invasive species, disease, and chemicals. Because habitat is an important driver of SGCN population declines, and habitat stressors will be exacerbated by a changing climate, staff reviewed reports and journal articles to identify current or predicted climate change impacts on Minnesota's habitats. Information was also obtained from a habitat climate change vulnerability assessment exercise conducted by the DNR with habitat experts. The purpose of the exercise was to explore how changes in temperature and precipitation under a changing climate could interact with other factors to affect the health of Minnesota's terrestrial and aquatic habitats.

Introduction

The distribution, abundance, and interactions of species, along with physical elements in their environment (temperature, precipitation, moisture, soils, and topography) shape ecological

communities and govern ecosystem functions. Climate change is disrupting these complex interactions; however, the scale and extent of the disruptions are unknown.

Species movements in response to climate change are already apparent. There is evidence that major changes in species composition and ecological system structure and functions (primary productivity and nutrient cycling) are occurring as a result of plant and animal range shifts (Grimm 2013). Root and Schneider (2002) summarized evidence from 45 studies that indicated significant changes in the timing of life-cycle events for a wide range of plant and animal species. These changes could result in the unavailability of essential food resources during critical life-history stages. The unavailability of a resource during peak migration periods, for example, could reduce the size of the population over time and potentially contribute to its extinction.

Biological diversity, the variety of living organisms and their wide range of functions and genetic variability, contributes to ecological resilience. Resilience as it applies to Minnesota's Wildlife Action Plan is the capacity of an ecological system to absorb some level of disturbance and reorganize while still retaining essential functions, structures, and feedbacks. The expansion of human populations and the increased demands for natural resources are driving a loss in biological diversity. Significant changes in ecosystems could occur if climate change, along with current stressors, accelerates that loss.

Activities that fragment or degrade habitats can independently or in conjunction with invasive species reduce biological diversity. Climate change further stresses the system, creating conditions conducive for invasive species to colonize new areas or expand in existing areas. These stressors act in tandem to simplify habitats, resulting in the loss of diversity and thus resilience. For example, buckthorn and reed canary grass can rapidly expand in disturbed sites, creating large monocultures, and invasive carp can deplete essential food resources at such a rate as to severely limit the resources required by other species in the community.

Forest Ecosystems

Forests in the Laurentian Mixed Forest Province

As part of the Northwoods Climate Change Response Framework project (Handler et al. 2014), the vulnerability of forest ecosystems in the Laurentian Mixed Forest Province of Minnesota was assessed under a range of future climate scenarios. This assessment covered 85 percent of the forested area of the state. Vulnerability was considered in terms of the potential impacts to a system and its adaptive capacity. Vulnerability rankings were based on evidence and agreement among reviewers. A brief summary of those findings is provided below.

Climate change predictions for this province include warmer temperatures or drier conditions that reduce available moisture, more intense storm events, and shifts in the timing or amount of precipitation.

Fire-Dependent Forest System. This system is vulnerable to increased drought and warming that increases moisture stress. Major system stressors include fire suppression, insect pests and diseases, understory hazel competition, and deer herbivory.

Mesic Hardwood Forest System. This system is vulnerable to increased droughts that could produce moisture stress and increase the occurrence of wildfires. This system generally contains a larger

number of plant species than some forest systems, which may increase its adaptive capacity. Species diversity along with warming temperatures may allow this system to expand into previously unsuitable areas. However, stands with few species and reduced structural diversity may have lower adaptive capacity. Major system stressors include earthworms, invasive plants, insect pests and diseases, freeze-thaw cycles, drought, and deer herbivory.

Floodplain Forest System. This system is vulnerable to the timing and intensity of precipitation events resulting in changes in the timing or volume of stream flows. Major system stressors include changes in flood regime, increase of invasive species (buckthorn, garlic mustard, and reed canary grass), drought, and deer herbivory.

Wet Forest System. This system is vulnerable to shifts in the timing or amount of precipitation that could disrupt system functions. Management knowledge and history are lacking for these systems; thus, less is known about how these systems function and respond to disturbance. Because these forests often exist as large complexes of a single species or few species, they have lower adaptive capacity in areas where they exist as isolated pockets on the landscape that may limit migration and gene flow. Major stressors include changes in soil moisture, ongoing ash decline, invasive species such as reed canary grass, insect pests (emerald ash borer), and drought.

Managed Aspen System. This system is vulnerable to increased moisture stress during the growing season, which could result in greater mortality. Warmer growing-season temperatures could result in more suckering after harvests. Increased wildfires could help maintain aspen; however, frequent disturbances from herbivory, drought, and more intensive management could result in aspen becoming a less successful competitor. Major system stressors include forest tent caterpillar and gypsy moth, drought, deer herbivory, hypoxylon canker, and earthworms.

Managed Red Pine System. This system is vulnerable to seasonal shifts in precipitation patterns, which may decrease the survival of planted seedlings, particularly if the trend is for wetter springs and drier summers. Red pine plantations typically have very little genetic, structural, and species diversity, which may result in low resilience to future disturbance or changing conditions. Major stressors include armillaria fungi disease, red pine shoot blight, understory hazel competition, deer herbivory, bark beetles, and drought stress in dense stands.

Forests within the Prairie-Forest Border

It is expected that this area will experience warmer temperatures, increased evapotranspiration, and more intense storm events.

Insect damage, larger blowdown areas, droughts, and fire are expected to interact, resulting in many forests, particularly ones on marginal soils, becoming savannas. Invasive species, including earthworms, may limit the establishment and growth of native tree seedlings and other understory plants (Galatowitsch et al. 2009).

Deciduous forests within the prairie-forest border are severely fragmented by agriculture and urban/suburban sprawl (Galatowitsch et al. 2009). Should fragmentation increase, thereby creating smaller forest patches and increasing edge habitat, the ability of some plant and animal species to adapt to climate change could become progressively limited. Reasons for this include increased predation on

wildlife, the spread of invasive species, and competition from other native species that prefer forest edge.

Prairie and Surrogate Grasslands

Less than 1 percent of Minnesota's native prairie remains of what was once a diverse and extensive prairie system. These prairie communities range from the nutrient-rich southern wet prairie to the nutrient-poor northern dry prairie. Their relatively small size and isolation increase their vulnerability to climate change.

Warmer temperatures, increased evapotranspiration rates, and periods of drought interacting with invasive species, agricultural expansion, and altered hydrology (resulting in part from increased demands on groundwater resources) could result in further loss and degradation of native prairie habitats. Isolated, low-diversity mesic and wet prairie communities are the most vulnerable. Wet prairies and meadows will be reduced in extent, and some rare wet-prairie species will likely be lost (Galatowitsch et al. 2009).

Prairie communities with higher biological diversity and connectivity are expected to have a greater capacity to respond to changes in precipitation, moisture, and temperature than are lower-diversity, fragmented communities (Galatowitsch et al. 2009). Where these prairie complexes exist, the increased biological diversity and connectivity may increase their ability to reorganize while still retaining prairie species, structure, and functions. Given the fragmented nature of Minnesota prairies, protecting remaining high-diversity prairie complexes should be a priority.

In some cases intensive management, such as prescribed burns, conservation grazing with a focus on system resilience, and seeding mixtures that reflect a changing climate may be necessary to maintain existing prairies or restore prairies. In addition, the restoration of pastures and limiting agricultural drainage in the vicinity of protected wetlands and wet prairies will become increasingly important (Galatowitsch et al. 2009).

Wetland Systems

All wetland systems, with the exception of some localized areas, are expected to experience shorter hydroperiods and decreased water supply (Galatowitsch et al. 2009). These changes will most likely result in significant shifts in plant communities, either as a direct result of water-level changes or indirectly through altered soil and water chemistry, decomposition, and disturbance regimes. Reed canary grass and other invasive species are expected to further reduce biological diversity. Freshwater marshes and meadows across western Minnesota may become brackish to alkaline if evapotranspiration increases as is expected (Galatowitsch et al. 2009).

Minnesota's globally significant boreal peatland system that covers more than 2,400,000 hectares of northern Minnesota may experience the most radical changes. An important carbon sink, the drying of peatlands and the potential for increased fires would increase carbon dioxide emissions into the atmosphere.

Rich Peatland System

In the rich peatland system, higher water tables could result in a transition to open peatland systems; however, lower water levels could allow other forest types to invade as peat layers dry and decompose. Major stressors include changes to the water table, roads and beaver dams, insect pests and diseases, winter burn, drought, and deer herbivory.

Acid Peatland System

Acidic peatlands are disconnected from groundwater inputs and are reliant on precipitation. Being on the southern edge of their range in Minnesota, they may not tolerate warmer conditions. Ecosystem models show significant declines in black spruce and tamarack, which are the dominant tree species in this system. Acidic peatlands contain a suite of rare and endemic plant species, which are also presumably vulnerable to changes in the water table and peat substrate. Major stressors include changes to the water table, roads and beaver dams, insect pests and diseases, winter burn, drought, and deer herbivory (Galatowitsch et al. 2009; Handler et al. 2014).

Aquatic Systems

Aquatic systems, particularly those with altered hydrology, are vulnerable to temperature extremes and to high-intensity and high-magnitude precipitation events. Changes to hydrologic regimes are affecting stream flow and water quality (turbidity, pollutants, water temperature), which in turn affect biological diversity. Aquatic systems may be further impacted if dry periods result in increased human demands for water.

An overview of climate change impacts on Minnesota's aquatic systems can be found in the DNR's 2011 report Climate Change and Renewable Energy: Management Foundations, pp. 26–31. Information from the report is summarized here:

- Increased air temperature and/or reduced ice cover could result in warmer water temperatures, altering fish communities. Warm-water fish such as largemouth bass and bluegill are becoming more common in northern Minnesota lakes (Schneider 2010; DNR Fisheries unpublished survey data). Relative abundance of cisco has declined, and evidence suggests that climate change is a primary factor. Walleye, pike, and lake trout could also be affected, as cisco is an important food source for those species (Jacobson et. al. 2012). Effects on cool-water species are likely to be variable. Species such as walleye, yellow perch, and northern pike are expected to have good growth volume in cold northern Minnesota lakes, but competition and predation from warm-water species, such as large and smallmouth bass, may affect populations (Stefan et al. 2001; Fang et al. 2004; Fayram et al. 2005; Minns 2009).
- Warmer air temperatures, reduced ice cover and/or reduced precipitation can lower water levels in lakes and streams, resulting in oxygen depletion. Longer periods of stratification can also reduce nutrient availability and increase the risk of oxygen depletion in lakes. Lower water levels can also concentrate pollutants.
- Climate change may reduce habitat suitability for native species and open up new niches for invasive species to exploit (Walther et al. 2009).

- Warming air temperatures, reduction in groundwater inputs (as a result of higher air temperatures and evaporation), altered and more extreme precipitation patterns, increased impervious surface, agricultural drainage, and human demands on groundwater are expected to reduce the amount of available habitat for cold-water stream species such as brook trout (Ficke et al. 2007; Herb and Stefan 2010).
- Large, deep lakes with balanced food webs and relatively low levels of nutrients may have greater resilience to climate change (Stefan et al. 2001; Beisner et al. 2003; Genkai-Kato and Carpenter 2005; Jacobson et al. 2010). Streams with significant groundwater inputs, channels shaded by trees, intact floodplains and meanders, and watersheds with deep-rooted perennial vegetation will be more resilient to changes in air temperature and surface flow variability (Chu et al. 2008; Palmer et al. 2009).

Wildlife Vulnerability to Climate Change

A number of reports have identified characteristics that could increase the sensitivities of species or populations to climate change (e.g., National Fish, Wildlife and Plants Climate Adaptation Strategy [2012]; Integrating Climate Change into Northeast and Midwest State Wildlife Action Plans [Staudinger et al. 2015], and Wisconsin Initiative on Climate Change Impacts [Wisconsin's Changing Climate: Impacts and Adaptations 2011]).

Characteristics include the following:

- highly specialized habitat requirements
- dependencies on interspecific interactions (host plants or animals)
- temperature limits or having narrow environmental tolerances
- isolated, rare, or declining populations with poor dispersal abilities
- long generation times, low fecundity, or reproductive potential
- narrow or restricted distribution
- special sensitivity to pathogens
- sensitivity to human disturbance

In another Wisconsin assessment, LeDee and Ribic (2015) categorized terrestrial vertebrate species according to traits sensitive to climate change:

- The primary trait of amphibians and reptiles was their dependence on specialized habitat and/or microhabitat (18 of 19 amphibians assessed [94.7 percent] and 16 of 36 reptiles assessed [50 percent]). Reptiles were also sensitive because of their dependence on environmental cues.
- Of 236 avian species assessed, 72.5 percent were sensitive because narrow environmental thresholds were likely to be exceeded.

- Mammals were likely to be affected because of disease and parasitism (36 of 62 species assessed; 58.1 percent).

A synthesis of four climate change vulnerability assessments that looked at resident species occurring in the U.S. Corn Belt since 2010 found species associated with freshwater ecosystems, particularly those affiliated with ephemeral wetlands, cold- or cool-water environments, and shallow streams, appear to be most vulnerable (Small-Lorenz et al. 2013). Species and their vulnerabilities include the following:

- Mollusks
 - anthropogenic and natural dispersal barriers
 - hydrologic changes: flood regimes, sediment and streambed degradation
 - climate change mitigation impacts (increased ditching, tiling, irrigation)
 - interspecific interactions: host fish required
- Amphibians and reptiles
 - anthropogenic barriers to movements (roads)
 - hydrologic changes to damp and aquatic habitats; drought
 - climate change mitigation impacts (increased ditching, tiling, irrigation)
 - restricted habitat/geology
- Fish
 - temperature changes: cool- and cold-water species
 - precipitation changes: shallow water spawners, wetland species, species intolerant of turbidity
 - water chemistry: sensitive to low dissolved oxygen
 - barriers to movement: anthropogenic, large rivers

Addressing Stressors: Minnesota's Wildlife Action Plan's Goals, Objectives, and Conservation Actions

Many of the goals, objectives, and conservation actions in Minnesota's Wildlife Action Plan were developed to (1) reduce the impacts of current stressors on habitats and species, (2) increase the resilience of species and habitats, and (3) address specific issues related to life-history characteristics that increase a species' vulnerability to stressors. Following are a few examples of how the stressors discussed in this chapter are brought forward into the goals, objectives, and conservation actions presented in chapter 4.

Habitat degradation, loss, and fragmentation are the predominant stressors impacting SGCN populations. Habitats with higher biological diversity and habitats that are less fragmented are expected to have a greater resilience in a changing climate than are systems with lower biological diversity and greater fragmentation.

Goal 1, Objective 1 focuses on maintaining and enhancing the resilience of habitats upon which SGCN and other wildlife depend. This will be accomplished by implementing conservation actions such as those identified under Objective 1.1 to “sustain and enhance species, habitat, and landscape

biological diversity within the Wildlife Action Network” and Objective 1.2 to “maintain or enhance habitat in at least 6 Conservation Focus Areas.” Examples of conservation actions for Objective 1 include maintaining and restoring terrestrial and aquatic habitat connectivity; expanding habitat cores; protecting and enhancing wetland, floodplain, and shoreline habitats; and acquiring from willing sellers threatened sites providing exceptional habitat or ecological value.

Changes in Minnesota’s climate are already impacting habitats, and future impacts are predicted. The habitats identified by the literature review and the DNR expert-based habitat vulnerability assessment as having higher vulnerability to these climate changes, or for which management knowledge is lacking, include wet forest systems; isolated, low-diversity mesic and wet prairie communities; floodplain forests; the peatland system; and the prairie stream ecosystem with altered hydrology. Communities where maintaining complexes or forest stands with high biological diversity is important to maintain adaptive capacity include mesic hardwood forest stands, high-diversity prairie complexes, wetland complexes, and cold-water lakes and streams.

Goal 1, Objective 1.1 prioritizes these habitats for the implementation of conservation actions. In addition, a number of Conservation Focus Areas have been identified with a watershed focus for the protection, enhancement, or restoration of stream habitats (see Conservation Focus Area Overviews for more information).

Invasive species, insects, pest, disease, and deer herbivory in forested systems are important stressors interacting with climate to reduce biological diversity.

Preventing new introductions and controlling the spread of invasive plants and animals is a conservation action under Goal 1, Objective 1. Goal 1, Objective 4 addresses ensuring compliance with invasive species regulations to protect SGCN or their habitats.

Climate change is expected to affect surface and groundwater availability and flow regimes, which are important factors for maintaining biological diversity in many habitats (mesic and wet prairies; forests; wetlands; and river, stream, and lake systems).

In addition to this impact being addressed by conservation actions for Goal 1, Objectives 1 and 4, two Conservation Focus Areas (Pine Sands – South and Bonanza Valley) include DNR groundwater protection management areas (see Conservation Focus Area Overviews for more information).

An unknown variable in all habitats is how social and economic systems will respond to weather events. Natural resource managers will need to consider this uncertainty when developing and implementing habitat or species management plans. This uncertainty also highlights the importance of implementing long-term monitoring and research projects, developing demonstration management sites, and applying an adaptive management approach.

A conservation action under Goal 1, Objective 1.1 is to assist conservation partners with the development of research, monitoring, and demonstration projects to evaluate habitat and SGCN responses to management practices to inform adaptive management. Chapter 5 in the Wildlife Action Plan addresses monitoring and adaptive management.

Life-history traits can increase a species' vulnerability to other stressors.

The Wildlife Action Network and many of the habitat conservation actions identified under Goal 1, Objective 1 are directed at reducing habitat stressors related to specific life-history traits. For example, protecting, restoring, and enhancing habitat quality may help ensure that special resources are available to species. Increasing connectivity within sites for species that have limited dispersal ability, and among sites for species that require multiple habitats throughout their life history may increase opportunities for those species to adapt to stressors, including climate change. Increasing connectivity may increase opportunities for species to connect to special resources, such as mussels to their host fish. Increasing habitat diversity may provide more specialized habitats and niches, such as thermal refugia.

Addressing Emerging Issues

Minnesota's Wildlife Action Plan will address over the plan's 10 years any emerging issues, such as new diseases, insect outbreaks, invasive species, technologies, recreational activities, and economic practices that may present potentially serious challenges to ensuring the long-term health and viability of Minnesota's wildlife as stated in Goal 1. Addressing these issues could include implementing conservation actions such as surveys, research and monitoring; participating in educational/training workshops and conferences; developing and implementing species or habitat management plans; engaging the public through education and technical guidance; and developing policy, guidance, and regulations. These actions may be undertaken as part of a state, regional, or national initiative.

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Chapter 4.

Goals, Objectives, Conservation Actions, and Performance Measures

Below are the three goals of the 2015-25 Wildlife Action Plan. Listed under each goal are the objectives, potential conservation actions, and performance measures.

Goal 1: Ensure the long-term health and viability of Minnesota's wildlife, with a focus on species that are rare, declining, or vulnerable to decline.

Objective 1. Within the Wildlife Action Network, maintain and enhance the resilience of the habitats upon which Species in Greatest Conservation Need (SGCN) and other wildlife depend.

Objective 1.1. Sustain and enhance species, habitat, and landscape biological diversity within the Wildlife Action Network, giving priority to the following eight ecological communities, which are thought to be most vulnerable to changing climate: prairie stream ecosystems, high-diversity native prairie complexes, grassland-wetland complexes, peatlands, priority cold-water cisco lakes, cool-/cold-water streams, lowland conifer forests, and mesic hardwood forests.

Potential conservation actions:

- Restore the hydrology of prairie streams, rivers, and wetlands.
- Develop strategies for sustaining or restoring terrestrial and aquatic connections among conservation lands within the Wildlife Action Network, where appropriate.
- Sustain a diversity of wetland types within the Wildlife Action Network that are critical waterfowl and shorebird migratory stopovers.
- Restore wetlands that have been identified by the DNR as restorable.
- Implement forest certification.
- Implement the Minnesota Prairie Conservation Plan.
- Implement Subsection Forest Resource Management plans and Minnesota Forest Resources Council's Regional Landscape plans.
- Provide technical guidance to private landowners adjacent to public lands within the Wildlife Action Network to improve buffers, habitat quality, and connectivity.
- Prevent new introductions, and control the spread of invasive plants and animals and diseases that can harm wildlife and habitats.
- Assist conservation partners in the development of research, monitoring, and demonstration projects to evaluate the response of habitat and species to management practices to inform adaptive management.

- Develop policies and guidelines in cooperation with partners as appropriate, using the best available science.
- Work with the DNR's Strategic Land Asset Management Program, other agencies, public land managers, and conservation groups to include areas within the Wildlife Action Network in their acquisition plans and guidelines.
- Enhance protection of Minnesota's peatlands and support efforts to recognize their importance at a global scale.
- Continue or develop additional long-term species and habitat monitoring projects for early detection of changes in the resilience of ecological communities.
- Develop best management practices for lowland conifer SGCN.
- Promote the implementation of best management practices, in particular those developed for the following species or groups (see chapter 3, Table 3.3):
 - monarch butterfly and other pollinators
 - golden-winged warbler
 - four-toed salamander
 - Blanding's turtle
- Develop and refine the Wildlife Action Network over the next 10 years by:
 - Surveying habitats believed to meet the criteria for inclusion in the Wildlife Action Network and incorporating new data as appropriate.
 - Incorporating additional conservation targets or ecosystem services that support resilience, and applying spatial prioritization tools.

Performance measures for Objective 1.1:

- Further development of the Wildlife Action Network
- Enhanced protection for patterned peatlands
- Implementation of demonstration and adaptive management projects
- Number and types of projects implemented
- Number of programs that have incorporated information about the Wildlife Action Network into their prioritization process
- Successful promotion of best management practices
- Population levels of monarch butterflies in Minnesota have stabilized or increased
- Golden-winged warbler populations in Minnesota area are stable as evidenced from Breeding Bird Survey data

Objective 1.2. Maintain or enhance habitat in at least 6 Conservation Focus Areas.

Potential conservation actions: Conservation actions specific to each Focus Area will be developed and implemented with partners. Examples of conservation actions include the following:

- Protect, enhance, and restore wetland, floodplain, and shoreline habitats.
- Maintain or restore habitat connectivity within and between terrestrial and aquatic communities, where appropriate.
- Expand habitat cores.
- Implement the Minnesota Prairie Conservation Plan.
- Acquire from willing sellers (fee or easement) threatened sites providing exceptional habitat or ecological values.
- Improve the conditions of disturbance-dependent habitats through the appropriate reintroduction or mimicking of natural disturbance.
- Develop and promote the implementation of best management practices for SGCN and their habitats.
- Identify new Conservation Focus Areas, including at least one lake-focused Conservation Focus Area, and revise the boundaries of existing Conservation Focus Areas as new data become available.

Performance measures for Objective 1.2:

Performance measures for each Conservation Focus Area will be developed by Conservation Focus Area teams and will include shorter-term measures (number of acres protected or restored, or number of demonstration projects) along with longer-term monitoring of status and trends to evaluate the effectiveness of conservation actions. Additional information on the development of performance measures for Conservation Focus Areas is provided in Chapter 5 (Monitoring and Adaptive Management) and Chapter 6 (Implementation).

Objective 2. Maintain or increase populations for at least three of the SGCN for which non-habitat-related issues have been identified.

Issue: White-nose Syndrome

Targeted species: northern long-eared bat, little brown myotis, big brown bat, tricolored bat

Potential conservation actions:

- Continue to monitor caves and hibernating bats for the presence of the fungus and signs of the disease.
- Educate the public about the fungus and how it spreads; target cavers and other groups or locations in the state where the risk is highest.
- Install boot/shoe decontamination stations at caves with public access.
- Protect vulnerable caves.
- Improve knowledge of summer habitat requirements to maintain healthy bat populations to mitigate impacts of white-nose syndrome.

Performance measures for Objective 2:

- Number of caves and/or bats assessed for presence of fungus; change in number of caves where fungus is detected over time
- Northern long-eared bat population status and trends
- Better definition of characteristics of roost trees
- Best management practices developed for summer habitat

Issue: Species with a limited ability to recover on their own

Targeted species: freshwater mussels

Potential conservation actions:

- Continue to implement the freshwater mussel propagation and reintroduction plan.
- Continue long-term mussel monitoring activities.
- Remove dams to provide access to host fish, where appropriate.

Performance measures for Objective 2:

- Number of species for which host fish have been identified
- Number of species being propagated and reintroduced
- Number of reintroduction sites
- Number of reintroduction sites with evidence of naturally occurring reproduction
- Population status and trends

Targeted species: wood turtle

Potential conservation actions:

- Develop and implement a statewide wood turtle management plan.
- Collect population data as needed to assess current status of populations in Minnesota and other data essential for the plan.

Performance measures for Objective 2:

- Implementation of actions included in the management plan
- Population status and trends

Issue: Stewardship species with limited distribution

Targeted species: brook trout, southeastern Minnesota heritage strain

Potential conservation actions:

- Propagate heritage-strain brook trout in southeastern Minnesota cool-water hatcheries.
- Reintroduce heritage-strain brook trout to former stream reaches in southeastern Minnesota using fish from hatcheries or surplus individuals from streams with identified populations.

Performance measures for Objective 2:

- Status and trends of heritage-strain brook trout populations
- Number of individuals propagated and released
- Evidence of reproduction in streams where reintroductions or maintenance stocking occurred

Issue: Deliberate killing, overexploitation, or unregulated taking

Targeted species: gophersnake, plains hog-nosed snake, mudpuppy, hornyhead chub

Potential conservation actions:

- Establish legal protection for snakes and salamanders.
- Continue educational efforts to address deliberate killing of snakes.
- Conduct a population structure study for the hornyhead chub using Otter Creek as a reference site.
- Monitor hornyhead chub spawning activity through nest counts; based on results, consider establishing a harvest season to prevent wild collection during spawning.

Performance measures for Objective 2:

- Legal protection established for salamanders and snakes
- Status and trends of mudpuppy and hornyhead chub populations

Objective 3. Improve knowledge of the status, distribution, and conservation needs of select wildlife in Minnesota.

Objective 3.1. By 2022, obtain additional survey information for at least 3 of the following 23 state-listed SGCN to determine if their classification on the state list is accurate.

Mammals Richardson's ground squirrel	Snails dull gloss
Birds Bell's vireo boreal owl	Butterflies and Moths abbreviated underwing leadplant flower moth Whitney's underwing
Amphibians great plains toad mudpuppy spotted salamander	Caddisflies <i>Anabolia ozburni</i> <i>Protoptila erotica</i> <i>Triaenodes flavescens</i>
Fish bluntnose darter crystal darter pygmy whitefish redside dace warmouth	Jumping spiders <i>Habronattus viridipes</i> <i>Habronattus calcaratus maddisoni</i> <i>Marpissa formosa</i>
Leafhoppers caped leafhopper hill prairie shovelhead leafhopper	

Potential conservation actions:

- Develop and implement a strategy for conducting surveys.
- Enter survey data into the Natural Heritage Information System database.
- Report annually on survey activities and results.
- Use results to inform review of Minnesota's list of endangered, threatened, and special concern species.

Performance measures for Objective 3.1:

- Total number of species surveyed
- Number of species for which data are likely to result in a change in state status
- 100 percent of species surveyed have survey data entered into the database
- Annual survey reports are submitted

Objective 3.2. By 2022, survey at least 3 of the 15 species or groups of species for which data were insufficient in 2014 to determine if the species met the criteria for SGCN.

Mammals

long-tailed weasel
water shrew
woodland jumping mouse

Amphibians

western tiger salamander

Birds

brown creeper
gray jay
Lincoln's sparrow
spotted sandpiper

Butterflies and Moths

blazing star stem borer
Melaporphyria immortua

Reptiles

Ouachita map turtle

Dragonflies and Damselflies

Cyrano darner
great spreadwing
stygian shadowdragon
larval odonates

Potential conservation actions:

- Develop and implement a strategy for conducting surveys.
- Enter survey data into the Natural Heritage information System database.
- Report annually on survey activities and results.

Performance measures for Objective 3.2:

- Total number of species surveyed
- Number of species for which data are usable for evaluating SGCN status
- 100 percent of species surveyed have survey data entered into the Natural Heritage Information System database
- Annual survey reports are submitted

Objective 3.3. By 2022, implement research projects to identify the cause(s) of population decline for one or more of the following SGCN.

Birds

American kestrel
belted kingfisher
olive-sided flycatcher

Fish

longnose sucker
redfin shiner
suckermouth minnow

Potential conservation actions:

- Design, implement, and assess results of research project(s).
- Develop and implement one or more conservation actions to address the cause(s) of population decline.
- Monitor conservation actions to determine effectiveness.

Performance measures for Objective 3.3:

- Number of research projects implemented
- Number of species for which cause(s) of decline was identified
- Number of species for which conservation actions were developed and implemented to address cause(s) of decline
- Monitoring plan developed and implemented to assess changes in population status and trends over time, and adaptive management implemented

Objective 3.4. Implement survey and research projects to understand the cause(s) of pollinator declines, and improve knowledge about the status of native bees.

Potential conservation actions:

- Work with partners such as the University of Minnesota, Xerces Society, Minnesota Zoo, and others to conduct research into the causes of pollinator declines.
- Conduct surveys to assess the status of native bee populations.

Performance measures for Objective 3.4:

- Number of research projects implemented
- Number of species for which causes of declines were identified
- Number of species for which conservation actions were developed and implemented to address cause(s) of decline

Objective 3.5. Enhance and update information on the status and distribution of SGCN in Minnesota.

Potential conservation actions:

- Support the county by county survey effort undertaken by the Minnesota Biological Survey.
- Develop a strategy and time line for surveying underrepresented sites and species.
- Identify priorities for updating occurrence information that is more than 25 years old.

Performance measures for Objective 3.5:

- Strategies and time lines are developed

Objective 3.6. Establish additional expert advisory teams focused on invertebrates.

Potential conservation actions:

- Invertebrate teams develop priorities for survey, monitoring, and research efforts.

Performance measures for Objective 3.6:

- At least two new teams are established and provide guidance on determining the status of invertebrate groups
- Surveys are implemented on up to two species not previously surveyed, as identified by the teams

Objective 4. Ensure compliance with regulations and provide technical guidance to protect SGCN and their habitats.

Potential conservation actions:

- Enforce wildlife, land, wetland, and water laws and regulations.
- Use information from the Wildlife Action Plan in environmental review activities to inform recommendations that prevent or reduce threats to SGCN.
- Incorporate information from the Wildlife Action Plan in other planning efforts to promote the conservation of SGCN and their habitats.

Performance measures for Objective 4:

- Information from the Wildlife Action Plan is incorporated into the Environmental Review process
- Planning efforts incorporate information from the Wildlife Action Plan

Goal 2: Enhance opportunities to enjoy Species in Greatest Conservation Need and other wildlife and to participate in conservation.

Objective 1. Increase the number and diversity of people participating in wildlife-related outdoor recreation.

Potential conservation actions:

- Partner with the DNR Division of Parks and Trails and other organizations to implement interpretive programs focused on SGCN and other wildlife, especially in habitats where these opportunities have been limited in the past.
- Incorporate wildlife viewing and conservation awareness into local tourism projects.

Objective 2. Increase the number and diversity of people directly engaged in conservation of SGCN.

Potential conservation actions:

- Partner with agencies and organizations to develop and implement additional citizen science or habitat stewardship projects focused on SGCN.
- Provide increased opportunities for the public to show their support, including financially for conservation.
- Develop a survey to be given at 10-year intervals that evaluates the public support for conservation of wildlife in Minnesota.

Performance measures for Objectives 1 and 2:

- Number of interpretive programs developed that focus on SGCN
- Data for the number of Minnesotans participating in various types of outdoor recreational activities and the revenues generated from those activities from the US Fish and Wildlife Service recurring National Survey of Fishing, Hunting and Wildlife Associated Recreation, Minnesota
- Number of volunteers participating in Minnesota frog, toad, and loon surveys each year
- Results of surveys at 10-year intervals to evaluate Minnesotans' conservation values, including support for conservation of rare wildlife and participation in conservation activities

Goal 3: Acquire the resources necessary to successfully implement the Minnesota Wildlife Action Plan.

Objective 1. Increase and diversify funding and partnerships for implementing the Wildlife Action Plan and reporting on the plan's effectiveness.

Potential conservation actions:

- Maintain and develop partnerships.
- Develop proposals for other funding sources including the Outdoor Heritage Fund, Parks and Trails Fund, Environment and Natural Resources Trust Fund, and competitive State Wildlife Grant program to help leverage existing funds.
- Work with partners to use State Wildlife Grant funds for work on private lands that complements projects funded through the Outdoor Heritage Fund.
- Increase and diversify efforts to promote contributions to the Nongame Wildlife Program.

Performance measures for Objective 1:

- Donations to the Nongame Wildlife Program increase by 10 percent by 2020
- Number of proposals funded through new funding sources

Objective 2. Enhance the Minnesota Department of Natural Resources' capacity to provide information needed for effective wildlife conservation

Potential conservation actions:

- Maintain or enhance the current level of Natural Heritage Information System staff.
- Provide leadership and coordination of the establishment or implementation of monitoring initiatives or projects focused on biological diversity and ecosystem resilience.
- Promote development of shared databases with internal and external partners when appropriate, especially related to monitoring efforts.
- Promote the standardization of data collections and digital field data collection.
- Develop additional web-based tools to facilitate implementation of the Wildlife Action Plan.

Performance measures for Objective 2:

- Mapped information from Wildlife Action Plan is available through a web site
- New data are made available within one year of the information being collected

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.

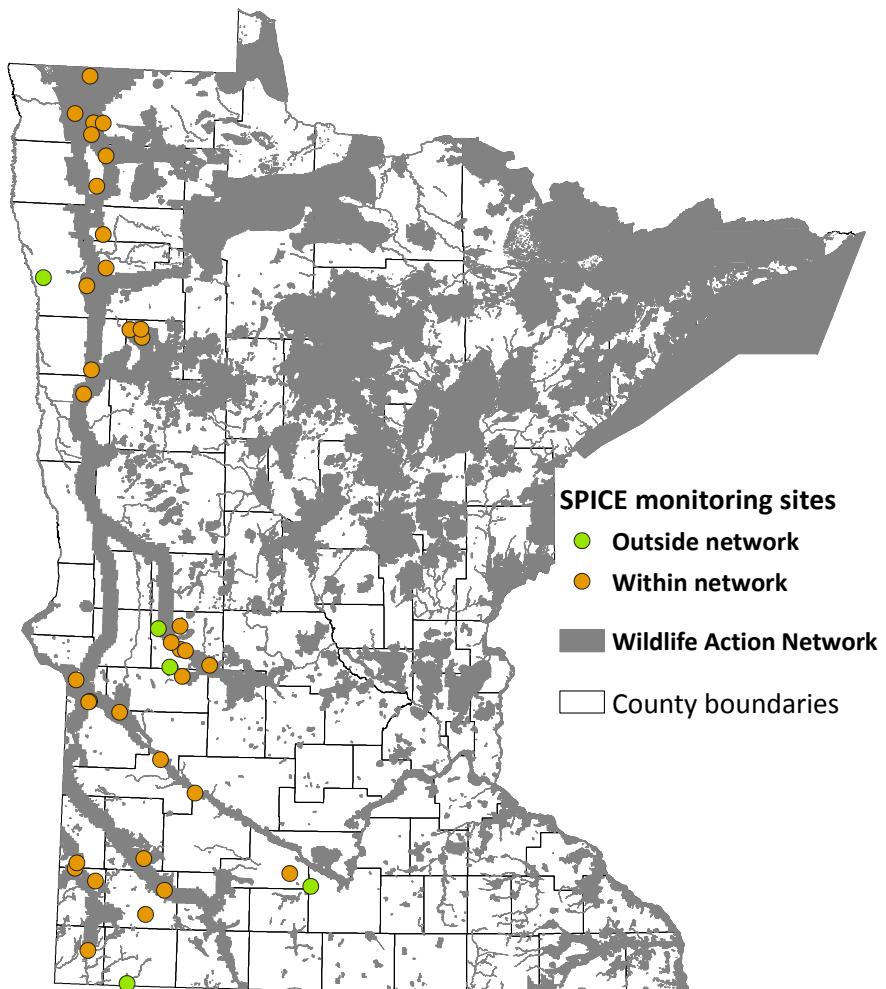


Figure 5.1. Sustaining Prairies in a Changing Environment (SPICE) monitoring sites that are located within (orange) and outside of (green) the Wildlife Action Network. Five of the 40 prairie monitoring sites are located outside of the Wildlife Action Network. The area in northeastern Minnesota delineating 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

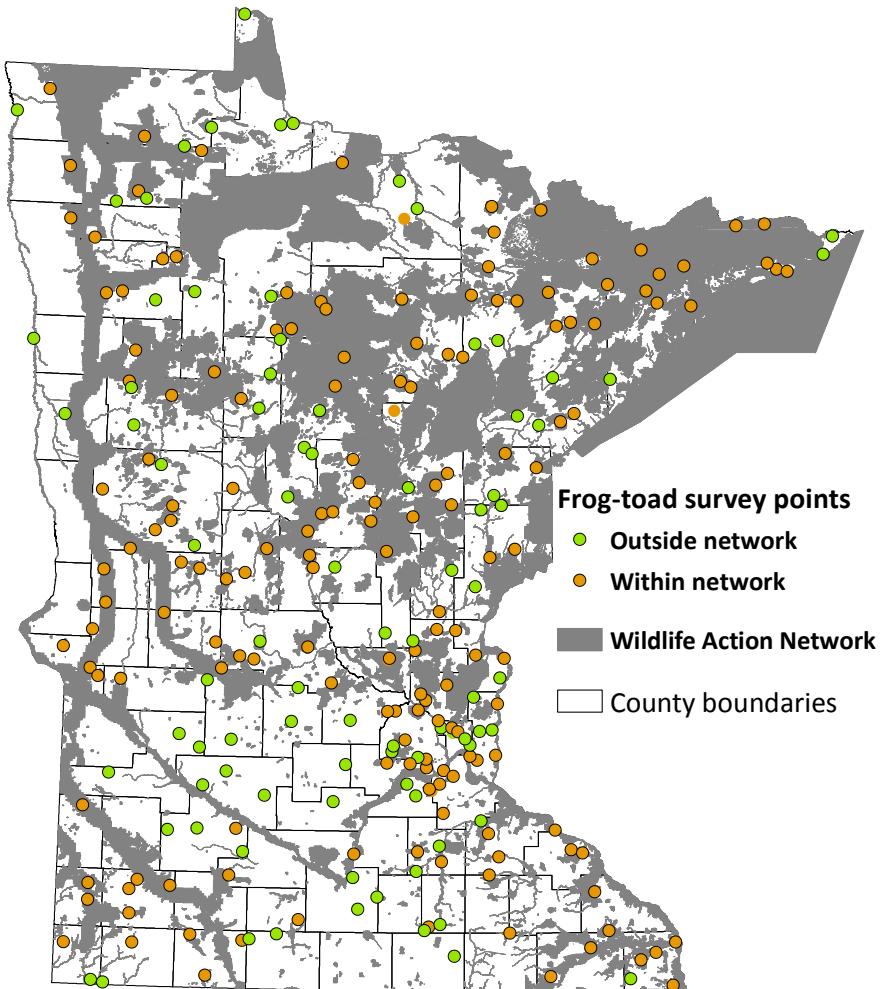


Figure 5.2. Minnesota Frog and Toad Calling Survey points that are located within (orange) and outside of (green) the Wildlife Action Network. The calling survey contains approximately 240 active routes and over 2,400 survey points across the state; 66% of the routes have at least one survey point within 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 is 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).

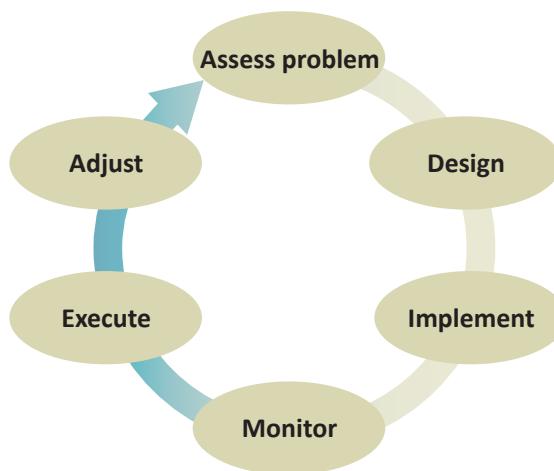


Figure 5.3. Adaptive management process

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)

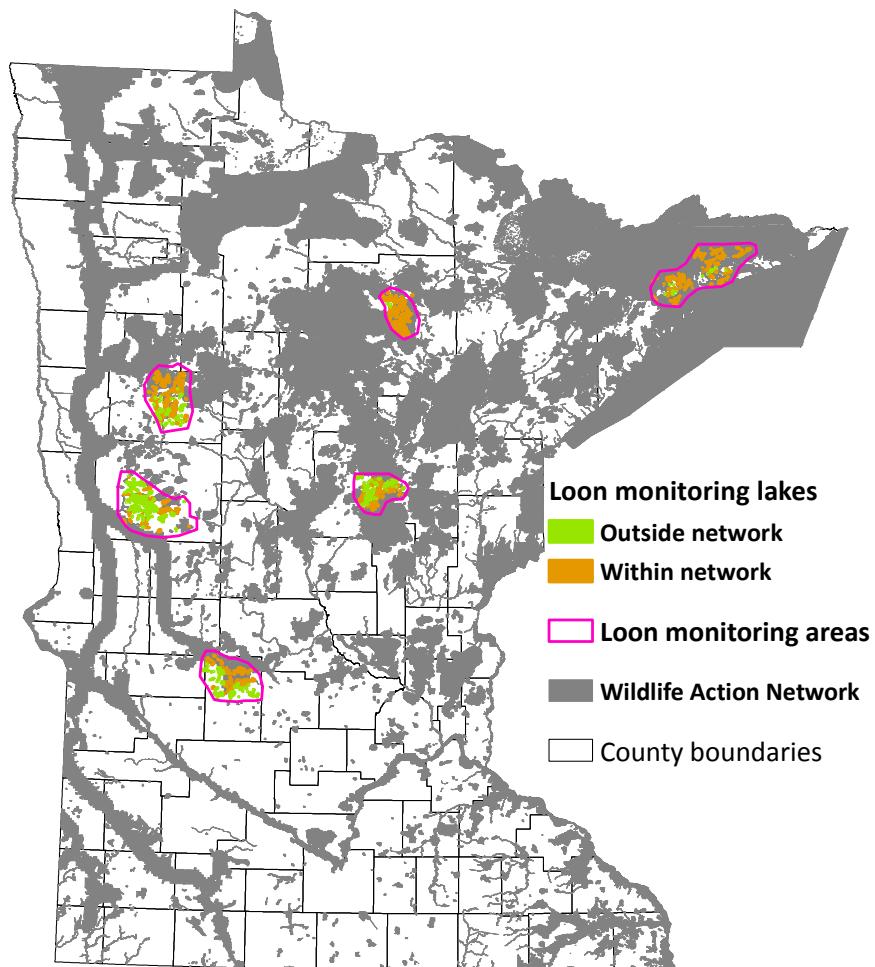


Figure 5.4. Minnesota loon monitoring lakes that are located within (orange) and outside of (green) the Wildlife Action Network. Out of approximately 600 lakes that are monitored annually for loons, 60% fall partially or entirely within the network boundary. The area in northeastern Minnesota delineating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

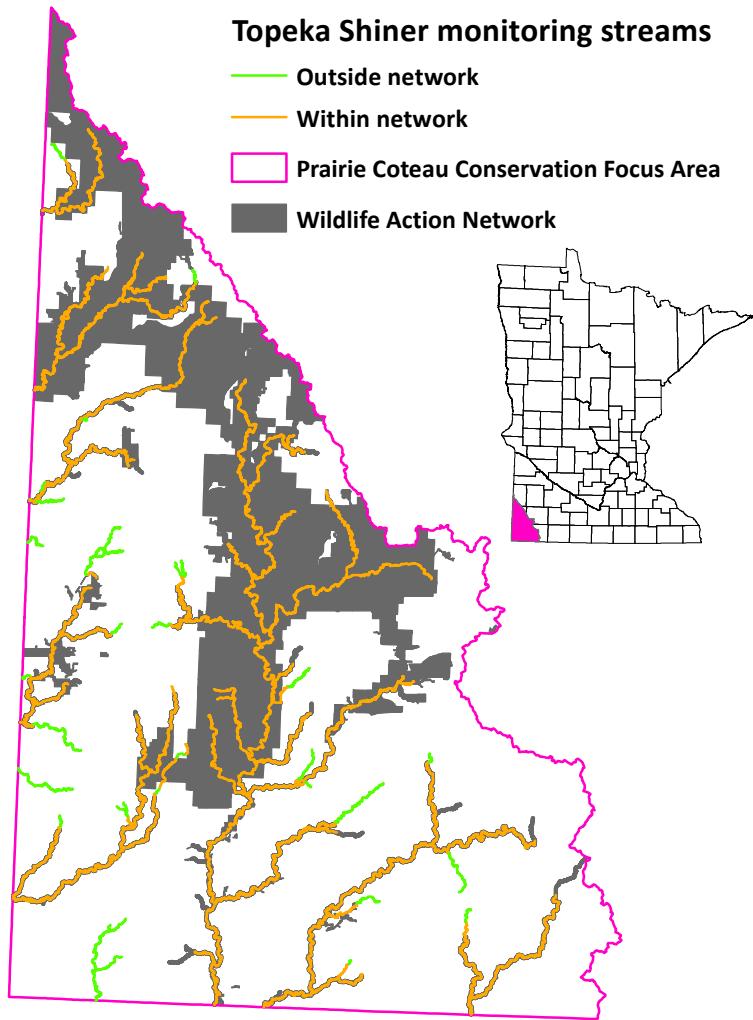


Figure 5.5. Minnesota Topeka shiner monitoring streams that are located within (orange) and outside of (green) the Wildlife Action Network. The orange lines indicate that the majority of streams within the Topeka shiner monitoring area are included in the network. Note: The gray coloration of the network 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.

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Chapter 6.

Implementation of the Minnesota Wildlife Action Plan

Introduction

The Wildlife Action Plan has been implemented in various ways throughout Minnesota by DNR staff and a variety of partners:

- Within the DNR, the Nongame Wildlife Program, the Division of Fish and Wildlife habitat programs, the Scientific and Natural Areas Program, the Environmental Review Program, Subsection Forest Resource Management Planning, and the Minnesota Biological Survey have integrated the plan into their work.
- Local units of government and lakeshore associations are working to protect and restore lakeshores.
- State, national, and county forest managers are assisting with the implementation of research projects to benefit forest SGCN.
- Private landowners, the DNR, the National Wild Turkey Federation, and the Prairie Enthusiasts are restoring southeastern Minnesota bluff prairies, oak savannas, and woodlands for SGCN.
- The Nature Conservancy's multi-partner initiative is developing and implementing the Minnesota Prairie Conservation Plan.
- Audubon Minnesota has established 57 Important Bird Areas across the state.
- A partnership of the Minnesota Department of Commerce-Energy Facilities Permitting and the Minnesota Public Utilities Commission is collecting baseline information on bat fatalities at commercial wind farms in southern Minnesota to inform the siting of future turbines, thereby sustaining bat populations and the public's support of commercial wind farms.
- Nine Species Technical Advisory Teams made up of experts from within and outside the DNR helped prioritize survey, research, and monitoring needs and assisted with the updating of Wildlife Action Plan.
- An Executive Partnership Committee made up of representatives from The Nature Conservancy, the US Fish and Wildlife Service, Audubon Minnesota, Natural Resources Conservation Service, and the DNR assists with the coordination of implementation efforts among their agencies and organizations.

The successful implementation of the 2015–25 Wildlife Action Plan will be ensured through the continued involvement of the existing partners and the development of new partnerships. Two new planning initiatives and one long-standing partnership will join many other partners in the implementation of the plan. These are described below.

The Minnesota Prairie Conservation Plan

The Minnesota Prairie Conservation Plan sets goals to protect the state's remaining native prairie, create prairie core areas and connecting corridors, and enhance the surrounding agricultural matrix

for wildlife by maintaining native perennial vegetation. The plan implements this conservation work using grass-based agriculture in ways that are cost effective and supported by local communities. Organizations and agencies that developed the plan include the Lessard-Sams Outdoor Heritage Council, Minnesota Board of Water and Soil Resources, Minnesota DNR, Minnesota Prairie Chicken Society, Pheasants Forever, The Conservation Fund, The Nature Conservancy, and the US Fish and Wildlife Service.

Staff revising Minnesota's Wildlife Action Plan worked in close partnership with the Prairie Conservation Plan staff to ensure that the two plans are complementary and that the Conservation Focus Area boundaries align with the Prairie Conservation Plan cores. The Prairie Conservation Plan will be a primary partner in the implementation of Minnesota's Wildlife Action Plan in the Prairie Parkland and Tallgrass Aspen Parkland Provinces.

Watershed Restoration and Protection Strategy (WRAPS)

The Minnesota Pollution Control Agency is implementing a watershed approach that includes a process to identify and address the threats to water quality in each major watershed. The Watershed Restoration and Protection Strategy includes monitoring water bodies, collecting and assessing data, developing strategies to restore and protect water bodies, and conducting restoration and protection projects in the watershed. Local units of government including watershed districts, municipalities, and soil and water conservation districts take the lead in developing and carrying out implementation plans. DNR staff participate in the WRAPS and provide opportunities for collaboration to improve watershed health.

Audubon Minnesota

Audubon Minnesota, in partnership with the DNR's Nongame Wildlife Program and others, began implementing the Important Bird Area (IBA) program in Minnesota in February 2003. Fifty-seven IBA sites covering 12,551,345 acres have been designated in Minnesota, 55 of which are represented in the Wildlife Action Network. Subsequently Audubon MN developed Implementation Blueprints for Minnesota Bird Conservation to further direct bird conservation efforts in the state. Audubon Minnesota will continue to be a primary partner in the implementation of the Wildlife Action Plan.

Implementation Structures

Division of Ecological and Water Resources

The DNR's Division of Ecological and Water Resources provides staff support and leadership for the implementation of the plan. This work is done in partnership with other DNR divisions and programs and external partners at the state, regional, and national levels. This plan puts greater emphasis than the previous plan on implementation through more formalized structures, as outlined below.

Regional Partnership Meetings

Biennial regional meetings with partners from within the DNR divisions and other agencies and organizations will be held in each DNR region beginning in early 2016. Wildlife Action Plan staff will coordinate with the Division of Ecological and Water Resources Regional Managers and staff in the planning and implementation of these meetings.

The need for a multi-partnership coordination structure was expressed by staff in all four DNR regions during meetings to discuss the revision of the Wildlife Action Plan and Conservation Focus Areas. Examples of regional partners include Tribal Governments, Soil and Water Conservation Districts, US Department of Agriculture Natural Resources Conservation Service, Minnesota Pollution Control Agency, Bureau of Water and Soil Resources, US Fish and Wildlife Service, US Forest Service, The Nature Conservancy, The Wildlife Society, Ducks Unlimited, and other land managers, including local and regional governments.

These meetings will accomplish the following:

- Provide opportunities to coordinate implementation of on-the-ground habitat conservation projects to meet Wildlife Action Plan objectives.
- Identify, prioritize, and develop Wildlife Action Plan projects to be implemented within one or more of the mapped Conservation Focus Areas. This could include assessing available resources needed to implement projects; selecting projects; reviewing new information on species and habitats that has become available; establishing clear results specific to SGCN or their habitats; developing Specific, Measurable, Attainable, Results-oriented and Time-bound (SMART) objectives; identifying conservation actions; defining project effectiveness; and implementing monitoring to evaluate and report on effectiveness.
- Recommend new Conservation Focus Areas for the region or revise the boundaries of existing Conservation Focus Areas.
- Address opportunities for watershed/landscape project planning within Conservation Focus Areas or the Wildlife Action Network. This can include considering how management objectives and actions at the site level can be coordinated across sites to sustain or enhance landscape-scale biological diversity and improve the ecological functionality of conservation lands and waters.

Division of Ecological and Water Resources Operational Planning

Wildlife Action Plan staff will work with the managers and staff to incorporate the Wildlife Action Plan into the Division of Ecological and Water Resources' operational and work planning:

- As part of annual work planning, Wildlife Action Plan staff will meet with the Division of Ecological and Water Resources Regional Managers and staff to identify priorities for the coming year and assess opportunities and resources available to implement Wildlife Action Plan objectives and conservation actions.
- Similar meetings will be held with the Minnesota Biological Survey and Nongame Wildlife Program managers and staff.
- Additional meetings will be held throughout the year as needed to evaluate progress and identify any issues or barriers to implementation.
- Because Division of Ecological and Water Resources regional staff work closely with staff from other divisions and many external partners within their regions, including local units of government, opportunities exist for involving partners in implementation of the Wildlife Action Plan through programs such as Reinvest In Minnesota Reserve, Conservation Reserve Program,

- Conservation Reserve Enhancement Program, Agricultural Conservation Easement Program, and the Minnesota Forest Legacy Program.
- Wildlife Action Plan staff in collaboration with division staff and supervisors will prepare annual work and spending plans to implement the Wildlife Action Plan.

Additional Implementation Actions

Refine and Add to the Wildlife Action Network and Conservation Focus Areas

Meeting the Wildlife Action Plan's goal of ensuring the long-term health and viability of Minnesota's wildlife with a focus on species that are rare, declining, or vulnerable to decline will require increasing the knowledge about SGCN and the priority areas within which to focus conservation actions over the next 10 years. The Minnesota Biological Survey does not yet have animal and native plant community survey data for all of Minnesota. This effort along with other surveys will provide important information for the identification of areas for inclusion in the Wildlife Action Network and the prioritization of Conservation Focus Areas. As this new information becomes available, staff will use the expert-based, GIS methodology described in Appendix E to further develop and refine the Wildlife Action Network, identify new Conservation Focus Areas, and revise the boundaries of existing Conservation Focus Areas over the next 10 years.

Maintain Species Technical Advisory Teams (STATS)

The DNR will maintain existing Species Technical Advisory Teams to provide guidance on surveying, monitoring, and implementing conservation actions for SGCN. The DNR will establish an invertebrate advisory team(s) to provide recommendations on how to most effectively implement invertebrate conservation including developing guidelines for prioritizing survey or monitoring efforts. Species Technical Advisory Teams will also participate in the review and revision of the SGCN list in preparation for the 2025 Wildlife Action Plan.

Maintain and Enhance the Capabilities of Minnesota's Natural Heritage Information System (NHIS)

SGCN and native plant community data are stored in Minnesota's Natural Heritage Information System (NHIS). This information system is considered the most current and comprehensive source of information on the state's rare wildlife resources and their habitats. Survey and observation information on Minnesota's wildlife species and the ecological communities that support wildlife populations is managed so that the information 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.

The DNR's Data Governance and Decision Support Program considers the collection, management, and use of quality information as fundamental to DNR's work. Effectively implementing Minnesota's Wildlife Action Plan will require additional resources to develop standardized data collection and management protocols and to train staff to enter data into the system in a timely manner so that the demands of a growing user base can be met. In addition the capabilities of the current system need to be expanded to adequately incorporate species and habitat monitoring information.

Develop Web-based Resources

Develop new and update current web resources, such as updating the Rare Species Guide and developing Wildlife Action Network and Conservation Focus Area GIS-based maps to assist partners with the implementation of the plan and reporting on its effectiveness.

Participate in Multistate, Ecoregional, and International Conservation Partnerships

Wildlife Action Plan staff will participate to the extent resources allow in conservation initiatives directed at the implementation of Wildlife Action Plans at multistate, ecoregional, and international scales, such as the State Wildlife Competitive Grant program and the US Fish and Wildlife Service's regional Landscape Conservation Cooperatives (Upper Midwest Great Lakes, Plains and Prairie Potholes, Eastern Tallgrass Prairie and Big Rivers). These and other regional initiatives (such as the Midwest Association of Fish and Wildlife Agency State Wildlife Action Plan Technical Committee) are essential to effectively conserving SGCN and their habitats in a changing climate and for assessing and reporting on the effectiveness of Wildlife Action Plans at landscape scales.

As resources allow, participation will also continue in international conservation initiatives that sustain or enhance habitats for Minnesota SGCN, such as the Southern Wings Program.

Communicate with Groups That Enhance Opportunities for the Public to Enjoy Wildlife

Wildlife Action Plan staff should communicate at least annually with representatives from groups such as those listed below to discuss opportunities to enhance opportunities for the public to enjoy SGCN and other wildlife and participate in their conservation.

- DNR, Division of Parks and Trails
- DNR, Scientific and Natural Areas Program
- DNR, Project Wet and Project Wild
- Bell Museum of Natural History
- Minnesota Science Museum
- Minnesota Zoo
- conservation organizations and local governmental units implementing citizen science or other programs
- regional and local parks and environmental learning centers

Invest Current Funds and Seek Additional Funding

- Direct the development, administration, and implementation of State Wildlife Grant–funded projects.
- Identify funding needs for SGCNs, initiate or supervise efforts to obtain outside funding for implementation of the Wildlife Action Plan by developing and defending proposals, and work with national partners to secure permanent federal funding for program implementation by participating in activities not defined as lobbying.
- Issue requests for proposals when funding is sufficient.

Chapter 7.

Funding Wildlife Conservation

Minnesota has several sources of funding for its nongame wildlife program and Wildlife Action Plan. A primary source of funding is the Nongame Wildlife checkoff on state income and property tax forms, which generates approximately \$1 million per year. Since 2007 these donations have been matched (up to \$1 million annually) by receipts from the sale of conservation license plates, and another \$900,000 is available annually from the federal State Wildlife Grant program. This amounts to approximately \$3 million a year in base funding to cover the conservation of over 1,000 diverse wildlife species, from birds to tiger beetles. Minnesota is fortunate to have several additional sources of conservation funding that while not dedicated to nongame wildlife conservation, have benefited nongame wildlife. These include the Environment and Natural Resources Trust Fund, which is derived from the sale of lottery tickets, and the Outdoor Heritage Fund, derived from state sales tax receipts. These two supplemental sources of funding are awarded to specific projects that meet the guidelines and goals of the funding sources. Projects funded by these two sources focus on habitat protection and management; only the Environmental and Natural Resources Trust Fund also funds monitoring, research, and survey projects. Many of the conservation actions included in the Minnesota's Wildlife Action Plan focus on acquiring information to help manage and conserve Species in Greatest Conservation Need through survey, monitoring, and research efforts. Successful implementation of Minnesota's Wildlife Action Plan will require increased and stable funding sources.

Conservation funding for game species has been provided through license fees and by a federal excise tax on sporting arms and ammunition since the 1930s. The nation's hunters have long supported preserving and restoring populations of game species. Funding through federal excise taxes has helped recover populations of wood ducks, Canada geese, white-tailed deer, elk, wild turkeys, and bighorn sheep by providing a stable funding source for states to use to conserve wildlife and its habitat. Additional conservation funding comes from state game bird and waterfowl stamps and federal waterfowl stamp revenues.

However, there are no comparable "licenses" required for wildlife watching or obligatory "birding stamps" to provide revenue to help fund the conservation of nongame wildlife. And there has not been enough popular or legislative support for a comparable excise tax on products associated with "wildlife watching" to fund conservation of the large number and diversity of species that are not hunted.

In September 2014 a national "Blue Ribbon Panel on Sustaining America's Diverse Fish and Wildlife Resources" was created with representatives from the public and private sector. The panel brings together two dozen leaders from the outdoor recreation, energy, agricultural, automotive, financial, educational, and conservation communities to discuss and offer recommendations on how to achieve greater and sustained funding for the conservation of the fully array of fish and wildlife species. By October 2015, the panel will provide recommendations for a twenty-first-century funding model for wildlife conservation that includes dedicated funding for the implementation of state Wildlife Action Plans. The panel will address the best and most equitable way to fund this conservation need, balancing goals such as promoting the sustainability of fish and wildlife while meeting the needs of society for clean air and water, land, food and fiber, dependable energy, economic development, and recreation.

In light of these significant funding needs, watchable wildlife recreation and tourism provide the biggest potential bridge to the future for generating the public support necessary to achieve increased funding for conservation of wildlife diversity at the national level. The 2011 National Survey of Fishing, Hunting and Wildlife-Associated Recreation provides information on the popularity and economic impact of wildlife-watching activities. The survey found that during 2011, 71.8 million US residents participated in wildlife-watching activities, an increase of 9 percent from 2001, and 1.6 million people participated in wildlife watching in Minnesota. This is about the same number of people engaged in hunting and fishing in Minnesota.

Nationwide wildlife watchers spent about \$54.9 billion in 2011 viewing, photographing, and feeding wildlife. These expenditures increased 43 percent from 2001. This increase is significant considering the economic recession experienced during this survey period. People spent \$621 million on wildlife-watching activities in Minnesota in 2011, including trip-related expenditures such as gas, food, and lodging. About \$170 million was spent by wildlife watchers on equipment such as binoculars, spotting scopes, cameras, tripods, field guides, and clothing. By comparison, hunters spent \$152,697,000 on firearms.

The strong participation in wildlife-watching activities and the associated expenditures can be linked to the economic benefits of supporting these activities and developing a stable, adequate funding source for implementing state Wildlife Action Plans. Healthy and diverse wildlife populations ranging from bald eagles and trumpeter swans to dragonflies, bees, and butterflies contribute to the creation of wildlife-watching opportunities in small rural communities as well as in metropolitan areas. Wildlife watching provides memorable and healthy outdoor experiences, diversifies the economic bases of the communities involved, and can extend a community's tourism season by providing recreational opportunities in "shoulder seasons" when tourism is otherwise diminished. Positive wildlife experiences can also solidify public support for funding additional wildlife conservation and habitat protection initiatives by federal, state, and local conservation agencies and organizations. Conservation actions to build upon this interest in wildlife watching and increase funding for the conservation of Species in Greatest Conservation Need are included in Goals 2 and 3 of the Wildlife Action Plan (see chapter 4).

Reference

U.S. Department of the Interior, U.S. Fish and Wildlife Service, and U.S. Department of Commerce, U.S. Census Bureau. 2011 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation.

Glossary of Terms and Acronyms

Terms

adaptive management. A decision process that promotes flexible decision making in the face of uncertainty or changing conditions, and allows for adaptation as the effect of management actions and outcomes become better understood. Monitoring of conservation actions and outcomes is a key component of adaptive management.

biological diversity. The variety of living organisms that are recognized and analyzed by biologists at three levels of organization: ecosystems; the species that comprise those ecosystems; and the genetic variability within those species (Wilson 2001). Species present in an ecosystem include animals, plants, fungi, protists, and bacteria and range enormously in size and ecological functions. **Functional diversity** (see definition) is an aspect of biological diversity that some scientists believe may be of particular importance to ecosystem resilience. Biological diversity can be measured at different spatial scales (Whittaker 1960):

- alpha-diversity: the number of species found in a small homogeneous area.
- beta-diversity: extent of change in species composition among habitats or communities.
- gamma-diversity: total species diversity in a landscape.

Conservation Focus Areas. Priority areas for working with partners to identify, design, and implement conservation actions and report on the effectiveness toward achieving the goals and objectives defined in the Wildlife Action Plan. Conservation Focus Areas are intended to focus conservation efforts over the next 10 years to maintain and enhance the resiliency of the Wildlife Action Network.

ecological classification system. A system used to identify, describe, and map progressively smaller areas of land with increasingly uniform ecological features. The system uses associations of biotic and environmental factors, including climate, geology, topography, soils, hydrology, and vegetation. Map units for six levels occur in Minnesota: Provinces, Sections, Subsections, Land Type Associations, Land Types, and Land Type Phases. For more information see <http://www.dnr.state.mn.us/ecs/index.html>.

ecological engineers. Species that alter the habitat to such a degree that they modify the fates and opportunities of other species (for example, beavers).

ecosystem function. The flows of energy and material in food webs and cycles.

ecosystem process. A natural phenomenon in an ecosystem that leads toward a particular result.

ecosystem services. The benefits that people obtain from ecosystems. These include a wide range of products and services that include provisioning services such as food, water, timber, and fiber; regulation services such as the regulation of climate, floods, disease, wastes, and water quality; cultural services such as recreation, aesthetic enjoyment, and spiritual fulfillment; and supporting services such as soil formation, photosynthesis, and nutrient cycling.

ecosystem structure. The distribution of energy, materials, and species.

ecotone. A region of transition between two biological communities.

focal species. Species that have key, broad-scale ecosystem-level effects. These species affect ecological systems in diverse ways and can be further described as **indicator species**, **keystone species**, **ecological engineers**, **umbrella species**, and **link species**. See separate definitions for these concepts.

functional diversity. Species that influence ecosystem dynamics such as stability, productivity, nutrient balance, and water purification. Functional groups of species are sets of species that have similar traits, which contribute to the likelihood that the group will be similar in its effects on ecosystem functioning (Tilman 2001). Another aspect of species function in ecosystems is **response diversity** (see definition). Measures of functional diversity can take various forms; some examples are as follows:

- functional richness: the number of functional groups present in an area.
- functional diversity: the number of functional groups present relative to the abundance of individuals within a functional group (Jost 2007, Tuomisto 2010).
- functional evenness: calculated as the quotient between functional diversity and functional richness (Tuomisto 2012).
- functional redundancy: the number of species contributing similarly to an ecosystem function (Laliberte et al. 2010) and can be measured as the average number of species within each functional group (Allen et al. 2005).
- cross-scale redundancy: the average number of spatial scales at which each function is represented (Allen et al. 2005).

habitat. A place (ecosystem) where a species lives and interacts with the physical environment and other species. Some species require multiple habitats at different stages in their life cycle.

hydrologic unit code (HUC). A mapping system of watersheds at nested scales, where a smaller number represents a coarser scale.

indicator species. Species that tell us about the status of other species and habitats or the impacts of a stressor.

keystone species. Species that have greater effects on ecological processes than would be predicted from their abundance or biomass alone.

Lakes of Biological Significance. <https://gisdata.mn.gov/dataset/env-lakes-of-biological-significance>

link species. Species that exert critical roles in the transfer of matter and energy across trophic levels (of a food web) or provide critical links for energy transfer within complex food webs.

MarXan. A conservation prioritization mapping software that assists in finding the most efficient ways of physically linking conservation target areas.

recruitment. The increase in a natural population as juveniles are born and survive, or immigrants arrive. Usually measured or detected by the presence of multiple age-classes of juveniles.

resilience. The capacity of a system to absorb disturbance and reorganize while undergoing change so as to still retain essentially the same function, structure, and feedbacks, and therefore identity (Folke et al. 2010).

response diversity. The variability of responses to environmental change among species contributing to the same ecosystem function (Elmqvist et al. 2003, Laliberte et al. 2010).

Sites of Biodiversity Significance. http://www.dnr.state.mn.us/eco/mcbs/biodiversity_guidelines.html

species. A population whose members are able to interbreed freely under natural conditions.

species viability. A viable species is one with self-sustaining and interacting populations that are well-distributed throughout the species' range. Self-sustaining populations are those that are sufficiently

abundant and have sufficient diversity to display the array of life-history strategies and forms to provide for their long-term persistence and adaptability over time. The definition of the term well-distributed can vary based on current, historic, and potential population and habitat conditions. Maintaining viability is a means of ensuring, as much as possible, that a species will not go extinct in the foreseeable future (U.S. Department of Agriculture. Committee of Scientists 1999).

status and trend monitoring. Long-term measurement of one or more variables, such as species abundance or water clarity, used to identify patterns of change and determine the state of one or more species, habitats, or ecosystems.

stewardship species. A stewardship species is defined as either:

- A. Species for which populations in Minnesota represent a significant portion of their North American breeding or wintering population, or
- B. Species whose Minnesota populations are stable, but whose populations outside of Minnesota have declined or are declining in a substantial part of their range.
- C. Species for which migrating populations congregating in Minnesota represent a significant portion of the North American population.

Stream Index of Biological Integrity. <http://www.pca.state.mn.us/index.php/water/water-monitoring-and-reporting/biological-monitoring/index-of-biological-integrity.html>

stressor. A condition that directly or indirectly negatively impacts a habitat or species.

target habitat. Habitats that are present in a Conservation Focus Area that are utilized by Species in Greatest Conservation Need and require management attention to be sustained or enhanced over time. Target habitats are identified for individual Conservation Focus Areas.

target species. An individual or group of Species in Greatest Conservation Need that inhabit target habitats and require special management attention or could serve as focal species for monitoring purposes. Target species are identified for individual Conservation Focus Areas.

umbrella species. Species that either have large area requirements or use multiple habitats and thus overlap the habitat requirements of many other species.

vulnerability assessment. A tool used in adaptation planning for informing the development and implementation of resource management practices. Vulnerability assessment as it pertains to climate change is usually structured around three distinct components: sensitivity, exposure, and adaptive capacity.

Wildlife Action Network. Mapped aquatic and terrestrial habitats, buffers, and connections that represent a diversity of quality habitats that contain populations of Species in Greatest Conservation Need.

Acronyms

AMSD	Adaptive Management Spatial Database
BMP	Best Management Practice
CFA	Conservation Focus Area
DNR	Department of Natural Resources

ECS	Ecological Classification System
END	Endangered
FOM	Fishes of Minnesota
GAP	National Gap Analysis Program (http://gapanalysis.usgs.gov/gaplandcover/)
GIS	Geographic Information System
GMT	Grassland Monitoring Team
HAPET	Habitat and Population Evaluation Team (http://www.fws.gov/midwest/hapet/)
HUC	Hydrologic Unit Code
IBA	Important Bird Area
IBI	Index of Biological Integrity
MBS	Minnesota Biological Survey
MPCA	Minnesota Pollution Control Agency
NGO	Non-Governmental Organization
NHIS	Natural Heritage Information System
NL	Not Listed
NRV	Natural Range of Variation
RCG	Reed Canary Grass
SGCN	Species in Greatest Conservation Need
SMART	Specific, Measurable, Attainable, Results-oriented and Time-bound
SNA	Scientific and Natural Area
SOBS	Sites of Biodiversity Significance
SPC	Special Concern
SPICE	Sustaining Prairies in a Changing Environment
STAT	Species Technical Advisory Team
THR	Threatened
WHAF	Watershed Health Assessment Framework
WRAPS	Watershed Restoration and Protection Strategy

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Conservation Focus Areas

Overview Sheets

Conservation Focus Areas

Introduction to Overviews

Conservation Focus Areas (CFA) are priority areas for working with partners to identify, design, and implement actions and to report on the effectiveness toward achieving the goals and objectives defined in the Wildlife Action Plan. Conservation Focus Areas are intended to focus conservation efforts over the next 10 years to maintain and enhance the resiliency of the Wildlife Action Network.

Conservation Focus Areas were selected to represent locations with Species in Greatest Conservation Need (SGCN) and habitat resources that need attention and have the opportunity, such as organized and willing partners or funding, to address those needs over the next 10 years. Conservation Focus Areas do not represent all of the important areas in the Wildlife Action Network for SGCN. Some important areas have received a great deal of attention in the past so that relatively little additional conservation work needs to be done; for other important areas, there may be limited opportunity to address their needs over the next 10 years.

The following pages summarize 36 Conservation Focus Areas, of which at least 6 will be identified for work over the next 10 years. The CFA overviews include a map showing the Wildlife Action Network, ownership, and orientation landmarks such as cities and major highways. The Wildlife Action Network is presented with scores based on five scalable metrics: SGCN population viability scores, SGCN richness, spatially prioritized Sites of Biodiversity Significance, ranks of Lakes of Biological Significance, and Stream Indices of Biological Integrity (IBI). Lower scores (green) in a given area indicate the scores for any of the five metrics were either low or zero, while high scores (red) indicate that multiple metrics with high scores overlap. See Appendix E for more details. Ownership includes federal, state, county, and municipal fee title lands as well as permanent conservation easements on private land.

Each Conservation Focus Area overview also provides a list of target habitats and SGCN present for that focus area. Target habitats are defined as habitats that are present in a Conservation Focus Area which are utilized by SGCN and require management attention to be sustained or enhanced over time. Target species are defined as individual or groups of SGCN that inhabit target habitats and require special management attention or could serve as focal species for monitoring purposes. The target habitats are presented as broad categories (e.g., Upland Hardwood Forest) with crosswalks to the MN DNR Native Plant Community Classification when available (see: <http://www.dnr.state.mn.us/npc/index.html>). Lakes, rivers, and surrogate grasslands do not have related native plant community classifications. Not all target habitats have associated target species listed as there may not be specific management needs or monitoring opportunities for species that use those habitats. The overview also contains examples of issues and approaches to address those issues related to the target habitats and species. This list is illustrative and not exhaustive. The target habitats, species, issues, and approaches will be reviewed and refined during implementation.

Implementation will consist of biennial regional meetings with partners from within the DNR divisions and other agencies and organizations to be held in each DNR region beginning in early 2016. Examples of regional partners include Tribal Governments, Soil and Water Conservation

Districts, US Department of Agriculture Natural Resources Conservation Service, Minnesota Pollution Control Agency, Bureau of Water and Soil Resources, US Fish and Wildlife Service, US Forest Service, The Nature Conservancy, The Wildlife Society, Ducks Unlimited, and other land managers, including local and regional governments. To the extent possible, CFA teams will utilize existing teams such as the Local Technical Teams organized for implementation of the Minnesota Prairie Conservation Plan.

These meetings will accomplish the following:

- Provide opportunities to coordinate implementation of on-the-ground habitat conservation projects to meet Wildlife Action Plan objectives.
- Identify, prioritize, and develop Wildlife Action Plan projects to be implemented within one or more of the mapped Conservation Focus Areas. This could include assessing available resources needed to implement projects; selecting projects; reviewing new information on species and habitats that has become available; establishing clear results specific to SGCN or their habitats; developing Specific, Measurable, Attainable, Results-oriented and Time-bound (SMART) objectives; identifying conservation actions; defining project effectiveness; and implementing monitoring to evaluate and report on effectiveness.
- Recommend new Conservation Focus Areas for the region or revise the boundaries of existing Conservation Focus Areas.
- Address opportunities for watershed/landscape project planning within Conservation Focus Areas or the Wildlife Action Network. This can include considering how management objectives and actions at the site level can be coordinated across sites to sustain or enhance landscape-scale biological diversity and improve the ecological functionality of conservation lands and waters.

Some conservation issues and approaches were not included in individual Conservation Focus Areas since they apply to most areas or have policy issues best addressed at a statewide scale. Examples of these are the following:

Example conservation issues	Example conservation approaches
Loss of wetlands	Apply Minnesota Wetland Conservation Act standards, and ensure replacement standards are followed.
Reduced incentives for conservation easements due to increased commodity prices	Influence Farm Bill policy: Make incentives match commodity prices, strategically target landowners within Wildlife Action Network.
Pesticide and herbicide impacts on pollinators and other invertebrates and insectivores	Provide Best Management Practices and habitat buffers.

Agassiz Beach Ridges

Targets, Conservation Issues, Approaches

Target Habitats (with NPC class/type):

Grassland-wetland complexes: ABR_CX-Agassiz Beach Ridge Complex, AIP_CX-Agassiz Interbeach Prairie Complex, PWL_CX-Prairie Wetland Complex, SEW_CX-Seepage Wetland Complex, SWP_CX-Saline Wet Prairie Complex

Prairie/grassland: UPn12b-Dry Sand-Gravel Prairie (Northern), UPn23b-Mesic Prairie (Northern), UPs13b-Dry Sand-Gravel Prairie (Southern), WPn53-Northern Wet Prairie, WPn53a-Wet Seepage Prairie (Northern), WPn53b-Wet Brush-Prairie (Northern), WPn53c-Wet Prairie (Northern), WPn53d-Wet Saline Prairie (Northern), also includes surrogate grasslands

Prairie streams (Buffalo River)

Open peatland: OPp93a-Calcareous Fen (Northwestern)

Wetland: MRn93-Northern Bulrush-Spikerush Marsh, MRp83-Prairie Mixed Cattail Marsh, MRp83a-Cattail-Sedge Marsh (Prairie), WMn82a-Willow-Dogwood Shrub Swamp, WMp73a-Prairie Meadow/Carr, WMs83a-Seepage Meadow/Carr, WMs92a-Basin Meadow/Carr

Target Species:

Prairie mammals: northern grasshopper mouse, prairie vole, Richardson's ground squirrel

Dry-mesic prairie birds: chestnut-collared longspur, grasshopper sparrow, greater prairie chicken, Henslow's sparrow, marbled godwit, upland sandpiper, western meadowlark

Wet prairie/sedge meadow birds: Le Conte's sparrow, Nelson's sparrow, Wilson's phalarope

Loggerhead shrike

Plains hog-nosed snake

Mussels: creek heelsplitter, black sandshell

Red-tailed leafhopper

Prairie butterflies: Aroga skipper, Assiniboin skipper, Dakota skipper, dusted skipper, Leonard's skipper, Poweshiek skipperling, Uhler's arctic, regal fritillary

Example conservation issues

Conversion of native habitat to agriculture or aggregate mining

Prairie and wetland habitat degradation due to invasive species

Habitat management impacts

Wind power development impacts on habitat quality

Example conservation approaches

Assess suitability to conversion through environmental review, Target land protection of prairie/grassland and wetland sites in the Wildlife Action Network using acquisition/easements.

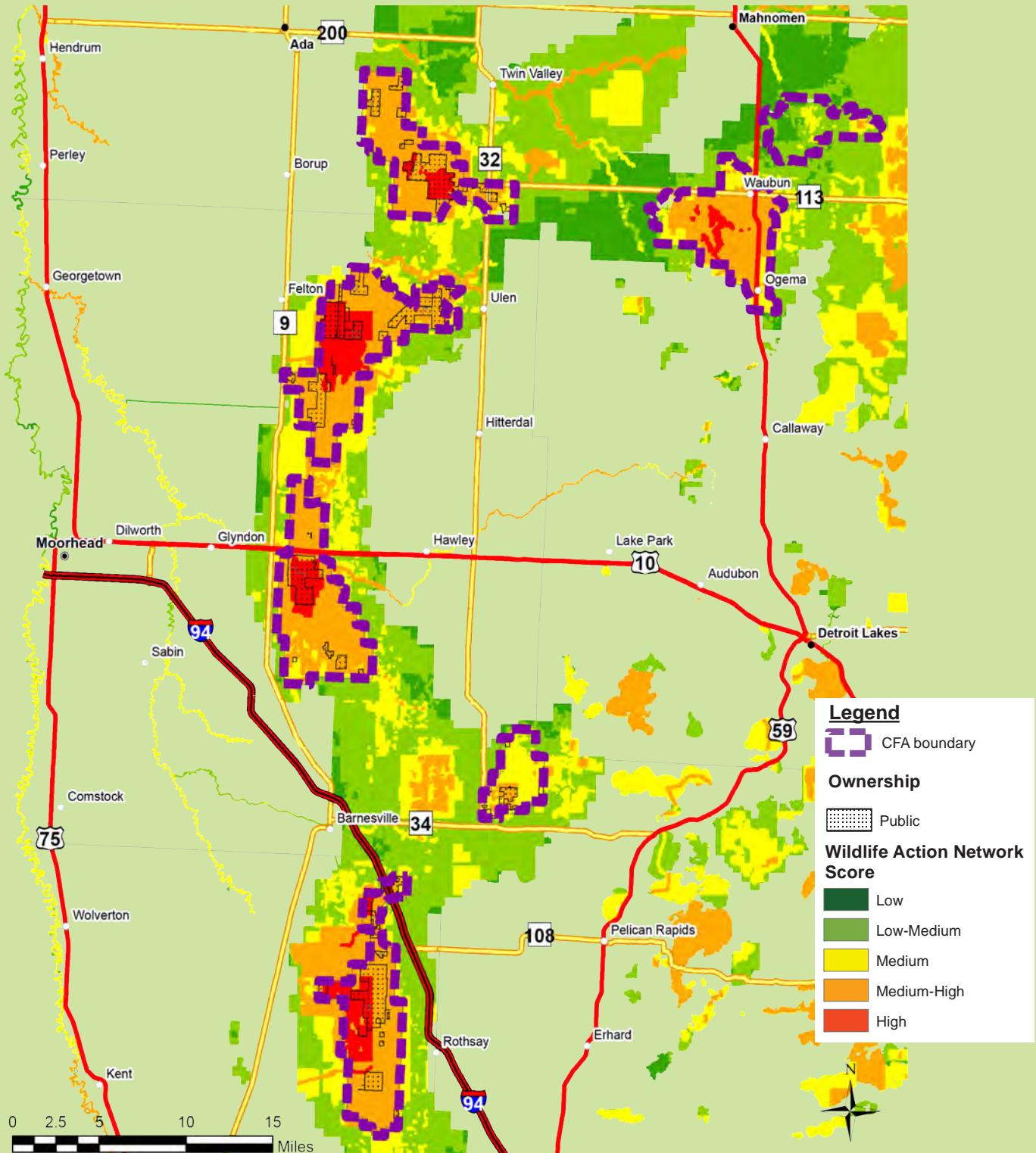
Natural disturbance management—use of prescribed fire, conservation grazing, haying in prairies as appropriate to maintain SGCN habitat. Remove woody species using mechanical removal from prairie/grassland habitat where natural disturbance management is not sufficient or feasible.

Alter frequency, timing, and extent of prescribed fires to minimize impacts on species with limited home-ranges and or mobility (such as invertebrate communities). Evaluate effects of conservation grazing on SGCN animal communities especially invertebrates, reptiles and mammals. Landscape-level coordination of management between landowners on individual protected parcels.

Provide guidelines for appropriate areas for siting of new towers to minimize habitat impacts.

Agassiz Beach Ridges

Conservation Focus Area



Aitkin Hardwoods

Targets, Conservation Issues, Approaches

Target Habitats (with NPC class/type):

Upland hardwood forest: MHc36-Central Mesic Hardwood Forest (Eastern), MHc47-Central Wet-Mesic Hardwood Forest, MHn35-Northern Mesic Hardwood Forest, MHn44-Northern Wet-Mesic Boreal Hardwood-Conifer Forest, MHn46-Northern Wet-Mesic Hardwood Forest, MHn47-Northern Rich Mesic Hardwood Forest

Wetland (forested): Vernal pool

Target Species:

Mature upland forest birds: red-shouldered hawk, wood thrush

Forest salamanders

Example conservation issues

Forest habitat degradation due to invasive species

Example conservation approaches

Monitor for new invasive species and utilize rapid treatment methods if detected.

Mature forest size requirements for SGCN habitat

Where possible, maintain large blocks of mature forest.

Reduced age, species, and structural diversity of mesic hardwood forests

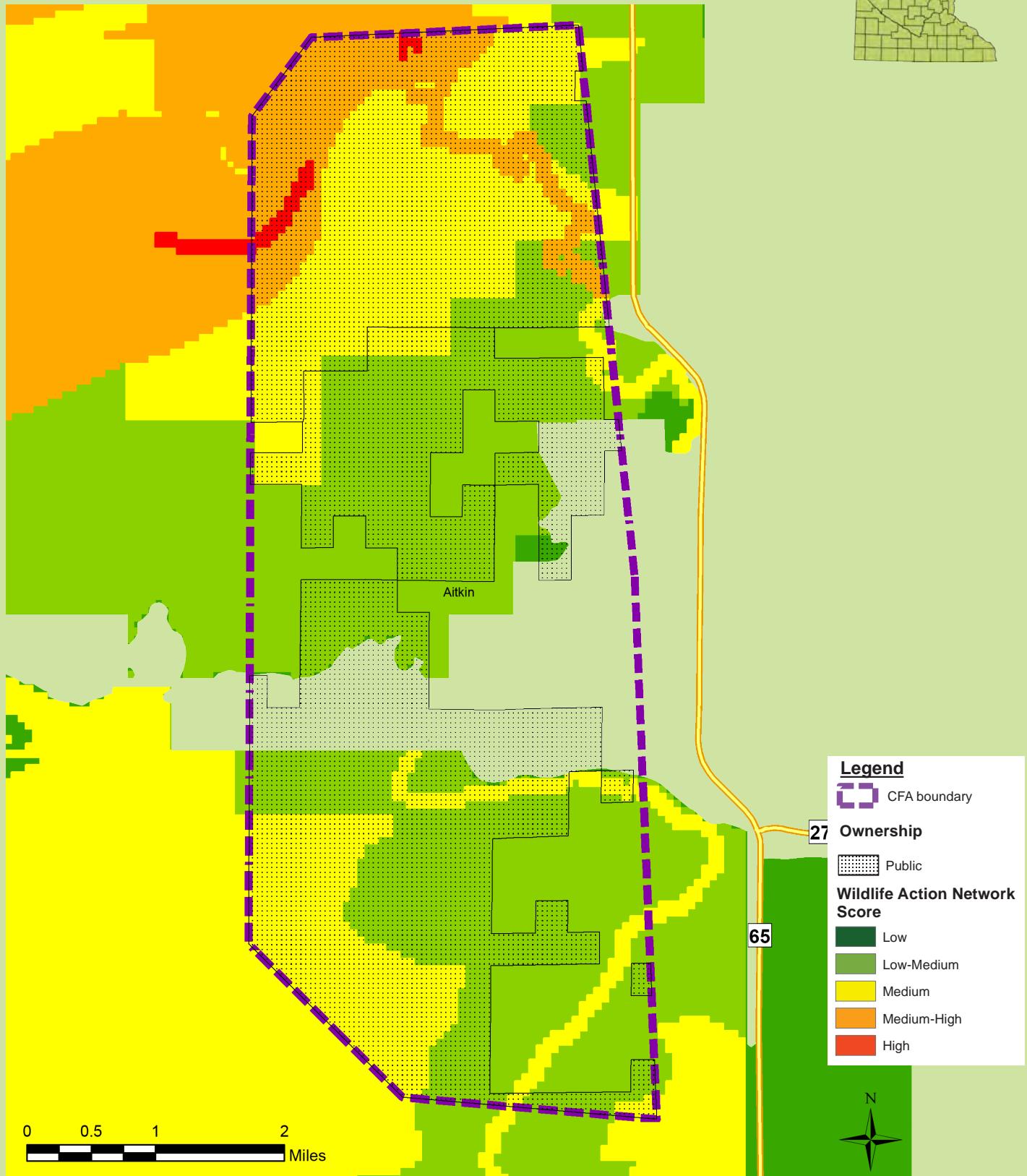
Manage for forests exhibiting mature characteristics such as multiple age-classes, snags, canopy gaps. Improve knowledge of the impacts of gap management on forest birds. Manage to increase plant species and structural diversity.

Degradation and loss of ephemeral wetlands (vernal pools)

Develop and implement Best Management Practices to reduce impacts to ephemeral wetlands (vernal pools). Improve knowledge of habitat requirements of salamanders that depend on vernal pools and adjacent upland habitat.

Aitkin Hardwoods

Conservation Focus Area



Altamont Moraine

Targets, Conservation Issues, Approaches

Target Habitats (with NPC class/type):

Grassland-wetland complexes: PWL_CX-Prairie Wetland Complex

Prairie / grassland: UPs13b-Dry Sand-Gravel Prairie (Southern), UPs13d-Dry Hill Prairie (Southern), UPs14-Southern Dry Savanna, UPs23-Southern Mesic Prairie, UPs23a-Mesic Prairie (Southern), WPs54-Southern Wet Prairie, also includes surrogate grasslands

Prairie stream ecosystems

Upland Hardwood Forest: MHS38b-Basswood-Bur Oak-(Green Ash) Forest, MHS39-Southern Mesic Maple-Basswood Forest, MHS49-Southern Wet-Mesic Hardwood Forest

Wetland: MRp83-Prairie Mixed Cattail Marsh, WMp73-Prairie Wet Meadow/Carr, WMp73a-Prairie Meadow/Carr, WMs83-Southern Seepage Meadow/Carr, WMs83a-Seepage Meadow/Carr, WMs92-Southern Basin Wet Meadow/Carr

Open Peatland: OPP93b-Calcareous Fen (Southwestern)

Target Species:

Prairie vole

Dry-mesic prairie birds: grasshopper sparrow, upland sandpiper, western meadowlark

Smooth greensnake

Prairie butterflies: Arogs skipper, Dakota skipper, dusted skipper, Leonard's skipper, Poweshiek skipperling, regal fritillary

Example conservation issues

Prairie/grassland loss and fragmentation

Groundwater depletion and contamination impacting municipal water availability, stream flows, and wetlands (especially calcareous fens)

Stream sedimentation and contamination, channelization, and impoundments, increased extreme rainfall events due to climate change

Prairie and wetland habitat degradation due to invasive species

Habitat management impacts

Management of shallow lakes for fish removal or vegetation objectives

Wind power effects on habitat quality

Example conservation approaches

Implement Minnesota Prairie Conservation Plan—buffer and connect prairie habitat.

Protect groundwater recharge areas using appropriate native vegetation.

Reduce channelization, maintain oxbows, enhance main stream connectivity, buffer stream banks with permanent, native vegetation.

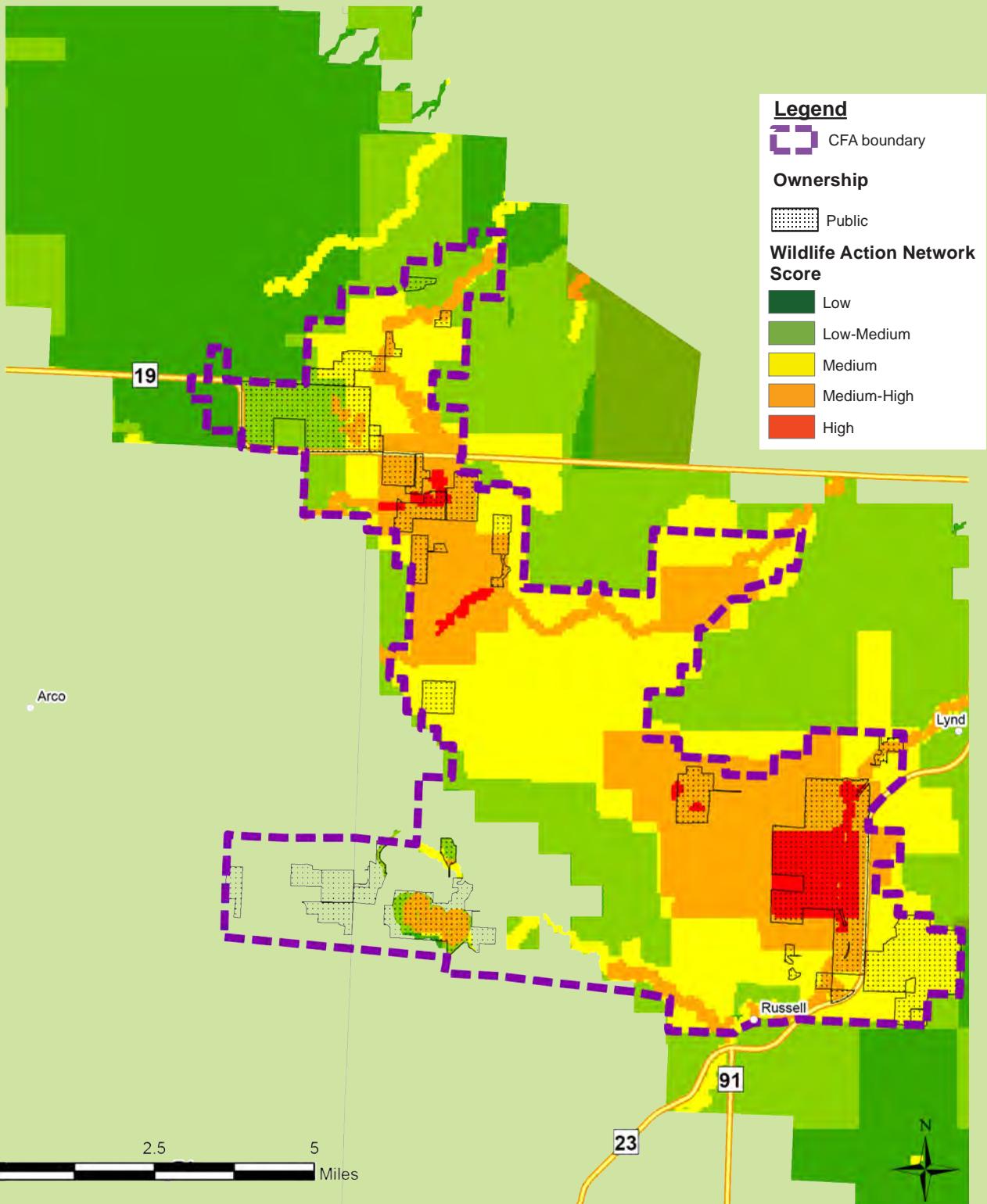
Natural disturbance management—use of prescribed fire, conservation grazing, haying in prairies as appropriate to maintain SGCN habitat. Remove woody species using mechanical removal from prairie/grassland habitat where natural disturbance management is not sufficient or feasible.

Alter frequency, timing, and extent of prescribed fires to minimize impacts on species with limited home-ranges and or mobility (such as invertebrate communities). Evaluate effects of conservation grazing on SGCN animal communities especially invertebrates, reptiles and mammals.

Coordinated approach to prioritize varying management needs for fish, amphibians, birds, and invasive species.

Provide guidelines for appropriate areas for siting of new towers to minimize habitat impacts.

Altamont Moraine Conservation Focus Area



Anoka Sand Plain

Targets, Conservation Issues, Approaches

Target Habitats (with NPC class/type):

Prairie/grasslands: UPs13a-Dry Barrens Prairie (Southern), UPs14a-Dry Barrens Oak Savanna (Southern), UPs14a2-Dry Barrens Oak Savanna (Southern), Oak Subtype, UPs14b-Dry Sand-Gravel Oak Savanna (Southern), WP54-Southern Wet Prairie, WP54b-Wet Prairie (Southern), also includes surrogate grasslands

Lowland conifer forest: FPs63a-Tamarack Swamp (Southern)

Wetlands (nonforested): MRn83-Northern Mixed Cattail Marsh, MRn93-Northern Bulrush-Spikerush Marsh, WMn82a-Willow-Dogwood Shrub Swamp, WMn82b-Sedge Meadow

Open Peatland: OPn92-Northern Rich Fen (Basin), OPn92a-Graminoid Rich Fen (Basin), OPp91-Prairie Rich Fen

Target Species:

Prairie mammals: American badger, plains pocket mouse

Dry-mesic prairie birds: eastern meadowlark, grasshopper sparrow

Woodland/savanna birds: brown thrasher, eastern towhee, eastern whip-poor-will, field sparrow, lark sparrow, red-headed woodpecker

Sand prairie reptiles: Blanding's turtle, gophersnake, plains hog-nosed snake, smooth greensnake

Prairie/dune invertebrates: dusky skipper, Leonard's skipper, Uncas skipper, *Pelegrina arizonis* (a jumping spider), northern barrens tiger beetle

Example conservation issues

Example conservation approaches

Habitat fragmentation

Target land protection in Wildlife Action Network through fee acquisition, easements, stewardship plans, Forest Legacy Program.

Impact of woody vegetation on grassland/savannah on SGCN species

Support savannah restoration efforts to improve habitat conditions for SGCN.

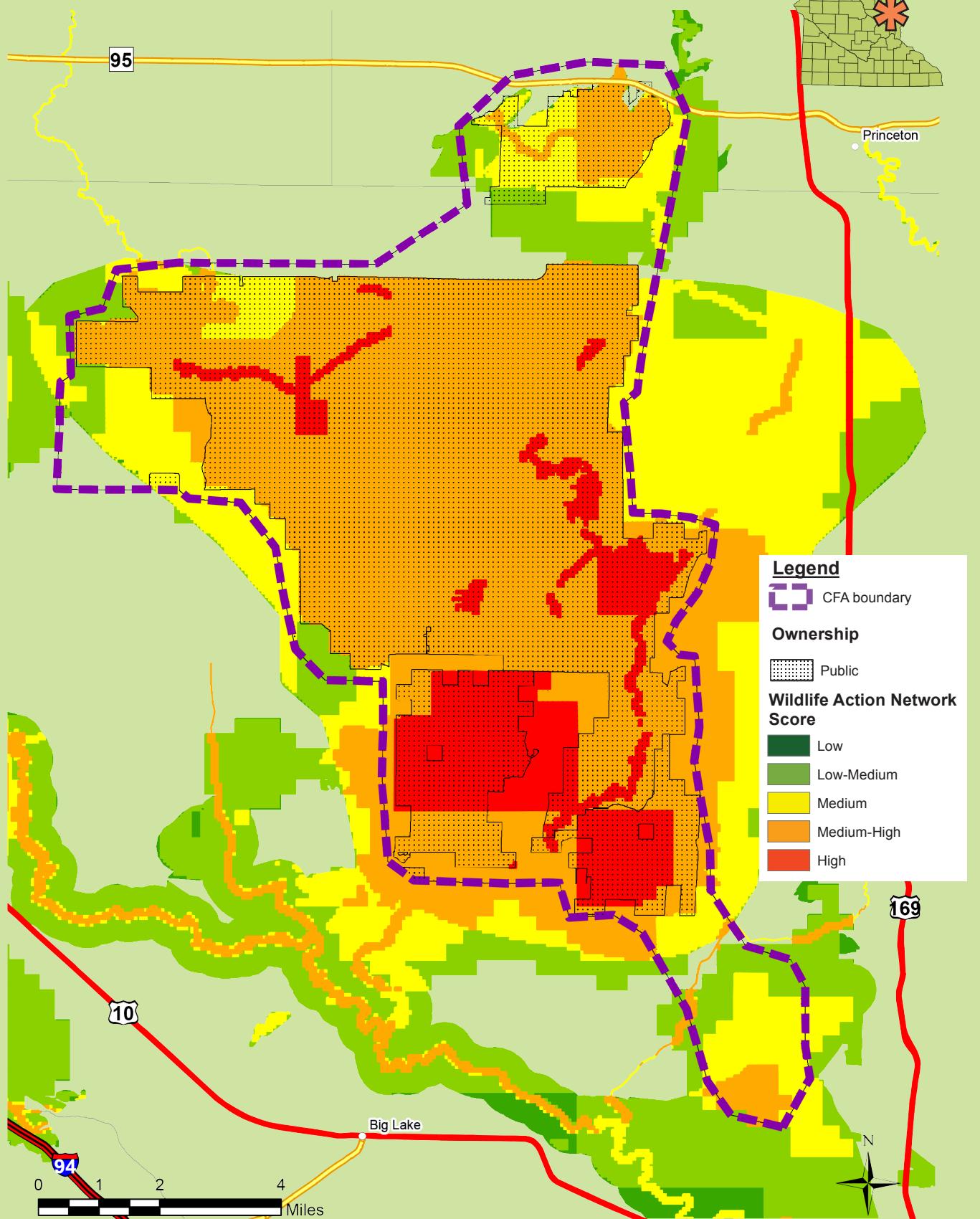
Prairie and wetland habitat degradation due to invasive species

Natural disturbance management—use of prescribed fire, conservation grazing, haying in prairies as appropriate to maintain SGCN habitat. Implement reed canary grass and invasive cattail control, monitor for new invasive species and utilize rapid treatment methods if detected. Remove woody species using mechanical removal from prairie/grassland habitat where natural disturbance management is not sufficient or feasible.

Habitat management impacts

Alter frequency, timing, and extent of prescribed fires to minimize impacts on species with limited home-ranges and or mobility (such as invertebrate communities). Evaluate effects of conservation grazing on SGCN animal communities especially invertebrates, reptiles and mammals. Research and trials of community restoration techniques. Provide management guidance.

Anoka Sand Plain Conservation Focus Area



Aspen Parklands

Targets, Conservation Issues, Approaches

Target Habitats (with NPC class/type):

Grassland-wetland complexes: AIP_CX-Agassiz Interbeach Prairie Complex, ASP_CX-Aspen Parkland Complex, ASR_CX-Agassiz Shoreline Ridge and Swale Complex, MFS_CX-Meadow-Marsh-Fen-Swamp Complex, PBW_CX-Parkland Brush Prairie-Wetland Complex, PWL_CX-Prairie Wetland Complex, SS_CX-Shrub Swamp Complex

Open Peatlands: OPp91-Prairie Rich Fen, OPp91a-Rich Fen (Mineral Soil), OPp91b-Rich Fen (Peatland), OPp91c-Rich Fen (Prairie Seepage), OPp93-Prairie Extremely Rich Fen, OPp93a-Calcareous Fen (Northwestern)

Shallow lakes

Prairie/grassland: UPn12a-Dry Barrens Prairie (Northern), UPn12b-Dry Sand-Gravel Prairie (Northern), UPn12c-Dry Sand-Gravel Brush-Prairie (Northern), UPn13-Northern Dry Savanna, UPn13b-Dry Barrens Oak Savanna (Northern), UPn13c-Dry Sand-Gravel Oak Savanna (Northern), UPn23a-Mesic Brush-Prairie (Northern), UPn23b-Mesic Prairie (Northern), UPn24b-Aspen Openings (Northern), WPn53a-Wet Seepage Prairie (Northern), WPn53b-Wet Brush-Prairie (Northern), WPn53c-Wet Prairie (Northern), WPn53d-Wet Saline Prairie (Northern), *also includes surrogate grasslands*

Prairie/forest complexes: AOX_CX-Aspen-Oak Woodland Complex, AWAF_CX-Aspen Woodland/Forest Complex, DPW_CX-Dry Prairie-Woodland Complex-Central, MSA_CX-Meadow-Marsh-Shrub Swamp-Wet Aspen Complex

Wetland (nonforested): MRn83-Northern Mixed Cattail Marsh, MRn83a-Cattail-Sedge Marsh (Northern), MRn83b-Cattail Marsh (Northern), MRn93-Northern Bulrush-Spikerush Marsh, MRp83a-Cattail-Sedge Marsh (Prairie), MRp93-Prairie Bulrush-Arrowhead Marsh, MRp93a-Bulrush Marsh (Prairie), WMn82b-Sedge Meadow, WMp73a-Prairie Meadow/Carr, WMs83a-Seepage Meadow/Carr, WMs92a-Basin Meadow/Carr

Target Species:

Mammals: elk, northern pocket gopher

Dry-mesic prairie birds: marbled godwit, short-eared owl, upland sandpiper, western meadowlark

Wet prairie/sedge meadow birds: Le Conte's sparrow, Nelson's sparrow, Wilson's phalarope, yellow rail

Wetland/shallow lake birds: Forster's tern, red-necked grebe, western grebe

Woodland/savanna birds: eastern towhee, eastern whip-poor-will

Reptiles: smooth greensnake, gophersnake

Prairie butterflies: Assiniboin skipper, Dakota skipper, dusted skipper, Garita skipperling, Poweshiek skipperling

Sandy tiger beetle

Example conservation issues

Conversion of native habitat to agriculture or aggregate mining

Example conservation approaches

Assess suitability to conversion through environmental review. Target land protection of prairie/grassland and wetland sites in the Wildlife Action Network using acquisition/easements.

Prairie and wetland habitat degradation due to invasive species

Natural disturbance management—use of prescribed fire, conservation grazing, haying in prairies as appropriate to maintain SGCN habitat. Implement reed canary grass and invasive cattail control, monitor for new invasive species and utilize rapid treatment methods if detected. Remove woody species using mechanical removal from prairie/grassland habitat where natural disturbance management is not sufficient or feasible.

Management of shallow lakes for fish removal

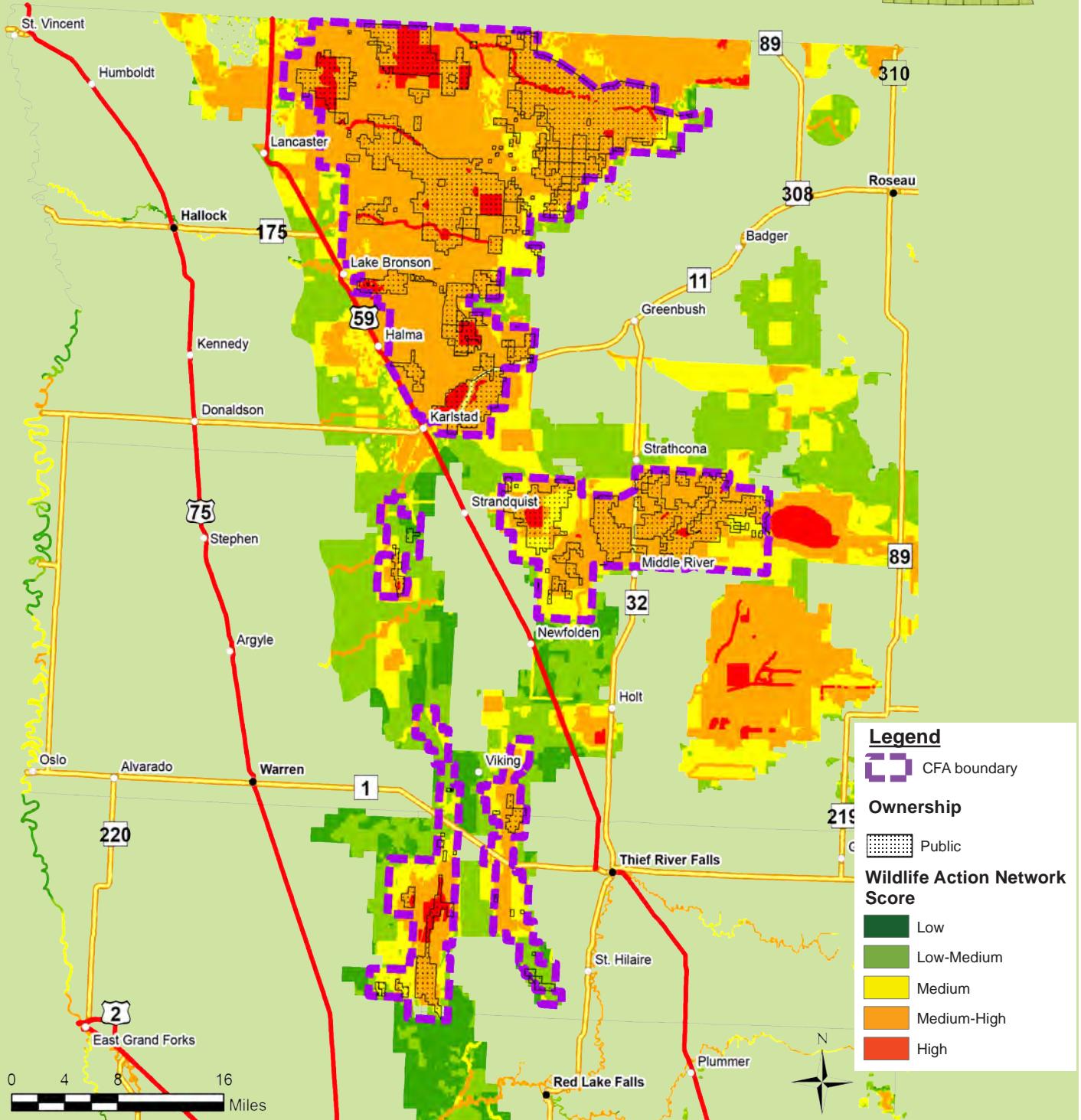
Coordinated approach to prioritize varying management needs for fish, amphibians, birds, and invasive species.

Habitat management impacts

Alter frequency, timing, and extent of prescribed fires to minimize impacts on species with limited home-ranges and or mobility (such as invertebrate communities). Evaluate effects of conservation grazing on SGCN animal communities especially invertebrates, reptiles and mammals.

Aspen Parklands

Conservation Focus Area



Avon Hills

Targets, Conservation Issues, Approaches

Target Habitats (with NPC class/type):

Upland hardwood forest: MHC36-Central Mesic Hardwood Forest (Eastern), MHC36a-Red Oak-Basswood Forest (Noncalcareous Till), MHS39c-Sugar Maple Forest (Big Woods), MHS49a-Elm-Basswood-Black Ash-(Hackberry) Forest

Lowland conifer forest: FPs63a-Tamarack Swamp (Southern)

Wetland (nonforested): WMn82a-Willow-Dogwood Shrub Swamp, WMn82b-Sedge Meadow

Target Species:

Mature upland forest birds: cerulean warbler, red-shouldered hawk, wood thrush

Example conservation issues

Forest fragmentation (urbanization)

Example conservation approaches

Target land protection in Wildlife Action Network through fee acquisition, easements, stewardship plans, Forest Legacy Program.

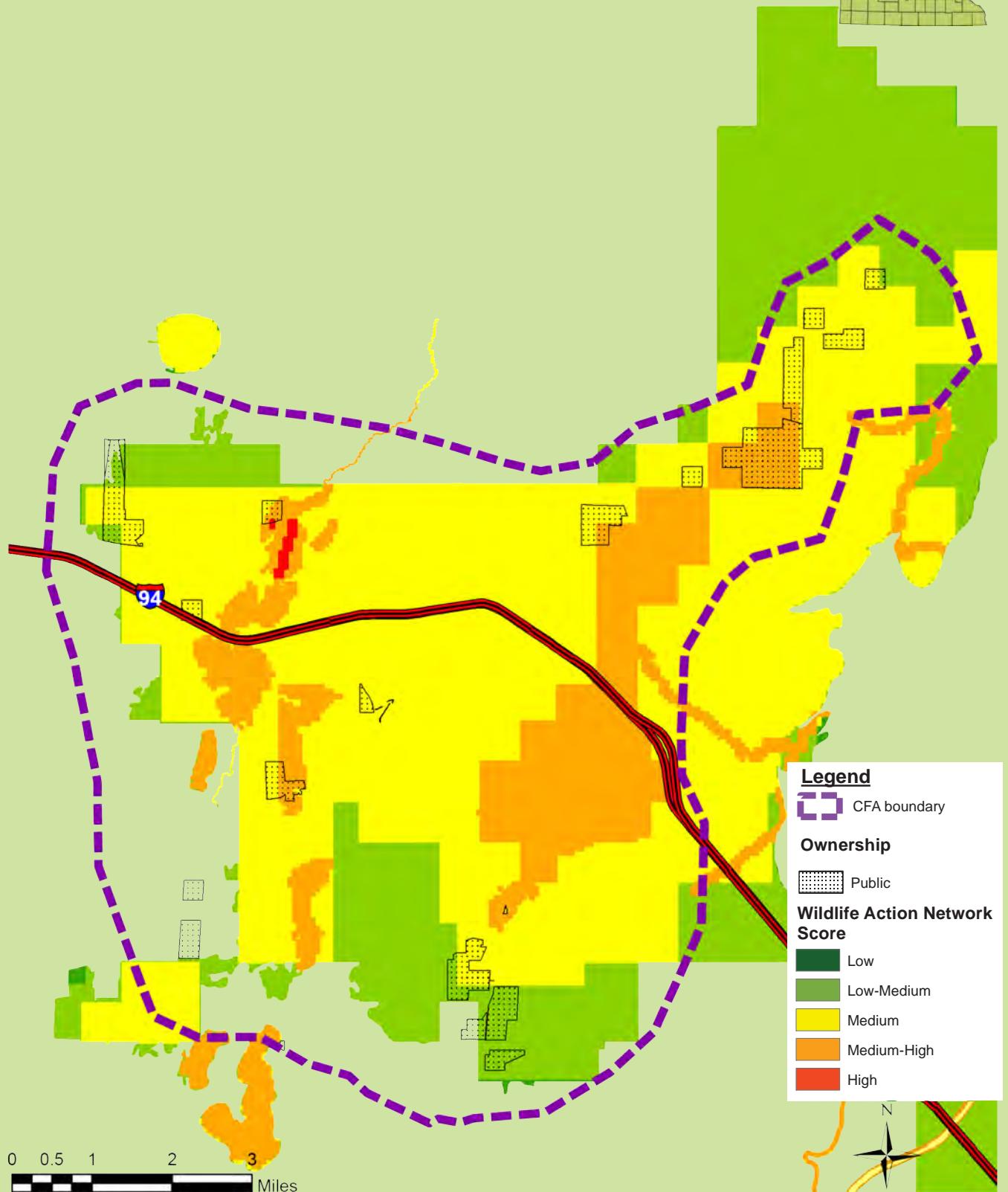
Degraded Conditions for Forest Interior Birds

Forest management plans to promote selective cutting and small patch cuts to minimize large gaps for cowbird nesting.

Forest and wetland habitat degradation due to invasive species

Remove invasive species from mesic forests. Implement reed canary grass and invasive cattail control, monitor for new invasive species and utilize rapid treatment methods if detected.

Avon Hills Conservation Focus Area



Big Rice-Lost Lake

Targets, Conservation Issues, Approaches

Target Habitats: (with NPC class/type):

Lowland conifer forest: AP-Acid Peatland System, FP-Forested Rich Peatland System

Upland deciduous forest: FDn32-Northern Poor Dry-Mesic Mixed Woodland, FDn33-Northern Dry-Mesic Mixed Woodland, FDn43-Northern Mesic Mixed Forest

Open peatland: OP-Open Rich Peatland System

Target Species:

Mature upland forest birds

Lowland conifer birds: boreal chickadee, Connecticut warbler

Other birds: northern goshawk, Philadelphia vireo

Dragonflies and damselflies

Example conservation issues

Example conservation approaches

Mature forest habitat size requirements for SGCN habitat Where possible, maintain large blocks of mature forest.

Species and structural diversity required for SGCN habitat and resilient forests Manage to maintain/increase plant species and structural diversity to improve quality habitat for forest SGCN and ensure more resilient forests.

Lowland conifer requirements for SGCN habitat Improve knowledge of pathogen management, clear cuts and the impact of gaps on lowland conifer bird habitat.

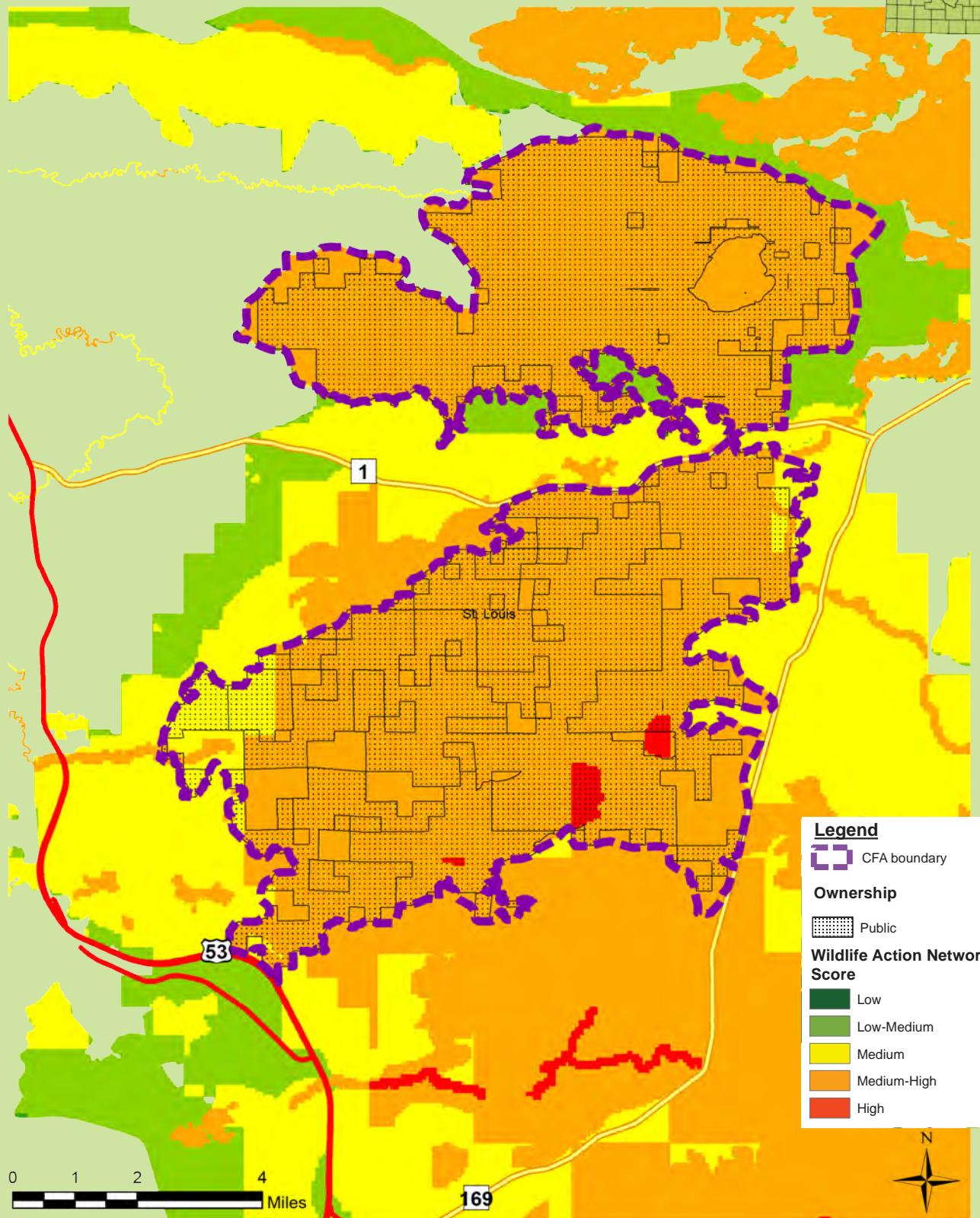
Maintain peatland hydrology Assess agricultural and mining conversion and management impacts to peatland hydrology.

Forest habitat degradation due to invasive species Monitor for new invasive species and utilize rapid treatment methods if detected.

Wetland loss Apply MN Wetland Conservation Act standards. Ensure replacement standards are followed. Regulate agricultural conversion of peatlands.

Big Rice-Lost Lake

Conservation Focus Area



Black Duck-Elephant

Targets, Conservation Issues, Approaches

Target Habitats: (with NPC class/type):

Lowland conifer forest: FPn63-Northern Cedar Swamp, WFn53-Northern Wet Cedar Forest, WFn64-Northern Very Wet Ash Swamp

Upland conifer forest

Deep lakes (Elephant Lake)

Target Species:

Lowland conifer birds: boreal chickadee, Connecticut warbler

Mature upland forest birds

Other birds: eastern whip-poor-will
northern goshawk

Example conservation issues

Mature forest size requirements for SGCN habitat

Example conservation approaches

Where possible, maintain large blocks of mature forest.

Species and structural diversity required for SGCN habitat and resilient forests

Manage to maintain/increase plant species and structural diversity to improve quality habitat for forest SGCN and ensure more resilient forests.

Reduced age, species, and structural diversity of mesic hardwood forests

Manage for forests exhibiting mature characteristics such as multiple age-classes, snags, canopy gaps.

Upland white cedar stressors: herbivory, reduce age classes, simplified structure, lack of regeneration

Reduce herbivory impacts through exclosures, bud capping, and landscape patterning. Selective cutting of hardwood stands to ensure remnant mature cedar.

Lowland conifer requirements for SGCN habitat

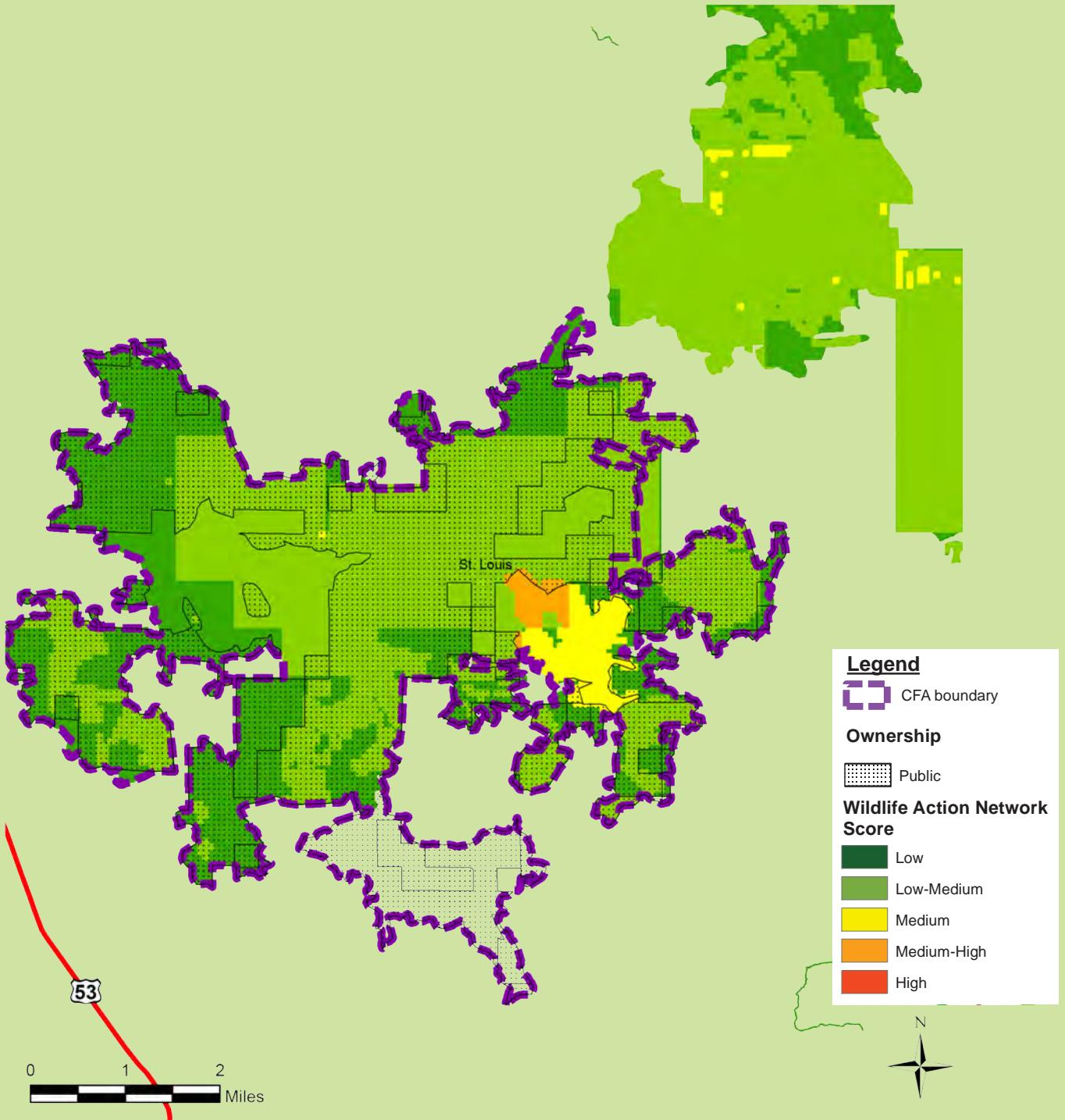
Improve knowledge of pathogen management, clear cuts, and the impact of gaps on lowland conifer bird habitat.

Forest habitat degradation due to invasive species

Monitor for new invasive species and utilize rapid treatment methods if detected.

Black Duck-Elephant

Conservation Focus Area



Bonanza Valley

Targets, Conservation Issues, Approaches

Target Habitats (with NPC class/type):

Prairie/grasslands: UPn12b-Dry Sand-Gravel Prairie (Northern), UPs13a-Dry Barrens Prairie (Southern), UPs13b-Dry Sand-Gravel Prairie (Southern), UP-s13c-Dry Bedrock Bluff Prairie (Southern), UPs13d-Dry Hill Prairie (Southern), UPs14c-Dry Hill Oak Savanna (Southern), UPs23a-Mesic Prairie (Southern), WPs54a-Wet Seepage Prairie (Southern), WPs54b-Wet Prairie (Southern), also includes surrogate grasslands

Grassland-Wetland complexes: FWMM_CX-Fen/Wet Meadow/Marsh Complex, MMS_CX-Meadow-Marsh-Fen-Swamp Complex, PWL_CX-Prairie Wetland Complex

Shallow Lakes

Wetland (nonforested): MRp83a-Cattail-Sedge Marsh (Prairie), MRp83b-Cattail Marsh (Prairie), MRp93c-Arrowhead Marsh (Prairie), WMn82b-Sedge Meadow, WMP73a-Prairie Meadow/Carr, WMs83a-Seepage Meadow/Carr, WMs83a1-Seepage Meadow/Carr, Tussock Sedge Subtype, WMs92a-Basin Meadow/Carr

Open Peatland: OPn92b-Graminoid-Sphagnum Rich Fen (Basin), OPP91a-Rich Fen (Mineral Soil), OPP91c-Rich Fen (Prairie Seepage), OPP93-Prairie Extremely Rich Fen, OPP93b-Calcareous Fen (Southwestern), OPP93c-Calcareous Fen (Southeastern)

Upland Hardwood Forest: FDs37b-Pin Oak-Bur Oak Woodland, MHs38b-Basswood-Bur Oak-(Green Ash) Forest

Target Species:

Dry-mesic prairie birds: grasshopper sparrow, marbled godwit, upland sandpiper, western meadowlark

Wetland/shallow lake birds: black-crowned night-heron, red-necked grebe, western grebe

Eastern newt

Plains hog-nosed snake

Fish: hornyhead chub, pugnose shiner

Red-tailed leafhopper

Prairie butterflies: Arogos skipper, Dakota skipper, dusky skipper, Leonard's skipper, Poweshiek skipperling, regal fritillary

Example conservation issues

Prairie/grassland loss and fragmentation

Groundwater depletion and contamination impacting municipal water availability, stream flows, and wetlands (especially calcareous fens)

Prairie, forest, and wetland habitat degradation due to invasive species

Management of shallow lakes for fish removal

Habitat management impacts

Example conservation approaches

Implement Minnesota Prairie Conservation Plan—buffer and connect prairie habitat.

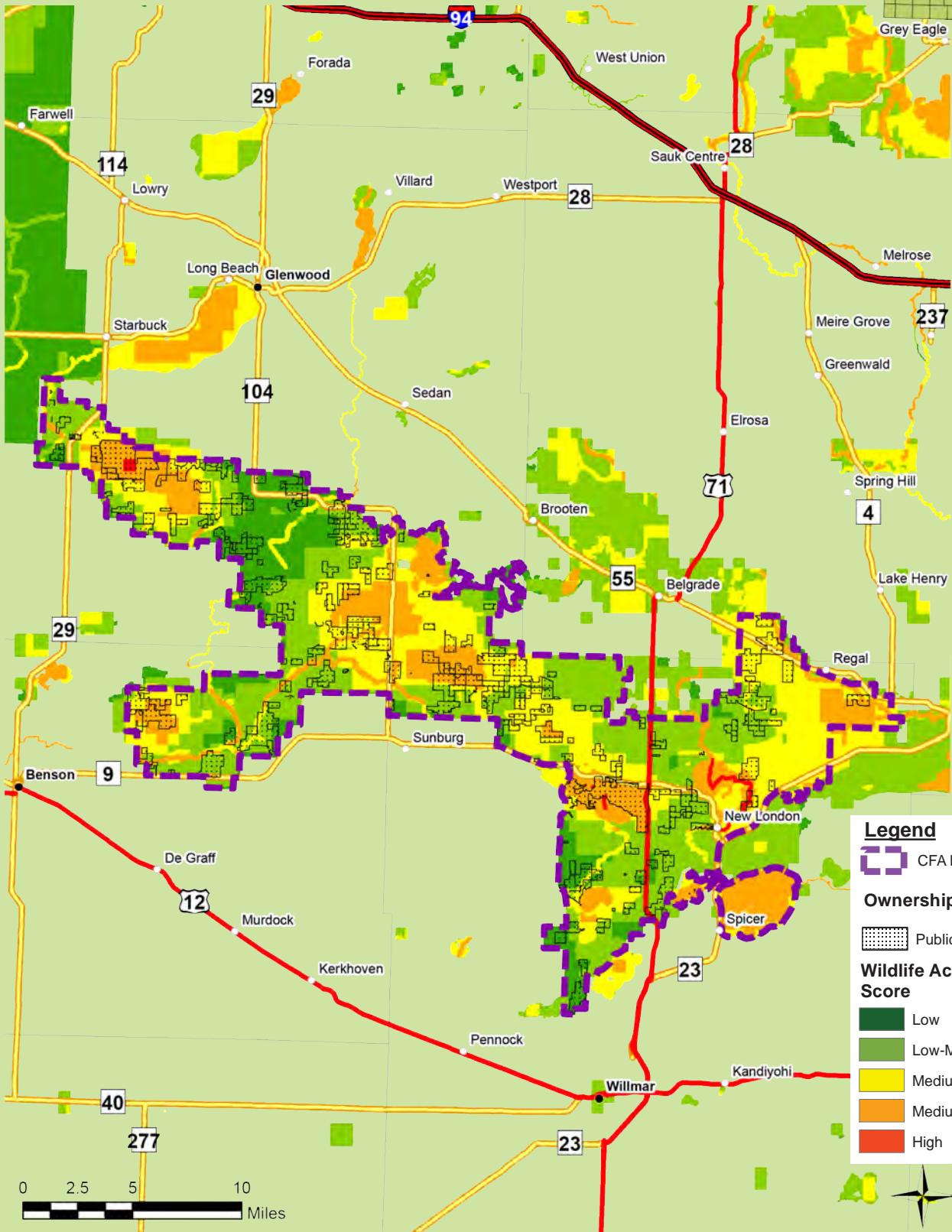
Protect groundwater recharge areas using appropriate native vegetation, monitor water levels in wetlands/ponds to help determine amount of groundwater pumping impacts.

Natural disturbance management—use of prescribed fire, conservation grazing, haying in prairies as appropriate to maintain SGCN habitat. Remove invasive species from forests. Implement reed canary grass and invasive cattail control, monitor for new invasive species and utilize rapid treatment methods if detected.

Coordinated approach to prioritize varying management needs for fish, amphibians, birds, and invasive species.

Alter frequency, timing, and extent of prescribed fires to minimize impacts on species with limited home-ranges and or mobility (such as invertebrate communities). Evaluate effects of conservation grazing on SGCN animal communities especially invertebrates, reptiles and mammals. Landscape level coordination of management between landowners on individual protected parcels.

Bonanza Valley Conservation Focus Area



Cedar River

Targets, Conservation Issues, Approaches

Target Habitats (with NPC class/type):

Native prairie and surrogate grasslands: UPs13b-Dry Sand-Gravel Prairie (Southern), UPs23a-Mesic Prairie (Southern), also includes surrogate grasslands

Prairie streams

Wetland (nonforested): MRp93c-Arrowhead Marsh (Prairie), WMs83a-Seepage Meadow/Carr

Lowland deciduous forest: FFs59a-Silver Maple-Green Ash-Cottonwood Terrace Forest, FFs68-Southern Floodplain Forest

Target Species:

Wood turtle

Slender madtom

SGCN Mussels

Prairie butterflies: Arogos skipper, dusted skipper, Poweshiek skipperling, regal fritillary

Caddisfly: *Hydroptila quinola*

Example conservation issues

Prairie/grassland loss and fragmentation

Groundwater depletion and contamination impacting municipal water availability, stream flows, and wetlands (especially calcareous fens)

Stream sedimentation and contamination, channelization, and impoundments, increased extreme rainfall events due to climate change

Prairie, forest, and wetland habitat degradation due to invasive species

Habitat management impacts

Wind power effects on habitat quality

Example conservation approaches

Buffer and connect prairie habitat.

Protect groundwater recharge areas using appropriate native vegetation.

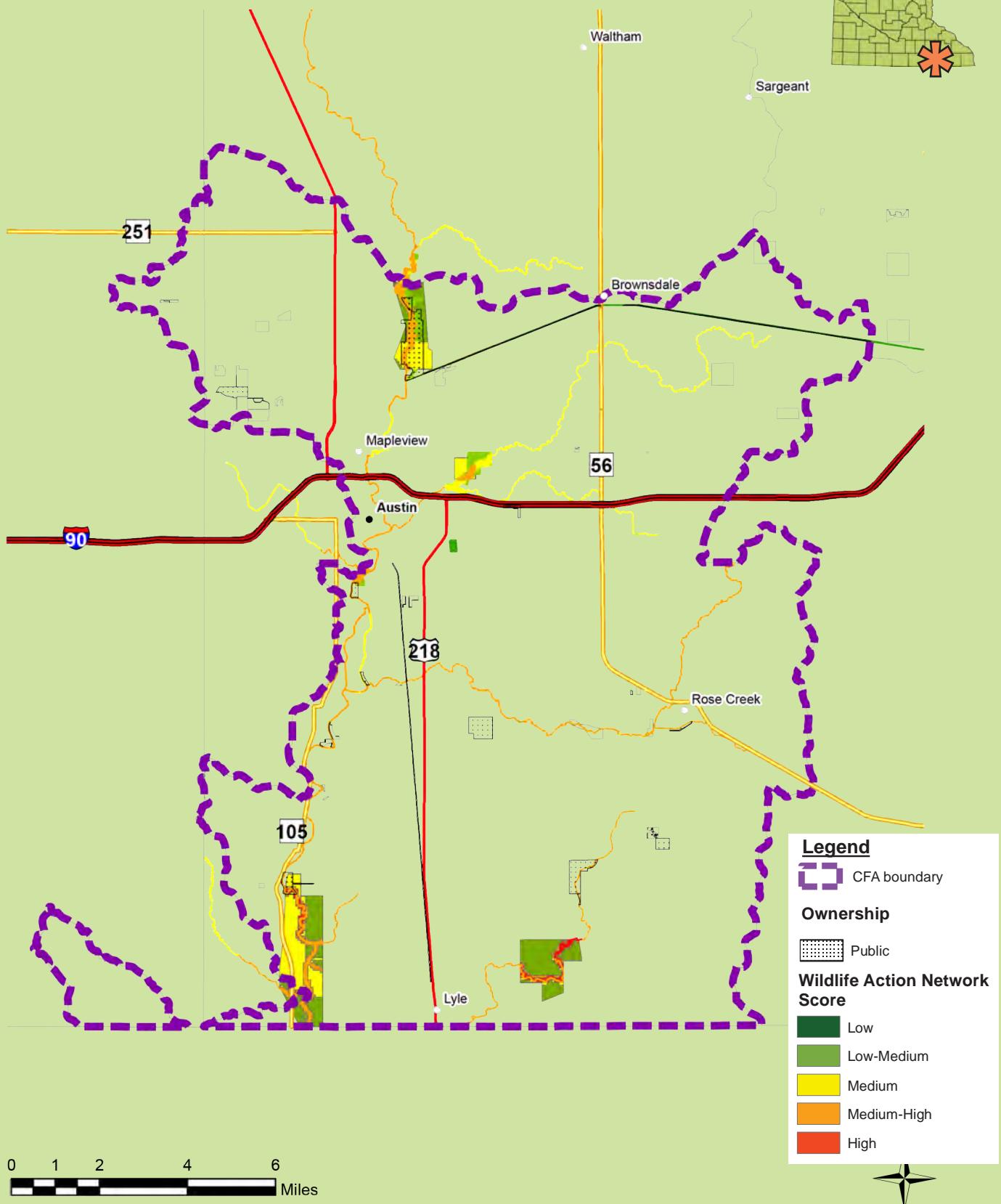
Reduce channelization, maintain oxbows, enhance main stream connectivity, buffer stream banks with permanent, native vegetation.

Natural disturbance management—use of prescribed fire, conservation grazing, haying in prairies as appropriate to maintain SGCN habitat. Remove invasive species from forests. Implement reed canary grass and invasive cattail control, monitor for new invasive species and utilize rapid treatment methods if detected.

Alter frequency, timing, and extent of prescribed fires to minimize impacts on species with limited home-ranges and or mobility (such as invertebrate communities). Evaluate effects of conservation grazing on SGCN animal communities especially invertebrates, reptiles and mammals.

Provide guidelines for appropriate areas for siting of new towers to minimize habitat impacts.

Cedar River Conservation Focus Area



Cloquet River

Targets, Conservation Issues, Approaches

Target Habitats: (with NPC class/type):

Lowland conifer forest: AFP_CX-Alder Swamp / Forested Peatland Complex, APn80a-Black Spruce Bog, APn81-Northern Poor Conifer Swamp, APn81a-Poor Black Spruce Swamp, APn81b-Poor Tamarack-Black Spruce Swamp, APn91-Northern Poor Fen, FPn62a-Rich Black Spruce Swamp (Basin), FPn63a-White Cedar Swamp (Northeastern), , FPn82-Northern Rich Tamarack Swamp (Western Basin), FPn82a-Rich Tamarack-(Alder) Swamp, WFn53-Northern Wet Cedar Forest, WFn64a-Black Ash-Conifer Swamp (Northeastern)

Lowland deciduous forest: FFn57a-Black Ash-Silver Maple Terrace Forest

Upland conifer forest: FDn32d-Jack Pine-Black Spruce Woodland (Sand), FDn33a1-Red Pine-White Pine Woodland, Balsam Fir Subtype, FDn33a2-Red Pine-White Pine Woodland, Mountain Maple Subtype, FDn43-Northern Mesic Mixed Forest, FDn43a-White Pine-Red Pine Forest, FDn12-Northern Dry-Sand Pine Woodland, FDn32-Northern Poor Dry-Mesic Mixed Woodland

Upland hardwood forest: MHn35b-Red Oak-Sugar Maple-Basswood-(Blue-bead Lily) Forest, MHn46-Northern Wet-Mesic Hardwood Forest, MHn46b-Black Ash-Basswood Forest

River/stream: Cloquet River

Target Species:

Mature upland forest birds

Lowland conifer forest birds: boreal chickadee, Connecticut warbler

Wood turtle

Mussels: black sandshell, creek heelsplitter

Dragonflies and damselflies: eastern least clubtail, riffle snaketail, subarctic bluet

Butterflies: arctic fritillary, Nabokov's blue, taiga alpine

Caddisfly: *Oxyethira itascae*

Example conservation issues

Maintain water quality, hydrology

Example conservation approaches

Maintain public ownership. Buffer tributary waterways from disturbance. Management of adjacent upland fire-dependent communities. In wood turtle habitat areas, restore fire to the forest management and silvicultural actions that enhance/maintain fire-dependent diversity

Mature forest size requirements for SGCN habitat

Where possible, maintain large blocks of mature forest, selective cutting.

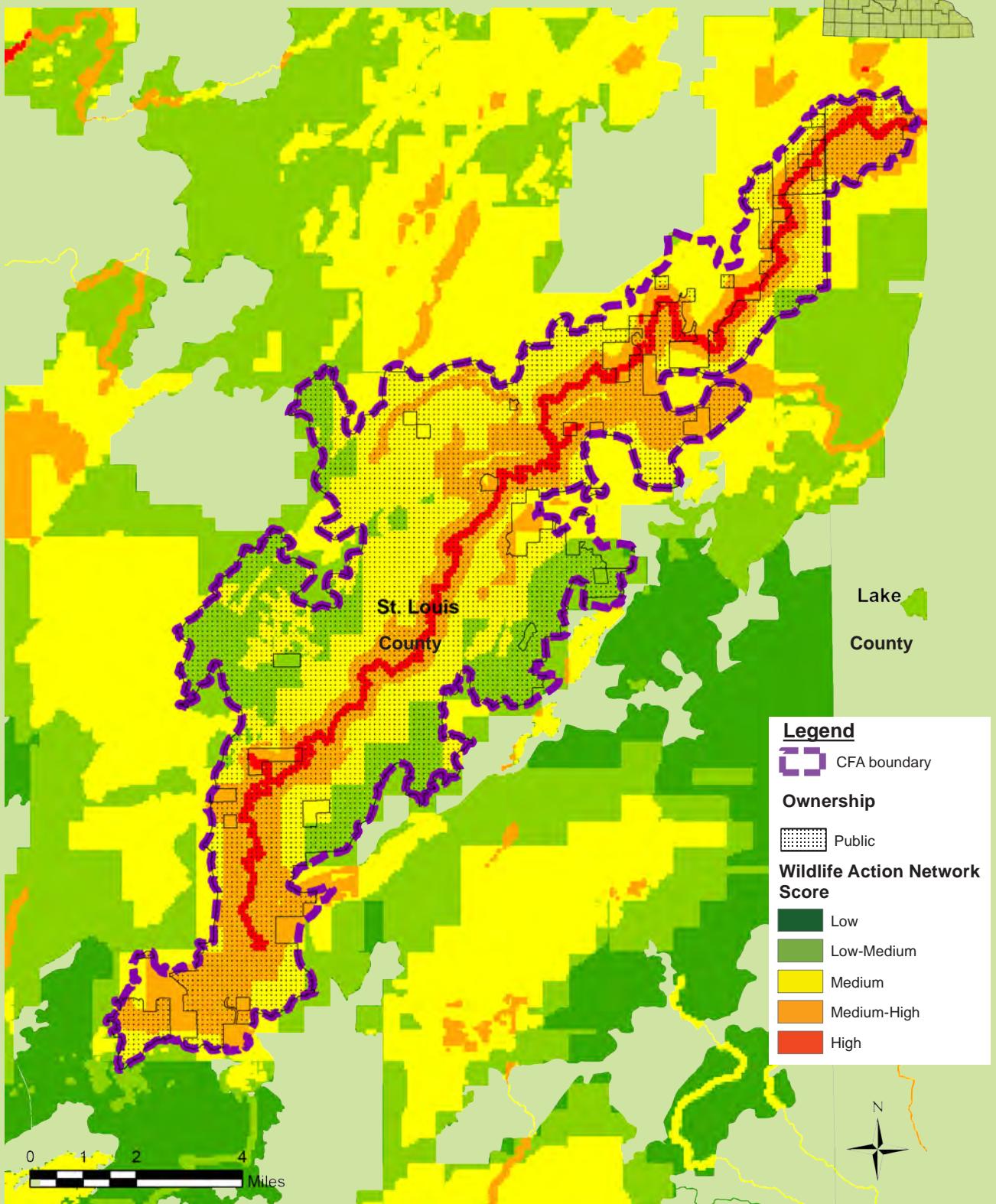
Lowland conifer requirements for SGCN habitat

Improve knowledge of pathogen management, clear cuts and gaps' impacts to lowland conifer bird habitat.

Forest habitat degradation due to invasive species

Monitor for new invasive species and utilize rapid treatment methods if detected.

Cloquet River Conservation Focus Area



Coon Creek

Targets, Conservation Issues, Approaches

Target Habitats (with NPC class/type):

Lowland conifer forest: FPn63b-White Cedar Swamp (Northcentral), FP-n82a-Rich Tamarack-(Alder) Swamp

Upland conifer forest: FDn12-Northern Dry-Sand Pine Woodland, FDn33a-Red Pine-White Pine Woodland, MHn44-Northern Wet-Mesic Boreal Hardwood-Conifer Forest

Upland hardwood forest: MHn35a-Aspen-Birch-Basswood Forest

Target Species:

Lowland conifer birds: boreal chickadee, Connecticut warbler

Mature upland forest birds

Northern goshawk

Example conservation issues

Mature forest size requirements for SGCN habitat

Example conservation approaches

Where possible, maintain large blocks of mature forest.

Lowland conifer requirements for SGCN habitat

Improve knowledge of pathogen management, clear cuts and the impact of gaps on lowland conifer bird habitat.

Limited pine regeneration

Manage for reproduction: thinning, low fuel burns, increase knowledge of new pathogens, reduce herbivory pressures.

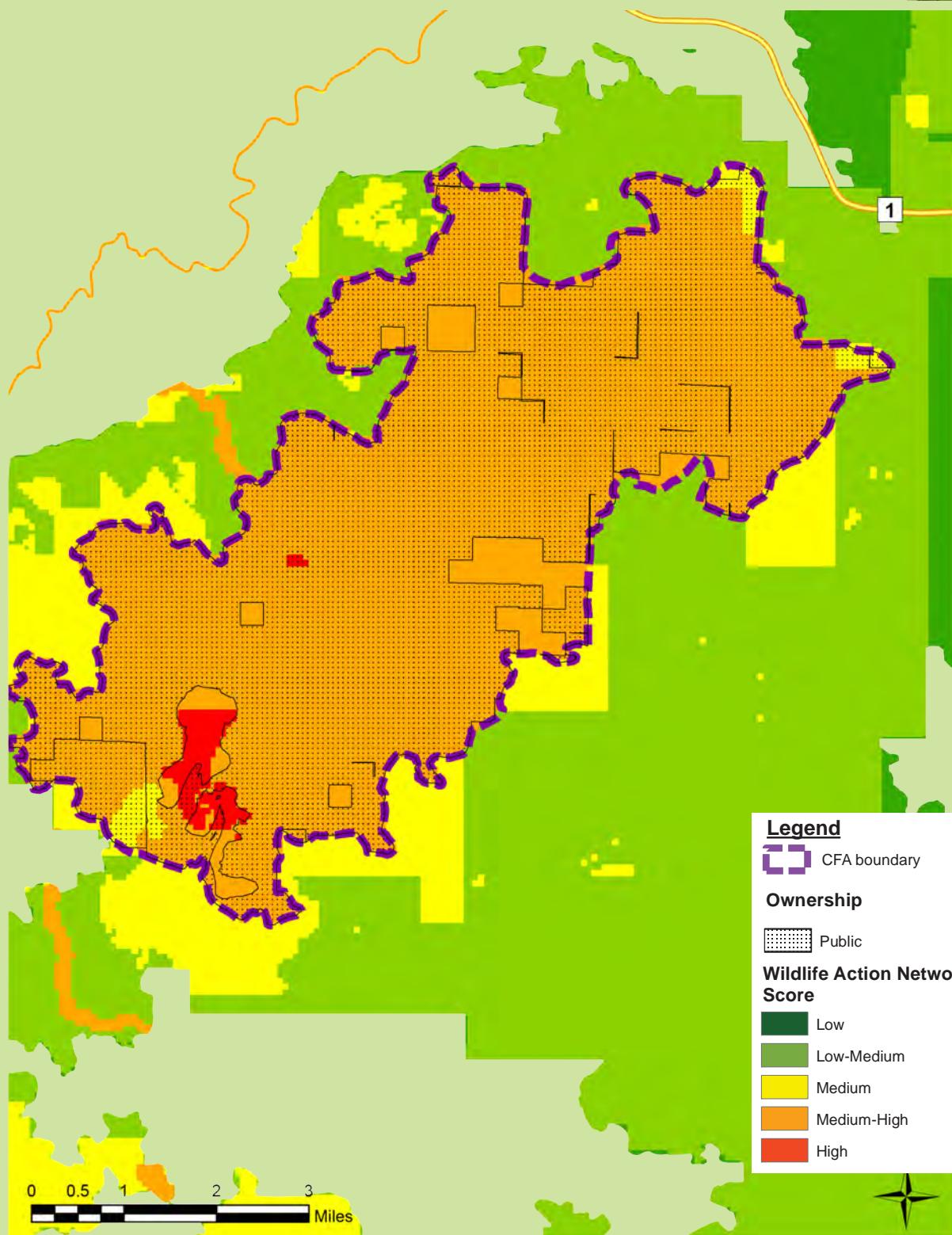
Species and structural diversity required for SGCN habitat and resilient forests

Manage to maintain/increase plant species and structural diversity to improve quality habitat for forest SGCN and ensure more resilient forests.

Forest habitat degradation due to invasive species

Monitor for new invasive species and utilize rapid treatment methods if detected.

Coon Creek Conservation Focus Area



Cornish Hardwoods

Targets, Conservation Issues, Approaches

Target Habitats (with NPC class/type):

Lowland conifer forest: APn80-Northern Spruce Bog, APn80a-Black Spruce Bog, APn80a1-Black Spruce Bog, Treed Subtype, APn80a2-Black Spruce Bog, Semi-Treed Subtype, APn81-Northern Poor Conifer Swamp, APn81a-Poor Black Spruce Swamp, APn81b-Poor Tamarack-Black Spruce Swamp, APn81b2-Poor Tamarack-Black Spruce Swamp, Tamarack Subtype, APn90-Northern Open Bog, APn91-Northern Poor Fen, APn91a-Low Shrub Poor Fen, APn91b-Graminoid Poor Fen (Basin), FPn62a-Rich Black Spruce Swamp (Basin), FPn63-Northern Cedar Swamp, FPn63b-White Cedar Swamp (Northcentral), FPn73-Northern Rich Alder Swamp, FPn73a-Alder-(Maple-Loosestrife) Swamp, FPn82-Northern Rich Tamarack Swamp (Western Basin), FPn82a-Rich Tamarack-(Alder) Swamp, FPn82b-Extremely Rich Tamarack Swamp, WFn53-Northern Wet Cedar Forest, WFn53b-Lowland White Cedar Forest (Northern), WFn64a-Black Ash-Conifer Swamp (Northeastern)

Open Peatland: OPn81-Northern Shrub Shore Fen, OPn81a-Bog birch-Alder Shore Fen, OPn92-Northern Rich Fen (Basin), OPn92a-Graminoid Rich Fen (Basin), OPn92b-Graminoid-Sphagnum Rich Fen (Basin)

Upland hardwood forest: MHn35-Northern Mesic Hardwood Forest, MHn35a-Aspen-Birch-Basswood Forest, MHn35b-Red Oak-Sugar Maple-Basswood-(Bluebead Lily) Forest, MHn44-Northern Wet-Mesic Boreal Hardwood-Conifer Forest, MHn44a-Aspen-Birch-Red Maple Forest, MHn46-Northern Wet-Mesic Hardwood Forest, MHn46b-Black Ash-Basswood Forest, MHn47-Northern Rich Mesic Hardwood Forest, MHn47b-Sugar Maple-Basswood-(Horsetail) Forest, FDc34b-Oak-Aspen Forest

Upland Conifer Forest: FDc34a-Red Pine-White Pine Forest, FDn33a-Red Pine-White Pine Woodland, FDn33b-Aspen-Birch Woodland

Wetland (forested): Vernal pool

Target Species:

Lowland conifer birds: Connecticut warbler

Mature upland forest birds: red-shouldered hawk, wood thrush

Forest salamanders: eastern red-backed salamander, four-toed salamander

Example conservation issues

Example conservation approaches

Mature forest size requirements for SGCN habitat

Where possible, maintain large blocks of mature forest.

Age, species, and structural diversity required for SGCN habitat and resilient forests

Manage to maintain/increase plant species and structural diversity to improve quality habitat for forest SGCN and ensure more resilient forests. Manage for forests exhibiting mature characteristics such as multiple age-classes, snags, and canopy gaps.

Forest habitat degradation due to invasive species

Monitor for new invasive species and utilize rapid treatment methods if detected.

Degradation and loss of ephemeral wetlands (vernal pools)

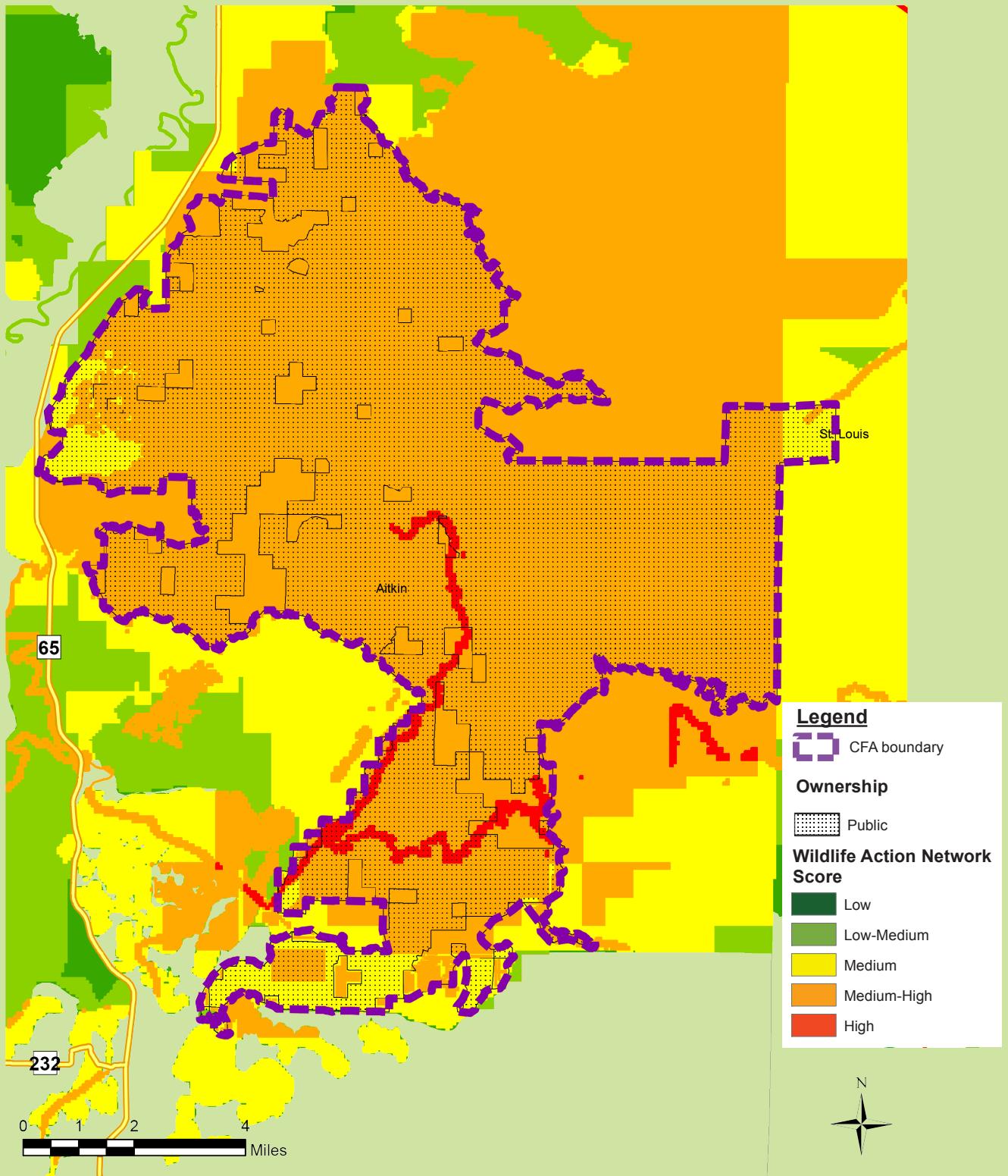
Develop and implement Best Management Practices to reduce impacts to ephemeral wetlands (vernal pools). Improve knowledge of habitat requirements of salamanders that depend on vernal pools and adjacent upland habitat.

Lowland conifer requirements for SGCN habitat

Improve knowledge of pathogen management, clear cuts and the impact of gaps on lowland conifer bird habitat.

Cornish Hardwoods

Conservation Focus Area



Cottonwood River-Red Rock Ridge

Targets, Conservation Issues, Approaches

Target Habitats (with NPC class/type):

Grassland-wetland complexes: PWL_CX-Prairie Wetland Complex

Prairies/grasslands: UPs13b-Dry Sand-Gravel Prairie (Southern), UPs13d-Dry Hill Prairie (Southern), UPs23a-Mesic Prairie (Southern), WPs54b-Wet Prairie (Southern), also includes surrogate grasslands

Wetland: WMp73a-Prairie Meadow/Carr, WMs83a-Seepage Meadow/Carr

Cliff/Talus community: CTs12c-Dry Sioux Quartzite Cliff (Southern)

Rock outcrop communities: ROs12a2-Crystalline Bedrock Outcrop (Prairie), Sioux Quartzite Subtype

Target Species:

Dry-mesic prairie birds: grasshopper sparrow, Henslow's sparrow, upland sandpiper, western meadowlark

Great plains toad

Blanding's turtle

Prairie butterflies: Arogos skipper, dusted skipper, Poweshiek skipperling, regal fritillary

Example conservation issues

Increased flashiness of river flows due to extreme rainfall events causing sedimentation, undercutting of banks, vertical separation from oxbows and floodplain wetlands

Prairie and wetland habitat degradation due to invasive species

Prairie/grassland loss and fragmentation

Habitat management impacts

Conversion of native habitat to agriculture or aggregate mining

Example conservation approaches

Promote infiltration practices in cultivated and urbanized landscapes; restore riparian cross-sections, connect floodplains with main channels.

Natural disturbance management—use of prescribed fire, conservation grazing, haying in prairies as appropriate to maintain SGCN habitat. Implement reed canary grass and invasive cattail control, monitor for new invasive species and utilize rapid treatment methods if detected. Remove woody species using mechanical removal from prairie/grassland habitat where natural disturbance management is not sufficient or feasible.

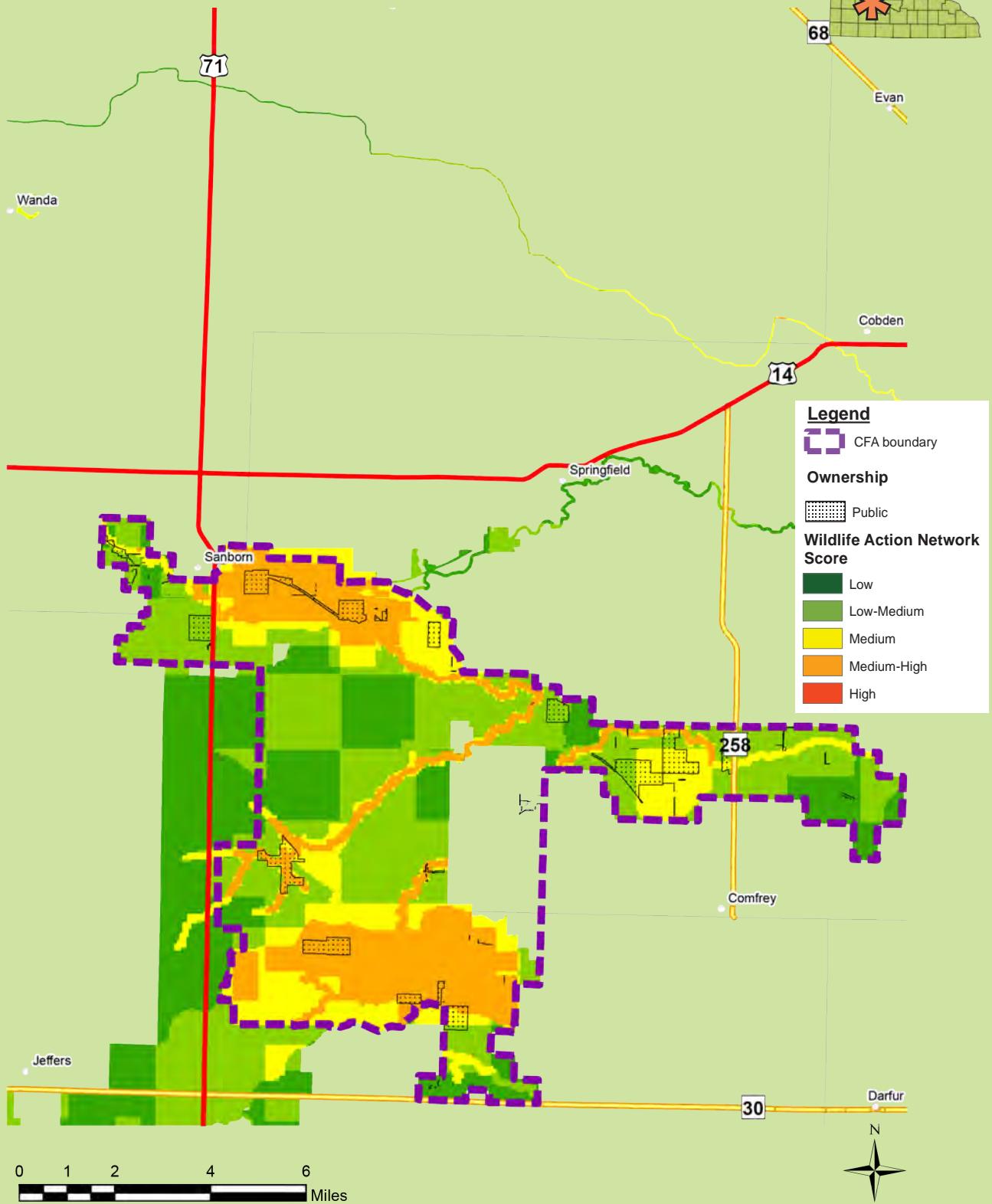
Implement Minnesota Prairie Conservation Plan-buffer and connect prairie habitat.

Alter frequency, timing, and extent of prescribed fires to minimize impacts on species with limited home-ranges and or mobility (such as invertebrate communities and Blanding's turtles). Evaluate effects of conservation grazing on SGCN animal communities especially invertebrates, reptiles and mammals.

Assess suitability to conversion through environmental review. Target land protection of prairie/grassland, wetland, and rock outcrop sites in the Wildlife Action Network using acquisition/easements.

Cottonwood River-Red Rock Ridge

Conservation Focus Area



Des Moines River Valley

Targets, Conservation Issues, Approaches

Target Habitats (with NPC class/type):

Grassland-wetland complexes: PWL CX-Prairie Wetland Complex

Prairie/grassland: UPs13-Southern Dry Prairie, UPs23-Southern Mesic Prairie, WP54-Southern Wet Prairie, *also includes surrogate grasslands*

Prairie streams

Open peatland: OPP93b-Calcareous Fen (Southwestern)

Shallow lakes (Heron Lake)

Wetlands: MRp83-Prairie Mixed Cattail Marsh, WMp73-Prairie Wet Meadow/Carr, WMs83-Southern Seepage Meadow/Carr, WMs83a-Seepage Meadow/Carr, WMs92-Southern Basin Wet Meadow/Carr

Upland hardwood forest: MHS38-Southern Mesic Oak-Basswood Forest, MHS38b-Basswood-Bur Oak-(Green Ash) Forest, MHS39-Southern Mesic Maple-Basswood Forest, MHS49-Southern Wet-Mesic Hardwood Forest, MHS49a-Elm-Basswood-Black Ash-(Hackberry) Forest

Target Species:

Dry-mesic prairie birds: grasshopper sparrow, Henslow's sparrow, upland sandpiper, western meadowlark

Wetland/shallow lake birds: black-crowned night heron, black tern, Forster's tern, red-necked grebe, western grebe, yellow-headed blackbird

Blanding's turtle

Great Plains toad

Prairie butterflies: Arogos skipper, dusted skipper, Poweshiek skipperling, regal fritillary

Example conservation issues

Prairie/grassland loss and fragmentation

Groundwater depletion and contamination impacting municipal water availability, stream flows, and wetlands (especially calcareous fens)

Stream sedimentation and contamination, channelization, and impoundments, increased extreme rainfall events due to climate change

Prairie and wetland habitat degradation due to invasive species

Terrestrial habitat management impacts

Management of shallow lakes for fish removal or vegetation objectives

Shallow lakes water level fluctuation

Example conservation approaches

Implement Minnesota Prairie Conservation Plan-buffer and connect prairie habitat.

Protect groundwater recharge areas using appropriate native vegetation.

Reduce channelization, maintain oxbows, enhance main stream connectivity, buffer stream banks with permanent, native vegetation.

Natural disturbance management—use of prescribed fire, conservation grazing, haying in prairies as appropriate to maintain SGCN habitat. Implement reed canary grass and invasive cattail control, monitor for new invasive species and utilize rapid treatment methods if detected. Remove woody species using mechanical removal from prairie/grassland habitat where natural disturbance management is not sufficient or feasible.

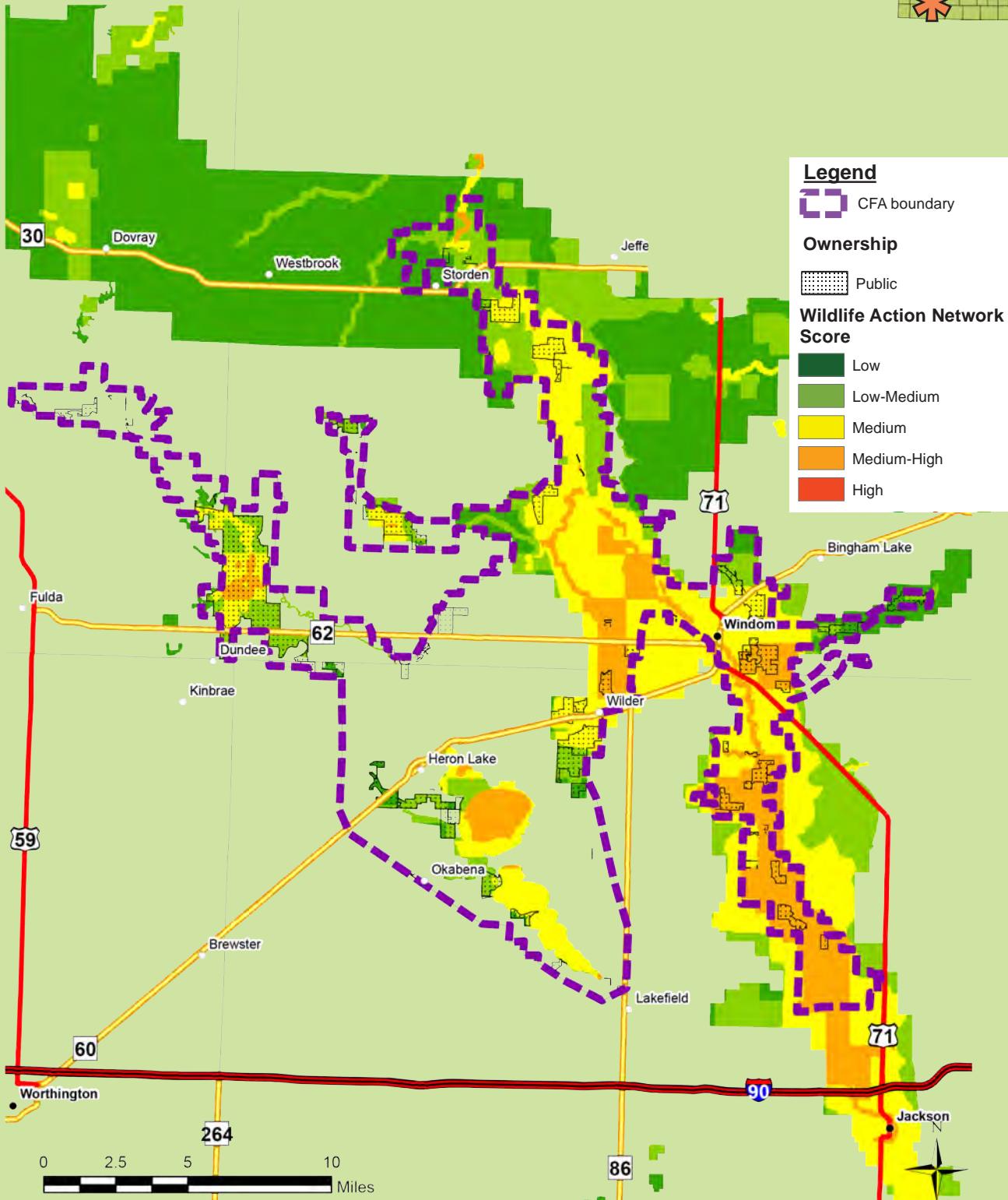
Alter frequency, timing, and extent and other factors of prescribed fires to minimize impacts on species with limited home-ranges and or mobility (such as invertebrate communities). Evaluate effects of conservation grazing on SGCN animal communities especially invertebrates, reptiles and mammals.

Coordinated approach to prioritize varying management needs for fish, amphibians, turtles, birds, and exotic, invasive species.

BMPs that promote infiltration within watersheds. Protect recharge areas.

Des Moines River Valley

Conservation Focus Area



Glacial Ridge

Targets, Conservation Issues, Approaches

Target Habitats (with NPC class/type):

Grassland-wetland complexes: AIP_CX-Agassiz Interbeach Prairie Complex, MFS_CX-Meadow-Marsh-Fen-Swamp Complex, MMS_CX-Meadow-Marsh-Fen-Swamp Complex, PMA_CX-Wet-Mesic Prairie / Lowland Aspen Complex, PWL_CX-Prairie Wetland Complex, SEW_CX-Seepage Wetland Complex

Prairie/grassland: UPn12b-Dry Sand-Gravel Prairie (Northern), UPn13-Northern Dry Savanna, UPn13b-Dry Barrens Oak Savanna (Northern), UPn23a-Mesic Brush-Prairie (Northern), UPn23b-Mesic Prairie (Northern), WPn53-Northern Wet Prairie, WPn53a-Wet Seepage Prairie (Northern), WPn53b-Wet Brush-Prairie (Northern), WPn53c-Wet Prairie (Northern), WPn53d-Wet Saline Prairie (Northern), *also includes surrogate grasslands*

River/streets (Red Lake and Clearwater Rivers)

Lowland conifer forest: FPw63b-Tamarack Seepage Swamp (Aspen Parkland)

Open peatland: OPn92a-Graminoid Rich Fen (Basin), OPP91-Prairie Rich Fen, OPP91a-Rich Fen (Mineral Soil), OPP91b-Rich Fen (Peatland), OPP91c-Rich Fen (Prairie Seepage), OPP93-Prairie Extremely Rich Fen, OPP93a-Calcareous Fen (Northwestern)

Wetland (nonforested): MRn83-Northern Mixed Cattail Marsh, MRp83a-Cattail-Sedge Marsh (Prairie), MRp93a-Bulrush Marsh (Prairie), WMn82b-Sedge Meadow, WMp73a-Prairie Meadow/Carr, WMs83-Southern Seepage Meadow/Carr, WMs83a-Seepage Meadow/Carr, WMs83a1-Seepage Meadow/Carr, Tussock Sedge Subtype, WMs92a-Basin Meadow/Carr

Target Species:

Prairie mammals: plains pocket mouse, prairie vole, Richardson's ground squirrel

Dry-mesic prairie birds: marbled godwit, short-eared owl, upland sandpiper, western meadowlark

Wet prairie/sedge meadow birds: Le Conte's sparrow, Nelson's sparrow, Wilson's phalarope, yellow rail

Mussels: black sandshell, creek heelsplitter

Prairie butterflies: Assiniboin skipper, Dakota skipper, dusted skipper, Poweshiek skipperling

Tiger beetles: ghost tiger beetle, sandy tiger beetle

Example conservation issues

Conversion of native habitat to agriculture or peat or aggregate mining

Example conservation approaches

Assess suitability to conversion through environmental review. Target land protection of prairie/grassland and wetland sites in the Wildlife Action Network using acquisition/easements. Implement Minnesota Prairie Conservation Plan. Develop a sensitive, cost-effective trend monitoring strategy for Lepidoptera SGCNs,

Prairie and wetland habitat degradation due to invasive species

Natural disturbance management—use of prescribed fire, conservation grazing, haying in prairies as appropriate to maintain SGCN habitat. Implement reed canary grass and invasive cattail control, monitor for new invasive species and utilize rapid treatment methods if detected. Remove woody species using mechanical removal from prairie/grassland habitat where natural disturbance management is not sufficient or feasible.

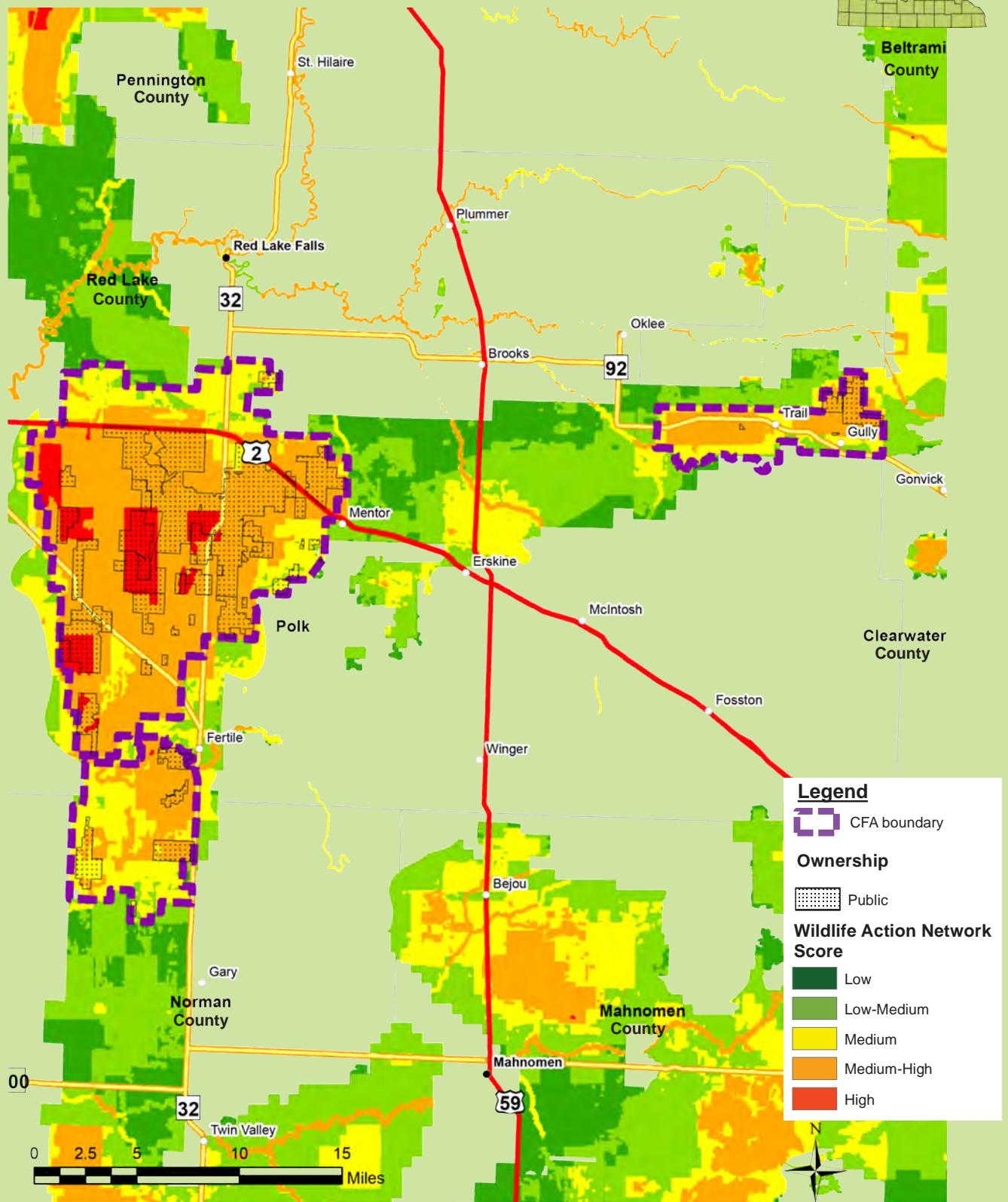
Habitat management impacts

Alter frequency, timing, and extent of prescribed fires to minimize impacts on species with limited home-ranges and or mobility (such as invertebrate communities). Evaluate effects of conservation grazing on SGCN animal communities especially invertebrates, reptiles and mammals. Landscape level coordination of management between landowners on individual protected parcels.

Stream sedimentation and contamination, channelization, and impoundments, increased extreme rainfall events due to climate change

Reduce channelization, reduce stream entrenchment, restore connections between streams and riparian wetlands, maintain oxbows, enhance main stream connectivity, Buffer stream banks with permanent, native vegetation.

Glacial Ridge Conservation Focus Area



Holyoke

Targets, Conservation Issues, Approaches

Target Habitats (with NPC class/type):

Lowland conifer forest: APn81-Northern Poor Conifer Swamp, APn81a-Poor Black Spruce Swamp, APn81b-Poor Tamarack-Black Spruce Swamp, APn81b1-Poor Tamarack-Black Spruce Swamp, Black Spruce Subtype, APn81b2-Poor Tamarack-Black Spruce Swamp, Tamarack Subtype, WFn53b-Lowland White Cedar Forest (Northern), WFn64a-Black Ash-Conifer Swamp (Northeastern)

Upland hardwood forest: MHn35-Northern Mesic Hardwood Forest, MHn35a-Aspen-Birch-Basswood Forest, MHn35b-Red Oak-Sugar Maple-Basswood-(Bluebead Lily) Forest, MHn44-Northern Wet-Mesic Boreal Hardwood-Conifer Forest, MHn46b-Black Ash-Basswood Forest, MHn47a-Sugar Maple-Basswood-(Bluebead Lily) Forest

Wetland (forested): Vernal pool

Target Species:

Mature upland forest birds: red-shouldered hawk, wood thrush

Forest salamanders: eastern red-backed salamander, four-toed salamander, spotted salamander

Example conservation issues

Mature forest habitat size requirements for SGCN habitat

Forest habitat degradation due to invasive species

Degradation and loss of ephemeral wetlands (vernal pools)

Lowland conifer requirements for SGCN habitat

Species and structural diversity required for SGCN habitat and resilient forests

Example conservation approaches

Where possible, maintain large blocks of mature forest.

Monitor for new invasive species and utilize rapid treatment methods if detected.

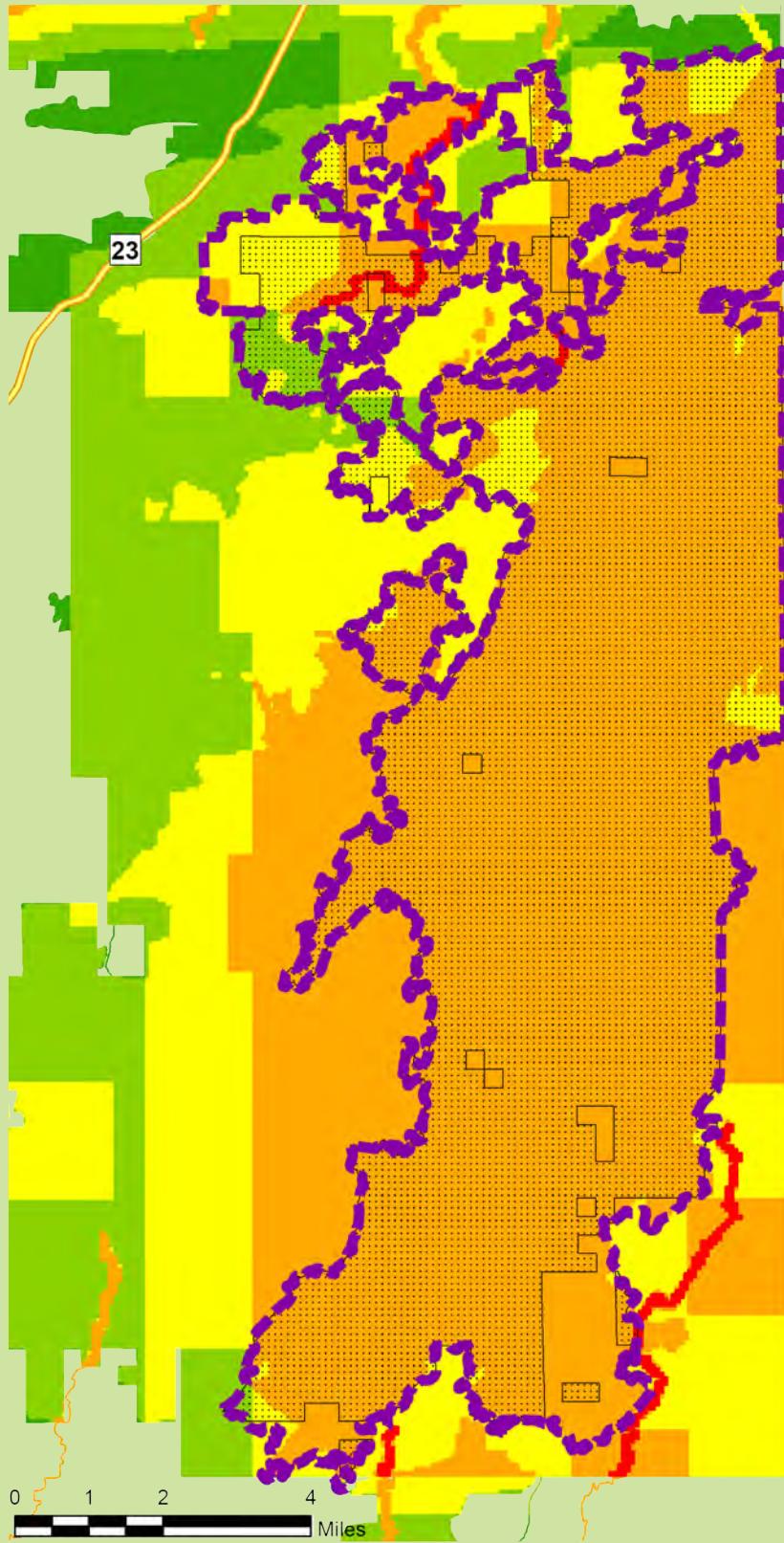
Improve knowledge of habitat requirements of salamanders that depend on vernal pools and adjacent upland habitat. Develop and implement Best Management Practices to reduce impacts to ephemeral wetlands (vernal pools).

Improve knowledge of pathogen management, clear cuts and the impact of gaps on lowland conifer bird habitat.

Improve plant species and structural diversity to create higher quality habitat for SGCN and more resilient forests.

Holyoke

Conservation Focus Area



Legend	
	CFA boundary
Ownership	
	Public
Wildlife Action Network Score	
	Low
	Low-Medium
	Medium
	Medium-High
	High



Lower Minnesota River Valley

Targets, Conservation Issues, Approaches

Target Habitats (with NPC class/type):

Upland hardwood forest: MHs37b-Red Oak-White Oak-(Sugar Maple) Forest, MHs38b-Basswood-Bur Oak-(Green Ash) Forest, MHs38c-Red Oak-Sugar Maple-Basswood-(Bitternut Hickory) Forest, MHs39a-Sugar Maple-Basswood-(Bitternut Hickory) Forest, MHs39c-Sugar Maple Forest (Big Woods), MHs49a-Elm-Basswood-Black Ash-(Hackberry) Forest

River/stream: Minnesota River

Lowland deciduous forest: FFs68a-Silver Maple-(Virginia Creeper) Floodplain Forest

Wetland: MRn93a-Bulrush Marsh (Northern), MRn93b-Spikerush-Bur Reed Marsh (Northern), WMn82a-Willow-Dogwood Shrub Swamp, WMn82b-Sedge Meadow, WMs83a-Seepage Meadow/Carr

Open peatland: OPr93c-Calcareous Fen (Southeastern)

Prairie/grassland: UPs13-Southern Dry Prairie, UPs13a-Dry Barrens Prairie (Southern), UPs13b-Dry Sand-Gravel Prairie (Southern), UPs13d-Dry Hill Prairie (Southern), UPs14a2-Dry Barrens Oak Savanna (Southern), Oak Subtype, UPs14b-Dry Sand-Gravel Oak Savanna (Southern), UPs14c-Dry Hill Oak Savanna (Southern), UPs23a-Mesic Prairie (Southern), *also includes surrogate grasslands.*

Target Species:

Mature upland/woodland forest birds: Acadian flycatcher, cerulean warbler, hooded warbler, prothonotary warbler, wood thrush

Blanchard's cricket frog

Smooth softshell

SGCN fish

SGCN mussels

Prairie butterflies: Arogos skipper, dusted skipper, regal fritillary

Sandy Stream Tiger Beetle

Example conservation issues

Increased flashiness of river flows due to extreme rainfall events causing sedimentation, undercutting of banks, vertical separation from oxbows and floodplain wetlands

Prairie, forest, wetland, river habitat quality impacted by invasive species

Mining, urban development impact habitat

Example conservation approaches

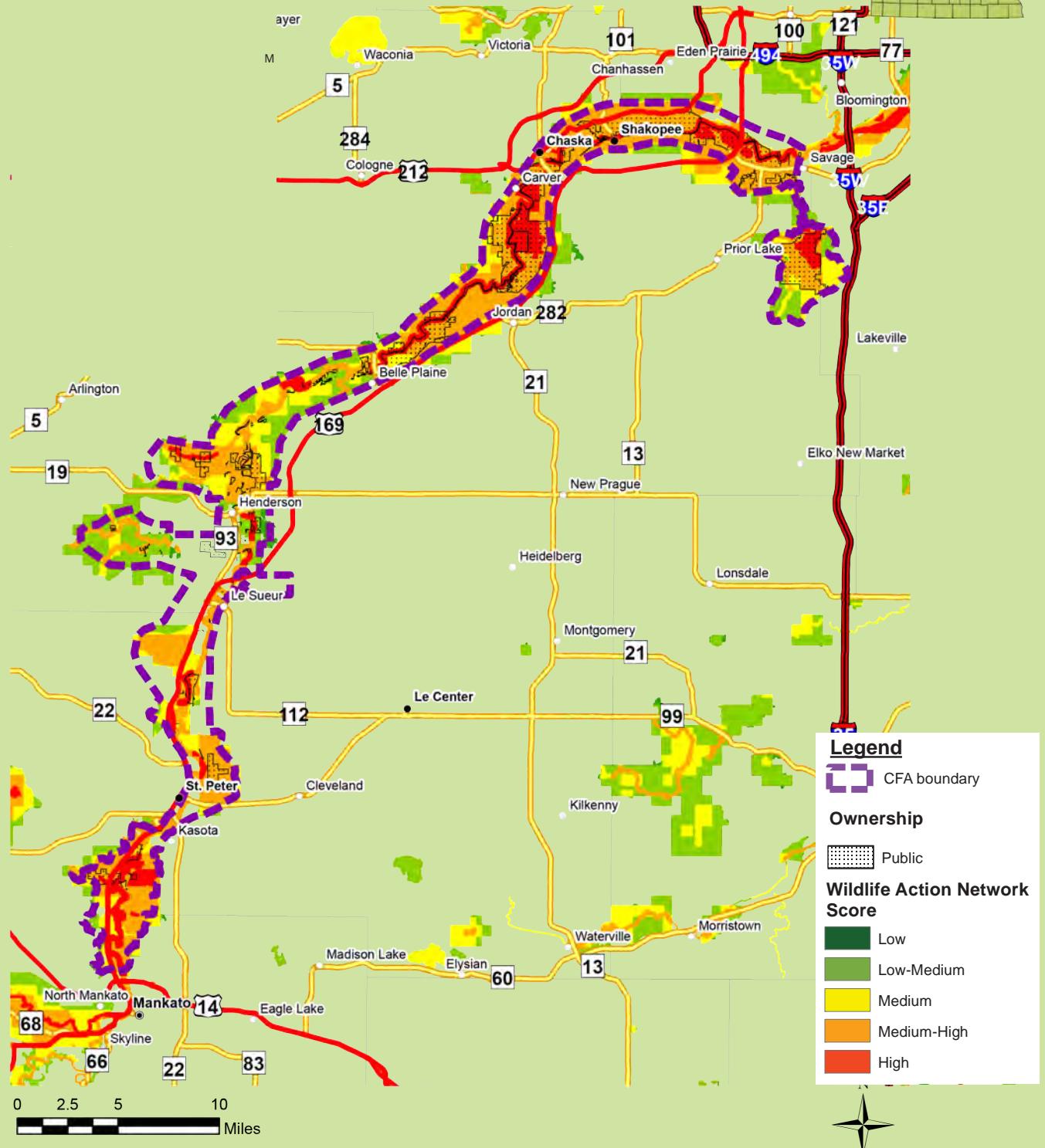
Promote infiltration practices in cultivated and urbanized landscapes; restore riparian cross-sections, connect floodplains with main channels, buffer stream banks with permanent, native vegetation.

Natural disturbance management—use of prescribed fire, conservation grazing, haying in prairies as appropriate to maintain SGCN habitat. Remove invasive species from forests. Implement reed canary grass and invasive cattail control. Remove woody species using mechanical removal from prairie/grassland habitat where natural disturbance management is not sufficient or feasible. Reduce cultural disturbances that provide opportunities for invasion. Monitor for new invasive species, including invasive carp, and utilize rapid treatment methods if detected.

Protect critical areas.

Lower Minnesota River Valley

Conservation Focus Area



Mahnomen

Targets, Conservation Issues, Approaches

Target Habitats (with NPC class/type):

Grassland-wetland complexes: MMS_CX-Meadow-Marsh-Fen-Swamp Complex, PWL_CX-Prairie Wetland Complex

Prairie/grassland: UPn12b-Dry Sand-Gravel Prairie (Northern), UPn23a-Mesic Brush-Prairie (Northern), UPn23b-Mesic Prairie (Northern), WPn53-Northern Wet Prairie, also includes surrogate grasslands.

Wetland (nonforested): MRn83-Northern Mixed Cattail Marsh, WMn82b-Sedge Meadow, WMs83-Southern Seepage Meadow/Carr

Open Peatland: OPP91-Prairie Rich Fen, OPP91c-Rich Fen (Prairie Seepage), OPP93-Prairie Extremely Rich Fen, OPP93a-Calcareous Fen (Northwestern)

Target Species:

Dry-mesic prairie birds: marbled godwit, upland sandpiper, western meadowlark

Wet prairie/sedge meadow birds: Le Conte's sparrow, Nelson's sparrow, yellow rail

Prairie butterflies: dusted skipper, Poweshiek skipperling

Example conservation issues

Prairie/grassland loss and fragmentation

Example conservation approaches

Implement Minnesota Prairie Conservation Plan—buffer and connect prairie habitat.

Prairie and wetland habitat degradation due to invasive species

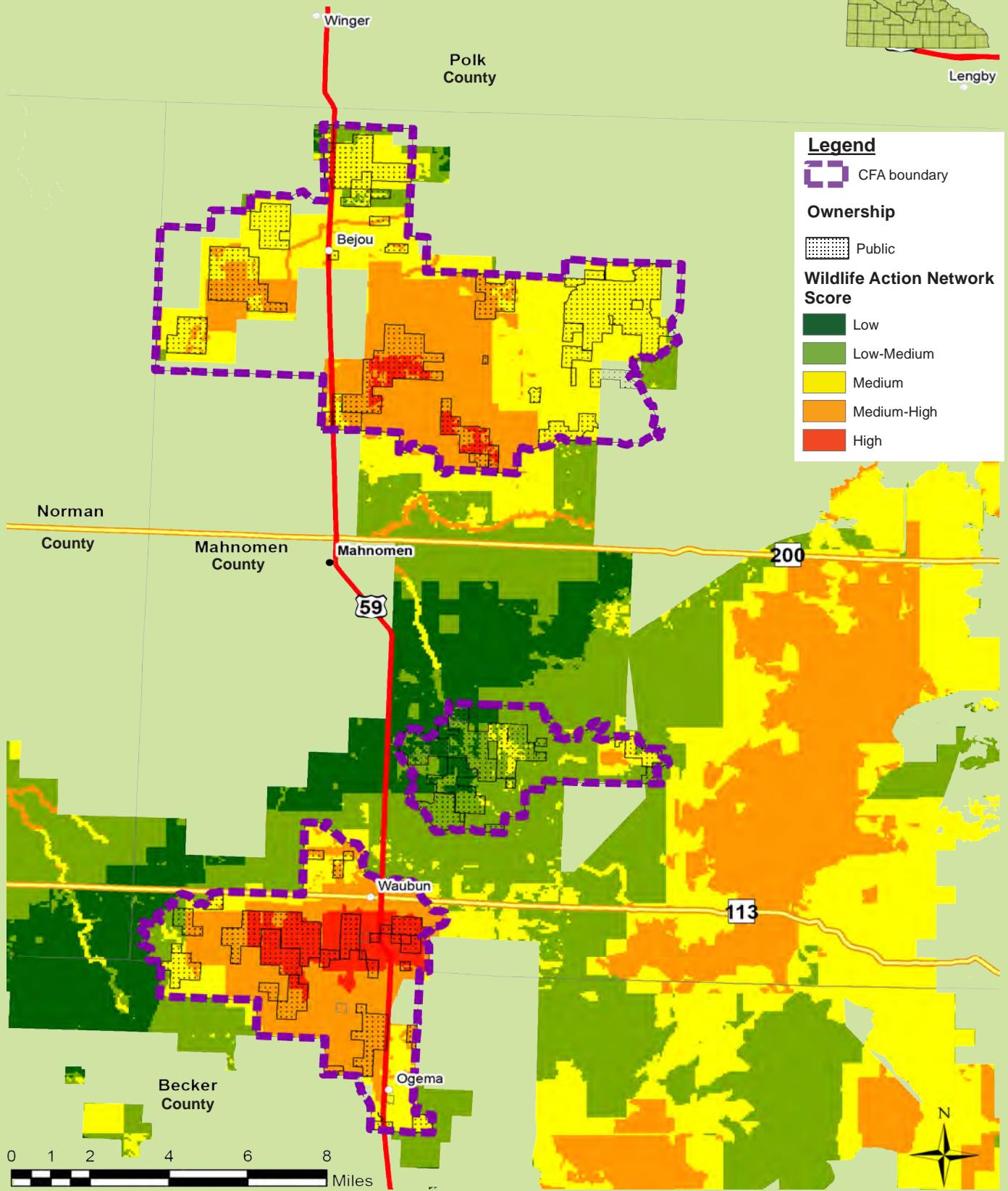
Natural disturbance management—use of prescribed fire, conservation grazing, haying in prairies as appropriate to maintain SGCN habitat. Implement reed canary grass and invasive cattail control, monitor for new invasive species and utilize rapid treatment methods if detected. Remove woody species using mechanical removal from prairie/grassland habitat where natural disturbance management is not sufficient or feasible.

Habitat management impacts

Alter frequency, timing, and extent of prescribed fires to minimize impacts on species with limited home-ranges and or mobility (such as invertebrate communities). Evaluate effects of conservation grazing on SGCN animal communities especially invertebrates, reptiles and mammals.

Mahnomen

Conservation Focus Area



Manitou

Targets, Conservation Issues, Approaches

Target Habitats (with NPC class/type):

Upland hardwood forest: MHn44-Northern Wet-Mesic Boreal Hardwood-Conifer Forest, MHn45a-Paper Birch-Sugar Maple Forest (North Shore), MHn45c-Sugar Maple Forest (North Shore)

Upland conifer forest: FDn43b1-Aspen-Birch Forest, Balsam Fir Subtype, FDn43c-Upland White Cedar Forest, MHn45b-White Cedar-Yellow Birch Forest

Lowland conifer forest: WFn53a-Lowland White Cedar Forest (North Shore)

Target Species:

Northern long-eared bat

Mature upland forest birds: black-throated blue warbler, wood thrush

Other birds: boreal owl, northern goshawk

Example conservation issues

Forest habitat degradation due to invasive species

Example conservation approaches

Monitor for new invasive species and utilize rapid treatment methods if detected.

Mature forest size requirements for SGCN habitat

Where possible, maintain large blocks of mature forest.

Lowland conifer requirements for SGCN habitat

Improve knowledge of pathogen management, clear cuts and the impact of gaps on lowland conifer bird habitat.

Species and structural diversity required for SGCN habitat and resilient forests

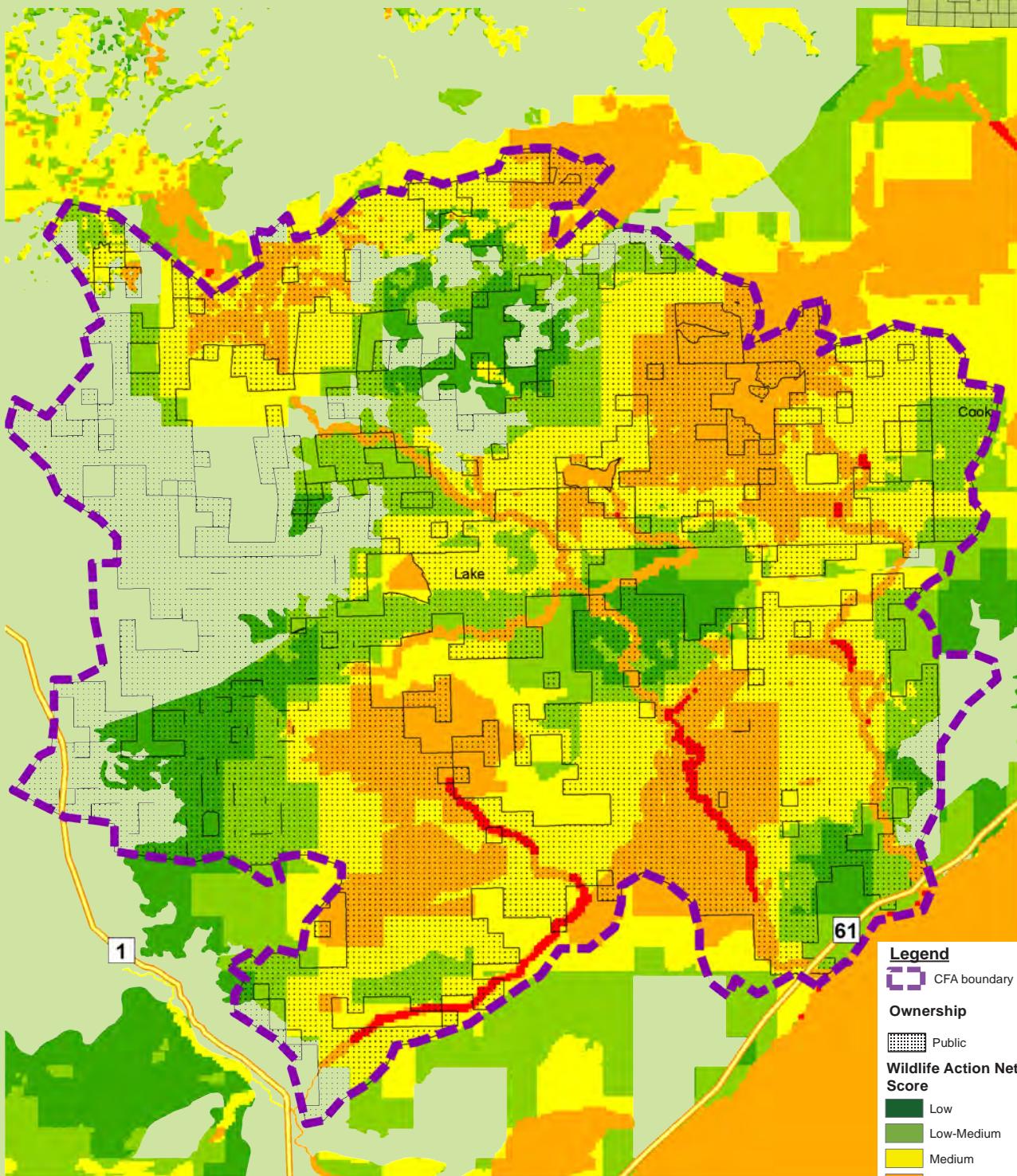
Manage to maintain/increase plant species and structural diversity to improve quality habitat for forest SGCN and ensure more resilient forests.

Fire-dependent forest management

Management for reproduction: thinning, low fuel burns, increase knowledge of new pathogens.

Manitou

Conservation Focus Area



0 0.5 1 2 3 4
Miles



Mille Lacs Moraines

Targets, Conservation Issues, Approaches

Target Habitats (with NPC class/type):

Upland hardwood forest: MHc26-Central Dry-Mesic Oak-Aspen Forest, MHc26b-Red Oak-Sugar Maple-Basswood-(Large-Flowered Trillium) Forest, MHc36-Central Mesic Hardwood Forest (Eastern), MHc36a-Red Oak-Basswood Forest (Noncalcareous Till), MHc36b-Red Oak-Basswood Forest (Calcareous Till), MHc37b-Sugar Maple-Basswood-(Aspen) Forest, MHc47-Central Wet-Mesic Hardwood Forest, MHc47a-Basswood-Black Ash Forest, MHn35-Northern Mesic Hardwood Forest, MHn44-Northern Wet-Mesic Boreal Hardwood-Conifer Forest, MHn46a-Aspen-Ash Forest, MHn47a-Sugar Maple-Basswood-(Bluebead Lily) Forest, MHs38a-White Pine-Oak-Sugar Maple Forest

Lowland deciduous forest: WFn55-Northern Wet Ash Swamp, WFn55b-Black Ash-Yellow Birch-Red Maple-Basswood Swamp (Eastcentral), WFn64-Northern Very Wet Ash Swamp, WFn64b-Black Ash-Yellow Birch-Red Maple-Alder Swamp (Eastcentral), WFn74-Northern Wet Alder Swamp

Wetland (forested): Vernal pool

Target Species:

Mature upland/lowland forest birds: cerulean warbler, red-shouldered hawk

Golden-winged warbler

Forest salamanders: eastern newt, eastern red-backed salamander, four-toed salamander

Example conservation issues

Conservation approaches

Forest fragmentation

Facilitate wildlife movement across transportation barriers, such as US Hwy 169. Strategic land protection to maintain forest connectivity. Provide terrestrial habitat by protecting large parcels and corridors connecting them.

Reduced age, species, and structural diversity of mesic hardwood forests

Explore the use of economically viable alternative selective harvest strategies (for example, gap management). Provide technical guidance to private landowners.

Degradation and loss of ephemeral wetlands (vernal pools)

Develop and implement Best Management Practices to reduce impacts to ephemeral wetlands (vernal pools). Improve knowledge of habitat requirements of salamanders that depend on vernal pools and adjacent upland habitat.

Climate change impacts on soil moisture and forest composition

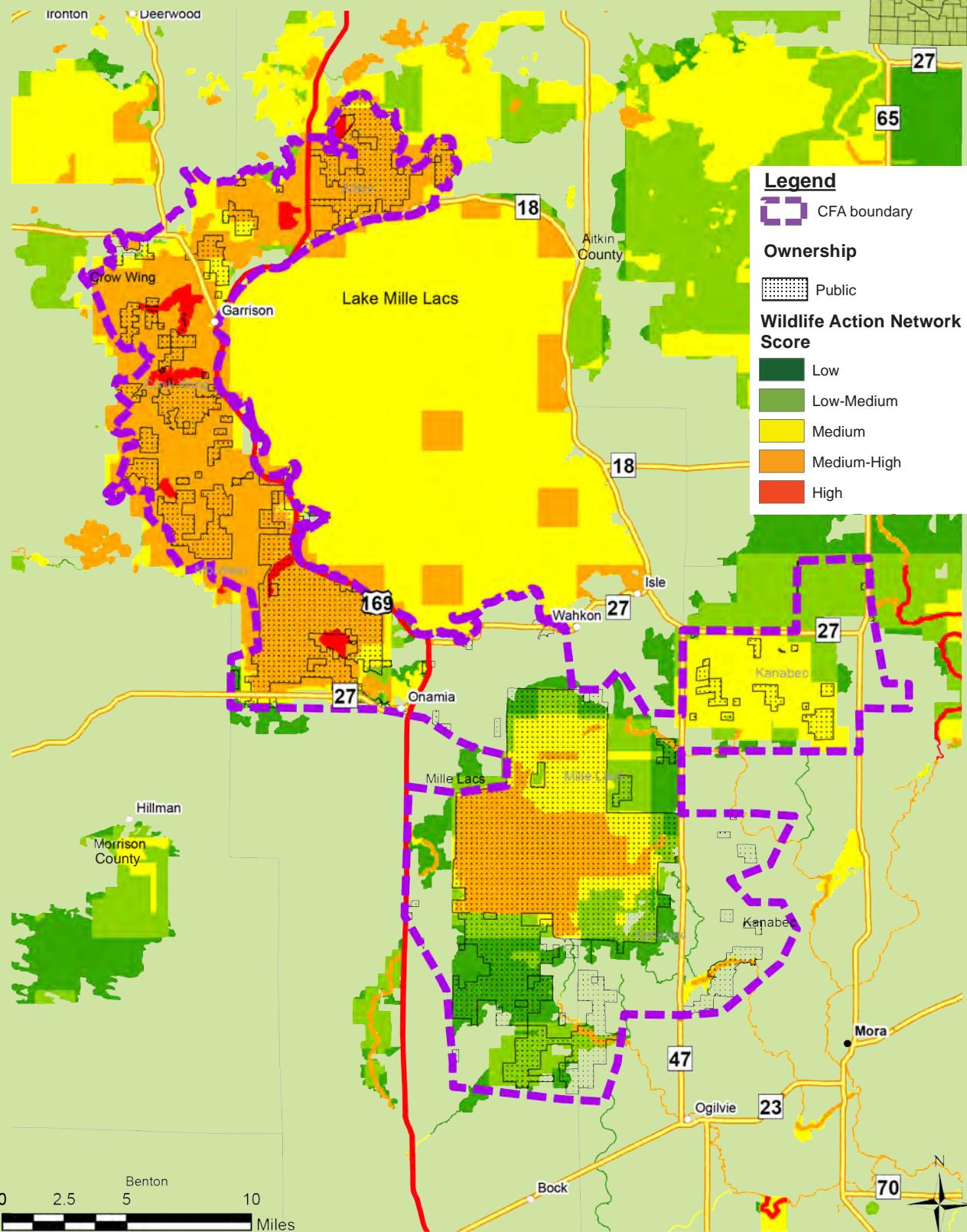
Practice adaptive management to respond to changes in soil moisture.

Invasive species may impact forest and wetland structure and diversity

Monitor for new invasive species and utilize rapid treatment methods if detected.

Mille Lacs Moraines

Conservation Focus Area



North Shore Hardwoods

Targets, Conservation Issues, Approaches

Target Habitats (with NPC class/type):

Upland hardwood forest: MHn45a-Paper Birch-Sugar Maple Forest (North Shore), MHn45c-Sugar Maple Forest (North Shore)

Upland conifer forest: FDn43c-Upland White Cedar Forest, MHn45b-White Cedar-Yellow Birch Forest

Lowland conifer forest: WFn53a-Lowland White Cedar Forest (North Shore), WFn64a-Black Ash-Conifer Swamp (Northeastern)

Target Species:

Smoky shrew

Mature upland forest birds: black-throated blue warbler, wood thrush

Other birds: boreal owl, northern goshawk

Example conservation issues

Forest habitat degradation due to invasive species

Example conservation approaches

Monitor for new invasive species and utilize rapid treatment methods if detected.

Mature forest habitat size requirements for SGCN habitat

Where possible, maintain large blocks of mature forest.

Upland white cedar stressors: herbivory, reduce age classes, simplified structure, lack of regeneration

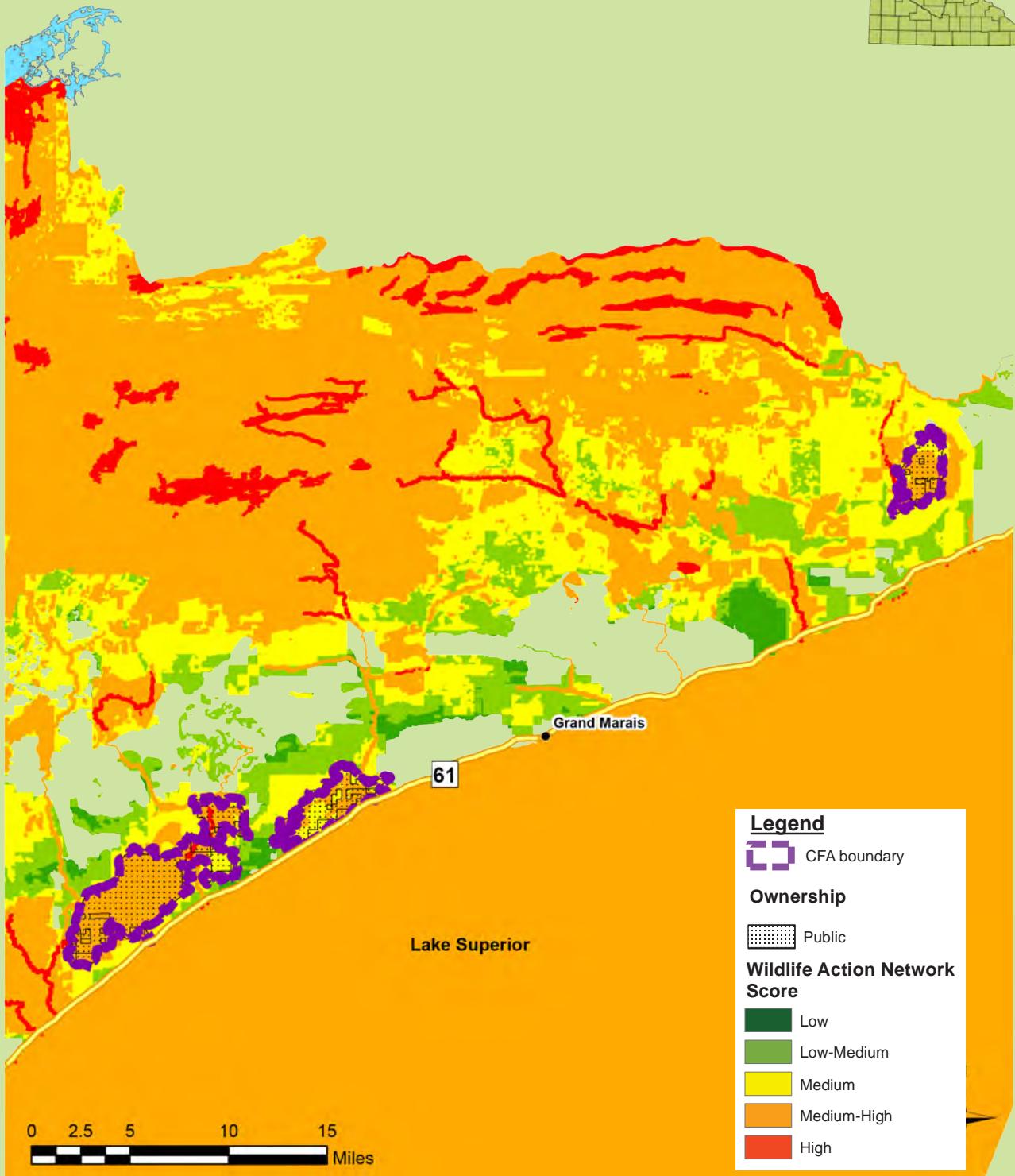
Reduce herbivory impacts through exclosures, bud capping, and landscape patterning. Maintain and increase forest age and structural diversity.

Species and structural diversity required for SGCN habitat and resilient forests

Manage to maintain/increase plant species and structural diversity to improve quality habitat for forest SGCN and ensure more resilient forests.

North Shore Hardwoods

Conservation Focus Area



Pike Range

Targets, Conservation Issues, Approaches

Target Habitats (with NPC class/type):

Upland hardwood forest: MH-Mesic Hardwood Forest System

(NPC types not provided as NPC mapping has not been completed within this CFA)

Upland conifer forest: FDn43c-Upland White Cedar Forest (NPC types not fully provided as NPC mapping has not been completed within this CFA)

Lowland conifer forest: FP-Forested Rich Peatland System (NPC types not provided as NPC mapping has not been completed within this CFA)

Open Peatland: AP-Open Rich Peatland System

Target Species:

Smoky shrew

Mature upland forest birds: black-throated blue warbler, wood thrush

Lowland conifer birds: boreal chickadee, Connecticut warbler

Northern goshawk

Example conservation issues

Mature forest habitat size requirements for SGCN habitat

Example conservation approaches

Where possible, maintain large blocks of mature forest.

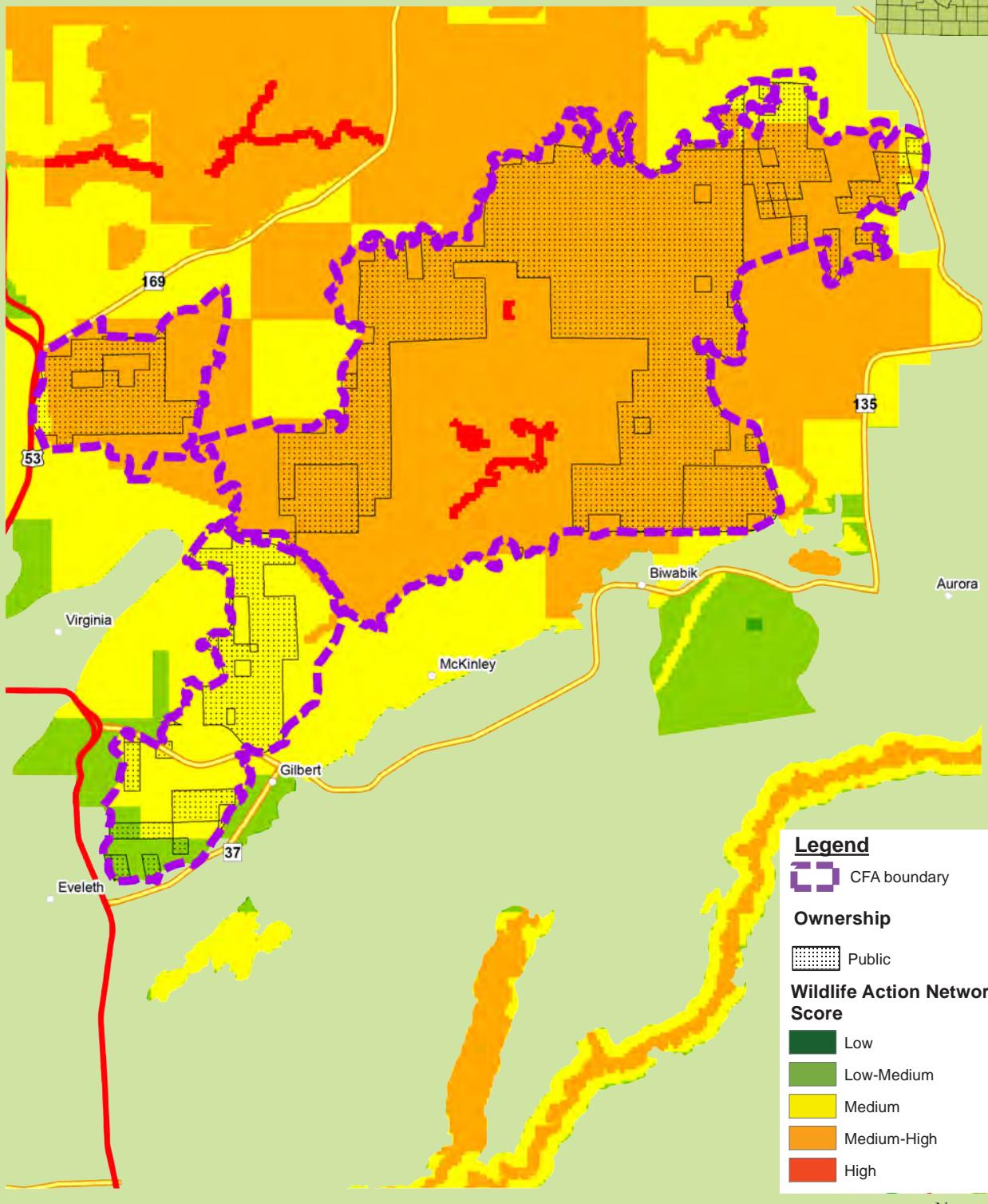
Lowland conifer requirements for SGCN habitat

Improve knowledge of pathogen management, clear cuts and the impact of gaps on lowland conifer bird habitat.

Species and structural diversity required for SGCN habitat and resilient forests

Manage to maintain/increase plant species and structural diversity to improve quality habitat for forest SGCN and ensure more resilient forests.

Pike Range Conservation Focus Area



0 1 2 4 Miles



Pine Island

Targets, Conservation Issues, Approaches

Target Habitats (with NPC class/type):

Lowland conifer forest: AP Acidic Peatland System, FP-Forested Rich Peatland System (NPC types not provided as NPC mapping has not been completed within this CFA)

Peatland systems: OP-Open Rich Peatland System (NPC types not provided as NPC mapping has not been completed within this CFA)

Target Species:

Lowland conifer birds: boreal chickadee, Connecticut warbler

Example conservation issues

Mature forest habitat size requirements for SGCN habitat

Lowland conifer requirements for SGCN habitat

Maintain peatland hydrology

Forest habitat degradation due to invasive species

Wetland loss

Example conservation approaches

Where possible, maintain large blocks of mature forest.

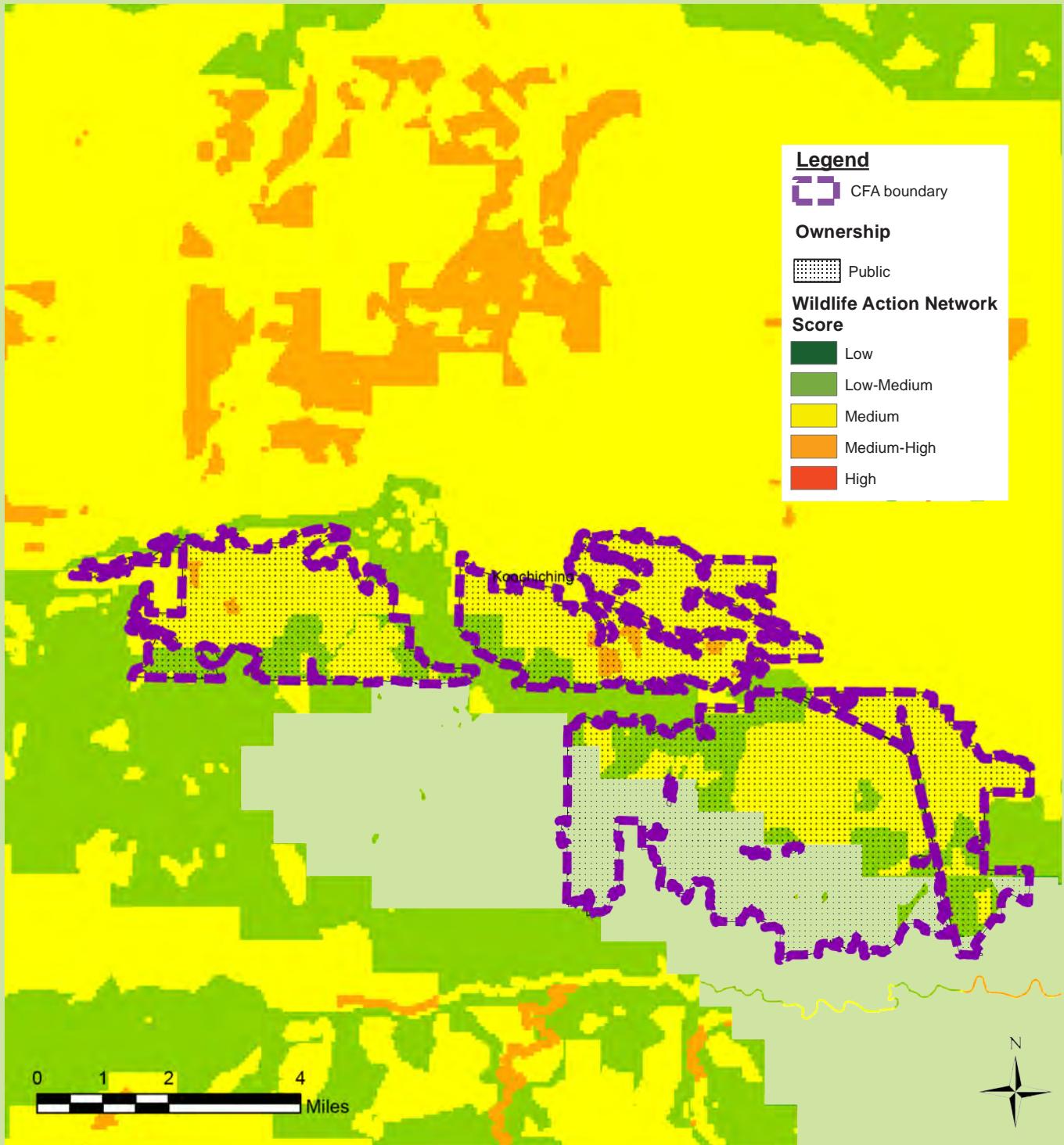
Improve knowledge of pathogen management, clear cuts and the impact of gaps on lowland conifer bird habitat. Utilize information from existing harvesting experiments.

Assess agricultural and mining conversion and management impacts to peatland hydrology.

Monitor for new invasive species and utilize rapid treatment methods if detected.

Apply MN Wetland Conservation Act standards. Ensure replacement standards are followed. Regulate agricultural and mining conversion of peatlands.

Pine Island Conservation Focus Area



Pine Sands North

Targets, Conservation Issues, Approaches

Target Habitats (with NPC class/type):

Upland conifer forest: FFDc12a-Jack Pine-(Bearberry) Woodland, FDc23-Central Dry Pine Woodland, FDc23a-Jack Pine-(Yarrow) Woodland, FDc24a-Jack Pine-(Bush Honeysuckle) Woodland, FDc24a1-Jack Pine-(Bush Honeysuckle) Woodland, Bracken Subtype, FDc34-Central Dry-Mesic Pine-Hardwood Forest, FDc34a-Red Pine-White Pine Forest, FDn12b-Red Pine Woodland (Sand), FDn33a1-Red Pine-White Pine Woodland, Balsam Fir Subtype, FDn33a2-Red Pine-White Pine Woodland, Mountain Maple Subtype

Upland Hardwood Forest: FDc34b-Oak-Aspen Forest, MHc26-Central Dry-Mesic Oak-Aspen Forest, MHc26a-Oak-Aspen-Red Maple Forest, MHc26b-Red Oak-Sugar Maple-Basswood-(Large-Flowered Trillium) Forest, MHc37-Central Mesic Hardwood Forest (Western), MHc37a-Aspen-(Sugar Maple-Basswood) Forest, MHn35-Northern Mesic Hardwood Forest, MHn44a-Aspen-Birch-Red Maple Forest, MHn44c-Aspen-Fir Forest, MHn44d-Aspen-Birch-Fir Forest,

Target Species:

Woodland/savanna birds: eastern towhee, eastern whip-poor-will

Reptiles: eastern hog-nosed snake, smooth greensnake

Northern barrens tiger beetle

Example conservation issues

Conversion of native habitat to agriculture

Example conservation approaches

Target land protection of forest sites in the Wildlife Action Network using acquisition/easements.

Forest habitat degradation due to invasive species

Monitor for new invasive species and utilize rapid treatment methods if detected.

Changes in hydrology from groundwater-based irrigation

Increase knowledge of groundwater impacts to pine forest/woodland systems. Protect groundwater recharge areas.

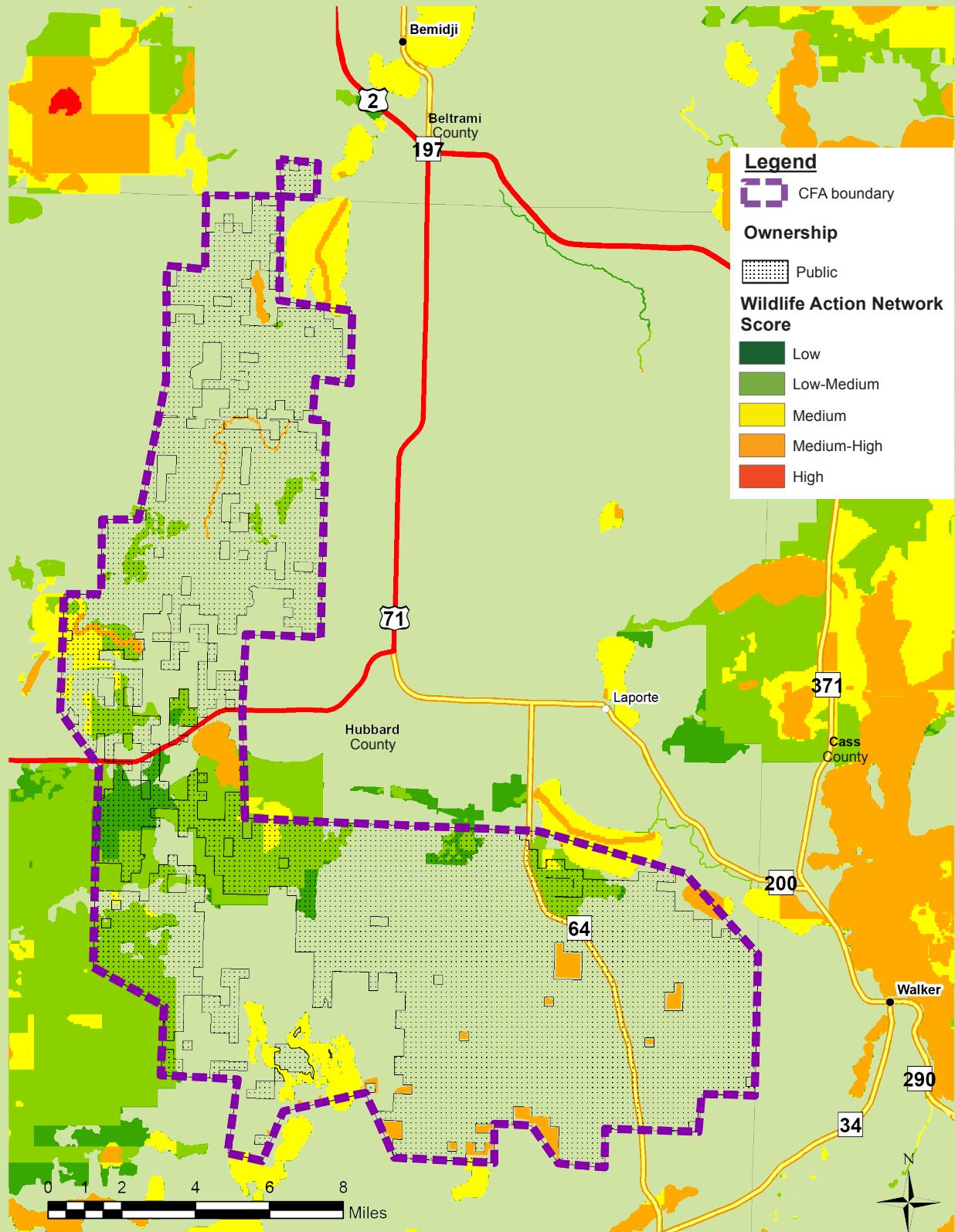
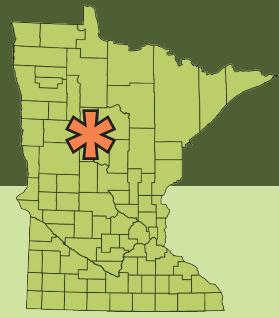
Decreasing connectivity

Protection strategies to increase buffers, corridors, and cores within the Wildlife Action Network. Use of prescribed fire, alternate management methods to increase natural regeneration, mechanical brush removal to lessen competition.

Limited pine regeneration

Manage for reproduction: thinning, low fuel burns, increase knowledge of new pathogens, reduce herbivory pressures.

Pine Sands North Conservation Focus Area



Pine Sands South

Targets, Conservation Issues, Approaches

Target Habitats (with NPC class/type):

Upland hardwood forest: FDc34b-Oak-Aspen Forest, MHC26-Central Dry-Mesic Oak-Aspen Forest, MHC26a-Oak-Aspen-Red Maple Forest, MHC26b-Red Oak-Sugar Maple-Basswood-(Large-Flowered Trillium) Forest, MHC37-Central Mesic Hardwood Forest (Western), MHC37a-Aspen-(Sugar Maple-Basswood) Forest, MHC37b-Sugar Maple-Basswood-(Aspen) Forest, MHn35-Northern Mesic Hardwood Forest, MHn44-Northern Wet-Mesic Boreal Hardwood-Conifer Forest, MHn46a-Aspen-Ash Forest

Upland conifer forest: FDc12-Central Poor Dry Pine Woodland, FDc23-Central Dry Pine Woodland, FDc23a-Jack Pine-(Yarrow) Woodland, FDc24-Central Rich Dry Pine Woodland, FDc24a-Jack Pine-(Bush Honeysuckle) Woodland, FDc34a-Red Pine-White Pine Forest, FDn33a-Red Pine-White Pine Woodland, FDn33a1-Red Pine-White Pine Woodland, Balsam Fir Subtype

Wetlands (nonforested): WMn82a-Willow-Dogwood Shrub Swamp, WMn82b-Sedge Meadow

Open peatland: OPn81a-Bog birch-Alder Shore Fen, OPn91b1-Graminoid Rich Fen (Water Track), Featureless Water Track Subtype, OPn92-Northern Rich Fen (Basin), OPn92a-Graminoid Rich Fen (Basin), OPn92b-Graminoid-Sphagnum Rich Fen (Basin)

Target Species:

Woodland/savanna birds: eastern towhee, eastern whip-poor-will

Reptiles: eastern hog-nosed snake, smooth greensnake

Northern barrens tiger beetle

Example conservation issues

Conversion of native habitat to agriculture

Example conservation approaches

Target land protection of forest sites in the Wildlife Action Network using acquisition/easements.

Forest habitat degradation due to invasive species

Monitor for new invasive species and utilize rapid treatment methods if detected.

Changes in hydrology from groundwater-based irrigation

Increase knowledge of groundwater impacts to pine forest/woodland systems. Protect groundwater recharge areas.

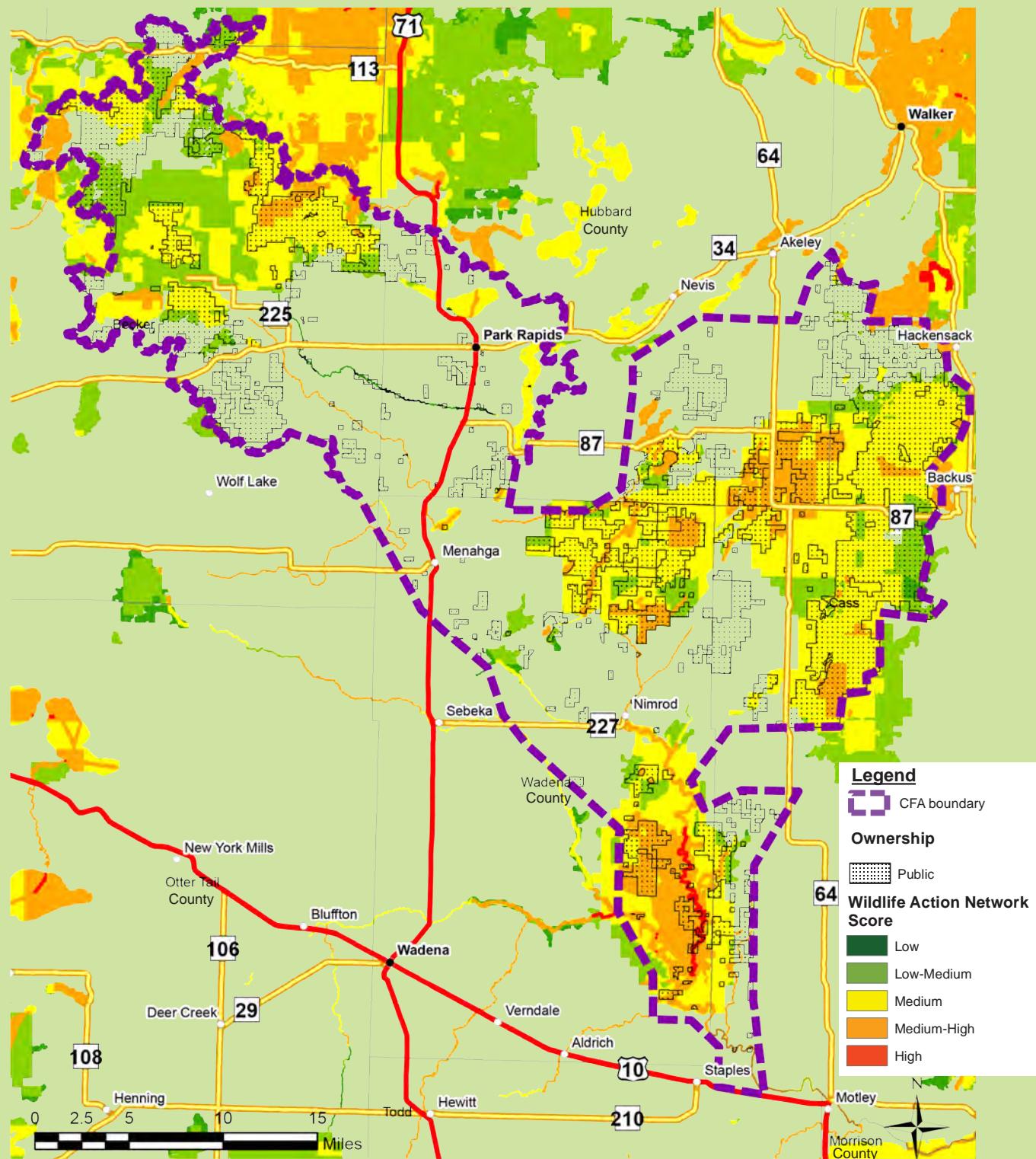
Decreasing connectivity

Protection strategies to increase buffers, corridors, and cores within the Wildlife Action Network. Use of prescribed fire, alternate management methods to increase natural regeneration, mechanical brush removal to lessen competition.

Limited pine regeneration

Manage for reproduction: thinning, low fuel burns, increase knowledge of new pathogens, reduce herbivory pressures.

Pine Sands South Conservation Focus Area



Prairie Coteau

Targets, Conservation Issues, Approaches

Target Habitats (with NPC class/type):

Prairie stream ecosystems

Open peatland: OPP93b-Calcareous Fen (Southwestern)

Prairie/grassland: UPs13-Southern Dry Prairie, UPs13b-Dry Sand-Gravel Prairie (Southern), UPs13d-Dry Hill Prairie (Southern), UPs14c-Dry Hill Oak Savanna (Southern), UPs23a-Mesic Prairie (Southern), UPs24a-Mesic Oak Savanna (Southern), WPs54-Southern Wet Prairie, WPs54a-Wet Seepage Prairie (Southern), WPs54b-Wet Prairie (Southern), *also includes surrogate grasslands*

Rock Outcrop community: ROs12a2-Crystalline Bedrock Outcrop (Prairie), Sioux Quartzite Subtype

Wetlands (nonforested): WMp73a-Prairie Meadow/Carr, WMs83-Southern Seepage Meadow/Carr, WMs83a-Seepage Meadow/Carr, WMs83a1-Seepage Meadow/Carr, Tussock Sedge Subtype, WMs83a2-Seepage Meadow/Carr, Aquatic Sedge Subtype

Target Species:

Prairie mammals: northern grasshopper mouse, prairie vole, Richardson's ground squirrel

Dry-mesic prairie birds: grasshopper sparrow, greater prairie chicken, upland sandpiper, western meadowlark

Reptiles: Blanding's turtle, lined snake

Blanchard's cricket frog

Fish: plains topminnow, Topeka shiner

Prairie Butterflies: Argos skipper, Dakota skipper, dusted skipper, Leonard's skipper, monarch, Ottoe skipper, Poweshiek skipperling, regal fritillary, Uhler's arctic

Example conservation issues

Prairie/grassland loss and fragmentation

Groundwater depletion and contamination impacting municipal water availability, stream flows, and wetlands (especially calcareous fens)

Stream sedimentation and contamination, channelization, and impoundments, increased extreme rainfall events due to climate change

Prairie and wetland habitat degradation due to invasive species

Habitat management impacts

Wind power effects on habitat quality

Example conservation approaches

Implement Minnesota Prairie Conservation Plan-buffer and connect prairie habitat.

Protect groundwater recharge areas (e.g., Lincoln-Pipestone Wellhead Protection Area) using appropriate native vegetation.

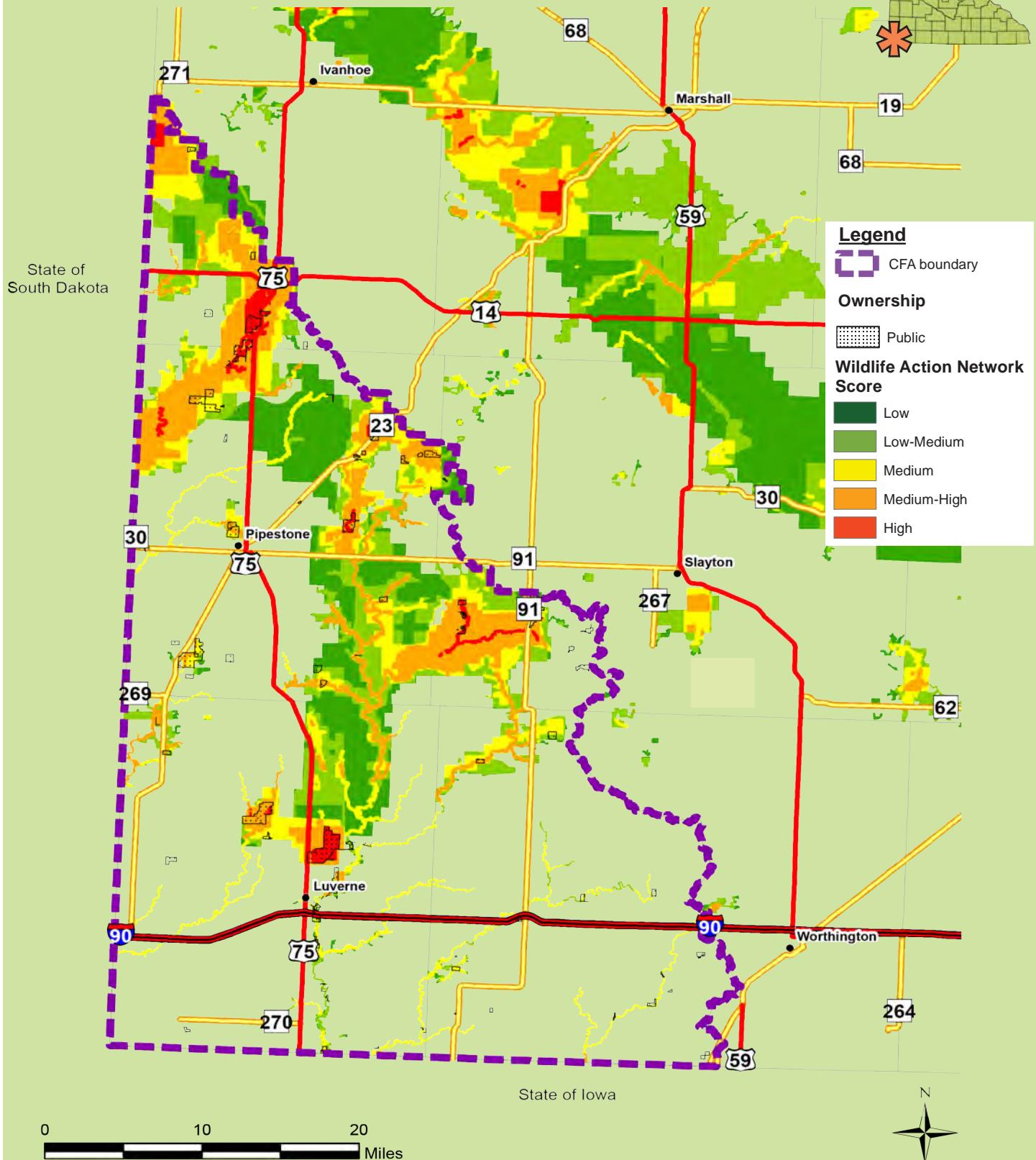
Reduce channelization, reduce stream entrenchment, restore connections between streams and riparian wetlands, maintain oxbows, enhance main stream connectivity, Buffer stream banks with permanent, native vegetation.

Natural disturbance management—use of prescribed fire, conservation grazing, haying in prairies as appropriate to maintain SGCN habitat. Implement reed canary grass and invasive cattail control, monitor for new invasive species and utilize rapid treatment methods if detected. Remove woody species using mechanical removal from prairie/grassland habitat where natural disturbance management is not sufficient or feasible.

Alter frequency, timing, and extent of prescribed fires to minimize impacts on species with limited home-ranges and or mobility (such as invertebrate communities). Evaluate effects of conservation grazing on SGCN animal communities especially invertebrates, reptiles and mammals.

Provide guidelines for appropriate areas for siting of new towers to minimize habitat impacts.

Prairie Coteau Conservation Focus Area



Root River Watershed

Targets, Conservation Issues, Approaches

Target Habitats (with NPC class/type):

River/stream: Warm and cold water tributaries, main stems of Root and Mississippi Rivers: RVx32b-Sand Beach/Sandbar (River), RVx32c2-Gravel/Cobble Beach (River), Permanent Stream Subtype

Lowland deciduous Forest: FFs59a-Silver Maple-Green Ash-Cottonwood Terrace Forest, FFs59b-Swamp White Oak Terrace Forest, FFs59c-Elm-Ash-Basswood Terrace Forest, FFs68a-Silver Maple-(Virginia Creeper) Floodplain Forest

Open peatland: OPP93c-Calcareous Fen (Southeastern)

Upland hardwood forest: FDs27b-White Pine-Oak Woodland (Sand), FDs27c-Black Oak-White Oak Woodland (Sand), FDs38-Southern Dry-Mesic Oak-Hickory Woodland, FDs38a-Oak-Shagbark Hickory Woodland, MHc38a-White Pine-Sugar Maple-Basswood Forest (Cold Slope), MHS37-Southern Dry-Mesic Oak Forest, MHS37a-Red Oak-White Oak Forest, MHS37b-Red Oak-White Oak-(Sugar Maple) Forest, MHS38-Southern Mesic Oak-Basswood Forest, MHS38a-White Pine-Oak-Sugar Maple Forest, MHS38c-Red Oak-Sugar Maple-Basswood-(Bitternut Hickory) Forest, MHS39-Southern Mesic Maple-Basswood Forest, MHS39a-Sugar Maple-Basswood-(Bitternut Hickory) Forest, MHS39b-Sugar Maple-Basswood-Red Oak-(Blue Beech) Forest, MHS49-Southern Wet-Mesic Hardwood Forest, MHS49b-Elm-Basswood-Black Ash-(Blue Beech) Forest, MHW36a-Green Ash-Bur Oak-Elm Forest

Bluff prairies/grasslands: UPS13-Southern Dry Prairie, UPS13a-Dry Barrens Prairie (Southern), UPS13c-Dry Bedrock Bluff Prairie (Southern), UPS14-Southern Dry Savanna, UPS14a2-Dry Barrens Oak Savanna (Southern), Oak Subtype

Cliff/Talus slopes: CTs12-Southern Dry Cliff, CTs12b-Dry Limestone-Dolomite Cliff (Southern), CTs23-Southern Open Talus, CTs23b-Mesic Limestone-Dolomite Talus (Southern), CTs33-Southern Mesic Cliff, CTs33a-Mesic Sandstone

Cliff (Southern), CTs33b-Mesic Limestone-Dolomite Cliff (Southern), CTs43a1-Moderate Cliff, Limestone Subtype, CTs43a2-Moderate Cliff, Dolomite Subtype, CTs46a1-Algific Talus , Limestone Subtype, CTs46a2-Algific Talus , Dolomite Subtype, CTs53-Southern Wet Cliff

Wetland (nonforested): MRn93-Northern Bulrush-Spikerush Marsh, WMn82b-Sedge Meadow, WMs83a-Seepage Meadow/Carr, WMs83a1-Seepage Meadow/Carr, Tussock Sedge Subtype

Target Species:

Mammals: northern long-eared bat, tri-colored bat

Mature upland/lowland forest birds

Reptiles: common five-lined skink, North American racer, smooth softshell, timber rattlesnake, western ratsnake

Pickerel frog

SGCN fish

SGCN mussels

Hill prairie shovelhead leafhopper

Prairie/savanna butterflies: Arogs skipper, Leonard's skipper, mottled duskywing, Ottoe skipper, Persius duskywing

Sandy stream tiger beetle

Example conservation issues

Degraded water quality, altered hydrology, increased extreme rainfall events due to climate change. Reduced stream connectivity

Age, species, and structural diversity required for SGCN habitat and resilient forests. Lack of oak regeneration

Prairie, forest, river and wetland habitat quality impacted by invasive species

Habitat management impacts

Impacts to talus slopes and cliff communities due to blufftop conversion and climate change

Example conservation approaches

Buffer riparian habitat, sinkholes and other groundwater input areas with appropriate native vegetation. Increase conservation tillage incentives. Increase perennial vegetation. Restore overgrazed pastureland. Restore wetlands and connect rivers with adjacent wetlands. Reduce channelization, maintain oxbows. Enhance main stream connectivity. Technical assistance to local governments and landowners. Restore river/stream connectivity by removing dams.

Manage to maintain/increase plant species and structural diversity to improve quality habitat for forest SGCN and ensure more resilient forests. Increase acreage of forests with multiple age classes. Use prescribed fire to increase oak regeneration.

Natural disturbance management—use of prescribed fire, conservation grazing, haying in prairies as appropriate to maintain SGCN habitat. Remove invasive species from forests. Implement reed canary grass and invasive cattail control, monitor for new invasive species and utilize rapid treatment methods if detected. Remove woody species using mechanical removal from prairie/grassland habitat where natural disturbance management is not sufficient or feasible.

Alter frequency, timing, and extent of prescribed fires to minimize impacts on species with limited home-ranges and or mobility (such as invertebrate communities). Evaluate effects of conservation grazing on SGCN animal communities especially invertebrates, reptiles and mammals.

Buffer cold air drainage source areas.

Root River Watershed

Conservation Focus Area



Legend

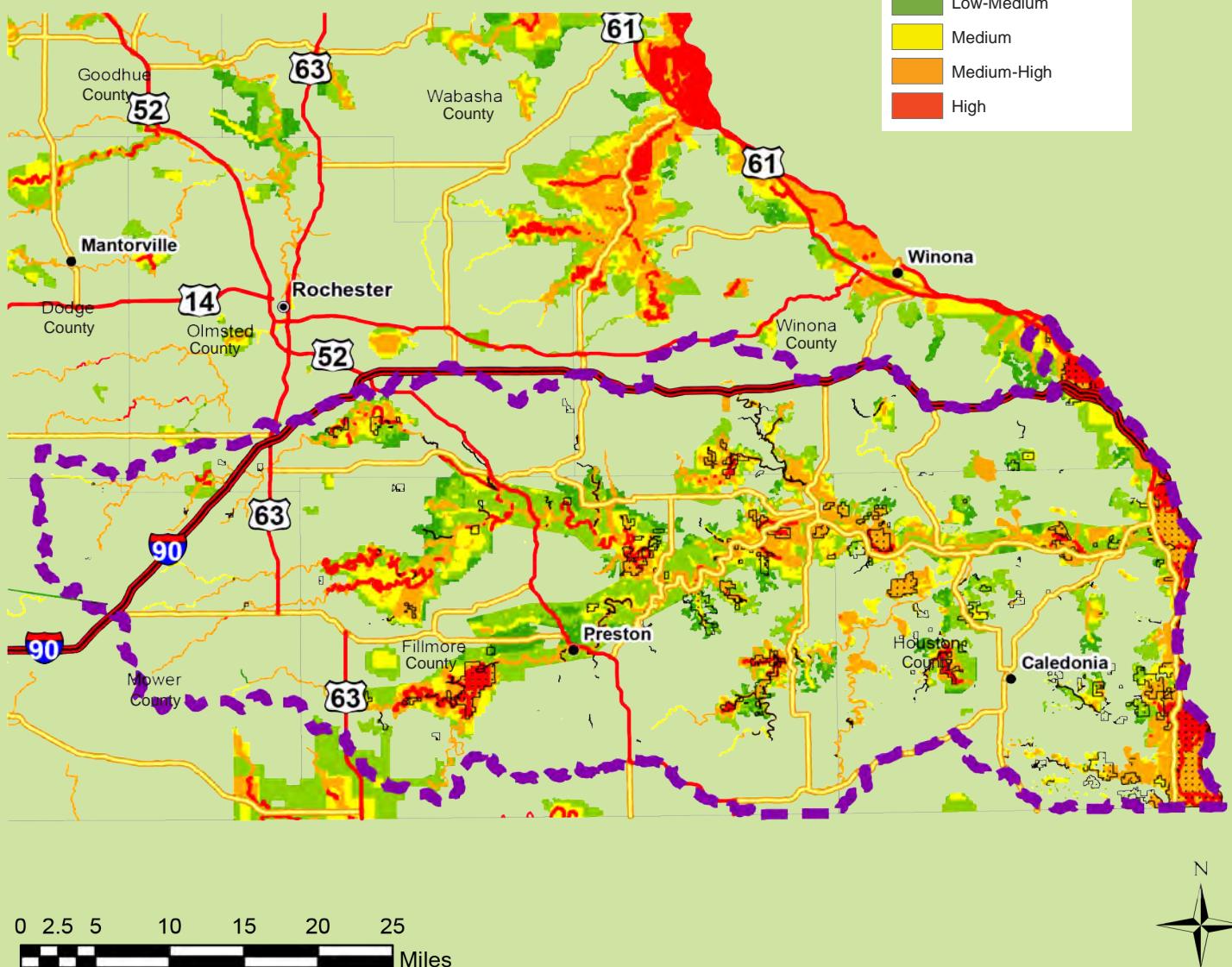
CFA boundary

Ownership

Public

Wildlife Action Network Score

	Low
	Low-Medium
	Medium
	Medium-High
	High



St. Croix River Watershed

Targets, Conservation Issues, Approaches

Target Habitats (with NPC class/type):

River/stream: Warm and cold water tributaries, main stems of St. Croix and Snake Rivers RVx32b-Sand Beach/Sandbar (River), RVx32b2-Sand Beach/Sandbar (River), Permanent Stream Subtype, RVx32c2-Gravel/Cobble Beach (River), Permanent Stream Subtype

Upland hardwood forests: Fdc25-Central Dry Oak-Aspen (Pine) Woodland, Fdc25b-Oak-Aspen Woodland, FDc34-Central Dry-Mesic Pine-Hardwood Forest, FDs37-Southern Dry-Mesic Oak (Maple) Woodland, FDs37a-Oak-(Red Maple) Woodland, FDs37b-Pin Oak-Bur Oak Woodland, MHc26-Central Dry-Mesic Oak-Aspen Forest, MHc26a-Oak-Aspen-Red Maple Forest, MHc26b-Red Oak-Sugar Maple-Basswood-(Large-Flowered Trillium) Forest, MHc36a-Red Oak-Basswood Forest (Noncalcareous Till), MHc36b-Red Oak-Basswood Forest (Calcareous Till), MHc38a-White Pine-Sugar Maple-Basswood Forest (Cold Slope), MHc47a-Basswood-Black Ash Forest, MHn35-Northern Mesic Hardwood Forest, MHn35a-Aspen-Birch-Basswood Forest, MHn35b-Red Oak-Sugar Maple-Basswood-(Bluebead Lily) Forest, MHn44-Northern Wet-Mesic Boreal Hardwood-Conifer Forest, MHn46-Northern Wet-Mesic Hardwood Forest, MHn47-Northern Rich Mesic Hardwood Forest, MHn47a-Sugar Maple-Basswood-(Bluebead Lily) Forest, MHs37b-Red Oak-White Oak-(Sugar Maple) Forest, MHs38a-White Pine-Oak-Sugar Maple Forest, MHs38b-Basswood-Bur Oak-(Green Ash) Forest, MHs38c-Red Oak-Sugar Maple-Basswood-(Bitternut Hickory) Forest, MHs39a-Sugar Maple-Basswood-(Bitternut Hickory) Forest

Prairie/grassland: UPs13-Southern Dry Prairie, UPs13b-Dry Sand-Gravel Prairie (Southern), UPs13c-Dry Bedrock Bluff Prairie (Southern), UPs14-Southern Dry Savanna, UPs14a2-Dry Barrens Oak Savanna (Southern), Oak Subtype, UPs14b-Dry Sand-Gravel Oak Savanna (Southern), UPs14c-Dry Hill Oak Savanna (Southern)

Lowland deciduous forests: FFn57a-Black Ash-Silver Maple Terrace Forest, FFn67a-Silver Maple-(Sensitive Fern) Floodplain Forest, FFs59c-Elm-Ash-Basswood Terrace Forest, FFs68a-Silver Maple-(Virginia Creeper) Floodplain Forest

Lowland conifer forests: APn80-Northern Spruce Bog, APn80a-Black Spruce Bog, APn80a1-Black Spruce Bog, Treed Subtype, APn80a2-Black Spruce Bog, Semi-Treed Subtype, APn81-Northern Poor Conifer Swamp, APn81a-Poor Black Spruce Swamp,

APn81b-Poor Tamarack-Black Spruce Swamp, APn81b1-Poor Tamarack-Black Spruce Swamp, Black Spruce Subtype, APn81b2-Poor Tamarack-Black Spruce Swamp, Tamarack Subtype, APn90-Northern Open Bog, APn90b-Graminoid Bog, APn91-Northern Poor Fen, APn91a-Low Shrub Poor Fen, APn91b-Graminoid Poor Fen (Basin), FPn72-Northern Rich Tamarack Swamp (Eastern Basin), FPn72a-Rich Tamarack Swamp (Eastcentral), FPn73-Northern Rich Alder Swamp, FPn73a-Alder-(Maple-Loosestrife) Swamp, FPn82-Northern Rich Tamarack Swamp (Western Basin), FPn82b-Extremely Rich Tamarack Swamp, FPs63-Southern Rich Conifer Swamp, FPs63a-Tamarack Swamp (Southern)

Target Species:

Mature upland/lowland forest birds: Acadian flycatcher, cerulean warbler, hooded warbler, Louisiana waterthrush, prothonotary warbler, red-shouldered hawk, wood thrush

Reptiles: common five-lined skink, eastern hog-nosed snake, gophersnake, smooth greensnake, wood turtle

Mudpuppy

SGCN fish

SGCN mussels

St. Croix snaketail

Mottled dusky wing

Caddisflies: *Limnephilus rossi*, *Ochrotrichia spinosa* and *Parapsyche apicali*

Example conservation issues

Degrading water quality, altered hydrology, increased extreme rainfall events due to climate change

Age, species, and structural diversity required for SGCN habitat and resilient forests. Lack of oak regeneration

Prairie, forest, wetland, river habitat quality impacted by invasive species

Habitat management impacts

Degraded conditions for forest interior birds

Decreased availability of nesting sites for forest birds

Example conservation approaches

Buffer riparian habitat and groundwater input areas using appropriate native vegetation. Increase conservation tillage incentives. Increase perennial vegetation. Restore overgrazed pasture land. Restore river/stream connectivity by removing dams.

Manage to maintain/increase plant species and structural diversity to improve quality habitat for forest SGCN and ensure more resilient forests. Increase acreage of forests with multiple age classes. Use prescribed fire to increase oak regeneration.

Natural disturbance management—use of prescribed fire, conservation grazing, haying in prairies as appropriate to maintain SGCN habitat. Remove invasive species from forests. Implement reed canary grass and invasive cattail control. Reduce cultural disturbances that provide opportunities for invasion. Monitor for new invasive species, including invasive carp, and utilize rapid treatment methods if detected. Remove woody species using mechanical removal from prairie/grassland habitat where natural disturbance management is not sufficient or feasible.

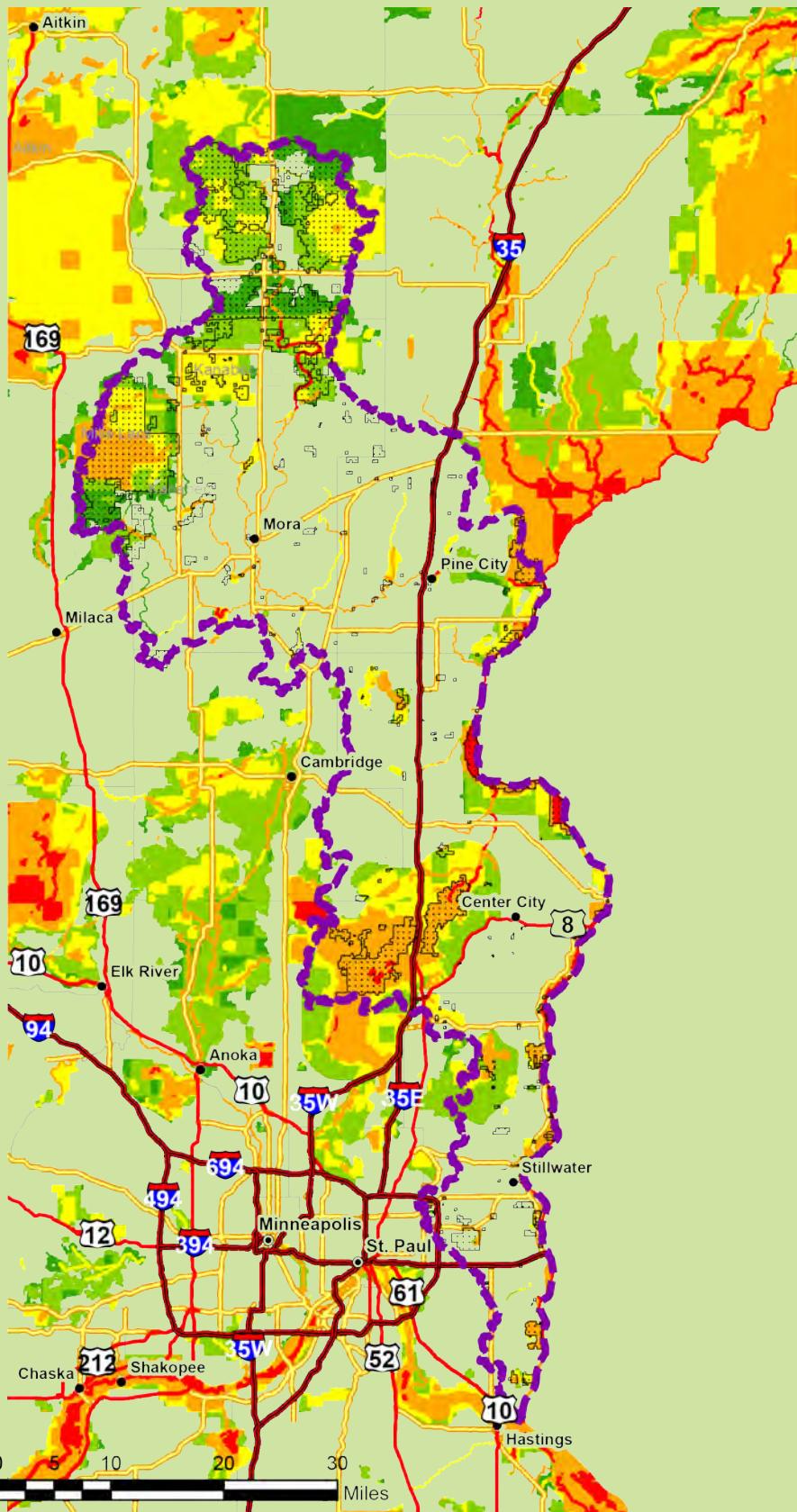
Alter frequency, timing, and extent of prescribed fires to minimize impacts on species with limited home-ranges and or mobility (such as invertebrate communities). Evaluate effects of conservation grazing on SGCN animal communities especially invertebrates, reptiles and mammals.

Forest management plans to promote selective cutting and small patch cuts to minimize large gaps for cowbird nesting.

Implement BMPs for species by retaining upright snags, buffers.

St. Croix River Watershed

Conservation Focus Area



Legend

CFA boundary

Ownership

Public

Wildlife Action Network Score

Low
Low-Medium
Medium
Medium-High
High

St. Louis Estuary

Targets, Conservation Issues, Approaches

Target Habitats (with NPC class/type):

Lakeshore: LKu32b-Juniper Dune Shrubland (Lake Superior), LKu32c-Sand Beach (Lake Superior)

River/Stream: RVx32a-Willow Sandbar Shrubland (River), RVx32c2-Gravel/Cobble Beach (River), Permanent Stream Subtype, RVx54a-Slumping Clay/Mud Slope (River)

Wetland (nonforested): MRu94a-Estuary Marsh (Lake Superior)

Target Species:

Birds: common tern, piping plover

Fish: lake sturgeon, longnose sucker

Eastern elliptio mussel

Hairy-necked tiger beetle ssp. *rhondensis*

Example conservation issues

Water quality degradation from contaminants

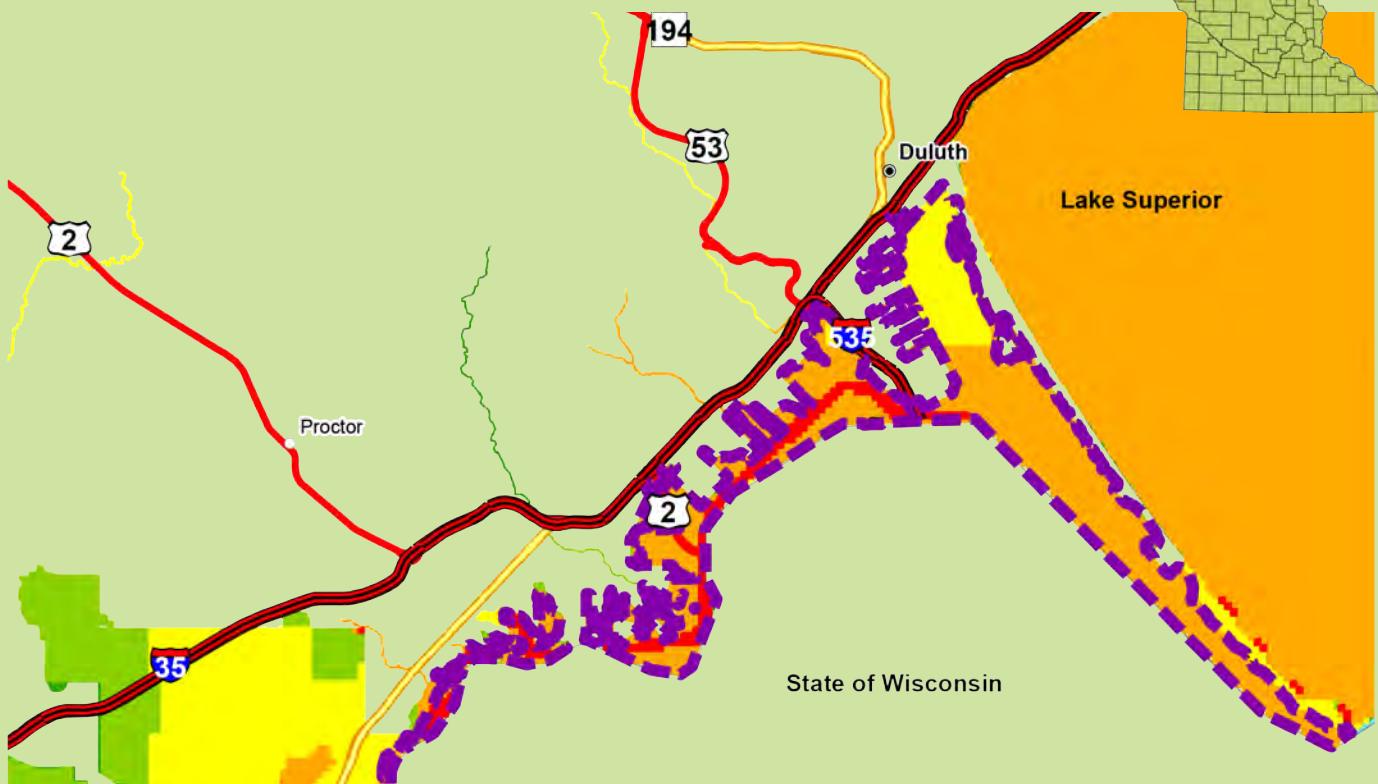
Loss of dune habitat

Example conservation approaches

Enforce existing standards. Incorporate SGCN consideration in remedial action plans.

Protect and/or restore dune areas.

St. Louis Estuary Conservation Focus Area



Legend	
	CFA boundary
Ownership	
	Public
Wildlife Action Network Score	
	Low
	Low-Medium
	Medium
	Medium-High
	High

0 1 2 4 Miles



Sand Lake

Targets, Conservation Issues, Approaches

Target Habitats (with NPC class/type):

Upland deciduous forest: FDn43b-Aspen-Birch Forest, FDn43b1-Aspen-Birch Forest, Balsam Fir Subtype,

Upland conifer forest: FDn32c1-Black Spruce-Jack Pine Woodland, Jack Pine-Balsam Fir Subtype, FDn32c2-Black Spruce-Jack Pine Woodland, Black Spruce-Feathermoss Subtype, FDn32d-Jack Pine-Black Spruce Woodland (Sand), FDn43a-White Pine-Red Pine Forest, FDn43c-Upland White Cedar Forest, MHN44-Northern Wet-Mesic Boreal Hardwood-Conifer Forest, MHN45b-White Cedar-Yellow Birch Forest,

Lowland conifer forest: AFP_CX-Alder Swamp / Forested Peatland Complex, APn80a-Black Spruce Bog, APn80a1-Black Spruce Bog, Treed Subtype, APn80a2-Black Spruce Bog, Semi-Treed Subtype, APn81-Northern Poor Conifer Swamp, APn81a-Poor Black Spruce Swamp, APn81b-Poor Tamarack-Black Spruce Swamp, APn90-Northern Open Bog, APn90a-Low Shrub Bog, APn90b1-Graminoid Bog, Typic Subtype, APn91-Northern Poor Fen, APn91a-Low Shrub Poor Fen, APn91b-Graminoid Poor Fen (Basin), APn91c1-Graminoid Poor Fen (Water Track), Featureless Water Track Subtype, APn91c2-Graminoid Poor Fen (Water Track), Flark Subtype, FPn62a-Rich Black Spruce Swamp (Basin), FPn63a-White Cedar Swamp (Northeastern), FPn73a-Alder-(Maple-Loosestrife) Swamp, FPn81-Northern Rich Tamarack Swamp (Water Track), FPn82a-Rich Tamarack-(Alder) Swamp, FPT_CX-Forested Peatland / Upland Transition Complex, NPF_CX-Northern Poor Fen Complex, WFn53-Northern Wet Cedar Forest, WFn53a-Lowland White Cedar Forest (North Shore), WFn53b-Lowland White Cedar Forest (Northern)

Open peatland systems: OOPn81-Northern Shrub Shore Fen, OPn81a-Bog birch-Alder Shore Fen, OPn81b-Leatherleaf-Sweet Gale Shore Fen, OPn91-Northern Rich Fen (Water Track), OPn91a-Shrub Rich Fen (Water Track), OPn91b-Graminoid Rich Fen (Water Track), OPn91b1-Graminoid Rich Fen (Water Track), Featureless Water Track Subtype, OPn91b2-Graminoid Rich Fen (Water Track), Flark Subtype, OPn92-Northern Rich Fen (Basin), OPn92a-Graminoid Rich Fen (Basin), OPn92b-Graminoid-Sphagnum Rich Fen (Basin),

Target Species:

Lowland conifer birds: boreal chickadee, Connecticut warbler

Mature upland forest birds

Other birds: boreal owl, northern goshawk

Butterflies: arctic fritillary, taiga alpine

Headwaters Chilogstigman caddisfly

Example conservation issues

Mature forest habitat size requirements for SGCN habitat

Example conservation approaches

Where possible, maintain large blocks of mature forest.

Lowland conifer requirements for SGCN habitat

Improve knowledge of pathogen management, clear cuts and the impact of gaps on lowland conifer bird habitat.

Maintain peatland hydrology

Assess agricultural and mining conversion and management impacts to peatland hydrology.

Forest habitat degradation due to invasive species

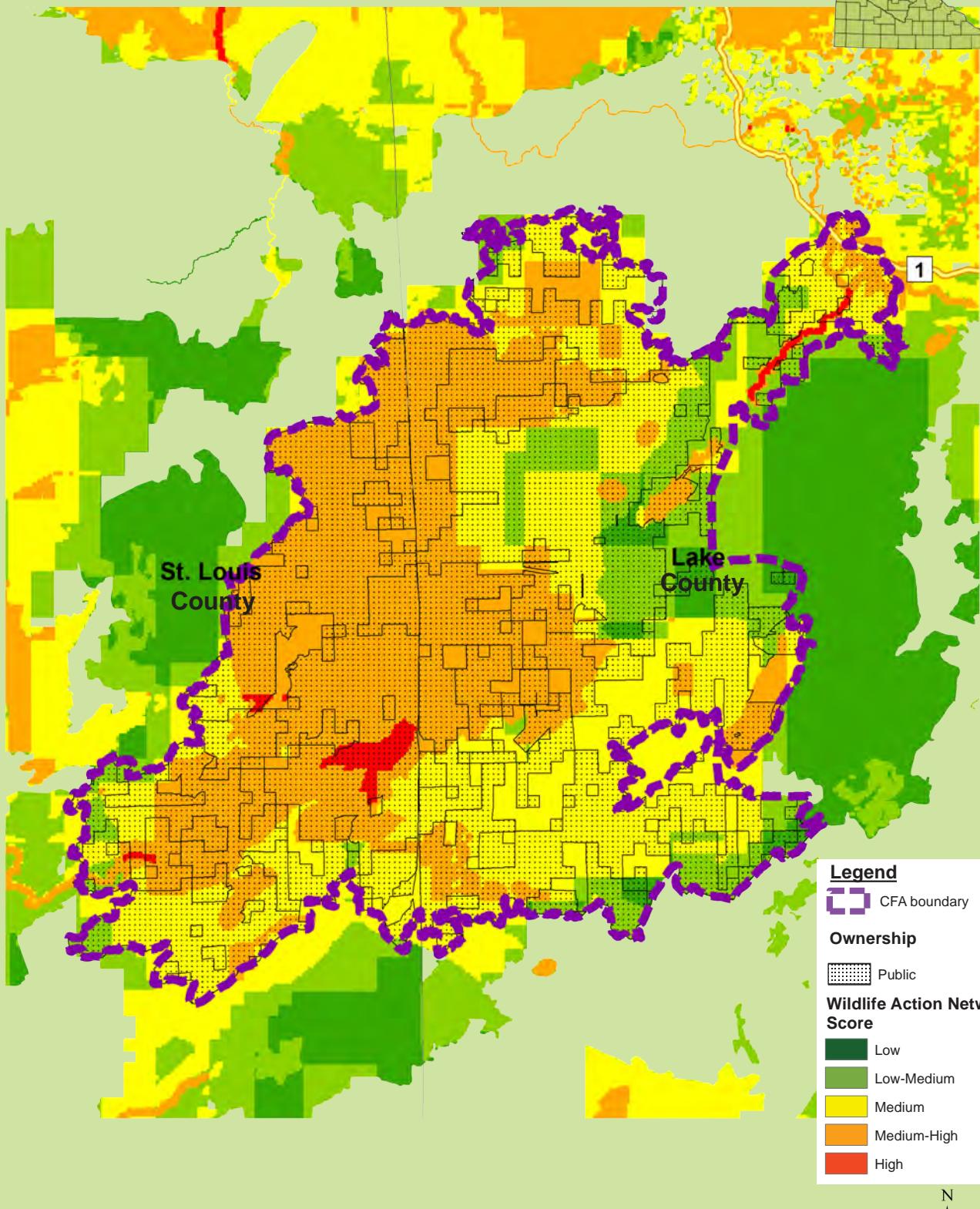
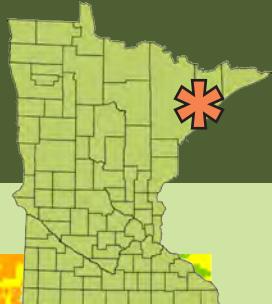
Monitor for new invasive species and utilize rapid treatment methods if detected.

Wetland loss

Apply MN Wetland Conservation Act standards. Ensure replacement standards are followed. Regulate agricultural and mining conversion of peatlands.

Sand Lake

Conservation Focus Area



Temperance Pines

Targets, Conservation Issues, Approaches

Target Habitats (with NPC class/type):

Upland Conifer Forest: FDn32c3-Black Spruce-Jack Pine Woodland, Jack Pine-Black Spruce-Aspen Subtype, FDn43a-White Pine-Red Pine Forest,

Upland Deciduous Forest: FDn43b1-Aspen-Birch Forest, Balsam Fir Subtype,

Target Species:

Smoky shrew

Mature upland coniferous forest birds: black-backed woodpecker, purple finch, spruce grouse

Other birds: boreal owl, northern goshawk

Example conservation issues

Example conservation approaches

Mature forest size requirements for SGCN habitat

Where possible, maintain large blocks of mature forest.

Limited pine regeneration

Manage for reproduction: thinning, low fuel burns, increase knowledge of new pathogens, reduce herbivory pressures.

Species and structural diversity required for SGCN habitat and resilient forests

Manage to maintain/increase plant species and structural diversity to improve quality habitat for forest SGCN and ensure more resilient forests.

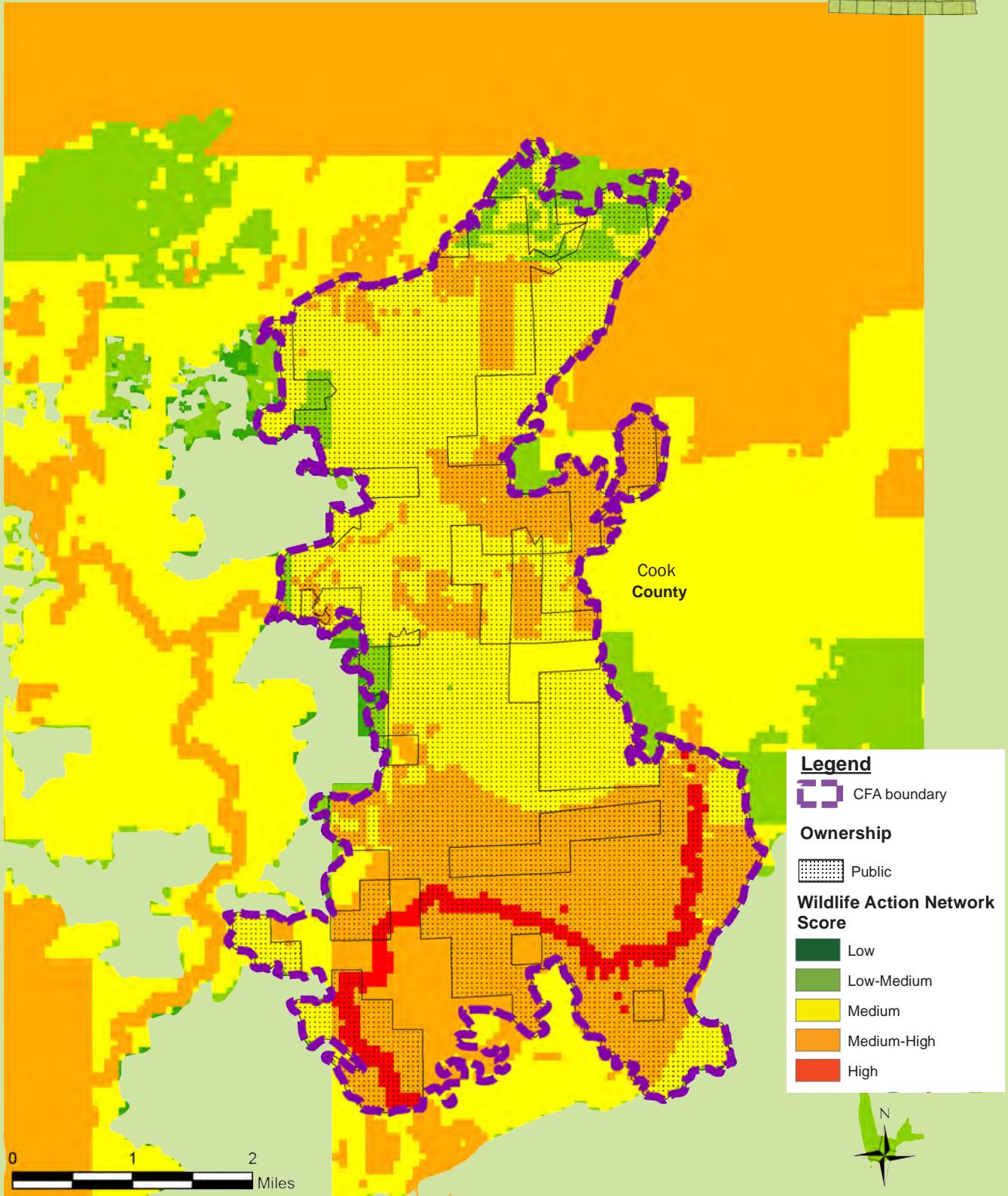
Forest habitat degradation due to invasive species

Monitor for new invasive species and utilize rapid treatment methods if detected.

Climate change-increased frequency of extended droughts, larger more frequent wildfires

Practice adaptive management to respond to forest regeneration and tree species migration. Reduce fire fuel loads through regular prescribed burning.

Temperance Pines Conservation Focus Area



Upper Minnesota River Valley

Targets, Conservation Issues, Approaches

Target Habitats (with NPC class/type):

Wetlands (nonforested): MRp83-Prairie Mixed Cattail Marsh, MRp93-Prairie Bulrush-Arrowhead Marsh, MRp93a-Bulrush Marsh (Prairie), WMp73a-Prairie Meadow/Carr, WMs83-Southern Seepage Meadow/Carr, WMs83a-Seepage Meadow/Carr, Riverine wetlands

Open peatlands: OPp93b-Calcareous Fen (Southwestern)

Rock outcrop communities: ROP_CX-Rock Outcrop-Prairie Complex, RO-s12a1-Crystalline Bedrock Outcrop (Prairie), Minnesota River Subtype

River/stream: Minnesota River

Prairie/grassland: UPs13-Southern Dry Prairie, UPs13b-Dry Sand-Gravel Prairie (Southern), UPs13d-Dry Hill Prairie (Southern), UPs14c-Dry Hill Oak Savanna (Southern), UPs23-Southern Mesic Prairie, UPs23a-Mesic Prairie (Southern), WPs54a-Wet Seepage Prairie (Southern), WPs54b-Wet Prairie (Southern), WP-s54c-Wet Saline Prairie (Southern)

Lowland deciduous forest: FFs59-Southern Terrace Forest, FFs68-Southern Floodplain Forest

Upland hardwood forest: FDs37b-Pin Oak-Bur Oak Woodland, MHs38-Southern Mesic Oak-Basswood Forest, MHs38b-Basswood-Bur Oak-(Green Ash) Forest, MHs38c-Red Oak-Sugar Maple-Basswood-(Bitternut Hickory) Forest, MHs39a-Sugar Maple-Basswood-(Bitternut Hickory) Forest, MHs49a-Elm-Basswood-Black Ash-(Hackberry) Forest

Target Species:

Dry-mesic prairie birds: grasshopper sparrow, Henslow's sparrow, marbled godwit, upland sandpiper, western meadowlark

Other birds: American white pelican, lark sparrow

Reptiles: common five-lined skink, gophersnake, plains hog-nosed snake

Amphibians: Great Plains toad, mudpuppy

SGCN fish

SGCN mussels

Prairie butterflies: Arogos skipper, Dakota skipper, dusted skipper, Leonard's skipper, Poweshiek skipperling, regal fritillary

Example conservation issues

Conversion of native habitat to agriculture or clay/aggregate mining. Prairie/grassland fragmentation and loss

Increased flashiness of river flows due to extreme rainfall events causing sedimentation, undercutting of banks, vertical separation from oxbows and floodplain wetlands

Prairie, forest, wetland, and river habitat quality impacted by invasive species

Habitat management impacts

Example conservation approaches

Assess suitability to conversion through environmental review. Target land protection of prairie/grassland and rock outcrop sites in the Wildlife Action Network using acquisition/easements. Implement Minnesota Prairie Conservation Plan.

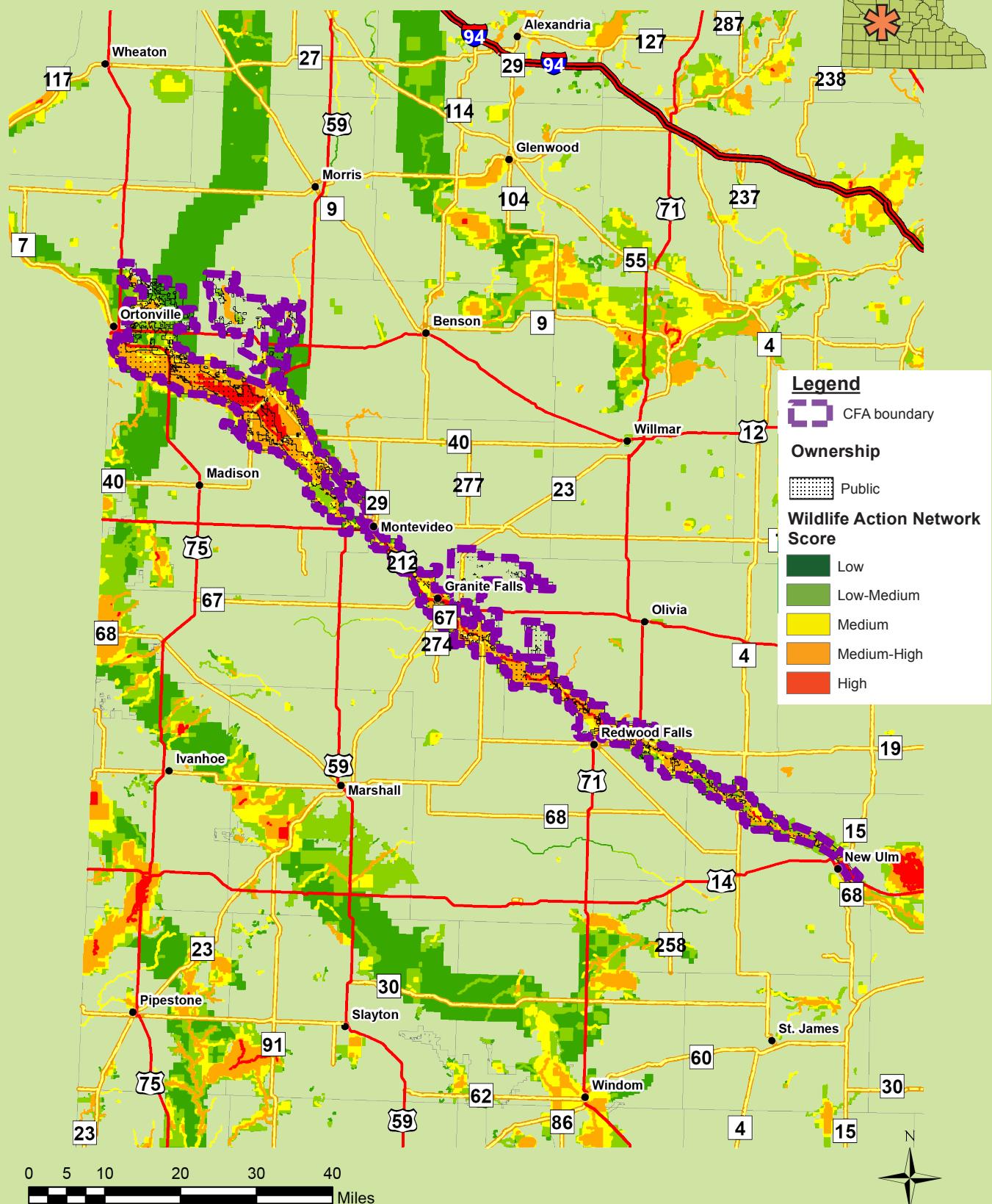
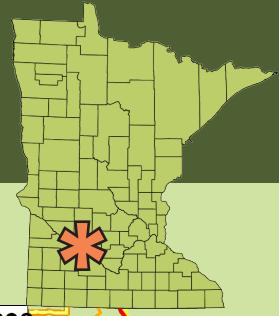
Promote infiltration practices in cultivated and urbanized landscapes; restore riparian cross-sections, connect floodplains with main channels, buffer stream banks with permanent, native vegetation.

Natural disturbance management—use of prescribed fire, conservation grazing, haying in prairies as appropriate to maintain SGCN habitat. Remove invasive species from forests. Implement reed canary grass and invasive cattail control, monitor for new invasive species and utilize rapid treatment methods if detected. Remove woody species using mechanical removal from prairie/grassland habitat where natural disturbance management is not sufficient or feasible.

Alter frequency, timing, and extent of prescribed fires to minimize impacts on species with limited home-ranges and or mobility (such as invertebrate communities).

Upper Minnesota River Valley

Conservation Focus Area



Vermillion River Watershed

Targets, Conservation Issues, Approaches

Target Habitats (with NPC class/type):

River/stream: Warm and cold water tributaries, main stems of Vermillion and Mississippi Rivers: RVx32-Sand/Gravel/Cobble River Shore, RVx32a-Willow Sandbar Shrubland (River), RVx32b2-Sand Beach/Sandbar (River), Permanent Stream Subtype

Upland hardwood Forest: FDs27b-White Pine-Oak Woodland (Sand), FDs27c-Black Oak-White Oak Woodland (Sand), FDs37b-Pin Oak-Bur Oak Woodland, FDs38-Southern Dry-Mesic Oak-Hickory Woodland, FDs38a-Oak-Shagbark Hickory Woodland, MHs37-Southern Dry-Mesic Oak Forest, MHs37a-Red Oak-White Oak Forest, MHs37b-Red Oak-White Oak-(Sugar Maple) Forest, MHs38-Southern Mesic Oak-Basswood Forest, MHs38a-White Pine-Oak-Sugar Maple Forest, MHs38c-Red Oak-Sugar Maple-Basswood-(Bitternut Hickory) Forest, MHs39-Southern Mesic Maple-Basswood Forest, MHs39a-Sugar Maple-Basswood-(Bitternut Hickory) Forest, MHs39b-Sugar Maple-Basswood-Red Oak-(Blue Beech) Forest, MHs49-Southern Wet-Mesic Hardwood Forest, MHs49b-Elm-Basswood-Black Ash-(Blue Beech) Forest

Prairies/grasslands: UPs13a-Dry Barrens Prairie (Southern), UPs13b-Dry Sand-Gravel Prairie (Southern), UPs13c-Dry Bedrock Bluff Prairie (Southern), UPs14a-Dry Barrens Oak Savanna (Southern), UPs14b-Dry Sand-Gravel Oak Savanna (Southern)

Lowland deciduous forest: FFs59a-Silver Maple-Green Ash-Cottonwood Terrace Forest, FFs59c-Elm-Ash-Basswood Terrace Forest, FFs68a-Silver Maple-(Virginia Creeper) Floodplain Forest

Wetlands (nonforested): MRn93-Northern

Bulrush-Spikerush Marsh, MRn93a-Bulrush Marsh (Northern), MRn93b-Spikerush-Bur Reed Marsh (Northern), OPp93c-Calcareous Fen (Southeastern)

Open peatlands: OPp93c-Calcareous Fen (South-eastern)

Target Species:

Mature upland/lowland forest bird: Acadian flycatcher, cerulean warbler, prothonotary warbler, wood thrush

Mudpuppy

Reptiles: smooth softshell, wood turtle, six-lined racerunner, timber rattlesnake

SGCN Fish

SGCN Mussels

Prairie butterflies: Arogos skipper, Leonard's skipper, regal fritillary

Example conservation issue

Degraded water quality, altered hydrology, increased extreme rainfall events due to climate change. Reduced stream connectivity. Low flow to Vermillion Bottoms

Age, species, and structural diversity required for SGCN habitat and resilient forests. Lack of oak regeneration

Prairie, forest, river and wetland habitat quality impacted by invasive species

Habitat management impacts

Reduced habitat diversity

Example conservation approaches

Buffer riparian habitat, sinkholes and other groundwater input areas with appropriate native vegetation. Increase conservation tillage incentives. Increase perennial vegetation. Restore overgrazed pastureland. Restore wetlands and connect rivers with adjacent wetlands. Reduce channelization, maintain oxbows, Enhance main stream connectivity. Technical assistance to local governments and landowners. Restore river/stream connectivity by removing dams. Improve flow from Truedale Slough to Vermillion Bottoms.

Manage to maintain/increase plant species and structural diversity to improve quality habitat for forest SGCN and ensure more resilient forests. Increase acreage of forests with multiple age classes. Use prescribed fire to increase oak regeneration.

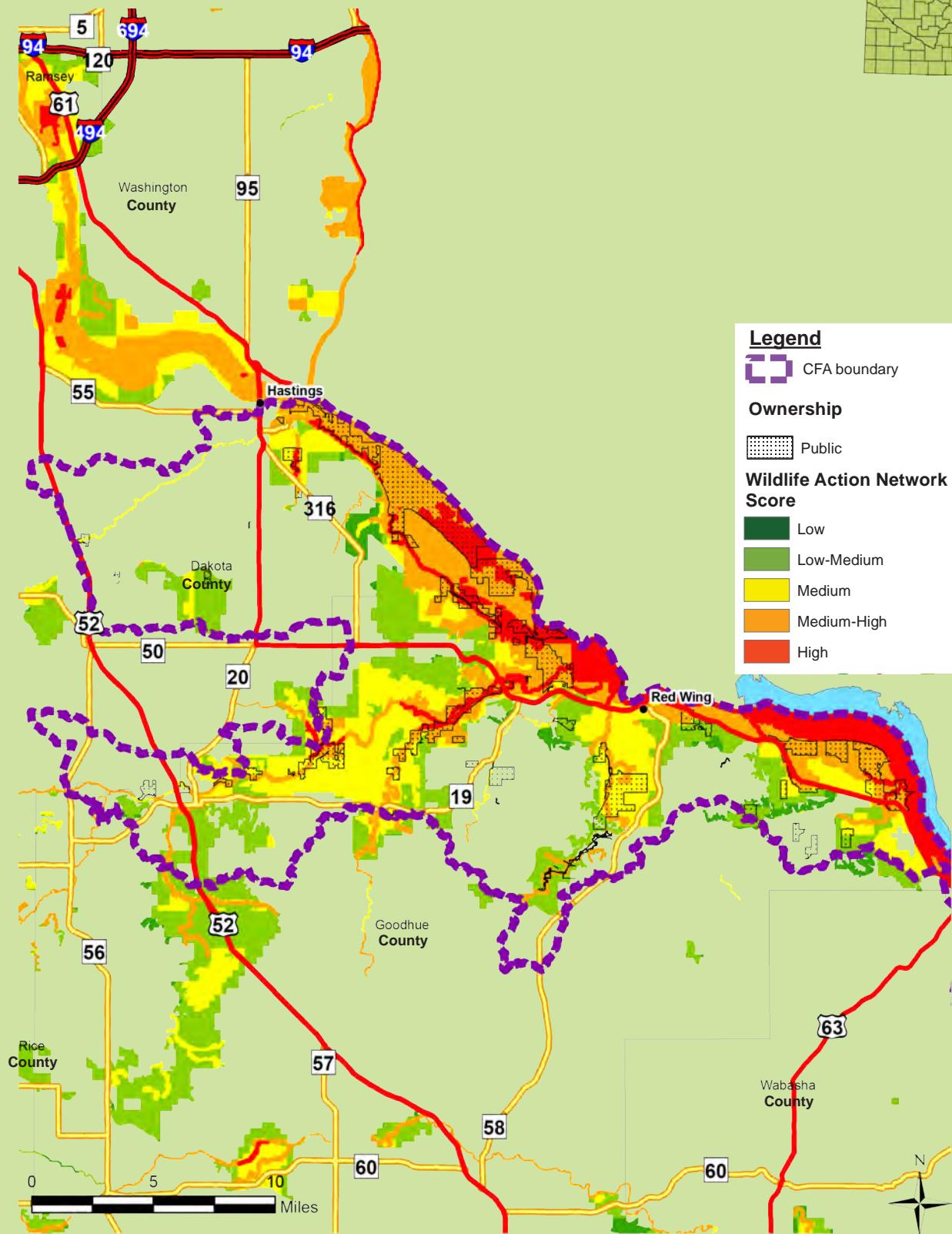
Natural disturbance management—use of prescribed fire, conservation grazing, haying in prairies as appropriate to maintain SGCN habitat. Remove invasive species from forests. Implement reed canary grass and invasive cattail control, monitor for new invasive species and utilize rapid treatment methods if detected. Remove woody species using mechanical removal from prairie/grassland habitat where natural disturbance management is not sufficient or feasible.

Alter frequency, timing, and extent of prescribed fires to minimize impacts on species with limited home-ranges and or mobility (such as invertebrate communities). Evaluate effects of conservation grazing on SGCN animal communities especially invertebrates, reptiles and mammals.

Increase amounts of wet meadow, lowland hardwood forest, and submergent marsh vegetation in the floodplain, and the full array of native plant communities elsewhere. Continue to restore dry prairie and dry oak savanna plant communities on Prairie Island.

Vermillion River Watershed

Conservation Focus Area



Whitewater River Watershed

Targets, Conservation Issues, Approaches

Target Habitats (with NPC class/type):

River/streets: Warm and cold water tributaries, main stems of Whitewater and Mississippi Rivers

Upland hardwood forest: FDs27b-White Pine-Oak Woodland (Sand), FDs27c-Black Oak-White Oak Woodland (Sand), FDs38a-Oak-Shagbark Hickory Woodland, MHC38a-White Pine-Sugar Maple-Basswood Forest (Cold Slope), MHs37-Southern Dry-Mesic Oak Forest, MHs37a-Red Oak-White Oak Forest, MHs37b-Red Oak-White Oak-(Sugar Maple) Forest, MHs38a-White Pine-Oak-Sugar Maple Forest, MHs38c-Red Oak-Sugar Maple-Basswood-(Bitternut Hickory) Forest, MHs39-Southern Mesic Maple-Basswood Forest, MHs39a-Sugar Maple-Basswood-(Bitternut Hickory) Forest, MHs39b-Sugar Maple-Basswood-Red Oak-(Blue Beech) Forest, MHs49-Southern Wet-Mesic Hardwood Forest, MHs49a-Elm-Basswood-Black Ash-(Hackberry) Forest, MHs49b-Elm-Basswood-Black Ash-(Blue Beech) Forest

Wetlands (nonforested): MRn83a-Cattail-Sedge Marsh (Northern), MRn93-Northern Bulrush-Spikerush Marsh, MRn93b-Spikerush-Bur Reed Marsh (Northern), WMn82b-Sedge Meadow, WMs83a-Seepage Meadow/Carr, WMs83a1-Seepage Meadow/Carr, Tussock Sedge Subtype, WMs83a3-Seepage Meadow/Carr, Impatiens Subtype

Prairies/grasslands: UPs13a-Dry Barrens Prairie (Southern), UPs13b-Dry Sand-Gravel Prairie (Southern), UPs13c-Dry Bedrock Bluff Prairie (Southern), UPs14a1-Dry Barrens Oak Savanna (Southern), Jack Pine Subtype, UPs14a2-Dry Barrens Oak Savanna (Southern), Oak Subtype, UPs14b-Dry Sand-Gravel Oak Savanna (Southern), UPs23a-Mesic Prairie (Southern)

Cliff/talus communities: CTs12-Southern Dry Cliff, CTs12b-Dry Limestone-Dolomite Cliff (Southern), CTs33a-Mesic Sandstone Cliff (Southern), CTs33b-Mesic Limestone-Dolomite Cliff (Southern), CTs43a1-Moderate Cliff, Limestone

Subtype, CTs43a2-Moderate Cliff, Dolomite
Subtype, CTs46a2-Algific Talus , Dolomite Subtype

Lowland deciduous forest: FFs59a-Silver Maple-Green Ash-Cottonwood Terrace Forest, FFs59b-Swamp White Oak Terrace Forest, FFs59c-Elm-Ash-Basswood Terrace Forest, FFs68a-Silver Maple-(Virginia Creeper) Floodplain Forest

Target Species:

Mature upland/lowland forest birds: Acadian flycatcher, cerulean warbler, Louisiana waterthrush, prothonotary warbler, red-shouldered hawk, wood thrush

Reptiles: gopher snake, North American racer, plains hog-nosed snake, six-lined racerunner, smooth softshell, timber rattlesnake,

Amphibians: Blanchard's cricket frog, pickerel frog

SGCN fish

SGCN mussels

Bluff vertigo

Jumping spiders: *Phidippus apacheanus*

Prairie/savanna butterflies: Arogos skipper, Karner blue, Leonard's skipper, mottled duskywing, Ottoe skipper, regal fritillary

Tiger beetles: ghost tiger beetle, splendid tiger beetle

Example conservation issues

Degraded water quality, altered hydrology, increased extreme rainfall events due to climate change. Reduced stream connectivity

Age, species, and structural diversity required for SGCN habitat and resilient forests. Lack of oak regeneration

Prairie, forest, river and wetland habitat quality impacted by invasive species

Habitat management impacts

Impacts to talus slopes and cliff communities due to blufftop conversion and climate change

Example conservation approaches

Buffer riparian habitat, sinkholes and other groundwater input areas with appropriate native vegetation. Increase conservation tillage incentives. Increase perennial vegetation. Restore overgrazed pastureland. Restore wetlands and connect rivers with adjacent wetlands. Reduce channelization, maintain oxbows, Enhance main stream connectivity. Technical assistance to local governments and landowners. Restore river/stream connectivity by removing dams.

Manage to maintain/increase plant species and structural diversity to improve quality habitat for forest SGCN and ensure more resilient forests. Increase acreage of forests with multiple age classes. Use prescribed fire to increase oak regeneration.

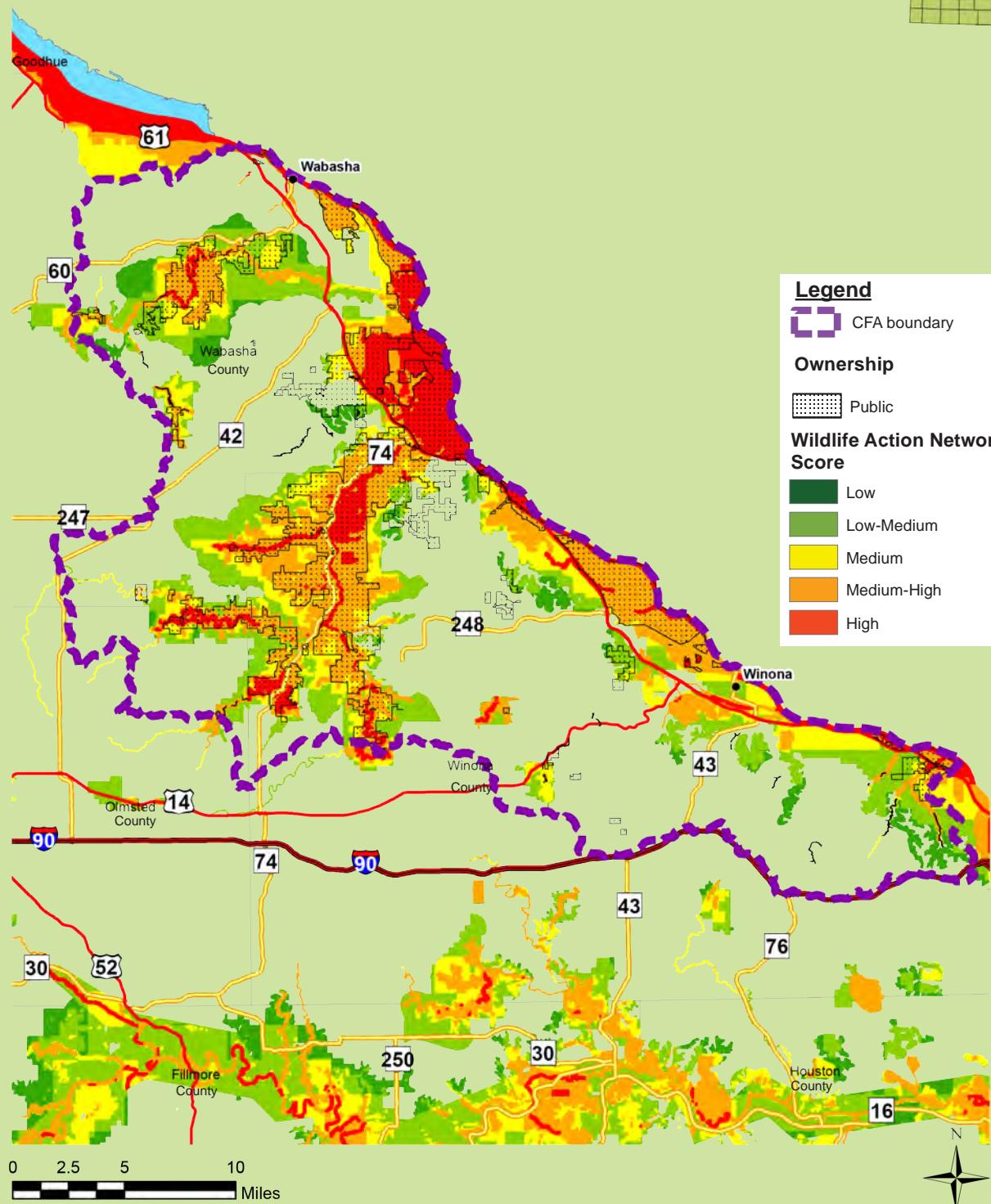
Natural disturbance management—use of prescribed fire, conservation grazing, haying in prairies as appropriate to maintain SGCN habitat. Remove invasive species from forests. Implement reed canary grass and invasive cattail control, monitor for new invasive species and utilize rapid treatment methods if detected. Remove woody species using mechanical removal from prairie/grassland habitat where natural disturbance management is not sufficient or feasible.

Alter frequency, timing, and extent of prescribed fires to minimize impacts on species with limited home-ranges and or mobility (such as invertebrate communities). Evaluate effects of conservation grazing on SGCN animal communities especially invertebrates, reptiles and mammals.

Buffer cold air drainage source areas (prioritize for bluff vertigo occurrences).

Whitewater River Watershed

Conservation Focus Area



Yellow Medicine Coteau

Targets, Conservation Issues, Approaches

Target Habitats (with NPC class/type):

Wetlands (nonforested): MR-Marsh System, MRp83-Prairie Mixed Cattail Marsh, MRp93-Prairie Bulrush-Arrowhead Marsh, MRp93a-Bulrush Marsh (Prairie), MRp93b-Spikerush-Bur Reed Marsh (Prairie), WMp73a-Prairie Meadow/Carr, WMs83a-Seepage Meadow/Carr, WMs83a1-Seepage Meadow/Carr, Tussock Sedge Subtype

Prairie/grasslands: UPs13b-Dry Sand-Gravel Prairie (Southern), UPs13d-Dry Hill Prairie (Southern), UPs14c-Dry Hill Oak Savanna (Southern), UPs23a-Mesic Prairie (Southern), WPs54b-Wet Prairie (Southern), WPs54c-Wet Saline Prairie (Southern), *includes surrogate grasslands*

Prairie stream ecosystems

Shallow lake

Saline Mud Flat: LKi54b1-Mud Flat (Inland Lake) Saline Subtype

Open peatland: OPp93b-Calcareous Fen (Southwestern)

Target Species:

Prairie mammals: northern grasshopper mouse, plains pocket mouse, prairie vole, Richardson's ground squirrel, white-tailed jackrabbit

Dry-mesic prairie birds: grasshopper sparrow, upland sandpiper, western meadowlark

Wet prairie/wetland/shallow lake birds: Red-necked grebe, Wilson's phalarope

Plains hog-nosed snake

Prairie butterflies: Arogos skipper, Dakota skipper, dusted skipper, Leonard's skipper, Poweshiek skipperling, regal fritillary

Crimson salt flat tiger beetle

Example conservation issues

Prairie/grassland loss and fragmentation

Groundwater depletion and contamination impacting municipal water availability, stream flows, and wetlands (especially calcareous fens)

Stream sedimentation and contamination, channelization, and impoundments, increased extreme rainfall events due to climate change

Prairie and wetland habitat degradation due to invasive species

Habitat management impacts

Management of shallow lakes for fish removal or vegetation objectives

Wind power effects on habitat quality

Example conservation approaches

Implement Minnesota Prairie Conservation Plan–buffer and connect prairie habitat.

Protect groundwater recharge areas (e.g., Lincoln-Pipestone Wellhead Protection Area) using appropriate native vegetation.

Reduce channelization, reduce stream entrenchment, restore connections between streams and riparian wetlands, maintain oxbows, enhance main stream connectivity, Buffer stream banks with permanent, native vegetation.

Natural disturbance management–use of prescribed fire, conservation grazing, haying in prairies as appropriate to maintain SGCN habitat. Implement reed canary grass and invasive cattail control, monitor for new invasive species and utilize rapid treatment methods if detected. Remove woody species using mechanical removal from prairie/grassland habitat where natural disturbance management is not sufficient or feasible.

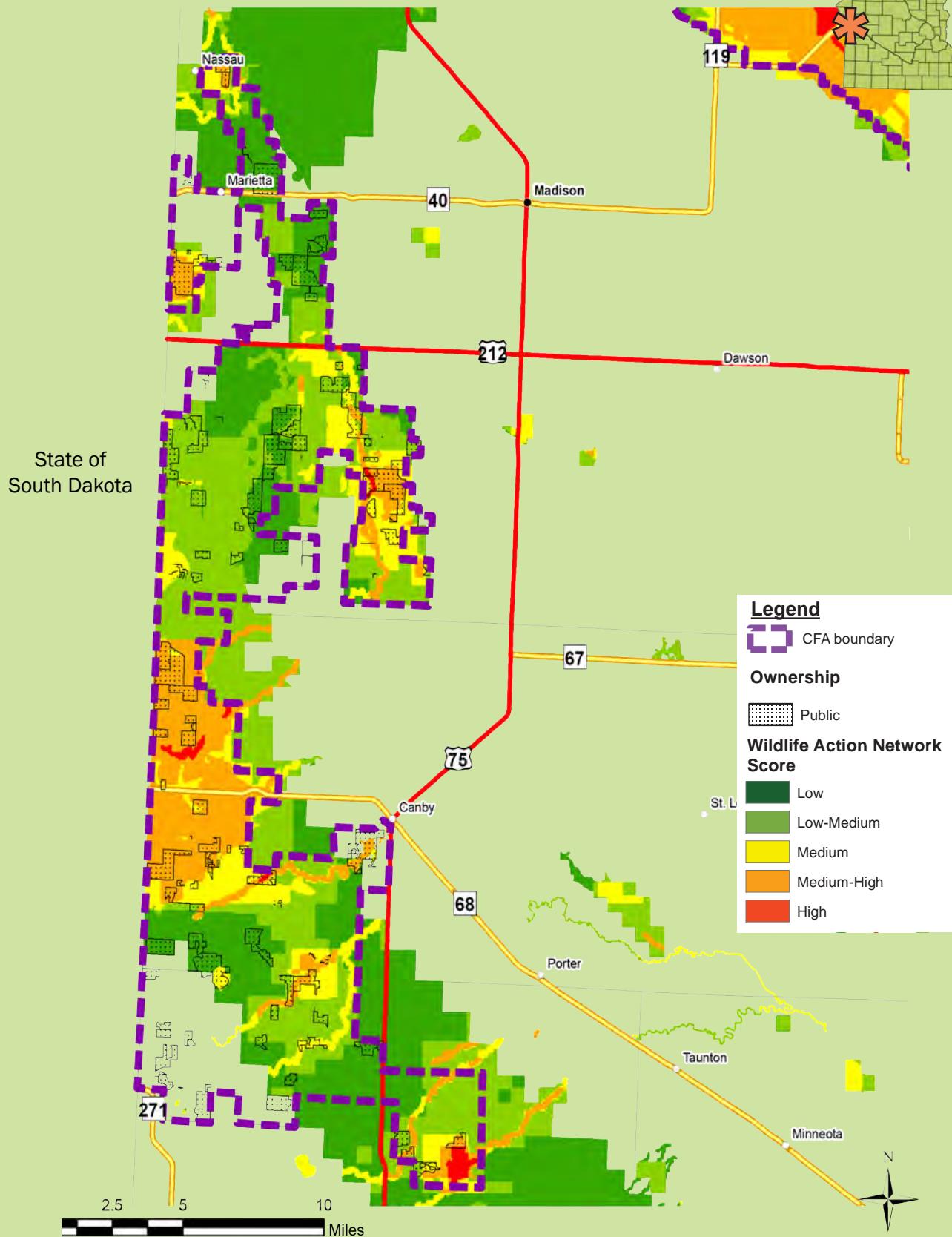
Alter frequency, timing, and extent of prescribed fires to minimize impacts on species with limited home-ranges and or mobility (such as invertebrate communities). Evaluate effects of conservation grazing on SGCN animal communities especially invertebrates, reptiles and mammals. Minimize water management in Salt Lake that maintains high water and eliminates the saline mudflat habitat, and allow seasonal drawdown.

Coordinated approach to prioritize varying management needs for fish, amphibians, turtles, birds, and invasive species.

Provide guidelines for appropriate areas for siting of new towers to minimize habitat impacts.

Yellow Medicine Coteau

Conservation Focus Area



Appendix A

The Eight Required Elements

Congress identified eight required elements for each State to address in the development of its Wildlife Action Plan. Minnesota's Wildlife Action Plan revision process addressed each of these elements (see MN Wildlife Action Plan 2015-25, Supplemental Document: The Eight Required Elements for details).

Element 1: The distribution and abundance of species of wildlife, including low and declining populations as each State fish and wildlife agency deemed appropriate, that are indicative of the diversity and health of wildlife of the State; (In subsequent discussions, these species were referred to as Species of Greatest Conservation Need or SGCN);

- A. The Strategy indicates sources of information (e.g., literature, data bases, agencies, individuals) on wildlife abundance and distribution consulted during the planning process.
- B. The Strategy includes information about both abundance and distribution for species in all major groups to the extent that data are available. There are plans for acquiring information about species for which adequate abundance and/or distribution information is unavailable.
- C. The Strategy identifies low and declining populations to the extent data are available.
- D. All major groups of wildlife have been considered or an explanation is provided as to why they were not (e.g., including reference to implemented marine fisheries management plans). The State may indicate whether these groups are to be included in a future Strategy revision.
- E. The Strategy describes the process used to select the species in greatest need of conservation. The quantity of information in the Strategy is determined by the State with input from its partners, based on what is available to the State.

Element 2: The location and relative condition of key habitats and community types essential to the conservation of each State's SGCN;

- A. The Strategy provides a reasonable explanation for the level of detail provided; if insufficient, the Strategy identifies the types of future actions that will be taken to obtain the information.
- B. Key habitats and their relative conditions are described in enough detail such that the State can determine where (i.e., in which regions, watersheds, or landscapes within the State) and what conservation actions need to take place.

Element 3: The problems which may adversely affect SGCN or their habitats, and priority research and surveys needed to identify factors which may assist in restoration and improved conservation of SGCN and their habitats;

- A. The Strategy indicates sources of information (e.g., literature, databases, agencies, or individuals) used to determine the problems or threats.
- B. The threats/problems are described in sufficient detail to develop focused conservation

actions (for example, “increased highway mortalities” or “acid mine drainage” rather than generic descriptions such as “development”, or “poor water quality”).

- C. The Strategy considers threats/problems, regardless of their origins (local, State, regional, national and international), where relevant to the State’s species and habitats.
- D. If available information is insufficient to describe threats/problems, research and survey efforts are identified to obtain needed information.
- E. The priority research and survey needs, and resulting products, are described sufficiently to allow for the development of research and survey projects after the Strategy is approved.

Element 4: The actions necessary to conserve SGCN and their habitats and establishes priorities for implementing such conservation actions;

- A. The Strategy identifies how conservation actions address identified threats to species of greatest conservation need and their habitats.
- B. The Strategy describes conservation actions sufficiently to guide implementation of those actions through the development and execution of specific projects and programs.
- C. The Strategy links conservation actions to objectives and indicators that will facilitate monitoring and performance measurement of those conservation actions (outlined in Element #5).
- D. The Strategy describes conservation actions (where relevant to the State’s species and habitats) that could be addressed by Federal agency or regional, national or international partners and shared with other States.
- E. If available information is insufficient to describe needed conservation actions, the Strategy identifies research or survey needs for obtaining information to develop specific conservation actions.
- F. The Strategy identifies the relative priority of conservation actions.

Element 5: The provisions for periodic monitoring of SGCN and their habitats, for monitoring the effectiveness of conservation actions, and for adapting conservation actions as appropriate to respond to new information or changing conditions;

- A. The Strategy describes plans for monitoring species identified in element 1, and their habitats.
- B. The Strategy describes how the outcomes of the conservation actions will be monitored.
- C. If monitoring is not identified for a species or species group, the Strategy explains why it is not appropriate, necessary or possible.
- D. Monitoring is to be accomplished at one of several levels including, individual species, guilds, or natural communities
- E. The monitoring utilizes or builds on existing monitoring and survey systems or explains how information will be obtained to determine the effectiveness of conservation actions.

- F. The monitoring considers the appropriate geographic scale to evaluate status of species or species groups and the effectiveness of conservation actions.
- G. The Strategy is adaptive in that it allows for evaluating conservation actions and implementing new actions accordingly.

Element 6: Each State's provision to review its Strategy [Plan] at intervals not to exceed ten years;

- A. The State describes the process that will be used to review the Strategy within the next ten years.

Element 7: Each State's provision for coordination during the development, implementation, review, and revision of its Strategy [Plan] with Federal, State, and local agencies and Indian Tribes that manage significant areas of land or water within the State, or administer programs that significantly affect the conservation or species or their habitats; and

- A. The State describes the extent of its coordination with and efforts to involve Federal, State, local agencies, and Indian Tribes in the development of its Strategy.
- B. The State describes its continued coordination with these agencies and tribes in the implementation, review and revision of its Strategy.

Element 8: Each State's provision to provide the necessary public participation in the development, revision, and implementation of its Strategy [Plan].

- A. The State describes the extent of its efforts to involve the public in the development of its Strategy.
- B. The State describes its continued public involvement in the implementation and revision of its Strategy.

Appendix B

Minnesota's Wildlife Action Plan Project Structure and Partnership Involvement

Management Team

The review and revision of Minnesota's Wildlife Action Plan was led by a Management Team made up of DNR employees. The team's function was to provide leadership and manage the revision process and ensure the involvement of the conservation community, including federal, state, and local agencies, tribal governments, and nongovernmental organizations. The Management Team planned and facilitated meetings; compiled, analyzed and provided GIS and other data; developed the content for the plan in consultation with other teams, particular the Production Advisory Team and the Core Team; and assured that the eight required elements were addressed and that the plan would be delivered to the US Fish and Wildlife Service by the Sept. 30, 2015, deadline. The Management Team included the following Division of Ecological and Water Resources staff:

Faith Balch, Minnesota Wildlife Action Plan coordinator

Bill Bleckwenn, principal planner, Minnesota Wildlife Action Plan and Scientific and Natural Areas Program

Daren Carlson, Minnesota Wildlife Action Plan monitoring ecologist and GIS specialist

Bob Dunlap, GIS specialist

Carrol Henderson, Nongame Wildlife Program supervisor

Krista Larson, nongame research biologist

Jane Norris, Conservation Management and Rare Resources Unit supervisor

Nancy Spooner-Mueller, principal planner (Bill Bleckwenn, filled this position the second year)

Production Advisory Team (PAT)

This team included representatives from DNR Divisions of Ecological and Wildlife Resources, Fish and Wildlife, Forestry, Parks and Trails, and the Office of Management and Budget Services, and Division of Ecological and Water Resources managers, including one from each of the four DNR Regions, and three conservation organizations (the Nature Conservancy, Audubon Minnesota, and The Wildlife Society). The function of the PAT members was to:

- advise the Management Team on key conservation issues addressed in the plan,
- review and recommend revisions to the plan to assure its functionality for users, and
- keep their divisions or organizations informed of plan content and progress, and serve as a conduit for incorporating information into the plan from their colleagues and conservation partners and other planning efforts.

PAT members:

Jacquelyn Bacigalupi, DNR Fish and Wildlife
Rich Baker, DNR Ecological and Water Resources
Peter Buesseler, DNR Ecological and Water Resources
Bruce Carlson, DNR Ecological and Water Resources
Steve Chaplin, The Nature Conservancy
Helen Cozzetto, DNR Forestry
Bill Faber, The Wildlife Society
Liz Harper, DNR Ecological and Water Resources
Carroll Henderson, DNR Ecological and Water Resources
Olivia LeDee, DNR Fish and Wildlife
Bryan Lueth, DNR Fish and Wildlife (replaced Bob Welsh)
Mark Martell, Audubon Minnesota
Keith Mykleseth, DNR Ecological and Water Resources (replaced Peter Buesseler)
Jane Norris, DNR Ecological and Water Resources
Laura Preus, DNR Parks and Trails
Jim Sehl, DNR Ecological and Water Resources
Bob Welsh, DNR Fish and Wildlife
Keith Wendt, DNR Office of Management and Budget Services

Core Team

The Core Team was composed of a Nongame Wildlife Specialist from each of the four DNR Regions. The team provided subject matter expertise and regional knowledge of conservation issues and opportunities. Their professional guidance was utilized in all elements of the plan's development including the revision of the SGCN list, the plan's goals and objectives, the identification of viable (or persistent) SGCN populations, the mapping of the Wildlife Action Network, and the identification of Conservation Focus Areas. Team members helped keep staff in their region informed about the plan's development and served as a conduit for incorporating information into the plan from their colleagues and conservation partners. Members were:

Gaea Crozier, DNR Region 2, Ecological and Water Resources
Jaime Edwards, DNR Region 3, Ecological and Water Resources
Lisa Gelvin-Innvaer, DNR Region 4, Ecological and Water Resources
Christine Herwig, DNR Region 1, Ecological and Water Resources

Species Technical Advisory Team (STAT)

Species Technical Advisory Team members are experts in their fields who were invited by the DNR to serve on an advisory team. Each STAT met at least twice to review and revise the SGCN list. Additional DNR staff facilitated phone and email discussions among team members as needed. Chapter 2 provides an overview of the revision process. The first member under each list served as the team leader.

Mammals

Gerda Nordquist, DNR Ecological and Water Resources

John Erb, DNR Fish and Wildlife

Ron Moen, University of Minnesota Natural Resources Research Institute

Dick Oehlenschlager, Science Museum of Minnesota

Birds

Steve Stucker, DNR Ecological and Water Resources

Jan Green, ornithologist

Tony Hertzel, Minnesota Ornithologists' Union

Scott Lanyon, University of Minnesota

Lee Pfannmueller, Audubon Minnesota

Randy Prachar, DNR Fish and Wildlife

Tom Will, US Fish and Wildlife Service

Amphibians and Reptiles

Carol Hall, DNR Ecological and Water Resources

Tony Gamble, University of Minnesota

Krista Larson, DNR Ecological and Water Resources

Jeff LeClere, DNR Ecological and Water Resources

John Moriarty, Three Rivers Parks District

Ed Quinn, DNR Parks and Trails

Fish

Nick Proulx, DNR Ecological and Water Resources

Dan Dieterman, DNR Fish and Wildlife

Jay Hatch, University of Minnesota

Brett Nagle, DNR Ecological and Water Resources (now with Minnesota Pollution Control Agency)

Scott Yess, US Fish and Wildlife Service

Mussels and Aquatic Snails

Mike Davis, DNR Ecological and Water Resources
Mark Hove, University of Minnesota
Dan Kelner, US Army Corps of Engineers
Bernard Sietman, DNR Ecological and Water Resources

Butterflies and Moths

Robert Dana, DNR Ecological and Water Resources
Ron Huber, Science Museum of Minnesota
Kyle Johnson, lepidopterist
David MacLean, lepidopterist
Erik Runquist, Minnesota Zoo

Dragonflies and Damselflies

Kurt Mead, Minnesota Odonata Survey Project Coordinator
Robert Dana, DNR Ecological and Water Resources

Tiger Beetles

Ron Huber, Science Museum of Minnesota
Robert Dana, DNR Ecological and Water Resources

Bees

Elaine Evans, University of Minnesota
Crystal Boyd, DNR Ecological and Water Resources
Robert Dana, DNR Ecological and Water Resources
Joel Gardner, University of Minnesota

Review of the Revised SGCN List

Once the STAT completed its review, the revised SGCN list was sent to the groups and individuals for review and comment (Table B1). Reviewers were asked to recommend species to be added to or removed from the list, and/or additions or deletions to the criteria listed for a species.

Table B1. Number of people and their affiliations notified to review and comment on the revised list of SGCN. This review was conducted in the spring of 2014.

Number of people	Affiliation
1	Anoka County Parks
5	Audubon Minnesota
1	Cass County
1	Cannon River Watershed Partnership
11	Commissioner's Advisory Committee on Natural Heritage
1	Ducks Unlimited
1	Environmental Learning Centers
1	Environmental Law and Policy Center
1	Fisherman's Village Resort, Battle Lake, MN
1	Friends of Mississippi River
3	Great River Greening
1	Izaak Walton League, Minnesota Division
2	lepidopterist
1	Midwest Natural Resources, Inc.
2	Minnesota Conservation Federation
2	Minnesota Ornithologists' Union
1	Minnesota State University
1	Minnesota Association of Watershed Districts
1	Minnesota Deer Hunters Association
1	Minnesota Department of Commerce
1	Minnesota Department of Transportation, Environmental Stewardship
1	Minnesota Environmental Partnership
2	Minnesota Forest Resource Council
1	Minnesota Land Trust
1	Minnesota and North American Falconer's Association
1	Minnesota Odonata Survey Project Coordinator
1	Minnesota Zoo
1	National Parks Service
2	National Wild Turkey Federation
1	Natural Resources Conservation Services
2	ornithologist
1	Pheasants Forever
3	Science Museum of Minnesota
1	St. Cloud State
2	St. Olaf College

1	St. Mary's University
9	The Nature Conservancy
1	Three Rivers Parks District
2	Trout Unlimited
1	Trust for Public Land
2	University of Minnesota, Natural Resources Research Institute
11	University of Minnesota
1	UPM Blandin Paper
1	US Army Corps of Engineers
26	US Fish and Wildlife Service
5	US Geological Survey
1	USDA Forest Service

Tribes/Tribal Governments

1	Bois Forte Reservation
2	Fond du Lac Reservation
2	Grand Portage RTC Trust Lands & Resources
1	Leech Lake Reservation
1	Lower Sioux Indian Community of Minnesota
1	Mille Lacs Band of Ojibwe
1	Prairie Island Indian Community
1	Red Lake Band of Chippewa Indians
1	Shakopee Mdewakanton Sioux Community
2	Upper Sioux Community
1	White Earth Reservation Department of Natural Resources

Minnesota Department of Natural Resources

4	Lands and Minerals
All staff	Ecological and Water Resources
All staff	Fish and Wildlife
Division Management	Forestry
Team and Central	
Office Administration	
Division Leadership	Parks and Trails
Team, Regional	
Resource Specialists,	
and Planners	
Management Service	Office of Management and Budget
Section	

Mapping Work Groups for the Identification of Viable or Persistent SGCN Populations

Species Technical Advisory Team members and additional experts used species occurrence data, other GIS data, and expert knowledge to identify, rank, and map viable and persistent SGCN populations. Mapping workshops lasted for an entire day, and for several of the taxa included a second meeting. The mapping methodology is discussed in Appendix E. Work group members included the following:

Mammals

Gerda Nordquist, DNR Ecological and Water Resources

Birds

Jan Green, ornithologist

Lee Pfannmueller, Audubon Minnesota

Steve Stucker, DNR Ecological and Water Resources

Tom Will, US Fish and Wildlife Services

Ed Zlonis, University of Minnesota Natural Resources Research Institute

Amphibians and Reptiles

Tony Gamble, University of Minnesota

Carol Hall, DNR Ecological and Water Resources

Krista Larson, DNR Ecological and Water Resources

Jeff LeClere, DNR Ecological and Water Resources

John Moriarty, Three Rivers Park District

Fish

Luke Borgstrom, DNR Fish and Wildlife

Jay Hatch, University of Minnesota

Brett Nagle, DNR Ecological and Water Resources (now with Minnesota Pollution Control Agency)

Mussels and Aquatic Snails

Mike Davis, DNR Ecological and Water Resources

Mark Hove, University of Minnesota

Dan Kelner, US Army Corps of Engineers

Bernard Sietman, DNR Ecological and Water Resources

Dragonflies and Damselflies*

Kurt Mead, DNR Parks and Trails (previously Minnesota Odonata Survey Project Coordinator)

Mitch Haag, Three Rivers Park District

Scott King, Minnesota Dragonfly Society

Ron Lawrenz, Warner Nature Center

Curt Oien, Three Rivers Park District

* Important habitat areas were identified; however, the team was not able to map viable populations because the location data were too coarse or only one year's data were available.

Reviewers of the Viable (Persistent) SGCN Population Maps

Once the maps were completed they were sent to the following people for feedback:

Birds

Jan Green, ornithologist

Scott Lanyon, University of Minnesota

Lee Pfannmueller, Audubon Minnesota

Steve Stucker, DNR Ecological and Water Resources

Randy Pracher, DNR Fish and Wildlife

Tom Will, US Fish and Wildlife Services

Ed Zlonis, University of Minnesota Natural Resources Research Institute

Amphibians and Reptiles

Tony Gamble, University of Minnesota

Carol Hall, DNR Ecological and Water Resources

Krista Larson, DNR Ecological and Water Resources

Jeff LeClere, DNR Ecological and Water Resources

John Moriarty, Three Rivers Park District

Ed Quinn, DNR Parks and Trails

Fish

Lucas Borgstrom, DNR Fish and Wildlife

Dan Dieterman, DNR Fish and Wildlife

Jay Hatch, University of Minnesota

Brett Nagle, DNR Ecological and Water Resources (now with Minnesota Pollution Control Agency)

Nick Proulx, DNR Ecological and Water Resources

Scott Yess, US Fish and Wildlife Service

Mussels and Aquatic Snails

Mike Davis, DNR Ecological and Water Resources

Mark Hove, University of Minnesota

Dan Kelner, US Army Corps of Engineers

Bernard Sietman, DNR Ecological and Water Resources

Various DNR Fish and Wildlife Program Staff

Ann Geisen

Emily Hutchins

Greg Hoch

Steve Kittelson

Ricky Lien

Clint Luedtke

Bryan Lueth

Dennis Opdahl

Jodie Provost

Dave Rave

Randy Schindle

Lindsey Shartell

The maps were also sent to the following individuals to distribute for feedback:

Ed Quinn, DNR Parks and Trails (forwarded to resource specialists for review)

Bob Welsh and DNR Fish and Wildlife regional supervisors

DNR Area Fisheries Managers and Fisheries research staff

Jim Leach, US Fish and Wildlife Service, Refuge Supervisor (forwarded to refuge staff for review)

Meredith Cornett, The Nature Conservancy (forwarded to The Nature Conservancy staff for review)

Wildlife Action Network and Conservation Focus Area Regional Meetings

Production Advisory Team members were fully engaged throughout the Wildlife Action Network and Conservation Focus Area identification and mapping process, as was the Core Team. Management Team members relied heavily on the expertise of these groups in the development of the draft network and Conservation Focus Areas, which were then reviewed by DNR staff at four regional meetings. Participants in those meetings were the following:

Region 1

Rita Albrecht, Operations Service
Peter Buesseler, Ecological and Water Resources
Lorilynn Clark, Ecological and Water Resources
Steve Colvin, Ecological and Water Resources
Shelley Gorham, Fish and Wildlife
Robert Guthrie, Ecological and Water Resources
Shelley Hettke, Ecological and Water Resources
Rodger Hemphill, Ecological and Water Resources
Christine Herwig, Ecological and Water Resources
Tyler Janke, Ecological and Water Resources
Nicholas Jensen, Ecological and Water Resources
Bruce Lenning, Ecological and Water Resources
Mike Locke, Forestry
Becky Marty, Ecological and Water Resources
Chris Weir-Koetter, Parks and Trails

Region 2

Cliff Bentley, Ecological and Water Resources
Bruce Carlson, Ecological and Water Resources
Gaea Crozier, Ecological and Water Resources
Maya Hamady, Ecological and Water Resources
Cathy Handrick, Parks and Trails
Erika Herr, Ecological and Water Resources
Anna Hess, Ecological and Water Resources

Paul Lundgren, Forestry

Darrell Schindler, Ecological and Water Resources

AmberBeth VanNingen, Ecological and Water Resources

Kevin Woizeschke, Ecological and Water Resources

Region 3

Anton Benson, Parks and Trails

Regina Bonsignor, Operations Services

Ian Chisholm, Ecological and Water Resources

Erica Hoaglund, Ecological and Water Resources

Jim LaBarre, Fish and Wildlife

Larissa Mottl, Ecological and Water Resources

Diana Regenscheid, Fish and Wildlife

Kathryn Resner, Ecological and Water Resources

Chris Smith, Ecological and Water Resources

Hannah Texler, Ecological and Water Resources

Trina Zieman, Lands and Minerals

Region 4

Megan Benage, Ecological and Water Resources

Rob Collett, Ecological and Water Resources

Lisa Gelvin-Innvaer, Ecological and Water Resources

Brooke Haworth, Ecological and Water Resources

Ethan Jenzen, Ecological and Water Resources

Tara Latozke, Fish and Wildlife

Cory Netland, Fish and Wildlife

Judy Schulte, Ecological and Water Resources

Brian Schultz, Fish and Wildlife

Joe Stangel, Fish and Wildlife

Molly Tranel Nelson, Parks and Trails

Jeanine Vorland, Fish and Wildlife

Lucas Youngsma, Ecological and Water Resources

Jeff Zajac, Fish and Wildlife

Review of the Final Draft Plan

The revised Wildlife Action Plan was posted for review on an http site for three weeks from July 27 through August 14, 2015. A brief survey was also included. Table B2 lists the number of people from DNR's partner agencies and organizations that were notified by email that the plan was available for review. Survey results follow the table.

Table B2. Number of people and their affiliations who were notified to review and comment on the revised Minnesota Wildlife Action Plan, 2015–25.

Number of people	Affiliation
1	Anoka County Parks
5	Audubon Minnesota
1	Cass County
1	Cannon River Watershed Partnership
14	Commissioner's Advisory Committee on Natural Heritage
1	Conservation Fund
8	Ducks Unlimited
2	Environmental Learning Centers/Nature Centers
1	Environmental Law and Policy Center
1	Fisherman's Village Resort, Battle Lake, MN
1	Friends of Mississippi River
1	Friends of Boundary Water Canoe Area (BWCA)
1	Friends of the Parks and Trails of St. Paul and Ramsey County
2	Great River Greening
2	Izaak Walton League, Minnesota Division
1	Leech Lake Area Watershed Foundation
1	lepidopterist
1	Midwest Natural Resources, Inc.
1	Minnesota Association of Watershed Districts
17	Minnesota Board of Water and Soil Resources
1	Minnesota Center for Environmental Advocacy
2	Minnesota Conservation Federation
2	Minnesota Deer Hunters Assoc.
1	Minnesota Department of Commerce
1	Minnesota Department of Transportation, Environmental Stewardship
1	Minnesota Dragonfly Society

2	Minnesota Department of Natural Resources Land Use Specialists
2	Minnesota Environmental Partnership
2	Minnesota Forest Industries
All members and staff	Minnesota Forest Resource Council
1	Minnesota Herpetological Society
1	Minnesota Land Trust
1	Minnesota and North American Falconer's Association
1	Minnesota Odonata Survey Project
1	Minnesota Ornithologists' Union
1	Minnesota Pollution Control Agency
2	Minnesota Society for Conservation Biology
1	Minnesota State University
1	Minnesota Zoo
1	National Parks Service
2	National Wild Turkey Federation
1	Natural Resources Conservation Services
2	ornithologist
4	Pheasants Forever
3	Ruffed Grouse Society
1	Science Museum of Minnesota
1	St. Cloud State
1	St. Mary's University
2	St. Olaf College
87	Soil and Water Conservation Districts
1	Superior National Forest
7	The Nature Conservancy
9	The Wildlife Society (Minnesota)
3	Three Rivers Parks District
9	Trout Unlimited
1	Trust for Public Land
4	University of Minnesota, Natural Resources Research Institute
12	University of Minnesota
1	University of Minnesota, Monarch Larva Monitoring
2	UPM Blandin Paper
2	US Army Corps of Engineers
26	US Fish and Wildlife Service
3	US Fish and Wildlife Services, Landscape Conservation Cooperatives
1	US Fish and Wildlife Service Native American Liaison
3	US Geological Survey

1	USDA Forest Service
1	Women Observing Wildlife-Minnesota

Tribes/Tribal Governments

1	Bois Forte Reservation
1	Fond du Lac Reservation
1	Grand Portage RTC Trust Lands & Resources
1	Leech Lake Reservation
1	Lower Sioux Indian Community of Minnesota
1	Mille Lacs Band of Ojibwe
1	Prairie Island Indian Community
1	Red Lake Band of Chippewa Indians
1	Upper Sioux Community
1	White Earth Reservation Department of Natural Resources

Minnesota Department of Natural Resources

3	Lands and Minerals
All staff	Ecological and Water Resources
All staff	Fish and Wildlife
Director, deputy director, Management	Forestry
Team and regional managers and staff	
Division Leadership	DNR Parks and Trails
Team, Regional Resource Specialists, and planners and naturalists	

Comments Received

- The Production Advisory Team signed off on the plan in June 2015. Their final comments were addressed in the final plan that went out for review. The team was very pleased with the final plan.
- The Commissioner's Advisory Committee on Natural Resources conducted a four-hour review of the plan on August 5, 2015. This 15-member citizen committee advises the Department of Natural Resources' programs on issues related to sustaining the state's natural heritage and biological diversity. The committee noted that the Wildlife Action Network and Conservation Focus Areas were a significant improvement to the 2005 plan. They encouraged us to find ways to consistently report on performance over the next 10 years. In addition, committee members provided a number of suggestions related to clarifying key concepts, improving information presented in tables and maps, and strengthening the conservation actions which were incorporated into the final plan.

- In addition to the survey responses there were a number of email comments from DNR Divisions of Ecological and Water Resources, Forestry, Parks and Trails, and Fish and Wildlife as well as from external partners: The Nature Conservancy, University of Minnesota, Natural Resources Research Institute, Science Museum of Minnesota, Bell Museum, The Wildlife Society, and Women Observing Wildlife. In addition to providing useful information on improving the plan, many comments also provided valuable information for plan implementation.

Survey Responses

Sixty-four people responded to the survey.

- 96 comments were provide on specific chapters.
- Additional comments were made on figures and tables
- Several new Conservation Focus Areas were recommended from the review process. Because the identification of Conservation Focus Areas seems to be the area of greatest discussion, the decision was made not to include newly recommended CFAs until they could be distributed for review. Language in the plan allows for the identification of new CFAs.

Responses to the survey questions

- **How well did you understand the description of the Habitat Approach?**
37 responses – 94 percent found it easy or somewhat easy to understand.
- **How well did you understand the Species Approach?**
38 responses – 99 percent found it easy or somewhat easy to understand.
- **Do you have a general understanding of the process used to identify the Wildlife Action Network and the Conservation Focus Areas?**
33 responses – only 12 percent thought they needed more information to incorporate the Wildlife Action Network and Conservation Focus Areas into their work.
- **Did we do an adequate job of explaining the functional difference between the Wildlife Action Network and the Conservation Focus Areas and how they relate?**
29 responses – 90 percent said yes
- **How well do the Conservation Focus Areas represent areas where you are currently implementing conservation projects or would implement projects in the future?**
32 responses – 74 percent felt the Conservation Focus Areas highly or somewhat reflect their current work areas.
- **Is the information on the stressors impacting wildlife clearly presented?**
30 responses – 97 percent said yes

- Is the information related to climate change as an additional stressor on habitats and species informative?
29 responses – 64 percent said yes; 24 percent said somewhat informative
- How useful is the section “Wildlife Action Plan Strategies for Reducing Stressors” in contributing to your understanding of how the plan’s approach, objectives, and conservation actions will reduce the impacts of the stressors habitats and wildlife?
30 responses - 27 percent said useful; 63 percent said somewhat useful
- How well do the goals and objectives relate to the information presented in chapters 1–3?
29 responses – 72 percent said goals and objectives relate well; 24 percent said relate somewhat
- Have critical conservation actions or performance measures been missed?
27 responses - 59 percent said there were additional actions and measures and provided that information.
- How well did you understand the approaches for monitoring at the various scales?
29 responses – 94 percent understood or somewhat understood
- How well does the monitoring chapter reflect or complement monitor or adaptive management approaches that you are currently using in your work?
28 responses – 32 percent said approaches complement; 28 percent said somewhat complement; 36 percent provided additional information.
- Have we missed important implementation opportunities or approaches?
25 responses - 68 percent said didn't miss anything; 13 said comments provided additional information

Additional Comments

- Excellent document, and I look forward to doing my part in successfully implementing and monitoring the plan.
- I appreciate all the good work here! I think this effort will do more to translate concerns to actions on the ground than the previous effort, and I think the CFA concept is a great approach in that regard.
- We commend all who have invested and will continue to invest much time and expertise into the process. Thank you!
- First, congrats! What a huge accomplishment to get this draft out. I thought the document looked quite good. It lays out the plan well. Particularly chapter 1, which does a really nice job describing the approaches.

Appendix B

Minnesota's Wildlife Action Plan 2015-2025

B17

Appendix C

Species in Greatest Conservation Need (SGCN) List for 2015 Update

SGCN are defined as native animals, nongame and game, whose populations are rare, declining, or vulnerable to decline and are below levels desirable to insure their long-term health and stability. Also included are species for which Minnesota has a stewardship responsibility.

All state-listed species and federally listed species that occur in Minnesota are automatically SGCN. Additional non-listed species are SGCN based on specific criteria and expert opinion.

The purpose of the SGCN list is to prioritize species and habitats on which to target conservation strategies and actions that are defined in Minnesota's 2015–25 Wildlife Action Plan.

The plan, including the SGCN list for 2015, will not be in effect until approval by the US Fish and Wildlife Service in late 2015.

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Status Key

State Status

- The state-listed status is noted to the right of the species common name.
- **END** = A species is considered **endangered (END)** if the species is threatened with extinction throughout all or a significant portion of its range within Minnesota.
- **THR** = A species is considered **threatened (THR)** if the species is likely to become endangered within the foreseeable future throughout all or a significant portion of its range within Minnesota.
- **SPC** = A species is considered a **species of special concern (SPC)** if, although the species is not endangered or threatened, it is extremely uncommon in Minnesota, or has unique or highly specific habitat requirements and deserves careful monitoring of its status. Species on the periphery of their range that are not listed as threatened may be included in this category along with those species that were once threatened or endangered but now have increasing or protected, stable populations.
- **NL** = **Nonlisted species (NL)** are species that are not included on the state or federal lists.

Federal Status

- The status of federally listed species that occur in Minnesota is noted to the left of the species criteria.
- **E**= endangered: A species that is in danger of extinction throughout all or a significant portion of its range.
- **T**= threatened: A species that is likely to become endangered in the foreseeable future throughout all or a significant portion of its range.
- **P**= proposed: A species that is proposed in the Federal Register to be listed under Section 4 of the Endangered Species Act
- **C** = candidate: A species for which the US Fish and Wildlife Service has sufficient information on their biological status and threats to propose them as endangered or threatened under the Endangered Species Act, but for which development of a proposed listing regulation is precluded by other higher priority listing activities.

Mammals

	Taxa	Scientific name	Common name	State status	Federal status	Criteria (stressors and life-history traits)
1	Mammals	<i>Alces americanus</i>	moose	SPC		habitat loss; disease; need special resources (narrow thermal preferences)
2	Mammals	<i>Cervus canadensis</i>	elk	SPC		state listed; no additional criteria identified
3	Mammals	<i>Cryptotis parva</i>	North American least shrew	SPC		need special resources (narrow thermal preferences); highly localized/restricted distribution
4	Mammals	<i>Eptesicus fuscus</i>	big brown bat	SPC		disease; need special resources (narrow thermal preferences); limited ability to recover (low reproductive rate); aggregate their populations
5	Mammals	<i>Lasionycteris noctivagans</i>	silver-haired bat	NL		habitat fragmentation; limited ability to recover (low reproductive rate)
6	Mammals	<i>Lasiurus borealis</i>	red bat	NL		habitat fragmentation; limited ability to recover (low reproductive rate)
7	Mammals	<i>Lasiurus cinereus</i>	hoary bat	NL		habitat fragmentation; limited ability to recover (low reproductive rate)
8	Mammals	<i>Lepus townsendii</i>	white-tailed jack-rabbit	NL		statistically valid decline documented; extensive surveys indicate a decline of unknown cause
9	Mammals	<i>Lynx canadensis</i>	Canada lynx	SPC	T	habitat degradation; need special resources (narrow thermal preferences); depend on ecological process no longer within NRV
10	Mammals	<i>Microtus ochrogaster</i>	prairie vole	SPC		habitat loss; habitat degradation; invasive species; highly localized/restricted distribution
11	Mammals	<i>Microtus pinetorum</i>	woodland vole	SPC		highly localized/restricted distribution
12	Mammals	<i>Mustela nivalis</i>	least weasel	SPC		highly localized/restricted distribution
13	Mammals	<i>Myotis lucifugus</i>	little brown myotis	SPC		disease; need special resources (narrow thermal preferences); limited ability to recover (low reproductive rate); aggregate their populations
14	Mammals	<i>Myotis septentrionalis</i>	northern long-eared bat	SPC	T	disease; need special resources (narrow thermal preferences); limited ability to recover (low reproductive rate); aggregate their populations
15	Mammals	<i>Onychomys leucogaster</i>	northern grasshopper mouse	SPC		state listed – no additional criteria identified
16	Mammals	<i>Perimyotis subflavus</i>	tri-colored bat	SPC		disease; need special resources (narrow thermal preferences); limited ability to recover (low reproductive rate); aggregate their populations
17	Mammals	<i>Perognathus flavescens</i>	plains pocket mouse	SPC		highly localized/restricted distribution
18	Mammals	<i>Phenacomys ungava</i>	eastern heather vole	SPC		highly localized/restricted distribution
19	Mammals	<i>Poliocitellus franklinii</i>	Franklin's ground squirrel	NL		populations in Minnesota stable, but have declined or are declining in a substantial part of range
20	Mammals	<i>Puma concolor</i>	mountain lion	SPC		state listed; no additional criteria identified
21	Mammals	<i>Reithrodontomys megalotis</i>	western harvest mouse	SPC		state listed; no additional criteria identified
22	Mammals	<i>Sorex fumeus</i>	smoky shrew	SPC		state listed; no additional criteria identified
23	Mammals	<i>Spilogale putorius</i>	eastern spotted skunk	THR		statistically valid decline documented; extensive surveys indicate a decline of unknown cause
24	Mammals	<i>Synaptomys borealis</i>	northern bog lemming	SPC		highly localized/restricted distribution
25	Mammals	<i>Taxidea taxus</i>	American badger	NL		habitat loss; habitat fragmentation
26	Mammals	<i>Thomomys talpoides</i>	northern pocket gopher	THR		habitat loss; deliberate killing; highly localized/restricted distribution
27	Mammals	<i>Urocitellus richardsonii</i>	Richardson's ground squirrel	SPC		habitat loss

Birds

	Taxa	Scientific name	Common name	State status	Federal status	Criteria (stressors and life-history traits)
1	Birds	<i>Accipiter gentilis</i>	northern goshawk	SPC		habitat fragmentation; requires large home ranges/multiple habitats; depend on large habitat
2	Birds	<i>Aechmophorus occidentalis</i>	western grebe	NL		rare, vulnerable/declining habitat; aggregate their populations
3	Birds	<i>Aegolius funereus</i>	boreal owl	SPC		rare, vulnerable/declining habitat; requires large home ranges/multiple habitats; highly localized/restricted distribution; extensive surveys indicate a decline of unknown cause
4	Birds	<i>Ammodramus bairdii</i>	Baird's sparrow	END		rare, vulnerable/declining habitat
5	Birds	<i>Ammodramus henslowii</i>	Henslow's sparrow	END		rare, vulnerable/declining habitat; habitat loss
6	Birds	<i>Ammodramus leconteii</i>	Le Conte's sparrow	NL		rare, vulnerable/declining habitat; habitat loss
7	Birds	<i>Ammodramus nelsoni</i>	Nelson's sparrow	SPC		rare, vulnerable/declining habitat
8	Birds	<i>Ammodramus savannarum</i>	grasshopper sparrow	NL		statistically valid decline documented; rare, vulnerable/declining habitat; habitat loss; depend on large habitat
9	Birds	<i>Anas acuta</i>	northern pintail	NL		statistically valid decline documented
10	Birds	<i>Anas rubripes</i>	American black duck	NL		highly localized/restricted distribution
11	Birds	<i>Anthus spragueii</i>	Sprague's pipit	END	C	rare, vulnerable/declining habitat; extensive surveys indicate a decline of unknown cause
12	Birds	<i>Antrostomus vociferus</i>	eastern whip-poor-will	NL		rare, vulnerable/declining habitat; habitat degradation; depend on ecological process no longer within NRV; extensive surveys indicate a decline of unknown cause
13	Birds	<i>Asio flammeus</i>	short-eared owl	SPC		rare, vulnerable/declining habitat; habitat loss
14	Birds	<i>Athene cunicularia</i>	burrowing owl	END		rare, vulnerable/declining habitat; need special resources (narrow thermal preferences)
15	Birds	<i>Aythya affinis</i>	lesser scaup	NL		statistically valid decline documented
16	Birds	<i>Bartramia longicauda</i>	upland sandpiper	NL		statistically valid decline documented; rare, vulnerable/declining habitat
17	Birds	<i>Botaurus lentiginosus</i>	American bittern	NL		statistically valid decline documented
18	Birds	<i>Buteo lineatus</i>	red-shouldered hawk	SPC		habitat degradation; habitat fragmentation; requires large home ranges/multiple habitats
19	Birds	<i>Buteo swainsoni</i>	Swainson's hawk	NL		rare, vulnerable/declining habitat
20	Birds	<i>Calcarius ornatus</i>	chestnut-collared longspur	END		rare, vulnerable/declining habitat; highly localized/restricted distribution
21	Birds	<i>Calidris canutus rufa</i>	rufa red knot		T	federally listed, no additional criteria identified
22	Birds	<i>Calidris pusilla</i>	semipalmated sandpiper	NL		migrating populations congregating in Minnesota represent a significant portion of the North American population
23	Birds	<i>Catharus fuscescens</i>	veery	NL		statistically valid decline documented; Minnesota population represents significant portion of their North American breeding or wintering population
24	Birds	<i>Chaetura pelagica</i>	chimney swift	NL		statistically valid decline documented
25	Birds	<i>Charadrius melanotos</i>	piping plover	END	E/T	rare, vulnerable/declining habitat; habitat loss; highly localized/restricted distribution
26	Birds	<i>Chlidonias niger</i>	black tern	NL		statistically valid decline documented; rare, vulnerable/declining habitat
27	Birds	<i>Chondestes grammacus</i>	lark sparrow	SPC		rare, vulnerable/declining habitat; habitat degradation
28	Birds	<i>Chordeiles minor</i>	common nighthawk	NL		extensive surveys indicate a decline of unknown cause

29	Birds	<i>Circus cyaneus</i>	northern harrier	NL		rare, vulnerable/declining habitat; habitat loss; depend on large habitat
30	Birds	<i>Cistothorus platensis</i>	sedge wren	NL		Minnesota population represents significant portion of their North American breeding or wintering population
31	Birds	<i>Coccothraustes vespertinus</i>	evening grosbeak	NL		extensive surveys indicate a decline of unknown cause
32	Birds	<i>Coccyzus americanus</i>	yellow-billed cuckoo	NL		statistically valid decline documented
33	Birds	<i>Coccyzus erythrophthalmus</i>	black-billed cuckoo	NL		statistically valid decline documented; depend on ecological process no longer within NRV
34	Birds	<i>Contopus cooperi</i>	olive-sided flycatcher	NL		statistically valid decline documented
35	Birds	<i>Coturnicops noveboracensis</i>	yellow rail	SPC		rare, vulnerable/declining habitat; habitat loss
36	Birds	<i>Cygnus buccinator</i>	trumpeter swan	SPC		Minnesota population represents significant portion of their North American breeding or wintering population
37	Birds	<i>Dolichonyx oryzivorus</i>	bobolink	NL		statistically valid decline documented; rare, vulnerable/declining habitat; habitat loss; Minnesota population represents significant portion of their North American breeding or wintering population
38	Birds	<i>Empidonax virescens</i>	Acadian flycatcher	SPC		rare, vulnerable/declining habitat; habitat degradation
39	Birds	<i>Falcipennis canadensis</i>	spruce grouse	NL		habitat loss; habitat fragmentation
40	Birds	<i>Falco peregrinus</i>	peregrine falcon	SPC		statistically valid decline documented; limited ability to recover (low reproductive rate)
41	Birds	<i>Falco sparverius</i>	American kestrel	NL		statistically valid decline documented
42	Birds	<i>Gallinula galeata</i>	common gallinule	SPC		habitat loss
43	Birds	<i>Gavia immer</i>	common loon	NL		contaminants
44	Birds	<i>Haemorhous purpureus</i>	purple finch	NL		statistically valid decline documented
45	Birds	<i>Hylocichla mustelina</i>	wood thrush	NL		habitat loss; habitat degradation
46	Birds	<i>Ixobrychus exilis</i>	least bittern	NL		rare, vulnerable/declining habitat; habitat loss; habitat degradation
47	Birds	<i>Lanius ludovicianus</i>	loggerhead shrike	END		rare, vulnerable/declining habitat; extensive surveys indicate a decline of unknown cause
48	Birds	<i>Leucophaeus pipixcan</i>	Franklin's gull	SPC		habitat loss; aggregate their populations
49	Birds	<i>Limnodromus griseus</i>	short-billed dowitcher	NL		migrating populations congregating in Minnesota represent a significant portion of the North American population
50	Birds	<i>Limosa fedoa</i>	marbled godwit	SPC		rare, vulnerable/declining habitat; depend on large habitat; depend on ecological process no longer within NRV
51	Birds	<i>Limosa haemastica</i>	Hudsonian godwit	NL		migrating populations congregating in Minnesota represent a significant portion of the North American population
52	Birds	<i>Megacyrle alcyon</i>	belted kingfisher	NL		statistically valid decline documented
53	Birds	<i>Melanerpes erythrocephalus</i>	red-headed woodpecker	NL		statistically valid decline documented
54	Birds	<i>Mergus merganser</i>	common merganser	NL		migrating populations congregating in Minnesota represent a significant portion of the North American population
55	Birds	<i>Nycticorax nycticorax</i>	black-crowned night-heron	NL		rare, vulnerable/declining habitat; aggregate their populations
56	Birds	<i>Oporornis agilis</i>	Connecticut warbler	NL		statistically valid decline documented; habitat loss; habitat fragmentation
57	Birds	<i>Parkesia motacilla</i>	Louisiana water-thrush	SPC		rare, vulnerable/declining habitat; habitat degradation; requires large home ranges/multiple habitats

58	Birds	<i>Pelecanus erythrorhynchos</i>	American white pelican	SPC		Minnesota population represents significant portion of their North American breeding or wintering population; aggregate their populations
59	Birds	<i>Phalaropus tricolor</i>	Wilson's phalarope	THR		rare, vulnerable/declining habitat; habitat loss
60	Birds	<i>Picoides arcticus</i>	black-backed wood-pecker	NL		habitat loss; habitat fragmentation; depend on ecological process no longer within NRV
61	Birds	<i>Pipilo erythrophthalmus</i>	eastern towhee	NL		statistically valid decline documented; depend on ecological process no longer within NRV
62	Birds	<i>Podiceps auritus</i>	horned grebe	END		rare, vulnerable/declining habitat; habitat loss
63	Birds	<i>Podiceps grisegena</i>	red-necked grebe	NL		rare, vulnerable/declining habitat
64	Birds	<i>Podiceps nigricollis</i>	eared grebe	NL		rare, vulnerable/declining habitat; aggregate their populations
65	Birds	<i>Poecile hudsonicus</i>	boreal chickadee	NL		habitat loss; habitat degradation; habitat fragmentation
66	Birds	<i>Progne subis</i>	purple martin	SPC		statistically valid decline documented; contaminants; aggregate their populations
67	Birds	<i>Protonotaria citrea</i>	prothonotary warbler	NL		habitat loss; habitat degradation; invasive species
68	Birds	<i>Rallus elegans</i>	king rail	END		rare, vulnerable/declining habitat; habitat loss
69	Birds	<i>Rallus limicola</i>	Virginia rail	NL		rare, vulnerable/declining habitat
70	Birds	<i>Scolopax minor</i>	American woodcock	NL		statistically valid decline documented
71	Birds	<i>Setophaga caerulescens</i>	black-throated blue warbler	NL		rare, vulnerable/declining habitat; habitat fragmentation
72	Birds	<i>Setophaga castanea</i>	bay-breasted warbler	NL		habitat loss; need special resources (narrow thermal preferences)
73	Birds	<i>Setophaga cerulea</i>	cerulean warbler	SPC		rare, vulnerable/declining habitat; habitat degradation
74	Birds	<i>Setophaga citrina</i>	hooded warbler	SPC		habitat loss; highly localized/restricted distribution
75	Birds	<i>Setophaga tigrina</i>	Cape May Warbler	NL		habitat loss; need special resources (narrow thermal preferences)
76	Birds	<i>Spiza americana</i>	dickcissel	NL		statistically valid decline documented
77	Birds	<i>Spizella pusilla</i>	field sparrow	NL		statistically valid decline documented; rare, vulnerable/declining habitat
78	Birds	<i>Stelgidopteryx serripennis</i>	northern rough-winged swallow	NL		statistically valid decline documented
79	Birds	<i>Sterna forsteri</i>	Forster's tern	SPC		rare, vulnerable/declining habitat; habitat loss; aggregate their populations
80	Birds	<i>Sterna hirundo</i>	common tern	THR		aggregate their populations
81	Birds	<i>Sturnella magna</i>	eastern meadowlark	NL		rare, vulnerable/declining habitat; habitat loss
82	Birds	<i>Sturnella neglecta</i>	western meadowlark	NL		statistically valid decline documented; rare, vulnerable/declining habitat; habitat loss
83	Birds	<i>Toxostoma rufum</i>	brown thrasher	NL		statistically valid decline documented
84	Birds	<i>Tringa melanoleuca</i>	greater yellowlegs	NL		migrating populations congregating in Minnesota represent a significant portion of the North American population
85	Birds	<i>Troglodytes hiemalis</i>	winter wren	NL		habitat loss
86	Birds	<i>Tympanuchus cupido</i>	greater prairie-chicken	SPC		rare, vulnerable/declining habitat
87	Birds	<i>Tympanuchus phasianellus</i>	sharp-tailed grouse	NL		rare, vulnerable/declining habitat; aggregate their populations
88	Birds	<i>Tyrannus verticalis</i>	western kingbird	NL		statistically valid decline documented; rare, vulnerable/declining habitat; depend on large habitat
89	Birds	<i>Vermivora chrysoptera</i>	golden-winged warbler	NL		Minnesota population represents significant portion of their North American breeding or wintering population; populations in Minnesota stable but have declined or are declining in a substantial part of range

Appendix C

90	Birds	<i>Vireo bellii</i>	Bell's vireo	SPC		rare, vulnerable/declining habitat; extensive surveys indicate a decline of unknown cause
91	Birds	<i>Vireo philadelphicus</i>	Philadelphia vireo	NL		rare, vulnerable/declining habitat; extensive surveys indicate a decline of unknown cause
92	Birds	<i>Xanthocephalus xanthocephalus</i>	yellow-headed blackbird	NL		statistically valid decline documented; rare, vulnerable/declining habitat

Amphibians

	Taxa	Scientific name	Common name	State status	Federal status	Criteria (stressors and life-history traits)
1	Amphibians	<i>Acris blanchardi</i>	Blanchard's cricket frog	END		habitat loss; habitat degradation; need special resources (narrow thermal preferences); highly localized/restricted distribution
2	Amphibians	<i>Ambystoma maculatum</i>	spotted salamander	SPC		rare, vulnerable/declining habitat; habitat loss; habitat degradation; habitat fragmentation; requires large home ranges/multiple habitats; highly localized/restricted distribution; aggregate their populations
3	Amphibians	<i>Anaxyrus cognatus</i>	Great Plains toad	SPC		rare, vulnerable/declining habitat; habitat loss; habitat degradation; habitat fragmentation; requires large home ranges/multiple habitats; aggregate their populations
4	Amphibians	<i>Hemidactylum scutatum</i>	four-toed salamander	SPC		rare, vulnerable/declining habitat; habitat loss; habitat degradation; habitat fragmentation; requires large home ranges/multiple habitats; limited ability to recover (low dispersal ability); highly localized/restricted distribution
5	Amphibians	<i>Lithobates palustris</i>	pickerel frog	NL		rare, vulnerable/declining habitat; habitat loss; habitat degradation; requires large home ranges/multiple habitats; highly localized/restricted distribution; aggregate their populations
6	Amphibians	<i>Necturus maculosus</i>	mudpuppy	SPC		habitat degradation; habitat fragmentation; over-exploitation; disease
7	Amphibians	<i>Notophthalmus viridescens</i>	eastern newt	NL		rare, vulnerable/declining habitat; habitat degradation; habitat fragmentation; requires large home ranges/multiple habitats
8	Amphibians	<i>Plethodon cinereus</i>	eastern red-backed salamander	NL		habitat degradation; habitat fragmentation

Reptiles

1	Reptiles	<i>Apalone mutica</i>	smooth softshell	SPC		rare, vulnerable/declining habitat; habitat loss; habitat degradation; predation beyond normal levels; highly localized/restricted distribution; aggregate their populations
2	Reptiles	<i>Aspidoscelis sexlineata</i>	six-lined racerunner	NL		rare, vulnerable/declining habitat; habitat degradation; highly localized/restricted distribution
3	Reptiles	<i>Coluber constrictor</i>	North American racer	SPC		rare, vulnerable/declining habitat; habitat loss; highly localized/restricted distribution; aggregate their populations
4	Reptiles	<i>Crotalus horridus</i>	timber rattlesnake	THR		rare, vulnerable/declining habitat; habitat loss; habitat degradation; habitat fragmentation; overexploitation; disease; deliberate killing; limited ability to recover (low reproductive rate); highly localized/restricted distribution; aggregate their populations
5	Reptiles	<i>Diadophis punctatus edwardsii</i> (northern subspecies)	northern ring-necked snake	NL		highly localized/restricted distribution
6	Reptiles	<i>Emydoidea blandingii</i>	Blanding's turtle	THR		rare, vulnerable/declining habitat; habitat loss; habitat degradation; habitat fragmentation; requires large home ranges/multiple habitats; depend on large habitat; limited ability to recover (low reproductive rate)
7	Reptiles	<i>Glyptemys insculpta</i>	wood turtle	THR		statistically valid decline documented; rare, vulnerable/declining habitat; habitat loss; habitat degradation; habitat fragmentation; requires large home ranges/multiple habitats; depend on large habitat; limited ability to recover (low reproductive rate); aggregate their populations

8	Reptiles	<i>Heterodon nasicus</i>	plains hog-nosed snake	SPC		rare, vulnerable/declining habitat; habitat loss; habitat degradation; habitat fragmentation; overexploitation
9	Reptiles	<i>Heterodon platirhinos</i>	eastern hog-nosed snake	NL		rare, vulnerable/declining habitat; habitat loss; habitat degradation; habitat fragmentation
10	Reptiles	<i>Opheodrys vernalis</i>	smooth greensnake	NL		habitat loss; habitat degradation; habitat fragmentation; contaminants
11	Reptiles	<i>Pantherophis obsoletus</i>	western ratsnake	THR		habitat degradation; disease; highly localized/restricted distribution; aggregate their populations
12	Reptiles	<i>Pituophis catenifer</i>	gophersnake	SPC		rare, vulnerable/declining habitat; habitat loss; habitat degradation; habitat fragmentation; overexploitation; deliberate killing; requires large home ranges/multiple habitats; depend on large habitat
13	Reptiles	<i>Plestiodon fasciatus</i>	common five-lined skink	SPC		rare, vulnerable/declining habitat; habitat degradation; highly localized/restricted distribution
14	Reptiles	<i>Sistrurus catenatus</i>	massasauga	END	C	rare, vulnerable/declining habitat; habitat loss; habitat degradation; habitat fragmentation; disease; deliberate killing; need special resources (narrow thermal preferences); depend on ecological process no longer within NRV; limited ability to recover (low reproductive rate); highly localized/restricted distribution; extensive surveys indicate a decline of unknown cause
15	Reptiles	<i>Tropidoclonion lineatum</i>	lined snake	SPC		habitat loss; habitat fragmentation; highly localized/restricted distribution

Fish

	Taxa	Scientific name	Common name	State status	Federal status	Criteria (stressors and life-history traits)
1	Fish	<i>Acipenser fulvescens</i>	lake sturgeon	SPC		habitat fragmentation; requires large home ranges/multiple habitats; depend on large habitats; depend on ecological process no longer within NRV
2	Fish	<i>Alosa chrysochloris</i>	skipjack herring	END		habitat fragmentation; depend on ecological process no longer within NRV; highly localized/restricted distribution
3	Fish	<i>Ammocrypta clara</i>	western sand darter	NL		habitat degradation; depend on ecological process no longer within NRV
4	Fish	<i>Anguilla rostrata</i>	American eel	SPC		habitat fragmentation; depend on ecological process no longer within NRV
5	Fish	<i>Aphredoderus sayanus</i>	pirate perch	SPC		habitat degradation; highly localized/restricted distribution
6	Fish	<i>Catostomus catostomus</i>	longnose sucker	NL		extensive surveys indicate a decline of unknown cause
7	Fish	<i>Clinostomus elongatus</i>	redside dace	SPC		habitat degradation; invasive species; need special resources (narrow thermal preferences)
8	Fish	<i>Coregonus kiyi</i>	kiyi	SPC		overexploitation; depend on ecological process no longer within NRV
9	Fish	<i>Coregonus nigripinnis</i>	Nipigon cisco	SPC		rare, vulnerable/declining habitat; need special resources (narrow thermal preferences); highly localized/restricted distribution
10	Fish	<i>Coregonus zenithicus</i>	shortjaw cisco	SPC		overexploitation
11	Fish	<i>Cottus ricei</i>	spoonhead sculpin	NL		highly localized/restricted distribution
12	Fish	<i>Couesius plumbeus</i>	lake chub	SPC		highly localized/restricted distribution
13	Fish	<i>Crystallaria asprella</i>	crystal darter	END		habitat degradation; depend on ecological process no longer within NRV
14	Fish	<i>Cyclopterus elongatus</i>	blue sucker	SPC		habitat degradation; habitat fragmentation; depend on ecological process no longer within NRV
15	Fish	<i>Erimystax x-punctata</i>	gravel chub	THR		habitat degradation; depend on ecological process no longer within NRV; highly localized/restricted distribution

16	Fish	<i>Etheostoma chlorosoma</i>	bluntnose darter	SPC		highly localized/restricted distribution
17	Fish	<i>Etheostoma microperca</i>	least darter	SPC		state listed; no additional criteria identified
18	Fish	<i>Fundulus sciadicus</i>	plains topminnow	THR		rare, vulnerable/declining habitat; habitat degradation; highly localized/restricted distribution
19	Fish	<i>Hybognathus nuchalis</i>	Mississippi silvery minnow	SPC		habitat fragmentation; depend on ecological process no longer within NRV; highly localized/restricted distribution
20	Fish	<i>Hybopsis amnis</i>	pallid shiner	END		extensive surveys indicate a decline of unknown cause
21	Fish	<i>Ichthyomyzon fossor</i>	northern brook lamprey	SPC		state listed; no additional criteria identified
22	Fish	<i>Ichthyomyzon gagei</i>	southern brook lamprey	SPC		state listed; no additional criteria identified
23	Fish	<i>Ictiobus niger</i>	black buffalo	THR		habitat degradation; habitat fragmentation; depend on ecological process no longer within NRV
24	Fish	<i>Lepomis gulosus</i>	warmouth	SPC		habitat degradation; highly localized/restricted distribution
25	Fish	<i>Lepomis peltastes</i>	northern longear sunfish	SPC		habitat loss; habitat degradation
26	Fish	<i>Lythrurus umbratilis</i>	redfin shiner	SPC		extensive surveys indicate a decline of unknown cause
27	Fish	<i>Morone mississippiensis</i>	yellow bass	SPC		state listed; no additional criteria identified
28	Fish	<i>Moxostoma duquesnei</i>	black redhorse	SPC		habitat degradation; highly localized/restricted distribution
29	Fish	<i>Myoxocephalus thompsoni</i>	deepwater sculpin	NL		highly localized/restricted distribution
30	Fish	<i>Nocomis biguttatus</i>	hornyhead chub	NL		habitat degradation; over-exploitation; extensive surveys indicate a decline of unknown cause
31	Fish	<i>Notropis anogenus</i>	pugnose shiner	THR		habitat loss; habitat degradation
32	Fish	<i>Notropis nubilus</i>	Ozark minnow	SPC		highly localized/restricted distribution
33	Fish	<i>Notropis texanus</i>	weed shiner	NL		highly localized/restricted distribution
34	Fish	<i>Notropis topeka</i>	Topeka shiner	SPC	E	Minnesota population represents significant portion of their North American breeding or wintering population
35	Fish	<i>Noturus exilis</i>	slender madtom	END		highly localized/restricted distribution
36	Fish	<i>Opsopoeodus emiliae</i>	pugnose minnow	NL		habitat degradation; habitat fragmentation; populations in Minnesota stable but have declined or are declining in a substantial part of range
37	Fish	<i>Percina evides</i>	gilt darter	SPC		habitat degradation; highly localized/restricted distribution
38	Fish	<i>Phenacobius mirabilis</i>	suckermouth minnow	SPC		extensive surveys indicate a decline of unknown cause
39	Fish	<i>Platygobio gracilis</i>	flathead chub	SPC		state listed; no additional criteria identified
40	Fish	<i>Polyodon spathula</i>	paddlefish	THR		invasive species; depend on ecological process no longer within NRV
41	Fish	<i>Prosopium coulterii</i>	pygmy whitefish	SPC		highly localized/restricted distribution
42	Fish	<i>Salvelinus fontinalis</i>	coaster brook trout	NL		statistically valid decline documented
43	Fish	<i>Salvelinus fontinalis</i>	brook trout SE Minnesota heritage strain	NL		highly localized/restricted distribution; Minnesota population represents significant portion of their North American breeding or wintering population

Mussels

	Taxa	Scientific name	Common name	State status	Federal status	Criteria (stressors and life-history traits)
1	Mussels	<i>Actinonaias ligamentina</i>	mucket	THR		statistically valid decline documented; habitat loss; habitat degradation; habitat fragmentation; invasive species; contaminants
2	Mussels	<i>Alasmidonta marginata</i>	elktoe	THR		statistically valid decline documented; habitat loss; habitat degradation; habitat fragmentation; invasive species; contaminants; need special resources (host species); highly localized/restricted distribution
3	Mussels	<i>Anodonta suborbicularis</i>	flat floater	SPC		contaminants; highly localized/restricted distribution
4	Mussels	<i>Arcidens confragosus</i>	rock pocketbook	END		statistically valid decline documented; habitat loss; habitat degradation; habitat fragmentation; invasive species; contaminants
5	Mussels	<i>Cumberlandia monodonata</i>	spectaclecase	END	E	statistically valid decline documented; habitat loss; habitat degradation; habitat fragmentation; invasive species; contaminants; limited ability to recover (low dispersal ability); highly localized/restricted distribution; aggregate their populations; Minnesota population represents significant portion of their North American breeding or wintering population
6	Mussels	<i>Cyclonaias tuberculata</i>	purple wartyback	END		statistically valid decline documented; habitat loss; habitat degradation; habitat fragmentation; invasive species; contaminants; need special resources (host species)
7	Mussels	<i>Ellipsaria lineolata</i>	butterfly	THR		statistically valid decline documented; habitat loss; habitat degradation; habitat fragmentation; invasive species; contaminants; need special resources (host species)
8	Mussels	<i>Elliptio complanata</i>	eastern elliptio	SPC		invasive species; highly localized/restricted distribution
9	Mussels	<i>Elliptio crassidens</i>	elephant-ear	END		statistically valid decline documented; habitat loss; habitat degradation; habitat fragmentation; invasive species; contaminants; need special resources (host species)
10	Mussels	<i>Elliptio dilatata</i>	spike	THR		statistically valid decline documented; habitat loss; habitat degradation; habitat fragmentation; invasive species; contaminants
11	Mussels	<i>Epioblasma triquetra</i>	snuffbox	END	E	statistically valid decline documented; habitat loss; habitat degradation; habitat fragmentation; invasive species; contaminants; need special resources (host species); Minnesota population represents significant portion of their North American breeding or wintering population
12	Mussels	<i>Fusconaia ebena</i>	ebonyshell	END		statistically valid decline documented; habitat loss; habitat degradation; habitat fragmentation; invasive species; contaminants; need special resources (host species)
13	Mussels	<i>Lampsilis higginsii</i>	Higgins eye	END	E	statistically valid decline documented; habitat loss; habitat degradation; habitat fragmentation; invasive species; contaminants
14	Mussels	<i>Lampsilis teres</i>	yellow sandshell	END		statistically valid decline documented; invasive species; contaminants; need special resources (host species); extensive surveys indicate a decline of unknown cause
15	Mussels	<i>Lasmigona compressa</i>	creek heelsplitter	SPC		habitat degradation; contaminants
16	Mussels	<i>Lasmigona costata</i>	fluted-shell	THR		statistically valid decline documented; habitat loss; habitat degradation; habitat fragmentation; invasive species; contaminants
17	Mussels	<i>Ligumia recta</i>	black sandshell	SPC		statistically valid decline documented; habitat loss; habitat degradation; habitat fragmentation; invasive species; contaminants
18	Mussels	<i>Ligumia subrostrata</i>	pondmussel	THR		statistically valid decline documented; habitat loss; habitat degradation; habitat fragmentation; contaminants; highly localized/restricted distribution

19	Mussels	<i>Megalonaia nervosa</i>	washboard	END		statistically valid decline documented; habitat loss; habitat degradation; habitat fragmentation; over-exploitation; invasive species; contaminants
20	Mussels	<i>Obovaria olivaria</i>	hickorynut	NL		statistically valid decline documented; habitat loss; habitat degradation; habitat fragmentation; invasive species; contaminants; need special resources (host species)
21	Mussels	<i>Plethobasus cyphyus</i>	sheepnose	END	E	statistically valid decline documented; habitat loss; habitat degradation; habitat fragmentation; invasive species; contaminants
22	Mussels	<i>Pleurobema sintoxia</i>	round pigtoe	SPC		statistically valid decline documented; habitat loss; habitat degradation; habitat fragmentation; invasive species; contaminants
23	Mussels	<i>Potamilus capax</i>	fat pocketbook	NL		statistically valid decline documented; habitat fragmentation; need special resources (host species); extensive surveys indicate a decline of unknown cause. currently extirpated in Minnesota, there is a strong likelihood that this species will be reintroduced within the next 10 years
24	Mussels	<i>Quadrula fragosa</i>	winged mapleleaf	END	E	Statistically valid decline documented; Habitat loss; Habitat degradation; Habitat fragmentation; Invasive species; Contaminants; Need special resources (host species); MN population represents significant portion of their N. Am. breeding or wintering pop.
25	Mussels	<i>Quadrula metanevra</i>	monkeyface	THR		statistically valid decline documented; habitat loss; habitat degradation; habitat fragmentation; invasive species; contaminants
26	Mussels	<i>Quadrula nodulata</i>	wartyback	THR		statistically valid decline documented; habitat loss; habitat degradation; habitat fragmentation; invasive species; contaminants; Minnesota population represents significant portion of their North American breeding or wintering population
27	Mussels	<i>Simpsonaias ambigua</i>	salamander mussel	END		statistically valid decline documented; habitat loss; habitat degradation; habitat fragmentation; invasive species; contaminants; need special resources (host species); limited ability to recover (low dispersal ability); highly localized/restricted distribution; highly localized/restricted distribution; aggregate their populations
28	Mussels	<i>Tritogonia verrucosa</i>	pistolgrip	END		statistically valid decline documented; habitat loss; habitat degradation; habitat fragmentation; invasive species; contaminants; need special resources (host species)
29	Mussels	<i>Truncilla donaciformis</i>	fawnsfoot	THR		statistically valid decline documented; habitat loss; habitat degradation; habitat fragmentation; invasive species; contaminants; need special resources (host species); extensive surveys indicate a decline of unknown cause
30	Mussels	<i>Venustaconcha ellipsiformis</i>	ellipse	THR		statistically valid decline documented; habitat loss; habitat degradation; habitat fragmentation; invasive species; contaminants; limited ability to recover (low dispersal ability)

Snails

	Taxa	Scientific name	Common name	State status	Federal status	Criteria (stressors and life-history traits)
1	Snails	<i>Gastrocopta rogersensis</i>	Rogers' snaggletooth snail	SPC		statistically valid decline documented; highly localized/restricted distribution
2	Snails	<i>Planogyra asteriscus</i>	eastern flat-whorl snail	SPC		rare, vulnerable/declining habitat; highly localized/restricted distribution
3	Snails	<i>Striatura ferrea</i>	black striate snail	SPC		highly localized/restricted distribution
4	Snails	<i>Vertigo meramecensis</i>	bluff vertigo	THR		rare, vulnerable/declining habitat; highly localized/restricted distribution
5	Snails	<i>Zonitoides limatulus</i>	dull gloss	SPC		highly localized/restricted distribution

Jumping Spiders

	Taxa	Scientific name	Common name	State status	Federal status	Criteria (stressors and life-history traits)
1	Jumping spiders	<i>Habronattus calcaratus maddisoni</i>	A species of jumping spider	SPC		rare, vulnerable/declining habitat; highly localized/restricted distribution
2	Jumping spiders	<i>Habronattus texanus</i>	A species of jumping spider	SPC		state listed; no additional criteria identified
3	Jumping spiders	<i>Habronattus viridipes</i>	A species of jumping spider	SPC		highly localized/restricted distribution
4	Jumping spiders	<i>Marpissa formosa</i>	A species of jumping spider	SPC		highly localized/restricted distribution
5	Jumping spiders	<i>Paradamoetas fontana</i>	A species of jumping spider	SPC		habitat loss; highly localized/restricted distribution
6	Jumping spiders	<i>Pelegrina arizonensis</i>	A species of jumping spider	SPC		rare, vulnerable/declining habitat; need special resources (host species); depend on ecological process no longer within NRV; highly localized/restricted distribution
7	Jumping spiders	<i>Phidippus apacheanus</i>	A species of jumping spider	SPC		rare, vulnerable/declining habitat; habitat loss; habitat degradation; highly localized/restricted distribution
8	Jumping spiders	<i>Phidippus pius</i>	A species of jumping spider	SPC		rare, vulnerable/declining habitat; habitat loss; habitat degradation; highly localized/restricted distribution
9	Jumping spiders	<i>Sassacus papenhoei</i>	A species of jumping spider	SPC		rare, vulnerable/declining habitat; highly localized/restricted distribution
10	Jumping spiders	<i>Tutelina formicaria</i>	A species of jumping spider	THR		rare, vulnerable/declining habitat; need special resources (host species); highly localized/restricted distribution

Leafhoppers

	Taxa	Scientific name	Common name	State status	Federal status	Criteria (stressors and life-history traits)
1	Leafhoppers	<i>Aflexia rubranura</i>	red-tailed leafhopper	SPC		rare, vulnerable/declining habitat; need special resources (host species)
2	Leafhoppers	<i>Attenuipyga vanduzeei</i>	hill prairie shovelhead leafhopper	SPC		rare, vulnerable/declining habitat; highly localized/restricted distribution
3	Leafhoppers	<i>Macrosteles clavatus</i>	caped leafhopper	SPC		rare, vulnerable/declining habitat; highly localized/restricted distribution

Dragonflies & Damselflies

	Taxa	Scientific name	Common name	State status	Federal status	Criteria (stressors and life-history traits)
1	Dragonflies & damselflies	<i>Aeshna sitchensis</i>	zigzag darner	SPC		rare, vulnerable/declining habitat; need special resources (narrow thermal preferences)
2	Dragonflies & damselflies	<i>Aeshna subarctica</i>	subarctic darner	SPC		rare, vulnerable/declining habitat; need special resources (narrow thermal preferences)
3	Dragonflies & damselflies	<i>Amphiagrion abbreviatum</i>	western red damsel	NL		rare, vulnerable/declining habitat; habitat loss; habitat degradation; need special resources (narrow thermal preferences)
4	Dragonflies & damselflies	<i>Argia plana</i>	springwater dancer	NL		highly localized/restricted distribution
5	Dragonflies & damselflies	<i>Boyeria grafiana</i>	ocellated darner	SPC		highly localized/restricted distribution
6	Dragonflies & damselflies	<i>Coenagrion angulatum</i>	prairie bluet	NL		rare, vulnerable/declining habitat; habitat loss
7	Dragonflies & damselflies	<i>Coenagrion interrogatum</i>	subartic bluet	NL		habitat loss; habitat degradation
8	Dragonflies & damselflies	<i>Cordulegaster obliqua</i>	arrowhead spiketail	NL		habitat degradation
9	Dragonflies & damselflies	<i>Gomphus adelphus</i>	mustached clubtail	NL		habitat degradation; need special resources (narrow thermal preferences)
10	Dragonflies & damselflies	<i>Gomphus lineatifrons</i>	splendid clubtail	NL		habitat degradation; need special resources (narrow thermal preferences)

11	Dragonflies & damselflies	<i>Gomphus quadricolor</i>	rapids clubtail	NL		habitat degradation; need special resources (narrow thermal preferences)
12	Dragonflies & damselflies	<i>Gomphus ventricosus</i>	skillet clubtail	NL		habitat degradation; need special resources (narrow thermal preferences)
13	Dragonflies & damselflies	<i>Gomphus viridifrons</i>	green-faced clubtail	NL		habitat degradation; need special resources (narrow thermal preferences)
14	Dragonflies & damselflies	<i>Ischnura posita</i>	fragile forktail	NL		statistically valid decline documented
15	Dragonflies & damselflies	<i>Leucorrhinia glacialis</i>	crimson-ringed whiteface	NL		rare, vulnerable/declining habitat
16	Dragonflies & damselflies	<i>Nannotheiris bella</i>	elfin skimmer	NL		rare, vulnerable/declining habitat
17	Dragonflies & damselflies	<i>Neurocordulia molesta</i>	smoky shadow-dragon	NL		habitat degradation
18	Dragonflies & damselflies	<i>Ophiogomphus anomalus</i>	extra-striped snaketail	SPC		habitat degradation; need special resources (narrow thermal preferences)
19	Dragonflies & damselflies	<i>Ophiogomphus carolus</i>	riffle snaketail	NL		habitat degradation; need special resources (narrow thermal preferences)
20	Dragonflies & damselflies	<i>Ophiogomphus colubrinus</i>	boreal snaketail	NL		habitat degradation; need special resources (narrow thermal preferences)
21	Dragonflies & damselflies	<i>Ophiogomphus howei</i>	pygmy snaketail	SPC		habitat degradation; need special resources (narrow thermal preferences)
22	Dragonflies & damselflies	<i>Ophiogomphus smithi</i>	Sioux snaketail	NL		habitat degradation; need special resources (narrow thermal preferences)
23	Dragonflies & damselflies	<i>Ophiogomphus susbehcha</i>	St. Croix snaketail	THR		habitat degradation; need special resources (narrow thermal preferences)
24	Dragonflies & damselflies	<i>Rhionaeschna multicolor</i>	blue-eyed darner	NL		habitat loss
25	Dragonflies & damselflies	<i>Rhionaeschna mutata</i>	spatterdock darner	NL		rare, vulnerable/declining habitat; habitat loss; need special resources (narrow thermal preferences); highly localized/restricted distribution
26	Dragonflies & damselflies	<i>Somatochlora brevicincta</i>	Quebec emerald	SPC		rare, vulnerable/declining habitat; need special resources (narrow thermal preferences)
27	Dragonflies & damselflies	<i>Somatochlora cingulata</i>	lake emerald	NL		rare, vulnerable/declining habitat; need special resources (narrow thermal preferences)
28	Dragonflies & damselflies	<i>Somatochlora elongata</i>	ski-tipped emerald	NL		rare, vulnerable/declining habitat; need special resources (narrow thermal preferences)
29	Dragonflies & damselflies	<i>Somatochlora ensigera</i>	plains emerald	NL		habitat loss; habitat degradation
30	Dragonflies & damselflies	<i>Somatochlora forcipata</i>	forcipate emerald	SPC		rare, vulnerable/declining habitat; need special resources (narrow thermal preferences)
31	Dragonflies & damselflies	<i>Somatochlora franklini</i>	delicate emerald	NL		rare, vulnerable/declining habitat; need special resources (narrow thermal preferences)
32	Dragonflies & damselflies	<i>Somatochlora kennedyi</i>	Kennedy's emerald	NL		rare, vulnerable/declining habitat; need special resources (narrow thermal preferences)
33	Dragonflies & damselflies	<i>Somatochlora minor</i>	ocellated emerald	NL		rare, vulnerable/declining habitat; need special resources (narrow thermal preferences)
34	Dragonflies & damselflies	<i>Somatochlora walshii</i>	brush-tipped emerald	NL		rare, vulnerable/declining habitat; need special resources (narrow thermal preferences)
35	Dragonflies & damselflies	<i>Stylogomphus albistylus</i>	eastern least clubtail	NL		habitat degradation
36	Dragonflies & damselflies	<i>Stylurus amnicola</i>	riverine clubtail	NL		habitat degradation
37	Dragonflies & damselflies	<i>Stylurus plagiatus</i>	russet-tipped clubtail	NL		habitat degradation
38	Dragonflies & damselflies	<i>Stylurus scudderi</i>	zebra clubtail	NL		habitat degradation
39	Dragonflies & damselflies	<i>Sympetrum madidum</i>	red-veined meadow-hawk	NL		highly localized/restricted distribution
40	Dragonflies & damselflies	<i>Williamsonia fletcheri</i>	ebony boghunter	NL		rare, vulnerable/declining habitat; need special resources (narrow thermal preferences)

Butterflies & Moths

	Taxa	Scientific name	Common name	State status	Federal status	Criteria (stressors and life-history traits)
1	Butterflies & moths	<i>Aspitates aberrata</i>	A species of geometrid moth	NL		rare, vulnerable/declining habitat

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2	Butterflies & moths	<i>Atrytone arogos iowa</i>	Arogos skipper	SPC		rare, vulnerable/declining habitat; habitat loss; habitat degradation; habitat fragmentation
3	Butterflies & moths	<i>Atrytonopsis hianna</i>	dusted skipper	NL		rare, vulnerable/declining habitat; habitat loss; habitat degradation; habitat fragmentation; need special resources (host species); depend on ecological process no longer within NRV; highly localized/restricted distribution
4	Butterflies & moths	<i>Boloria chariclea</i>	arctic fritillary	NL		habitat loss; habitat degradation; need special resources (host species)
5	Butterflies & moths	<i>Carmenta anthracipennis</i>	blazing star clear-wing moth	NL		rare, vulnerable/declining habitat; habitat loss; habitat degradation; habitat fragmentation; need special resources (host species)
6	Butterflies & moths	<i>Catocala abbreviatella</i>	abbreviated underwing	SPC		rare, vulnerable/declining habitat; habitat fragmentation; need special resources (host species)
7	Butterflies & moths	<i>Catocala whitneyi</i>	Whitney's underwing	SPC		rare, vulnerable/declining habitat; need special resources (host species)
8	Butterflies & moths	<i>Danaus plexippus</i>	monarch	NL		statistically valid decline documented; rare, vulnerable/declining habitat; habitat loss; habitat degradation; habitat fragmentation; need special resources (host species); Minnesota population represents significant portion of their North American breeding or wintering population
9	Butterflies & moths	<i>Erebia mancinus</i>	Disa alpine	SPC		habitat loss; habitat degradation; need special resources (narrow thermal preferences); highly localized/restricted distribution
10	Butterflies & moths	<i>Erynnis martialis</i>	mottled dusky wing	NL		rare, vulnerable/declining habitat; habitat loss; habitat degradation; habitat fragmentation; need special resources (host species); depend on ecological process no longer within NRV
11	Butterflies & moths	<i>Erynnis persius persius</i>	Persius duskywing	END		rare, vulnerable/declining habitat; habitat loss; habitat degradation; habitat fragmentation; need special resources (host species); depend on ecological process no longer within NRV
12	Butterflies & moths	<i>Euchloe ausonides</i>	large marble	NL		depend on large habitat; need special resources (host species, narrow thermal preferences); depend on ecological process no longer within NRV; highly localized/restricted distribution
13	Butterflies & moths	<i>Euphyes binacula illinois</i>	two-spotted skipper	NL		rare, vulnerable/declining habitat; habitat loss; habitat degradation; need special resources (host species); depend on ecological process no longer within NRV
14	Butterflies & moths	<i>Hesperia assiniboia</i>	Assiniboia skipper	END		rare, vulnerable/declining habitat; habitat loss; habitat degradation; habitat fragmentation; need special resources (host species); depend on ecological process no longer within NRV
15	Butterflies & moths	<i>Hesperia dacotae</i>	Dakota skipper	END	T	rare, vulnerable/declining habitat; habitat loss; habitat degradation; habitat fragmentation; depend on ecological process no longer within NRV; extensive surveys indicate a decline of unknown cause; Minnesota population represents significant portion of their North American breeding or wintering population
16	Butterflies & moths	<i>Hesperia leonardus</i>	Leonard's skipper	SPC		rare, vulnerable/declining habitat; habitat loss; habitat degradation; habitat fragmentation
17	Butterflies & moths	<i>Hesperia ottoe</i>	Ottoe skipper	END		rare, vulnerable/declining habitat; habitat loss; habitat degradation; habitat fragmentation; depend on ecological process no longer within NRV; highly localized/restricted distribution
18	Butterflies & moths	<i>Hesperia uncas</i>	Uncas skipper	END		rare, vulnerable/declining habitat; habitat loss; habitat degradation; habitat fragmentation; need special resources (host species); depend on ecological process no longer within NRV
19	Butterflies & moths	<i>Lasionycta secedens</i>	a species of owl moth	NL		need special resources (narrow thermal preferences); highly localized/restricted distribution
20	Butterflies & moths	<i>Lasionycta taigata</i>	a species of owl moth	NL		need special resources (narrow thermal preferences); highly localized/restricted distribution

21	Butterflies & moths	<i>Plebejus idas nabokovi</i>	Nabokov's blue	SPC		rare, vulnerable/declining habitat; habitat degradation; need special resources (host species); depend on ecological process no longer within NRV; highly localized/restricted distribution
22	Butterflies & moths	<i>Plebejus melissa samuelis</i>	Karner blue	END	E	rare, vulnerable/declining habitat; habitat loss; habitat degradation; habitat fragmentation; need special resources (host species); depend on ecological process no longer within NRV
23	Butterflies & moths	<i>Oarisma garita</i>	Garita skipper	THR		rare, vulnerable/declining habitat; habitat degradation; depend on ecological process no longer within NRV; highly localized/restricted distribution
24	Butterflies & moths	<i>Oarisma poweshiek</i>	Poweshiek skipper	END	E	statistically valid decline documented; rare, vulnerable/declining habitat; habitat loss; habitat degradation; habitat fragmentation; depend on ecological process no longer within NRV; extensive surveys indicate a decline of unknown cause
25	Butterflies & moths	<i>Oeneis uhleri varuna</i>	Uhler's arctic	END		rare, vulnerable/declining habitat; habitat loss; habitat degradation; habitat fragmentation, highly localized/restricted distribution
26	Butterflies & moths	<i>Polygonia gracilis</i>	hoary comma	NL		highly localized/restricted distribution
27	Butterflies & moths	<i>Proserpina juanita</i>	Juanita sphinx moth	NL		rare, vulnerable/declining habitat; habitat loss; habitat degradation; depend on large habitat; habitat fragmentation; need special resources (host species); depend on ecological process no longer within NRV
28	Butterflies & moths	<i>Pyrgus centaureae freija</i>	grizzled skipper	SPC		state listed; no additional criteria identified
29	Butterflies & moths	<i>Schinia indiana</i>	phlox moth	SPC		rare, vulnerable/declining habitat; habitat loss; habitat degradation; habitat fragmentation; need special resources (host species)
30	Butterflies & moths	<i>Schinia lucens</i>	Leadplant Flower Moth	SPC		rare, vulnerable/declining habitat; habitat loss; habitat degradation; habitat fragmentation; need special resources (host species)
31	Butterflies & moths	<i>Schinia sanguinea</i>	blazing star flower moth	NL		rare, vulnerable/declining habitat; habitat loss; habitat degradation; habitat fragmentation; need special resources (host species)
32	Butterflies & moths	<i>Speyeria idalia</i>	regal fritillary	SPC		rare, vulnerable/declining habitat; habitat loss; habitat degradation; habitat fragmentation; depend on large habitat; need special resources (host species); depend on ecological process no longer within NRV
33	Butterflies & moths	<i>Xestia mixta</i>	a species of owllet moth	NL		need special resources (host species); depend on ecological process no longer within NRV

Caddisflies

	Taxa	Scientific name	Common name	State status	Federal status	Criteria (stressors and life-history traits)
1	Caddisflies	<i>Agapetus tomus</i>	A species of caddisfly	SPC		habitat degradation; need special resources (narrow thermal preferences); highly localized/restricted distribution
2	Caddisflies	<i>Anabolia ozburni</i>	A species of northern caddisfly	SPC		habitat loss; habitat degradation; extensive surveys indicate a decline of unknown cause
3	Caddisflies	<i>Chilostigma itascae</i>	headwaters Chilostigman caddisfly	THR		highly localized/restricted distribution; Minnesota population represents significant portion of their North American breeding or wintering population
4	Caddisflies	<i>Goera stylata</i>	A species of caddisfly	THR		need special resources (narrow thermal preferences); highly localized/restricted distribution
5	Caddisflies	<i>Hydroptila metoeca</i>	A species of purse casemaker caddisfly	SPC		state listed; no additional criteria identified
6	Caddisflies	<i>Hydroptila quinola</i>	A species of purse casemaker caddisfly	SPC		habitat degradation; highly localized/restricted distribution
7	Caddisflies	<i>Hydroptila rono</i>	A species of purse casemaker caddisfly	THR		habitat degradation; highly localized/restricted distribution
8	Caddisflies	<i>Hydroptila tortosa</i>	A species of purse casemaker caddisfly	SPC		state listed; no additional criteria identified

9	Caddisflies	<i>Hydroptila waskesia</i>	A species of purse casemaker caddisfly	END		habitat degradation; highly localized/restricted distribution
10	Caddisflies	<i>Ironoquia punctatissima</i>	A species of northern caddisfly	THR		rare, vulnerable/declining habitat; highly localized/restricted distribution
11	Caddisflies	<i>Lepidostoma libum</i>	A species of caddisfly	THR		habitat degradation; highly localized/restricted distribution
12	Caddisflies	<i>Limnephilus janus</i>	A species of northern caddisfly	END		habitat degradation; highly localized/restricted distribution
13	Caddisflies	<i>Limnephilus rossi</i>	A species of northern caddisfly	THR		habitat degradation; highly localized/restricted distribution
14	Caddisflies	<i>Limnephilus secludens</i>	A species of northern caddisfly	END		habitat degradation
15	Caddisflies	<i>Ochrotrichia spinosa</i>	A species of purse casemaker caddisfly	END		highly localized/restricted distribution; extensive surveys indicate a decline of unknown cause
16	Caddisflies	<i>Oecetis ditissa</i>	A species of long-horned caddisfly	THR		habitat degradation; highly localized/restricted distribution
17	Caddisflies	<i>Oxyethira ecornuta</i>	A species of purse casemaker caddisfly	THR		highly localized/restricted distribution
18	Caddisflies	<i>Oxyethira itascae</i>	A species of purse casemaker caddisfly	SPC		highly localized/restricted distribution; Minnesota population represents significant portion of their North American breeding or wintering population
19	Caddisflies	<i>Parapsyche apicalis</i>	A species of netspinning caddisfly	THR		habitat degradation; highly localized/restricted distribution
20	Caddisflies	<i>Polycentropus glacialis</i>	A species of tube casemaker caddisfly	THR		highly localized/restricted distribution
21	Caddisflies	<i>Polycentropus milaca</i>	A species of tube casemaker caddisfly	END		highly localized/restricted distribution; Minnesota population represents significant portion of their North American breeding or wintering population
22	Caddisflies	<i>Protoptila erotica</i>	A species of saddle casemaker caddisfly	SPC		highly localized/restricted distribution
23	Caddisflies	<i>Triaenodes flavescens</i>	A species of long-horned caddisfly	SPC		highly localized/restricted distribution
24	Caddisflies	<i>Ylodes frontalis</i>	A species of long-horned caddisfly	THR		highly localized/restricted distribution

Tiger Beetles

	Taxa	Scientific name	Common name	State status	Federal status	Criteria (stressors and life-history traits)
1	Tiger Beetles	<i>Cicindela cursitans</i>	ant-like tiger beetle	NL		highly localized/restricted distribution
2	Tiger Beetles	<i>Cicindela denikei</i>	Laurentian tiger beetle	SPC		highly localized/restricted distribution
3	Tiger Beetles	<i>Cicindela fulgida fulgida</i>	crimson saltflat tiger beetle, fulgida ssp.	END		rare, vulnerable/declining habitat; need special resources; highly localized/restricted distribution; depend on ecological process no longer within NRV
4	Tiger Beetles	<i>Cicindela fulgida westbournei</i>	crimson saltflat tiger beetle, westb. ssp.	THR		rare, vulnerable/declining habitat; need special resources; highly localized/restricted distribution
5	Tiger Beetles	<i>Cicindela hirticollis hirticollis</i> ssp.	hairy-necked tiger beetle	NL		habitat degradation
6	Tiger Beetles	<i>Cicindela hirticollis rhodensis</i> ssp.	hairy-necked tiger beetle	END		habitat degradation; highly localized/restricted distribution
7	Tiger Beetles	<i>Cicindela lepida</i>	ghost tiger beetle	THR		rare, vulnerable/declining habitat; highly localized/restricted distribution
8	Tiger Beetles	<i>Cicindela limbata nympha</i>	sandy tiger beetle	END		rare, vulnerable/declining habitat; highly localized/restricted distribution
9	Tiger Beetles	<i>Cicindela macra macra</i>	sandy stream tiger beetle	SPC		highly localized/restricted distribution
10	Tiger Beetles	<i>Cicindela patruela patruela</i>	northern barrens tiger beetle	SPC		rare, vulnerable/declining habitat; habitat loss
11	Tiger Beetles	<i>Cicindela splendida cyanocephalata</i>	splendid tiger beetle	SPC		need special resources; highly localized/restricted distribution

Bees

	Taxa	Scientific name	Common name	State status	Federal status	Criteria (stressors and life-history traits)
1	Bees	<i>Bombus affinis</i>	rusty patched bumble bee	NL	E	extensive surveys indicate a decline of unknown cause
2	Bees	<i>Bombus bohemicus</i>	Ashton cuckoo bumble bee	NL		need special resources (host species)
3	Bees	<i>Bombus terricola</i>	yellowbanded bumble bee	NL		extensive surveys indicate a decline of unknown cause
4	Bees	<i>Bombus fervidus</i>	golden northern bumble bee or yellow bumble bee	NL		extensive surveys indicate a decline of unknown cause
5	Bees	<i>Bombus pensylvanicus</i>	American bumble bee	NL		extensive surveys indicate a decline of unknown cause

Appendix D

Minnesota Climate Trends

Short-term changes in Minnesota's climate have been observed and documented. Some of these changes follow climate trends observed within the continent, but they vary in intensity from other parts of North America. A number of sources that focused on recent Minnesota climatic data and trends were consulted. The *Minnesota Climate and Health Profile Report* provided some of the most current information used within this section.

Temperature

From 1895 to the present, Minnesota's average annual temperature has increased by 1.9°F, equivalent to a rate of 1.6°F per century. Most of the warming in the record has occurred since 1970. The greatest rate of warming has occurred in winter minimum temperatures. Winter temperatures have been rising at about twice the rate as annual average temperatures. Minimum temperatures (overnight lows) have also been rising two times faster than the maximum temperatures (Seely, 2015). Warming rates have been higher in northern than southern Minnesota, a pattern that is consistent throughout the northern hemisphere (greater warming rates at higher latitudes; Trenberth et al. 2007).

This trend is projected to continue with average winter temperatures expected to increase from historical norms (1870–1960) by 11°F in southern Minnesota to 14°F in northern Minnesota by the end of the 21st century. The average winter temperature of the Arrowhead region of northeastern Minnesota in 2100 would be comparable to the 2015 winter average of central Iowa (Local Climate Data, National Weather Service, National Oceanic and Atmospheric Administration websites). Average

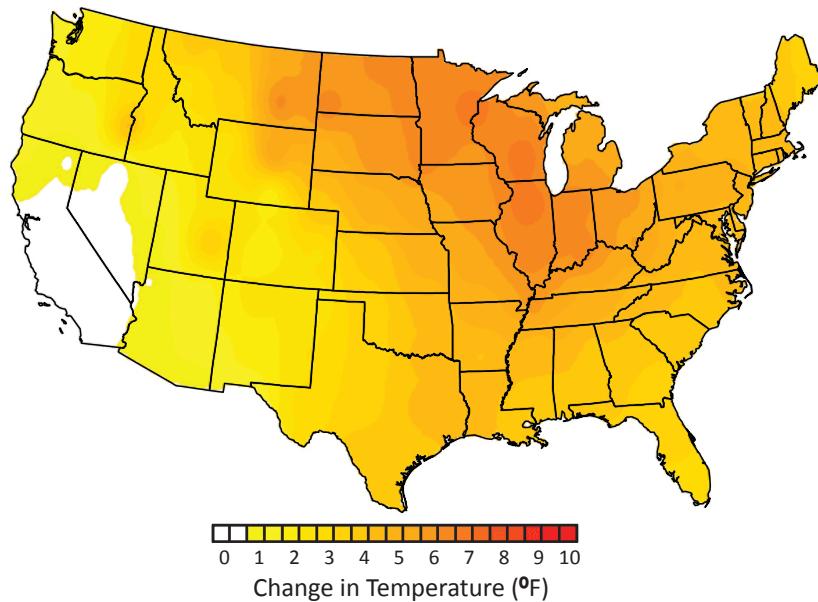


Figure D1. Average annual winter temperatures (°F) across the U.S. for 1975-2007. Temperatures are rising faster in winter than in any other season, especially in Minnesota and throughout the Midwest region. Figure source: Karl et al., 2009.

summer temperatures are projected to increase 10–11°F statewide during the same period. This would equate southern Minnesota's 2060–69 summer average temperatures with the current summer averages of Oklahoma, and general climate envelopes of mean annual precipitation and temperature of southern Nebraska and northern Kansas (Galatowitsch, 2009).

At one location near the center of Lake Superior, surface water has warmed 2.7°F since records began in 1981, or about 9.0°F per century. That warming rate is greater than those found in air temperature in adjacent Minnesota land areas. Longer periods of warmer surface waters generally result in reduced ice cover and higher evaporation rates. If not counteracted by increased precipitation, higher evaporation rates could lead to reduced lake levels. Warmer lake temperatures have already had noticeable effects on fish and other aquatic species. (Austin and Colman 2007; Huff and Thomas, 2014).

With warmer temperatures the air has a greater water vapor capacity. Dew points may continue to increase, adding to heat stress experience by different species, and adding to the available moisture for weather systems to utilize. The frequency of record high dew points has increased noticeably in the last 30 years in the Twin Cities since 1900 (Seeley, 2015).

Precipitation

Since 1895, annual precipitation (averaged statewide) has increased by about 3.1 inches (2.7 inches per century). However, precipitation has been variable across the state. While precipitation increased across most of the state—greater than 4 inches per century in some areas—precipitation decreased in several counties in the Red River valley.

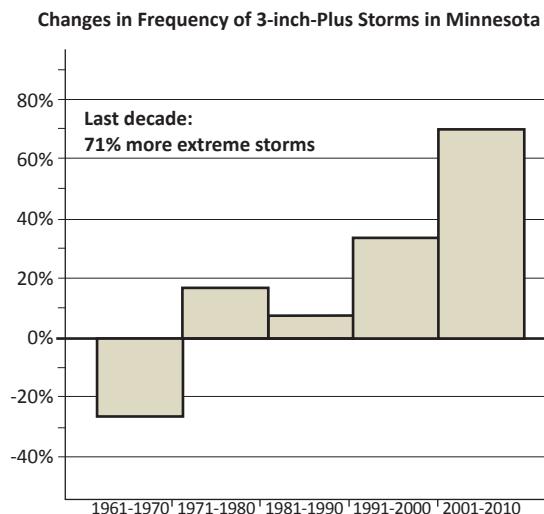


Figure D2. Changes in the frequency of storms with heavy precipitation data from Minnesota weather stations indicate that there has been a 71% increase in storms discharging 3 inches or more rainfall when comparing decades 2001-2010 to 1961-1970. Figure source: RMCO/NRDC, 2012.

Extreme rainfall events are becoming more common and heavier and are contributing a greater share of the annual precipitation. While an increase in extreme weather events is not clear from the Minnesota data, recent intense rainfalls are consistent with Midwest regional climate change predictions. Minnesota has experienced three 10-inch-plus rainfalls in southern Minnesota since 2004. Based on a calculated “return period” of 1,000 years, any given location would have only a 0.1 percent chance of experiencing such an intense rainfall each year. The state has also experienced a 71 percent increase in the frequency of rainfalls exceeding 3.0 inches since the 1960s.

Winter precipitation has showed a reduction in extremely high and extremely low seasonal snowfall. Winter precipitation types may change as the climate warms. Seasonal snowfall has increased in some areas of the eastern portions of the state; however, the number of days annually with snow cover has diminished. As temperatures continue to increase, the proportion of winter precipitation falling as liquid, versus frozen, may increase.

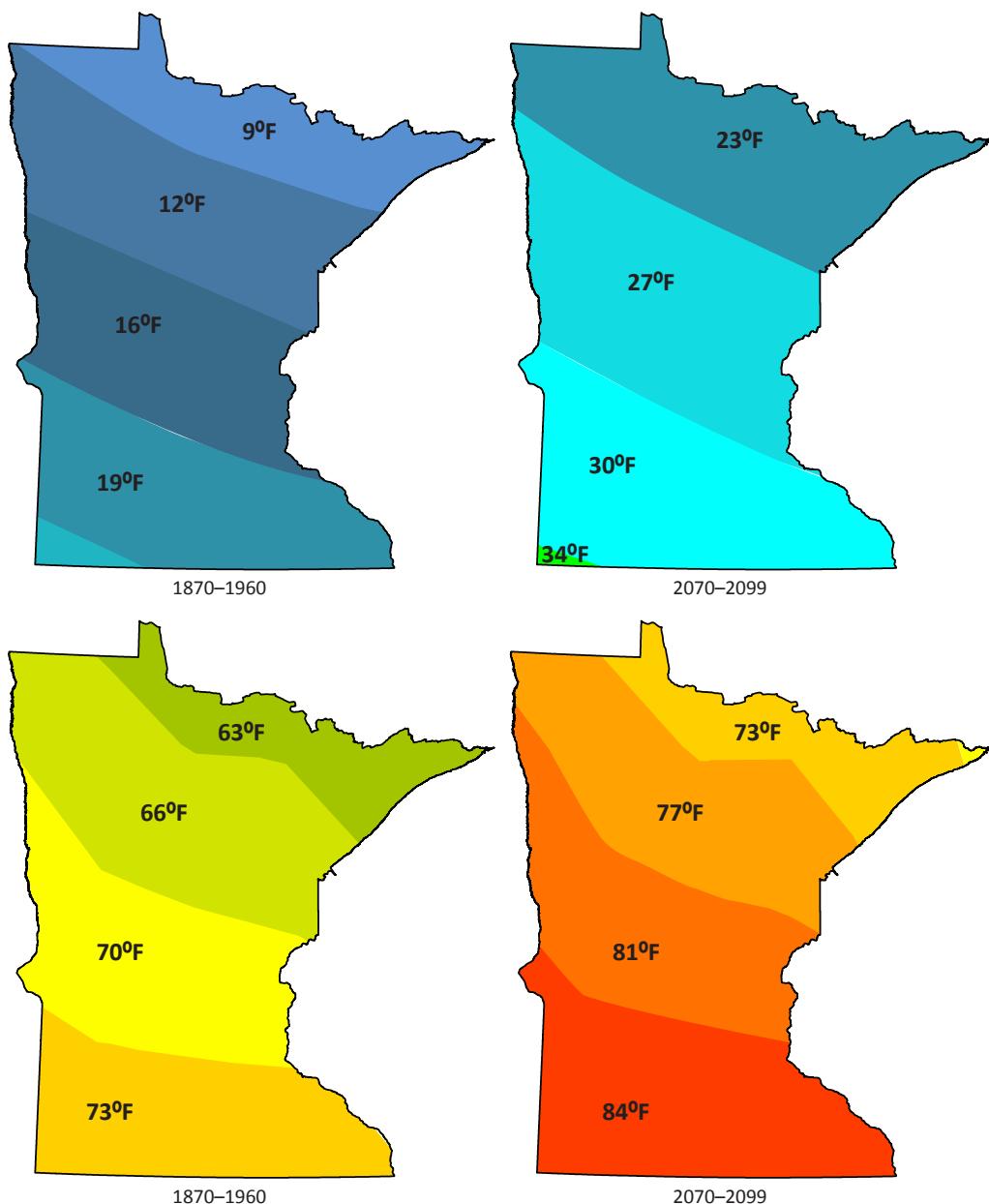


Figure D3. Approximate seasonal temperatures across Minnesota. Maps on the top display average winter (December–January) temperatures and maps on the bottom display average summer (June–August) temperatures. Maps on the left display average observed temperatures for 1870–1960 and maps on the right display average projected temperatures for 2070–2099. Maps are based on the A2 Emissions scenario data and image source: Climate Reanalyzer (<http://cci-reanalyzer.org>), Climate Change Institute, University of Maine.

Table D1. Predicted climate trends in Minnesota and associated impacts

Predicted trend (2041-2070)	Predicted impact (2041-2070)
Temperature	
Coldest temperatures will continue to warm with fewer cold extreme events (high confidence).	Reduced frost season, longer growing season, earlier ice-outs, fewer days with snow cover, new invasive and pathogenic species persist.
Heat waves may become more frequent in spite of current trends (low confidence).	Stress to vegetation and some animal species; reduced water levels and flows in streams and lakes.
Precipitation	
Unprecedented rainfall events will continue to occur (high confidence).	More intense, widespread, and damaging flash-flooding.
Winter precipitation types may change as the climate warms (moderate confidence).	Earlier occurrence of spring floods and decreased frequency as they become more related to major weather events. Shorter periods with snow cover.

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Appendix E

Methods for Developing the Wildlife Action Network

The development of the Wildlife Action Network drew on a variety of data. Through discussions internally with the Management Team, Core Team, and the Production Advisory Team, several data layers were determined to be most relevant in the development of the network. These data included Species in Greatest Conservation Need (SGCN) population maps based on viable or persistent populations, locations harboring a number of SGCN or “species richness hotspots,” threatened and endangered species populations, spatially prioritized Minnesota Biological Survey Sites of Biodiversity Significance, the Minnesota Prairie Conservation Plan cores and corridors (Minnesota Prairie Plan Working Group, 2011), and High Conservation Value Forests. Areas with generally two or more viable SGCN populations or areas with a single threatened or endangered species population were selected for incorporation in the network. In addition to mapped viable aquatic populations and species richness hotspots, streams with an exceptional Index of Biological Integrity (IBI) rating and Lakes of Biological Significance were included. Connectivity between Sites of Biodiversity Significance was provided by Marxan (Ball et al. 2009), a conservation prioritization mapping software that assists in finding the most efficient ways of physically linking conservation target areas, as well as through the inclusion of the Prairie Plan corridors.

Ranked Populations of SGCN

The ultimate goal of the population mapping exercise was to identify and rank viable populations of SGCN or vulnerable populations due to rarity in a region/watershed or within the state. However, since very little information on population viability exists for most species, especially at a given location, we convened workshops where taxa experts ranked populations through review of species occurrences and other GIS data. The data used varied depending on the taxon, but in most cases we used source features from the DNR Natural Heritage Information System converted to points, and observation data (see Table E1 for more information on data sources). Experts generally considered records from 1980 to 2014 to determine if a population was present, although earlier records were sometimes used to help decide if the population had persisted over time. Fish data, in particular, had a large number of records dated prior to 1980 and were commonly used to help determine persistence as well as trends in abundance.

To determine a population rank, the experts considered abundance (number of individuals at a site), persistence (occurrence data spans two or more decades), recruitment (presence of juveniles and/or multiple age classes), presence of suitable habitat based on knowledge of the local area or DNR Native Plant Community data, and experts’ local knowledge of the species’ population in an area (see ranking guidelines below). These components were used, to varying degrees depending on the available data, to give a population rank of poor, good, or excellent. In rare cases, isolated, but not necessarily viable, populations were also given high ranks in order to ensure these high-risk populations were tracked. This exception was made for 5 species, and were small mapped areas that commonly overlapped with mapped populations of other species and ultimately had little impact on the identification of the Wildlife Action Network or its score (Table E2). Bird populations ranked as poor were not mapped due to time limitations given the large number of species. Viable/persistent SGCN populations were mapped for 156 of the 346 SGCN and included mammals, birds, reptiles,

amphibians, fish, and mussels (Table E3). Invertebrate species other than mussels were not mapped due to insufficient occurrence information. Of the taxa that were mapped, several species within the taxa could not be mapped because they occurred over a wide range with no distinct population centers, or they used habitats that were not readily mappable (e.g., purple martin, a species that centers its populations near artificial nesting compartments). This occurred most often with birds (51 percent mapped) and mammals (67 percent mapped) (Table E3).

Ranking guidelines for SGCN populations

Excellent (strong evidence for viability/persistence):

- The population shows indications (abundance, age class distribution, persistence) of recruitment or immigration, or
- The population represents the only population in the region (ECS section or HUC 4 watershed) or one of three or fewer populations in the state regardless of viability/persistence.
- An additional consideration is that the habitat is known to be of good quality for supporting outstanding viable populations.

Good (evidence for viability/persistence):

- Species has persisted in the area over time.
- Evidence of abundance, recruitment, or persistence either indicates the population is not as viable as a population ranked as excellent, or
- Data and professional judgment are insufficient to rank the populations as excellent.
- An additional consideration can be the quality of the habitat.

Poor (little to no evidence for viability/persistence):

- Species is present but in low numbers.
- Evidence shows lack of persistence, or limited or no reproduction indicates the population is likely not viable.
- An additional consideration is that the habitat quality is known to be poor to the point of limiting population viability.

Mapping workshops lasted a full day and, for several of the taxa, included a second day at a later date (Table E1). Experts systematically worked through SGCN species individually and reviewed occurrence records to identify and rank areas. The experts achieved a consensus for ranking each area.

Table E1. Mapping workshops overview. Individuals' affiliations are provided in Appendix B.

Taxon	Meeting date	Experts present	Occurrence data sources
Birds	2/28/14	Jan Green, Lee Pfannmueller, Steve Stucker, Tom Will, Ed Zlonis	NHIS Source Features, DNR Observation data, MN Breeding Bird Atlas, Breeding Bird Survey
Birds	3/16/14	Steve Stucker – one on one meeting to complete birds not addressed in first meeting.	NHIS Source Features, DNR Observation data
Mussels	3/28/14	Mike Davis, Mark Hove, Dan Kelner, Bernard Sietman	DNR Mussel Survey database
Mussels	4/11/14	Mike Davis, Mark Hove, Dan Kelner, Bernard Sietman	DNR Mussel Survey database
Fish	4/21/14	Luke Borgstrom, Jay Hatch	NHIS Source Features, Fishes of Minnesota (FOM) database, DNR Fish Mapper
Fish	5/23/14	Luke Borgstrom, Jay Hatch	NHIS Source Features, FOM database, DNR Fish Mapper
Herps	5/16/14	Carol Hall, John Moriarty, Krista Larson, Jeff LeClere, Tony Gamble	NHIS Source Features, Observation data compiled by C. Hall
Herps	6/2/14	Carol Hall, John Moriarty, Krista Larson, Jeff LeClere	NHIS Source Features, Observation data compiled by C. Hall
Mammals	5/1/14	Gerda Nordquist	NHIS Source Features, DNR Observation data
Mammals	5/21/14	Gerda Nordquist	NHIS Source Features, DNR Observation data
Dragonflies	9/4/14	Mitchell Haag, Scott King, Ron Lorenz, Kurt Mead, Curt Oien	MN Odonata Survey Project (MOSP) database, Odonata Central database

Table E2. SGCN species given excellent population ranks due to regional or statewide rarity.

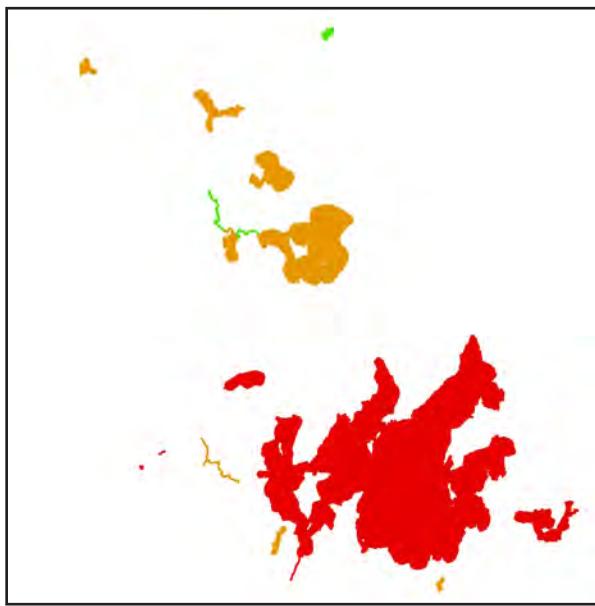
Taxa	Species	Location	Explanation
Bird	Chestnut-collared longspur	Clay County in western Minnesota	Small population represents the only known breeding population in the state, but has been declining over the past 10 to 20 years.
Bird	Common Tern	St. Louis Estuary in northeastern Minnesota.	Represents 1 of 5 known breeding populations that are widely scattered across the north half of Minnesota, but the population requires intensive management to maintain its persistence.
Fish	Flathead Chub	Red River in northwestern Minnesota	Single location (with records from 1890 and 1984) represents the only known records for the species in Minnesota.
Mussel	Elktoe	Pomme de Terre River in west-central Minnesota	Only viable population in the Minnesota River drainage. A good rank was increased to excellent.
Mussel	Spike	Chippewa River in west-central Minnesota	Only viable population in the Minnesota River drainage. A good rank was increased to excellent.

Table E3. Number of SGCN with mapped populations by taxa

Taxon	Total number of SGCN	Mapped?		% of SGCN mapped
		Yes	No	
mammals	27	18	9	67
birds	92	47	45	51
amphibians	8	7	1	88
reptiles	15	14	1	93
fishes	43	42	1	98
mussels	30	28	2	93
snails	5	0	5	0
bees	5	0	5	0
butterflies	22	0	22	0
caddisflies	24	0	24	0
dragonflies and damselflies	40	0	40	0
jumping spiders	10	0	10	0
leafhoppers	3	0	3	0
moths	11	0	11	0
tiger beetles	11	0	11	0
Total	346	156	190	45%

Mapped areas differed for aquatic and terrestrial species. For aquatic species, we used lake polygons if the population was identified in a lake (Figure E1a). If the population was associated with a stream or river, we used centerlines of streams order 3 and higher clipped by DNR Level 08 catchment basins and buffered by half the average width of the given stream order as identified in Downing et al. (2012). The one exception to this was wood turtle. For this species, stream centerlines were buffered by a quarter mile to capture the adjacent terrestrial habitat used by this species (Hall, C. personal communication 2014). For terrestrial species, several GIS layers were used. First priority was to use Sites of Biodiversity Significance (SOBS) polygons (both Final and Preliminary SOBS layers and, rarely, Survey Priority Areas) if they were available and adequately represented the habitat (Figure E1b). If SOBS polygons could not be used, then a variety of other layers were used depending on what best captured the population and habitat. These included managed area boundaries (e.g., state park), land cover (from GAP or HAPET), Audubon Minnesota Important Bird Area and/or Prairie Conservation Plan core boundaries (used if they were closely aligned with the habitat), manually drawn polygons using aerial photography, and DNR Level 08 catchment basins. The source of the polygon can be found in the “Source” field of the population shapefiles.

a.



b.



Figure E1. Example polygons mapped for a fish species (a) and a bird species (b). Red represents an excellent population rank, orange represents a good population rank, and green represents a poor population rank. In these examples, the fish populations were mapped using lake boundaries and stream segments and the bird populations were mapped using MBS Sites of Biodiversity Significance.

In addition to the above, modeled habitat results available for some bird species were used when it was determined that the model results accurately depicted species presence. Habitat model results were used for northern goshawk from the DNR Nongame Wildlife Program; boreal chickadee and Connecticut warbler, from the University of Minnesota Duluth's Natural Resources Research Institute; and grasshopper sparrow and Le Conte's sparrow, from US Fish and Wildlife Service's Habitat and Population Evaluation Team (HAPET). These model results had different output values, which required different scaling to represent excellent, good, or poor populations. In the goshawk model, habitat was scored on a gradient from 0 to 230, with higher values attributed to a greater potential for goshawk use. We gave an excellent population rank to any habitat with a value of 200 or greater. A good population rank was given to any habitat with a value between 150 and 199 (Figure E2). For boreal chickadee and Connecticut warbler, the original raster files were converted to vector files. For boreal chickadee, values above 60 were given an excellent population rank, values between 50 and 60 were given a good rank, and values below 50 were not included. For Connecticut warbler, values above 80 were given an excellent population rank, values between 60 and 80 were given a good rank, and values below 60 were not included. For grasshopper sparrow and Le Conte's sparrow, original raster values were first multiplied by 1000 and then reclassified. The resulting reclassified raster files were then converted to vector files. For grasshopper sparrow, reclassified values above 70 were given an excellent population rank, values between 50 and 70 were given a good rank, and values below 50 were not included. For Le Conte's sparrow, reclassified values above 200 were given an excellent population rank, values between 100 and 200 were given a good rank, and values below 100 were not included.

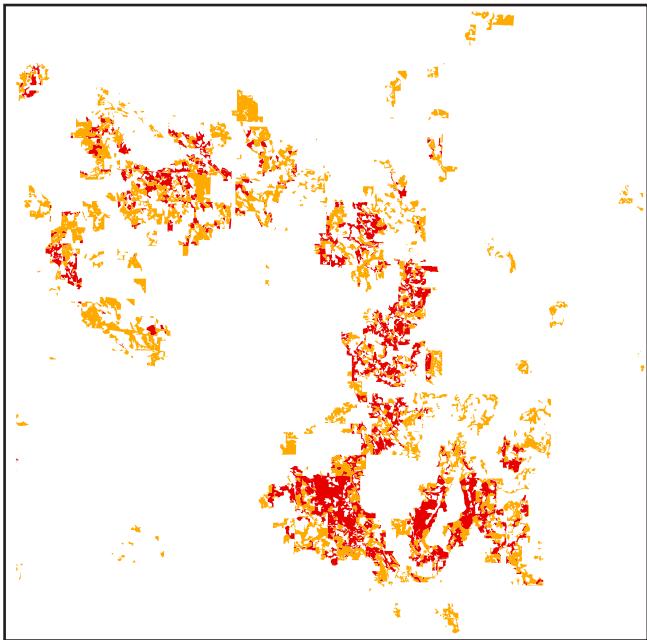


Figure E2. Modeled habitat mapped for an example bird species (northern goshawk). Red represents an excellent population rank, and orange represents a good population rank.

In addition to the mapping, careful notes were taken to capture the decisions made and other ideas that emerged from the conversations. For example, we sometimes recorded priority areas for restoration but did not map these as population areas. Following the final mapping workshops, follow-up mapping was completed using the notes and often included additional consultation with DNR Minnesota Biological Survey animal staff.

Population maps were sent out for both internal and external review to various wildlife staff, refuge biologists, land managers, and other taxa experts (see Appendix B). Revisions, including changing ranks of some mapped populations, adding and removing populations, and modifying boundaries of existing maps, were made per comments, suggestions, and additional consultation garnered through this review process and completed in November 2014.

SGCN Richness Hotspot Maps

Since about half of the SGCN populations could not be mapped, a SGCN richness hotspot analysis was also performed to identify additional areas in the Wildlife Action Network with high concentrations of SGCN. To complete this process, observation records of all SGCN, including invertebrates, were used to sum the number of species in 2.5-km-by-2.5 km (~2.4 square miles) blocks across the state. First, we created a grid containing 2.5-km-by-2.5 km blocks in ArcMap and then clipped it to the Minnesota state boundary. The grid block size was a compromise between a smaller area that captured too few points and a larger area that resulted in too much generalization. Next, we intersected all SGCN observation points from NHIS and other sources identified in Table E1 with the grid and then summarized the number of unique species per grid block. We then developed

the following criteria for identifying richness hotspots via clusters of these blocks:

1. A single block comprising ten or more species.
2. A cluster of at least 4 contiguous blocks each comprising 5 or more species.
3. A cluster of at least 8 contiguous blocks each comprising 3 or more species. This cluster must also contain a hotspot already defined in 1 or 2 above.

In the above criteria, “contiguous” includes both adjacent blocks and blocks whose corners touch (Figure E3).

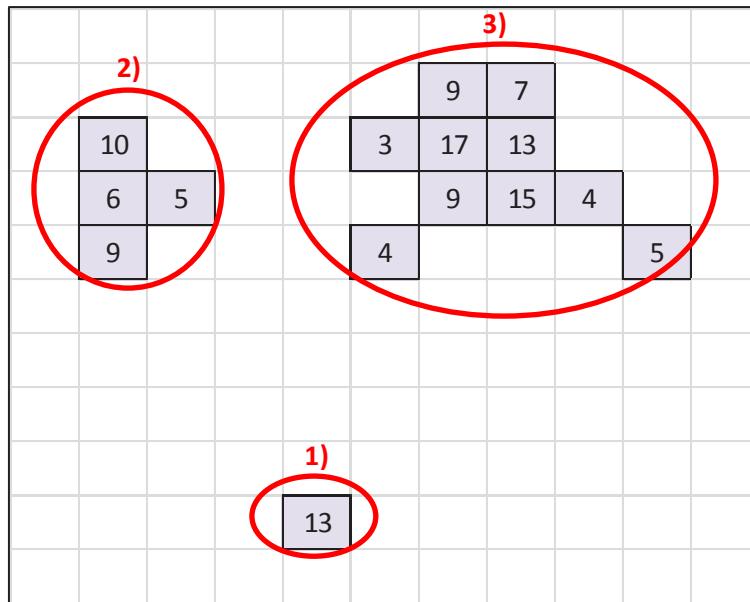


Figure E3. Clusters of grid blocks identified as richness hotspots by the above criteria. The number in each block refers to the number of species that have been observed within the area of each block. All blocks in this example met one of the three criteria listed above, and red circles illustrate examples of each the different criterion for inclusion as a hotspot where (1) represents a single block comprising 10 or more species, (2) represents a cluster of at least 4 contiguous blocks each comprising 5 or more species, and (3) represents a cluster of at least 8 contiguous blocks each comprising 3 or more species. “Contiguous” includes both adjacent blocks and blocks whose corners touch.

SGCN richness clusters that fell outside of the mapped SGCN populations were selected and then the underlying habitat was mapped in a similar manner to selecting habitat polygons for the populations mapping exercise detailed within the previous section, “Ranked Populations of SGCN.” If an individual block comprised aquatic species, corresponding lakes and buffered stream centerlines were mapped. If a block comprised terrestrial species, SOBS (final and preliminary) were mapped if available and adequately represented the habitat for the species present. If no SOBS were present or adequate within the area of an individual block, managed area boundaries were mapped next. If no managed area boundaries existed within the area of the block, a polygon was drawn around appropriate habitat using 1-meter resolution 2013 Color infrared and natural color FSA aerial maps. If a block comprised both aquatic and terrestrial species or species that use both, a combination of aquatic and terrestrial habitat polygons were mapped. Note that mapped habitat could extend beyond the boundaries of an individual block as long as some part of it intersected with the boundary of the block (Figure E4).

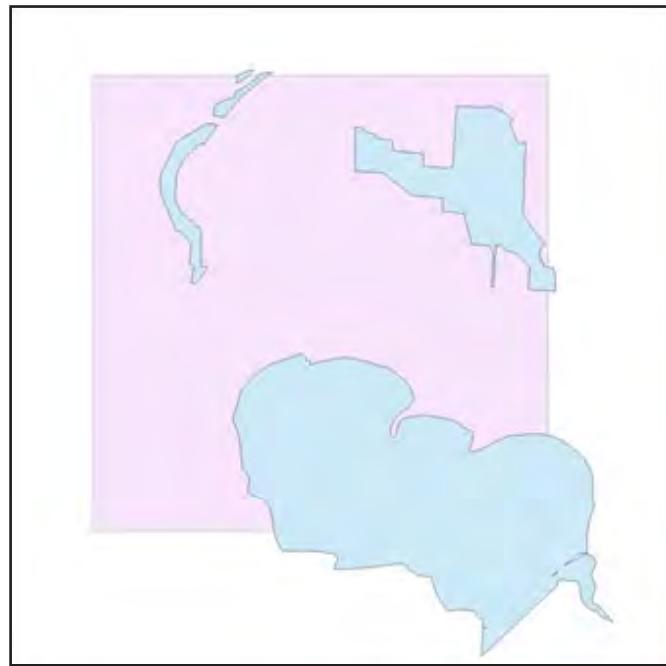


Figure E4. Example of habitat polygons (light blue) intersecting with a single richness hotspot block (light pink). Note that mapped habitat can extend beyond the boundaries of the block as long as some part of the polygon intersects with the block boundary.

SGCN Composite Population Scores

The population ranks for each species (Ranking Guidelines, p. E2, Appendix E) were assigned multipliers to use in developing a composite map for all taxa. An excellent population was given a score of 2.0; a good population was given a score of 1.0; and a poor population was given a score of 0.1. The 0.1 score for the poor population was chosen to represent that the population was unviable and should contribute very little to the composite map but still be present as a possible area for restoration. Composite maps for each taxon were then created by unioning (i.e., combining) the mapped populations of all SGCN in that taxon. This resulted in a single composite map with many overlapping areas containing a score for each species with a population in that specific location. These scores were then summed, creating a composite score for each overlapping area. Next, to create a composite map of all taxa, these sums were normalized by dividing the sum for each area by the maximum score possible for the given taxa (i.e., the score if an area had an excellent population rank for all species), resulting in five maps of composite population scores (one for each taxon; Figure E5). Since the number of mapped species varied among taxa, individual taxon composite maps were normalized to make the scores comparable between them. The five taxon composite maps were then unioned together, resulting in a single composite map of all mapped taxa. The normalized scores for each taxon were summed together to arrive at a new score for each overlapping area representing all taxa combined (Figure E6).

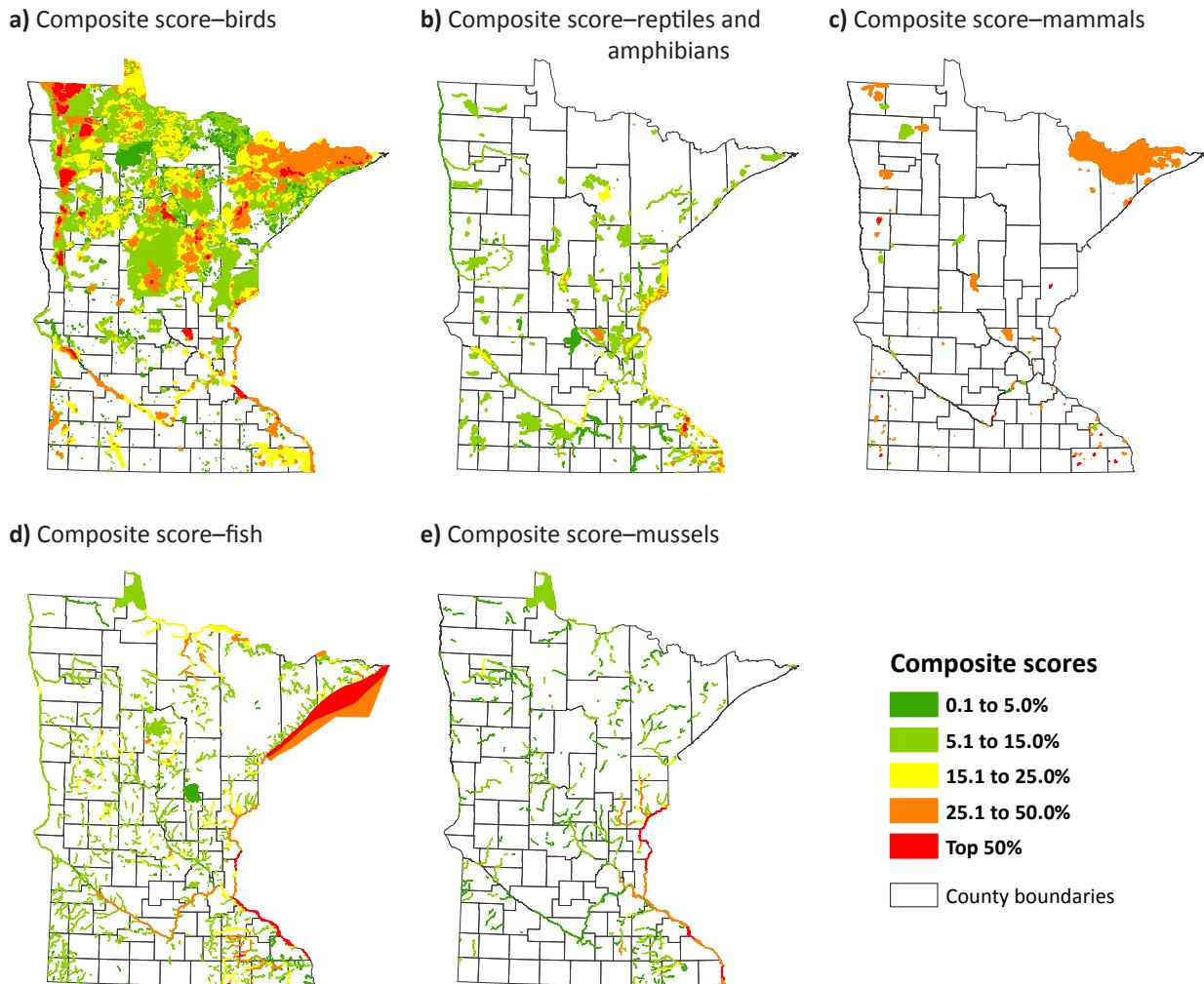


Figure E5. Composite population scores by taxon. The color scale represents the distribution of the scores among all polygons ranging from lowest 5 percent of composite scores (green) to the top 50 percent of composite scores (red). The legend breakpoints closely follow a geometrical interval as the data were skewed to the lower end of the distribution for many of the taxa (that is, many areas had few overlapping SGCN populations). This varied by taxa, but the breakpoints were standardized across taxa for clarity. For fish in (d), the area in northeastern Minnesota delineating a portion of Lake Superior represents Minnesota's managed area of the lake.

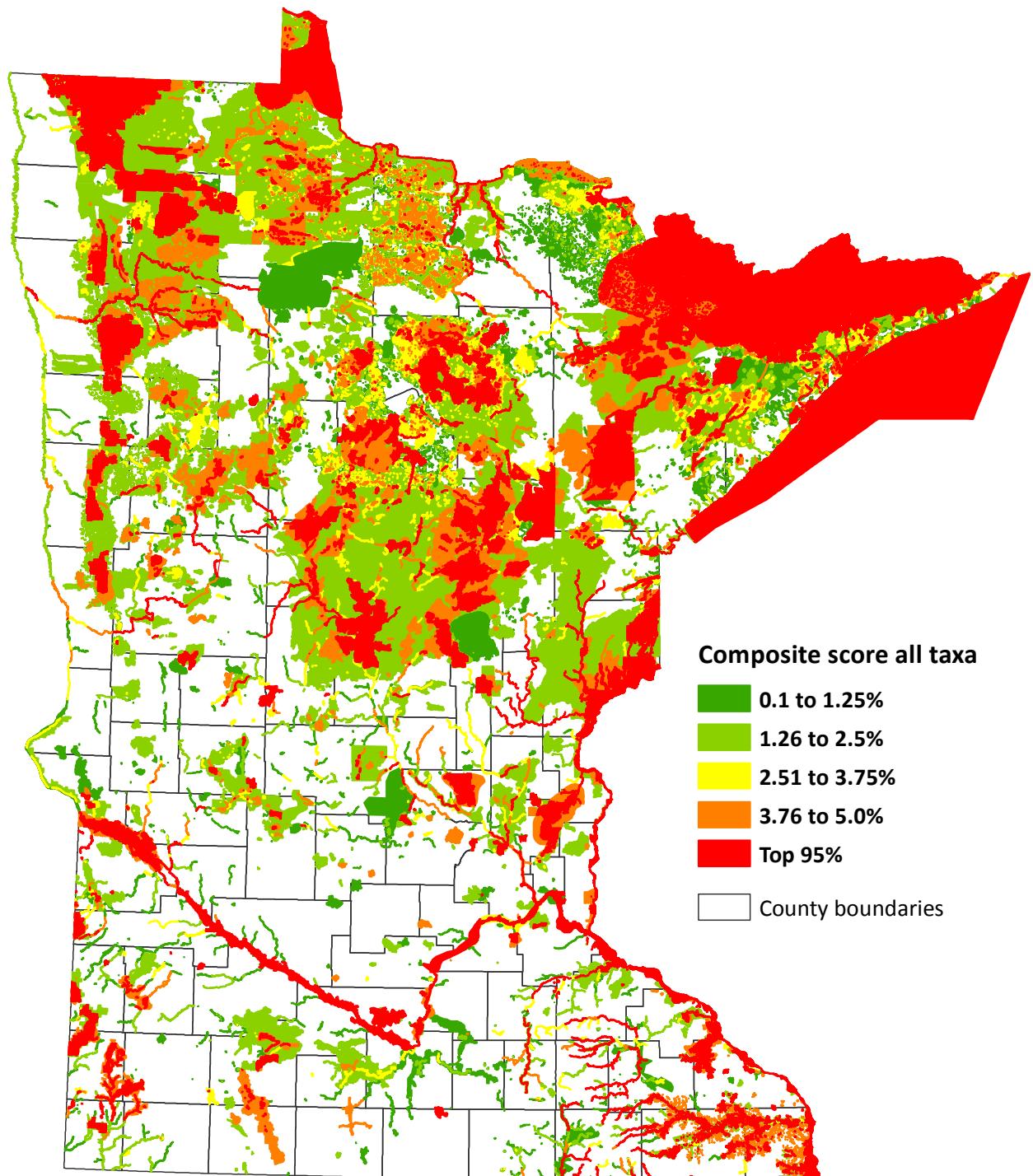


Figure E6. Composite population scores for all taxa combined. Normalized scores of all taxa were combined with equal weighting among each taxon. The color scale represents the distribution of the scores among all composited polygons ranging from lowest 1.25 percent of composite scores (green) to the top 95 percent of composite scores (red). The top 95 percent score breakpoint represents what was chosen for inclusion in the network, as this generally represents areas with at least one “excellent” SGCN population or at least two “good” SGCN populations. The area in northeastern Minnesota delineating a portion of Lake Superior represents Minnesota’s managed area of the lake.

Wildlife Action Network

The Wildlife Action Network was created from several GIS layers. It is important to note that some of the data used in its development are still considered draft, and the Wildlife Action Network will be updated over time as data are refined and new data become available. The following describes the GIS layers used in the Wildlife Action Network:

- a) **Top 95 percent of SGCN populations composite (Figure E7a).** This piece of the network comprises the areas in the composite populations map for all taxa that placed within the top 95 percent of scores (i.e., everything in red in Figure E6). In omitting the bottom 5 percent of population scores from this piece, we largely captured areas that contained good- or excellent-ranked populations of more than one SGCN, and omitted areas with only one SGCN population or multiple SGCN with poor-ranked populations.
- b) **Good or excellent populations of state or federally endangered and threatened species (Figure E7b).** Some good or excellent populations of state or federally endangered and threatened species were not represented in the top 95 percent of population scores because they were the only species mapped in a particular area. To ensure that these important populations of rare species were included in the network, all good or excellent mapped populations of state or federally endangered and threatened species were added to the network.
- c) **Richness hotspots falling outside the top 95 percent of populations (Figure E7c).** We included all SGCN richness hot spots that fell outside of the top 95 percent of population scores. Since the richness hotspots included all SGCN species for which we have observation points and not just those species that we mapped, these areas provide additional information on important SGCN habitat within the network.
- d) **Cores and Corridors from Minnesota Prairie Conservation Plan (Figure E7d).** These layers from the Minnesota Prairie Conservation Plan (MN 2011) include the January 2015 revised cores and the original corridors. The cores represent high concentrations of native prairie and surrogate grassland. The corridors represent planned areas of grassland restoration.
- e) **Marxan outputs from the Scientific and Natural Area strategic plan (Figure E7e).** Development of the Scientific and Natural Area (SNA) Strategic Land Protection Plan (SNA 2014) utilized Marxan conservation planning software to spatially prioritize and identify connections between the high and outstanding ranked MBS Sites of Biodiversity Significance. To create the output used in the Wildlife Action Network, we selected all areas with a Marxan rank of 3, 4 or 5 from the original Marxan outputs.
- f) **New Marxan runs of additional final and preliminary sites of biodiversity significance in remaining ecological subsections not analyzed for the SNA strategic plan (Figure E7f).** The SNA strategic plan used final Sites of Biodiversity data for the Marxan analysis in 2014. At the time, the status of Sites of Biodiversity Significance was preliminary or unmapped in a significant portion of northern Minnesota. Since the SNA Marxan analysis was completed, additional data have become finalized, and new areas have preliminary data. After consulting with MBS plant ecologist staff on which preliminary data were less likely to change significantly in terms of boundaries and rankings, additional Marxan runs were completed in the Agassiz Lowlands, Border Lakes, Chippewa Plains, Pine Moraines, St. Louis Moraines, and Tamarack Lowlands subsections. Data were limited to only the south half of the Agassiz Lowlands.

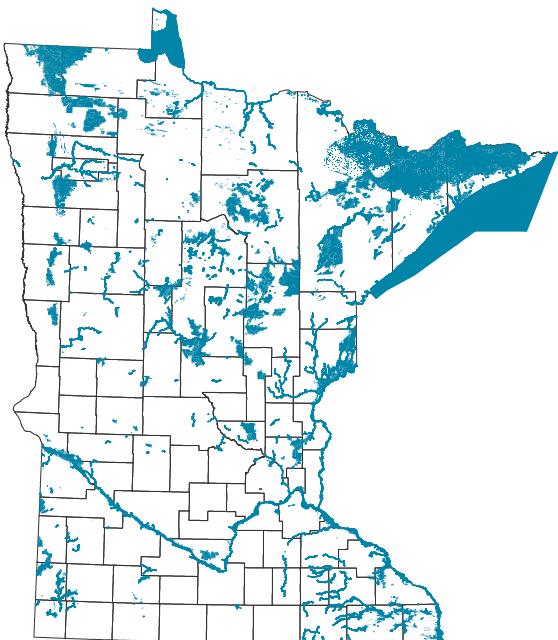
- g) Sites of Biodiversity Significance that intersect with Marxan outputs and high and outstanding sites where Marxan runs were not completed (Littlefork-Vermillion Uplands and the north half of the Agassiz Lowlands subsections) (Figure E7g).** These include all final and preliminary sites of Biodiversity Significance (SOBS) that intersect with the Marxan files in 7e and 7f. All ranks are included (i.e. Outstanding, High, Moderate, and Below). These mostly do not add anything new to the network from what is already represented by the Marxan outputs, but are included because they represent ground-truthed, mapped habitat. The Marxan layers represent modeled prioritized areas and include areas not mapped as SOBS. These areas can be considered as priorities for increasing buffers and connectivity of SOBS.

In addition, some preliminary polygons of Sites of Biodiversity Significance were mapped in the Littlefork-Vermillion Uplands and the north half of the Agassiz Lowlands subsections, but these areas were not complete enough to effectively do a Marxan spatial prioritization. High and outstanding ranked polygons, where MBS plant ecologist staff were reasonably confident of their boundaries and rankings, were included. These areas will be prioritized using Marxan when mapping of Sites of Biodiversity is completed.

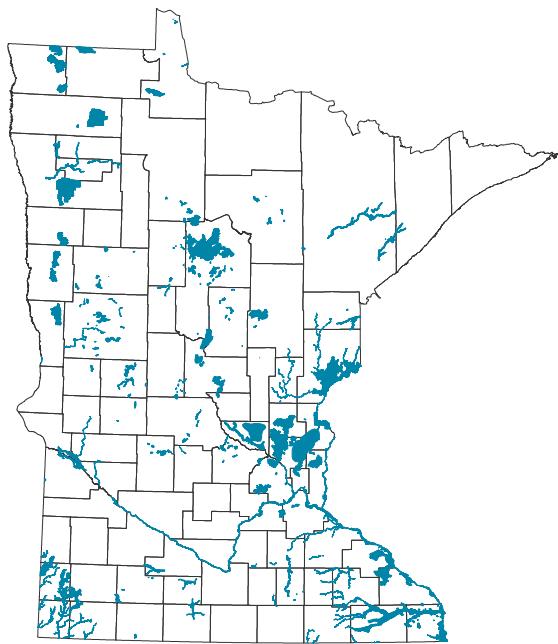
- h) High conservation value forests (Figure E7h).** We included all high conservation value forests as identified by the DNR as part of forest certification with the Forest Stewardship Council. These forests potentially offer important habitat for many SGCN and a diversity of forest wildlife.
- i) Lakes of biological significance (Figure E7i).** We included the final 2015 draft of Lakes of Biological Significance. These lakes offer important habitat for SGCN and a variety of wetland and aquatic wildlife.
- j) Streams with an exceptional index of biological integrity score (Figure E7j).** We extracted all streams that met the draft index of biological integrity (IBI) “exceptional” score for fish (Table E4) or a non-mussel invertebrate IBI score of 80 or higher using the normalized Watershed Health Assessment Framework (WHAF) IBI values. We then added stream reaches downstream to the next confluence, or upstream to the source or next confluence, if the stream reach met the general use threshold or if no IBI data were available and if the stream was not ditched and if no other tributaries with low IBI scores (below general use threshold) flowed into the selected stream reach. Streams were then buffered based on average stream width (diameter = $\frac{1}{2}$ width) by stream order (from Downing et al. 2012). Our assumption is that these streams offer important habitat or ecological functionality for aquatic SGCN and other wildlife.

These ten layers were then overlayed to create the complete Wildlife Action Network (Fig. E8).

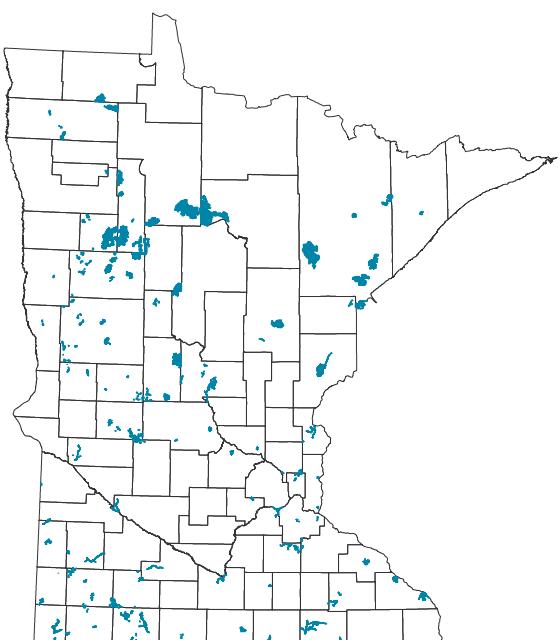
a) Top 95% of SGCN populations composite



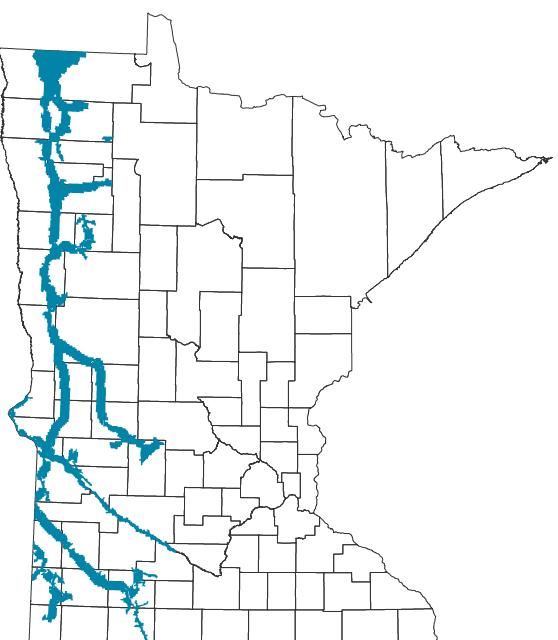
b) Populations of endangered and threatened species



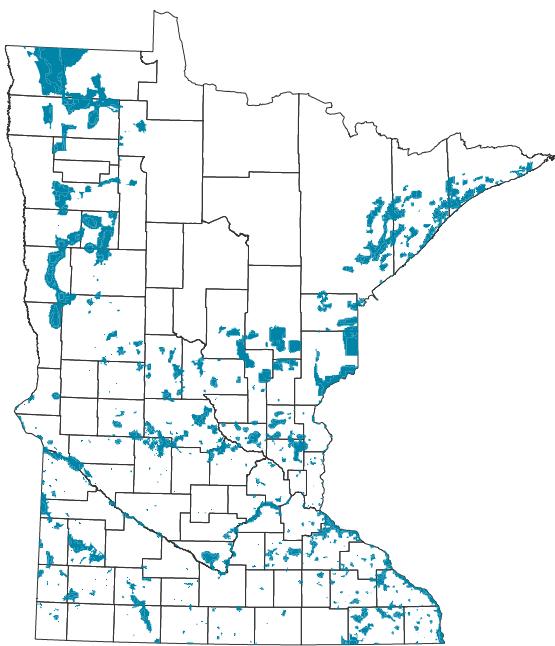
c) Richness hotspots falling outside the top 95 percent of populations



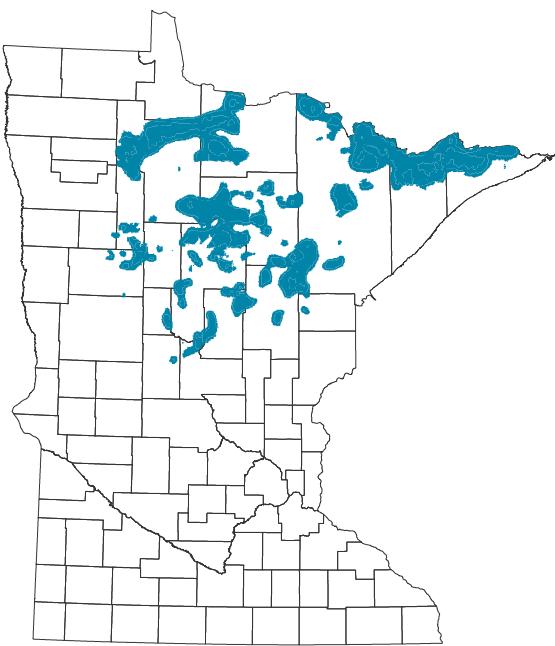
d) Cores and Corridors from Minnesota Prairie Conservation Plan



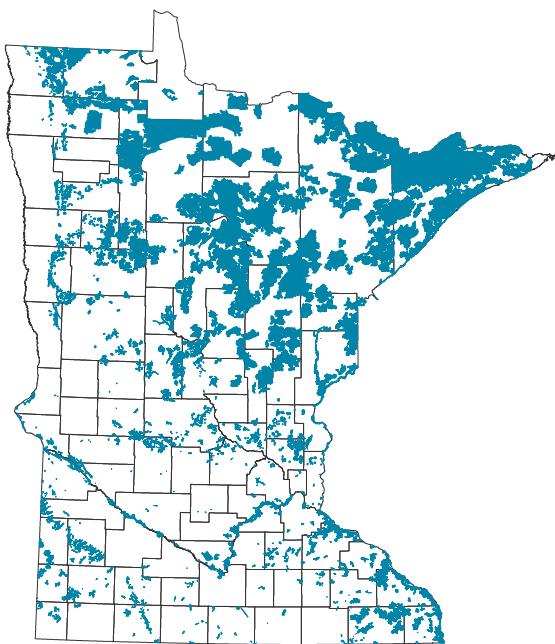
e) Marxan outputs from the Scientific and Natural Area Strategic Plan



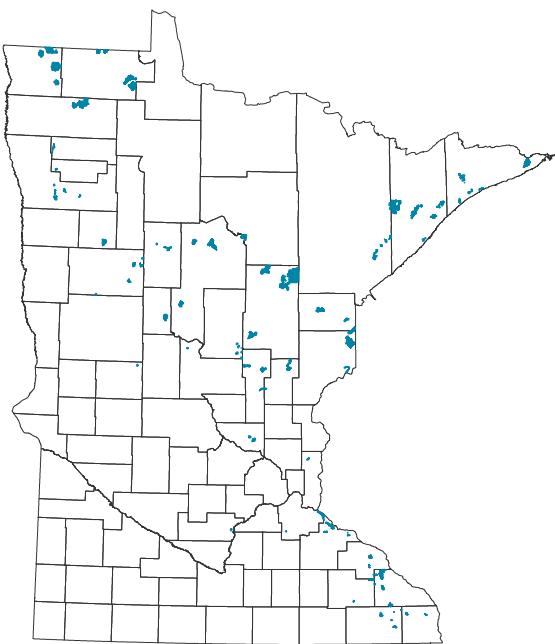
f) New Marxan prioritization of Sites of Biodiversity Significance



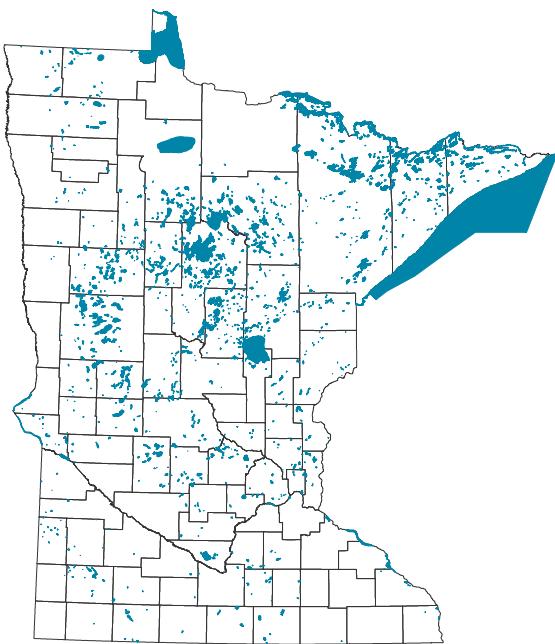
g) Sites of Biodiversity Significance that intersect with Marxan prioritization



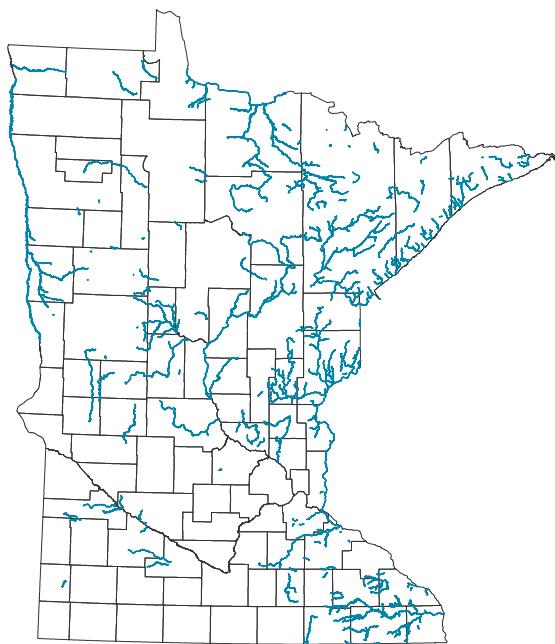
h) High Conservation Value Forests



i) Lakes of Biological Significance



j) Streams with exceptional IBI scores



Figures E7a-j. Layers comprising the Wildlife Action Network. In each map, the blue represents areas that were included as part of the Wildlife Action Network. See text above for a description for each of these layers. The area in northeastern Minnesota delineating a portion of Lake Superior represents Minnesota's managed area of the lake.

Table E4. Fish IBI general use and exceptional thresholds by stream class.

Stream class	Class description	General use threshold	Exceptional threshold
1	southern rivers	49	71
2	southern streams	50	66
3	southern headwaters	55	74
4	northern rivers	38	67
5	northern streams	47	61
6	northern headwaters	42	68
7	low gradient	42	70
10	southern coldwater	50	82
11	northern coldwater	35	60

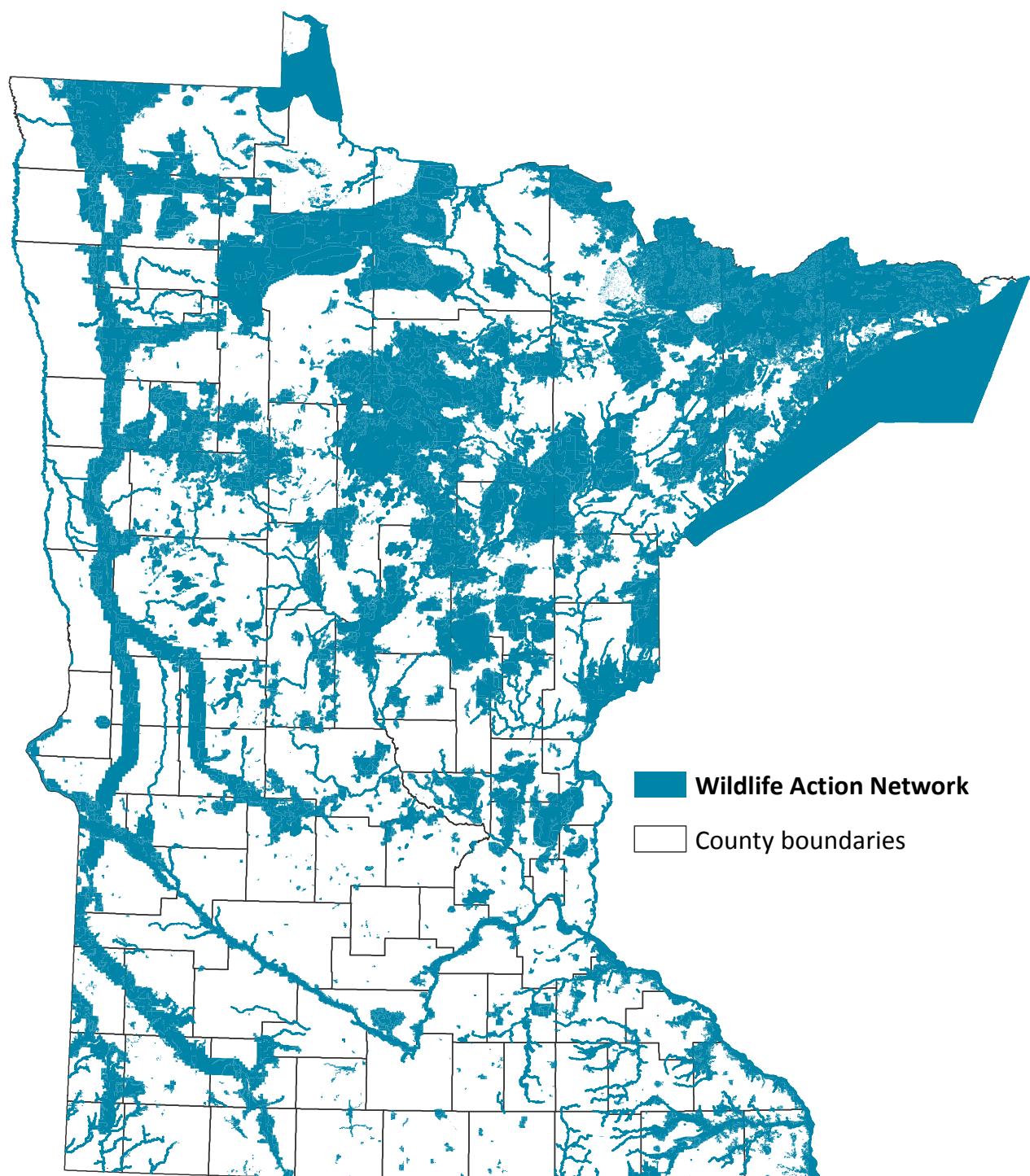


Figure E8. Wildlife Action Network (blue). The area in northeastern Minnesota delineating a portion of Lake Superior represents Minnesota's managed area of the lake.

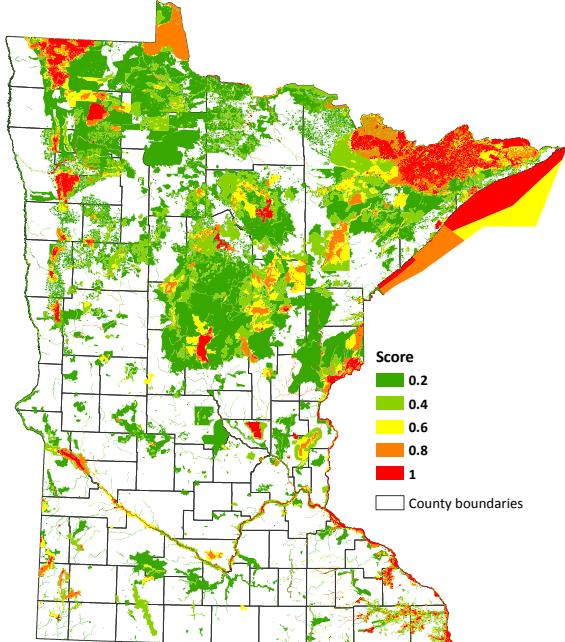
Scoring the Wildlife Action Network

To help prioritize the information provided in the conservation network, we carried out a GIS scoring exercise. This exercise was limited to five layers that were entirely or almost entirely statewide in extent and had a score that was either a continuous variable or an ordinal categorical variable. The five layers were also chosen for their complementarity. The composite SGCN population scores and the SGCN richness grid represent aquatic and terrestrial SGCN populations and occurrences. Marxan scores represent mainly terrestrial areas of biological significance, while the Stream Index of Biological Integrity and the Lakes of Biological Significance represent aquatic components of biological significance for those respective systems. While the SGCN population scores and SGCN richness grids are likely highly correlated, it was decided to use both as scoring variables since the SGCN richness grids provide information on SGCN that did not have mapped populations. With the exception of the composite SGCN population scores, the raw values of continuous variables were rescaled between 0 and 1. The highly skewed distribution of the composite SGCN population scores required first categorizing the data using Jenks natural breaks (Jenks 1977) in ArcMap and then scoring based on five categories. Other categorical variables had three categories and were linearly scaled starting at 0.4. This starting point was used since these data already represent a prioritization, and other areas not represented in this prioritization (e.g., Sites of Biodiversity Significance mapped as “below” or not mapped at all) likely have a distribution of levels with a “quality” below these prioritized layers.

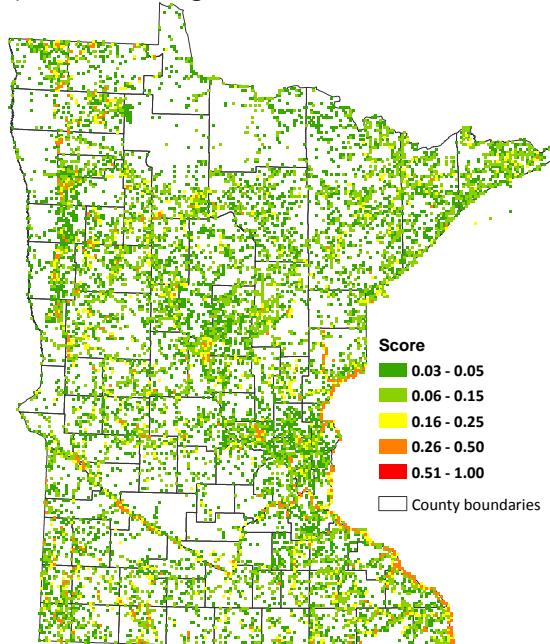
- a) Composite SGCN Population Scores (Figure E9a).** The composite population map including all levels of composite scores (not just the top 95 percent) was rasterized with a cell size of 90m and then multiplied by 10 to create an integer raster with an attribute table. The count of cells was added cumulatively for each value, resulting in a sum field capturing the amount of area (in raster cells) occupied for a particular value. This sum field was then reclassified by 5 natural breaks (Jenks) and then converted back to a vector shapefile. Within this new shapefile, the lowest break was scored as a 0.2, the second lowest break was scored as a 0.4, the middle break was scored as a 0.6, the second highest break was scored as a 0.8, and the highest break (i.e., the areas with the highest summed values) were scored as a 1.0.
- b) SGCN richness grid used in the hotspot analysis (Figure E9b).** The score for each block in the grid was divided by the maximum number of species found among all blocks, such that the block with the maximum number of species was given a score of 1.
- c) Marxan scores of prioritized Sites of Biodiversity Significance (Figure E9c).** An area with a rank of 5 was given a score of 0.8; with a rank of 4, a score of 0.6; with a rank of 3, a score of 0.4; with a rank of 2, a score of 0.2; and with a rank of 1, a score of 0. For the Littlefork-Vermillion Highlands subsection in which the Marxan analysis was not run for reasons given in section g on page E12, preliminary and survey priority Sites of Biodiversity Significance were scored as follows: “outstanding” sites were given a score of 0.8, and “high” sites were given a score of 0.6. “Moderate” sites and below were not included in the scoring scheme.
- d) Stream Index of Biological Integrity (Figure E9d).** All stream orders 3 and above were buffered using the stream width guidelines from Downing et al. (2012) and intersected with the DNR Level 08 catchments basins. The maximum IBI score for the stream (out of the fish, non-mussel invertebrate, and the corresponding extrapolated IBI scores from the WHAF) was divided by the maximum score among all the stream IBIs, such that the stream with the highest IBI score was given a score of 1.

e) Lakes of Biological Significance (Figure E9e). A lake identified as “outstanding” was given a score of 0.8; a lake identified as “high,” a score of 0.6; and a lake identified as “moderate,” a score of 0.4

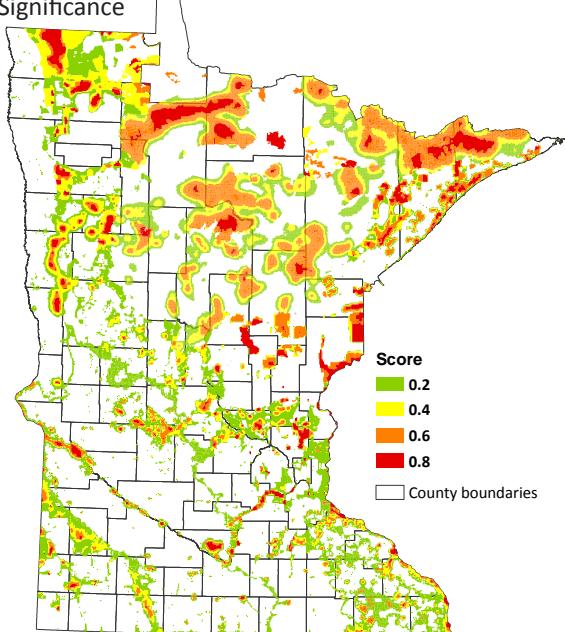
a) Composite SGCN Population Scores



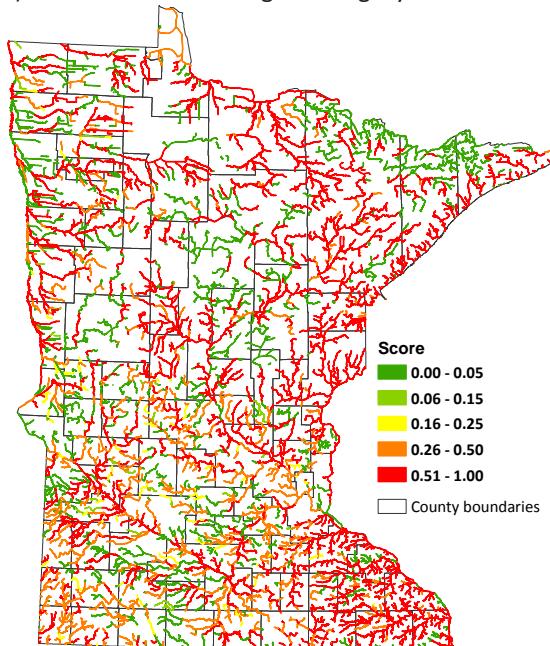
b) SGCN richness grid



c) Marxan scores of prioritized Sites of Biodiversity Significance



d) Stream Index of Biological Integrity



e) Lakes of Biodiversity Significance

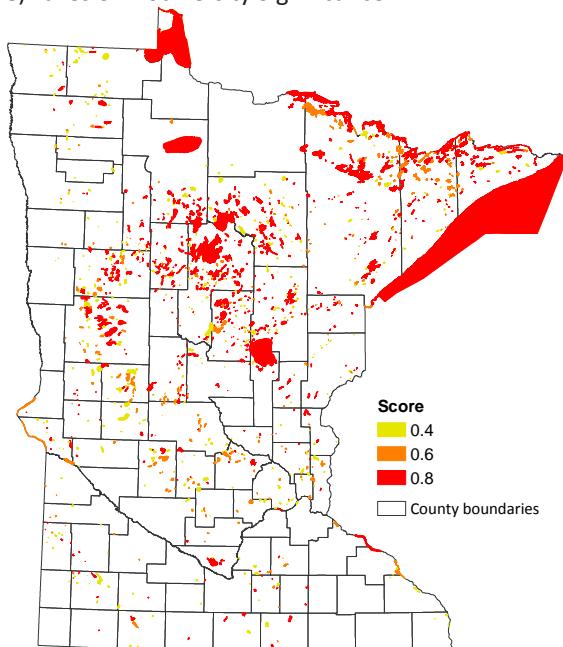


Figure E9. Layers scored for prioritization and are a) Composite SGCN Population Scores, b) SGCN richness grid, c) Marxan scores of prioritized Sites of Biodiversity Significance, d) Stream Index of Biological Integrity, e) Lakes of Biological Significance. See text for how each layer was scored. The break points in the legends for each of the layers are different because each layer varies in the distribution of the data. The area in northeastern Minnesota delineating a portion of Lake Superior represents Minnesota's managed area of the lake.

After the above layers were given their prioritization scores, each layer was converted to a raster file with a cell size of 90 by 90m. (Note: for stream orders 3–7, the buffer was increased to 90m to ensure that the raster cell captured the score.) Within each raster layer, each cell contained an individual value representing the score per the above scheme. These raster files were then added together using the raster calculator in ArcMap, resulting in a single raster file with each cell containing the sum of the scores of the five individual raster files. The resulting layer of combined scores was then clipped to the Wildlife Action Network boundary and reclassified based on the distribution of the data. Reclassification reflected the skewed nature of the distribution of data points and was classified into highest = the top 50 percent , high = 25–50 percent , medium = 15–25 percent , low = 5–15 percent, and lowest = the bottom 5 percent of the distribution of scores. This reclassified raster was then converted back into a vector shapefile showing the score cutoffs (Figure E10).

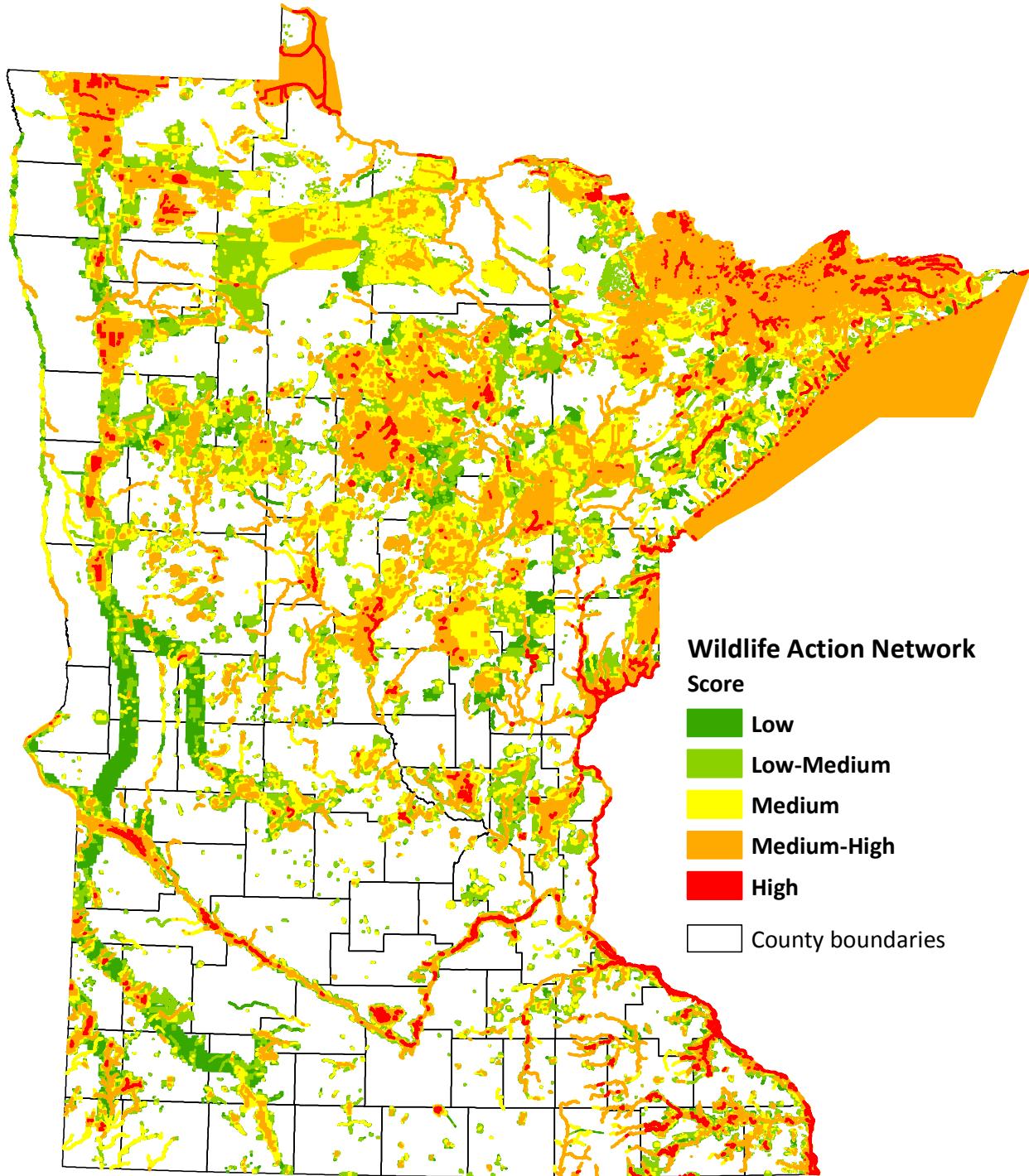


Figure E10. The Wildlife Action Network Scored. Scores are based on five scalable metrics: SGCN population viability scores, SGCN richness, spatially prioritized Sites of Biodiversity Significance, ranks of Lakes of Biological Significance, and Stream Indices of Biological Integrity (IBI). Lower scores (green) in a given area indicate the metric scores for any of these five components were either relatively low or zero, while high scores (red) indicate that multiple metrics of high scores overlap. For example, a red area could indicate several good or excellent SGCN populations, high SGCN richness (including species that did not have population maps available) and were either a high scored Site of Biodiversity Significance, lake of Biological significance, or stream IBI. The area in northeastern Minnesota delineating a portion of Lake Superior represents Minnesota's managed area of the lake.

Conservation Focus Areas

The scored Wildlife Action Network (Figure E10) was then used as a guide for regional DNR Nongame Wildlife staff and others to identify a set of potential Conservation Focus Areas, concentrating on areas with conservation needs, issues, and opportunities. Areas in red in Figure E10 potentially have the most importance to SGCN populations and a diversity of wildlife, and thus they represent top conservation priorities. However, this prioritization map was just one piece of information considered when creating Conservation Focus Areas. Conservation needs and opportunities, investment required to address the needs, and return on investment in terms of species or habitats benefited were all considerations for identifying Conservation Focus Areas. For example, if an area is red on the prioritization map but already being actively managed and monitored for wildlife, including SGCN, the area is obviously important, but it may not represent a focus for the Wildlife Action Plan over the next 10 years. Following initial input from MN DNR Nongame Wildlife Program staff, additional input on the draft Conservation Focus Areas was then solicited in day-long workshops with DNR regional staff from several DNR divisions. Following these meetings, staff from the Wildlife Action Plan management team further prioritized the draft proposed Conservation Focus Areas by evaluating them primarily based on conservation needs and opportunities, as well as investment required to address the needs, and return on investment in terms of species or habitats benefited.

Given the statewide scope of the plan and limited information to quantitatively assess each Conservation Focus Area for its needs and opportunities, decision guidelines were set such that any area that was determined to have relatively low needs or opportunities was removed from the potential list. A Conservation Focus Area was also removed if it was decided that the investment was too high, the return on investment was relatively low, or the area was primarily a single species focus. A candidate area may have received a low score if, for example, a large financial or staff investment is required, conservation actions are already adequately addressed by other partners, or an area focuses on a single species, thus limiting the return on investment. In some cases, areas with primarily a single species focus will be treated through fine-filter objectives (e.g., wood turtle, Blanding's turtle). This evaluation resulted in the final 36 Conservation Focus Areas, of which at least 6 will be identified for work over the next 10 years.

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Data sources referenced

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DNR Level 08 catchment basins: <https://gisdata.mn.gov/dataset/geos-dnr-watersheds>

DNR Mussel Survey Database: no link available.

DNR Native Plant Community: <http://www.dnr.state.mn.us/npa/index.html> and <https://gisdata.mn.gov/dataset/biota-dnr-native-plant-comm>

DNR Natural Heritage Information System (NHIS): <http://www.dnr.state.mn.us/nhnrp/nhis.html>

DNR Observation Data: no link available.

Fishes of Minnesota (FOM) Database: no link available.

Habitat and Population Evaluation Team (HAPET): <http://www.fws.gov/midwest/hapet/>

High Conservation Value Forests: <http://www.dnr.state.mn.us/forestry/certification/hcvf.html>

HUC 4 watersheds: <https://gisdata.mn.gov/dataset/geos-dnr-watersheds>

Important Bird Area: <http://mn.audubon.org/saving-important-bird-areas-5>

Index of Biological Integrity (IBI): <http://www.pca.state.mn.us/index.php/water/water-monitoring-and-reporting/biological-monitoring/index-of-biological-integrity.html>

Lakes of Biological Significance: <https://gisdata.mn.gov/dataset/env-lakes-of-biological-significance>

MBS Sites of Biodiversity Significance: http://www.dnr.state.mn.us/eco/mcbs/biodiversity_guidelines.html

Minnesota Breeding Bird Atlas Project: <http://mnbba.org/>

Minnesota Odonata Survey Project (MOSP) database: <http://www.mndragonfly.org/>

Natural Resources Research Institute: <http://www.nrri.umn.edu/default/default.htm>

NHIS Source Features: no link available.

North American Breeding Bird Survey: <https://www.pwrc.usgs.gov/bbs/>

Odonata Central database: <http://www.odonatacentral.org/index.php/PageAction.get/name/About>

Watershed Health Assessment Framework (WHAF): <http://www.dnr.state.mn.us/whaf/index.html>

Appendix F

Process for Developing the Species Approach

To evaluate which SGCN required conservation actions in addition to our habitat-based approach, we referred to the criteria used to identify Species in Greatest Conservation Need (chapter 2). We then reviewed species conservation needs that were gathered from (1) the 2013 revision of Minnesota's list of endangered, threatened, and special concern species, (2) the Species Technical Advisory Team (STAT) process, and (3) a 2014 multi-programmatic coordination meeting that identified top survey and data management needs.

1) Evaluation of issues and stressors

We evaluated the list of SGCN for which populations may be rare, have declined, or may decline within the next 10 years (Criterion 2). This criterion contained three subcategories: terrestrial and aquatic habitat concerns, specific threats, and life-history characteristics. Because habitat stressors are being addressed through the plan's habitat-based approach (Objective 1.1, 1.2 in chapter 4), we focused on the latter two subcategories of stressors and life-history traits impacting SGCN (Table 3.1 and 3.2). We then evaluated this group of 231 SGCN to determine if specific conservation actions and performance measures could be developed that meet the following three criteria: (1) specific conservation actions (other than survey, research, or monitoring) can be implemented to address the issues, (2) the conservation actions have a high likelihood of maintaining or increasing SGCN populations, and (3) we can monitor the effectiveness of the conservation actions on target populations. This resulted in a set of 10 species or groups of species for which conservation objectives are included in the Wildlife Action Plan (see Table 3.3; Objectives 1.1 and 2 in chapter 4).

Species or groups of species	Issues (stressors)
Hibernating bats (northern long-eared bat, little brown myotis, big brown bat, tri-colored bat)	White-nose syndrome
Freshwater mussels	Limited ability for populations to recover on own due to low dispersal ability or low reproductive rate
Four-toed salamander	
Blanding's turtle	
Wood turtle	
Gophersnake	Deliberate killing, overcollection, or unregulated take
Plains hog-nosed snake	
Mudpuppy	
Hornyhead chub	
Monarch butterfly	Insecticides, larval dependence on milkweed

2) Evaluation of stewardship species

During the process of developing the SGCN list, Species Technical Advisory Team members identified 23 species for which Minnesota has stewardship responsibility (see SGCN criteria 3 in chapter 2). We evaluated the list of stewardship species to determine if there were any species for which a habitat approach alone is not sufficient for maintaining or increasing populations, and if specific conservation actions (other than survey, research, or monitoring) were needed to maintain or increase populations in Minnesota. A species was removed from the list if it was already being covered by another plan objective (e.g., native pollinators, freshwater mussels). The result of this evaluation is a prioritized list of 2 stewardship species, golden-winged warbler and brook trout (southeastern Minnesota heritage strain), for which we identify conservation actions to maintain or increase populations. These 2 species were added to the set of 10 species or groups of species for which we are targeting factors or stressors impacting populations (see Table 3.3; Objectives 1.1 and 2 in chapter 4).

Stewardship species	Conservation actions needed
Golden-winged warbler	Incorporating forest cover type and age class diversity needs into best management practices
Brook trout, SE Minnesota heritage strain	Propagation and reintroduction to historical sites

3) Evaluation of species information needs

To identify priority species information needs, we compiled information contained in the Statement of Need and Reasonableness used in amending Minnesota's list of endangered, threatened, and special concern species in 2013 (DNR 2012). We also compiled notes from all Species Technical Advisory Team (STAT) meetings, all feedback received by nongame wildlife staff and other species experts on the STAT recommendations, and notes taken at a 2014 survey and data management coordination meeting. The three main information gaps identified were (1) species for which more information is needed to assess their state-listed status, (2) species for which data were insufficient to determine if the species met the SGCN criteria, and (3) species experiencing documented declines due to unknown causes. Details on each of these information needs are provided below.

a. Species for which more information is needed to assess their state-listed status

During the process of revising the Minnesota's list of endangered, threatened, and special concern species, status sheets were drafted for each species with a proposed change in state-listed status that served as the basis for listing. Twenty-nine of 117 species were identified as needing additional information to clarify their status. We removed species for which the information need would be addressed by our habitat-based approach, those where the information gap has since been filled, and those that are not currently feasible to pursue. We also requested feedback from DNR regional nongame wildlife biologists, who recommended adding boreal owl to this list. The result is 23 species for which data are needed to assess their state-listed status.

Taxon	Common name or subgroup	Scientific name	Information needs
Mammals	Richardson's ground squirrel	<i>Spermophilus richardsonii</i>	Assess distribution and abundance
Birds	boreal owl	<i>Aegolius funereus</i>	Assess distribution and abundance
Birds	Bell's vireo	<i>Vireo bellii</i>	Monitor occurrence at known nesting locations, assess distribution and abundance
Amphibians	spotted salamander	<i>Ambystoma maculatum</i>	Assess distribution, abundance, and ecology
Amphibians	Great Plains toad	<i>Anaxyrus cognatus</i>	Assess distribution and abundance
Amphibians	mudpuppy	<i>Necturus maculosus</i>	Assess distribution and abundance
Fish	redside dace	<i>Clinostomus elongates</i>	Research into life history and habitat (ecological) requirements
Fish	crystal darter	<i>Crystallaria asprella</i>	Development of effective survey methods; long-term monitoring and identification of habitat guilds to assess trends and guide management
Fish	bluntnose darter	<i>Etheostoma chlorosoma</i>	Assess distribution and abundance
Fish	warmouth	<i>Lepomis gulosus</i>	Targeted sampling using trapnets
Fish	pygmy whitefish	<i>Prosopium coulterii</i>	Research into life history/ecology; assess distribution and abundance
Snails	dull gloss	<i>Zonitoides limatulus</i>	Assess distribution and abundance
Butterflies & moths	abbreviated underwing	<i>Catocala abbreviatella</i>	Assess distribution and abundance, research into whether other Amorpha species besides leadplant are used as larval host plants
Butterflies & moths	Whitney's underwing	<i>Catocala whitneyi</i>	Assess distribution and abundance, research into whether other Amorpha species besides leadplant are used as larval host plants
Butterflies & moths	leadplant flower moth	<i>Schinia lucens</i>	Assess distribution and abundance
Caddisflies	species of northern caddisfly	<i>Anabolia ozburni</i>	Assess distribution and abundance, research into specific habitat needs
Caddisflies	species of saddle casemaker caddisfly	<i>Protoptila erotica</i>	Research into specific habitat needs
Caddisflies	species of long horned caddisfly	<i>Triaenodes flavescens</i>	Assess distribution and abundance, research into specific habitat needs
Jumping spiders	species of jumping spider	<i>Habronattus calcaratus maddisoni</i>	Assess distribution and abundance
Jumping spiders	species of jumping spider	<i>Habronattus viridipes</i>	Assess distribution and abundance
Jumping spiders	species of jumping spider	<i>Marpissa formosa</i>	Assess distribution and abundance
Leafhoppers	hill prairie shovelhead leafhopper	<i>Attenuipyga vanduzeei</i>	Assess distribution and abundance
Leafhoppers	caped leafhopper	<i>Macrosteles clavatus</i>	Assess distribution and abundance

The full list of species assessed including scores and ranking are available as an Excel spreadsheet (Table F1):
<http://files.dnr.state.mn.us/assistance/nrplanning/bigpicture/cwcs/appendix-f-species-tables-for-species-approach-2015-09-16.xlsx>

b. Species for which data were insufficient to determine if it met SGCN criteria

During the process of developing the SGCN list, Species Technical Advisory Team members identified a number of species for which there was insufficient information to determine whether they met criteria to be listed as a SGCN. During the next 10 years, we will address some of these information gaps so we can assess the species when the SGCN list is next updated.

Species Technical Advisory Team members were asked to assess these non-SGCN for which there is “insufficient information” in order to prioritize survey and research needs over the next 10 years. The four assessment categories were importance, feasibility, ability to assess conservation status, and overall priority rank. The first three categories were scored on a scale of 0 to 1 (0 = low, 0.5 = moderate, 1 = high). The overall priority was ranked from highest to lowest with a “1” representing the highest priority.

Results were compiled, and average scores for each species and category were tabulated. The list of species was then pared down by selecting the species with the highest scores based on the assessment categories and overall expert rankings as follows:

- average total score of 2.00 or higher (max = 3)
- average feasibility value of 0.625 or higher
- average conservation status value of 0.625 or higher
- average priority rank of 4 or less (within a given taxonomic group)

A few additional species were removed from the list if the information need was already being covered by another plan objective (e.g., native pollinators, freshwater mussels) or if it was unlikely that a conservation action could be developed. The result is 15 species for which data are needed to determine if the species meets criteria to be designated as a SGCN.

Taxon	Common name or subgroup	Scientific name	Description of need
Mammals	long-tailed weasel	<i>Mustela frenata</i>	Work with fur buyers to collect harvest information
Mammals	woodland jumping mouse	<i>Napaeozapus insignis</i>	Surveys to assess population status
Mammals	water shrew	<i>Sorex palustris</i>	Surveys on distribution and abundance; Research on habitat requirements/preferences
Birds	spotted sandpiper	<i>Actitis macularius</i>	Surveys to assess population status
Birds	brown creeper	<i>Certhia americana</i>	Surveys to assess population status
Birds	Lincoln’s sparrow	<i>Melospiza lincolni</i>	Surveys to assess population status
Birds	gray jay	<i>Perisoreus canadensis</i>	Surveys to assess population status
Amphibians	western tiger salamander	<i>Ambystoma mavortium</i>	Determine status and extent of species in Minnesota; need DNR sampling
Reptiles	Ouachita map turtle	<i>Graptemys ouachitensis</i>	Research on impacts of flooding, predators, and recreational activities on habitat availability and nestling recruitment.
Butterflies & moths		<i>Melaporphyria immortua</i>	Surveys to assess population status; research on habitat use and identify host plant
Butterflies & moths	blazing star stem borer	<i>Papaipema beeriana</i>	Targeted surveys and museum collection search to determine if species is present in Minnesota
Dragonflies & Damselflies	great spreadwing	<i>Archilestes grandis</i>	Surveys to assess population status
Dragonflies & damselflies	Cyrano darner	<i>Nasiaeschna pentacantha</i>	Surveys to assess population status
Dragonflies & damselflies	stygian shadowdragon	<i>Neurocordulia yamaskanensis</i>	Surveys to assess population status
Dragonflies & damselflies	larval dragonflies and damselflies		Identify larvae to species-level in MPCA macroinvertebrate reference collection

The full list of species assessed including scores and ranking are available as an Excel spreadsheet (Table F2):
<http://files.dnr.state.mn.us/assistance/nrplanning/bigpicture/cwcs/appendix-f-species-tables-for-species-approach-2015-09-16.xlsx>

c. Species whose populations are declining due to unknown causes

During the process of developing the SGCM list, Species Technical Advisory Team members identified a number of species for which populations are in decline due to unknown causes (see SGCN criteria 2A and 2C in Chapter 2). Species Technical Advisory Team members were asked to evaluate these species to identify the highest priority research needs for the next 10 years. The six assessment categories were: urgency, importance, feasibility, likelihood of obtaining actionable results, approach, and overall priority rank. The first four categories were scored on a scale of 0 to 1 (0 = low, 0.5 = moderate, 1 = high). To determine urgency, experts were asked to consider if the research need requires immediate attention; to determine importance, experts were asked to evaluate how vital the information is. For the approach, experts were asked to provide a written explanation for how they would design research that would help determine the cause of population decline for each species, including information to be measured, expertise needed, and so on. Lastly, the overall priority was ranked from highest to lowest with a “1” representing the highest priority.

Results were compiled, and average scores for each species and category were tabulated. The list of species was then pared down by selecting the species with the highest scores based on the assessment categories and overall expert rankings as follows:

- average total score greater than 2.00 (max = 4)
- average feasibility value greater than 0.5
- average actionable results value greater than 0.5
- average priority rank of 3 or less (within a given taxonomic group)

A few additional species were removed from the list if the approach was habitat based, was already being covered by another plan objective (e.g., native pollinators, freshwater mussels), or was unlikely to result in a conservation action. The result is 6 species for which research is needed to determine the cause(s) of population declines.

Taxon	Scientific name	Common name	Description of approach
Birds	<i>Contopus cooperi</i>	olive-sided flycatcher	investigate aerial insects and water quality; need migratory connectivity during non-breeding season
Birds	<i>Falco sparverius</i>	American kestrel	pesticides, competition from avian predators
Birds	<i>Megaceryle alcyon</i>	belted kingfisher	quality of riparian habitats/bank nesting, water turbidity, prey declines
Fishes	<i>Catostomus catostomus</i>	longnose sucker	surveys to compare catch per unit effort, stream spawning sites for substrate quality and reproduction, effect of harvest on populations
Fishes	<i>Lythrurus umbratilis</i>	redfin shiner	further work in SE Minnesota to determine what land use and landscape scales tell us about the changing fish communities; pair with suckermouth minnow
Fishes	<i>Phenacobius mirabilis</i>	suckermouth minnow	further work in SE Minnesota to determine what land use and landscape scales tell us about the changing fish communities; pair with redfin shiner

The full list of species assessed including scores and ranking are available as an Excel spreadsheet (Table F3):
<http://files.dnr.state.mn.us/assistance/nrplanning/bigpicture/cwcs/appendix-f-species-tables-for-species-approach-2015-09-16.xlsx>

References

Minnesota Department of Natural Resources. 2012. Statement of need and reasonableness in the matter of proposed amendment to and repeal of rules governing Minnesota's list of endangered, threatened, and special concern species in Minnesota Rules, Chapter 6134: *Endangered and Threatened Species*. Minnesota Department of Natural Resources, Division of Ecological and Water Resources. 337 pp.

Appendix G

Species Removed from the 2005 Species in Greatest Conservation Need List

Scientific name	Common name
Mammals	
<i>Canis lupus</i>	gray wolf
<i>Microtus chrotorrhinus</i>	rock vole
Rationale: <i>M. chrotorrhinus</i> : Survey data indicate this species is expanding in Minnesota, which is the southern limit of its range and while this species is found in a unique habitat, the habitat is not declining. <i>C. lupus</i> was removed from the state list in 2013. STAT experts believe the populations to be secure in Minnesota. The species does not meet the stewardship criteria as Minnesota's population is not a significant portion of the North American breeding or wintering population.	
Birds	
<i>Arenaria interpres</i>	ruddy turnstone
<i>Calidris alpina</i>	dunlin
<i>Calidris fuscicollis</i>	white-rumped sandpiper
<i>Cistothorus palustris</i>	marsh wren
<i>Contopus virens</i>	eastern wood-peewee
<i>Empidonax minimus</i>	least flycatcher
<i>Empidonax traillii</i>	willow flycatcher
<i>Euphagus carolinus</i>	rusty blackbird
<i>Haliaeetus leucocephalus</i>	bald eagle
<i>Melospiza georgiana</i>	swamp sparrow
<i>Numenius phaeopus</i>	whimbrel
<i>Pheucticus ludovicianus</i>	rose-breasted grosbeak
<i>Pluvialis dominica</i>	American golden plover
<i>Recurvirostra americana</i>	American avocet
<i>Seiurus aurocapillus</i>	ovenbird
<i>Sphyrapicus varius</i>	yellow-bellied sapsucker
<i>Tryngites subruficollis</i>	buff-breasted sandpiper
<i>Vermivora pinus</i>	blue-winged warbler
<i>Wilsonia canadensis</i>	Canada warbler
<i>Zonotrichia albicollis</i>	white-throated sparrow
Rationale: The majority of the birds recommended for removal were originally identified as a SGCN in 2005 as a result of the species being listed in another conservation plan (i.e., Partners In Flight.). Instead of automatically adding species from other plans to the 2015 list, experts spent considerable time evaluating Partners In Flight data for each of the Bird Conservation Regions within Minnesota. These data, along with Minnesota Biological Survey records and other sources of information, were used to determine if the species met the 2015 SGCN criteria (chapter 2).	
Amphibians and Reptiles	
<i>Chelydra serpentina</i>	common snapping turtle
<i>Elaphe vulpina</i>	eastern fox snake
<i>Lampropeltis triangulum</i>	milk snake
Rationale: Recent legislation placing restrictions on harvest has reduced threats to <i>C. serpentina</i> . Recent survey information also informed the recommendations.	

Fish	
<i>Campostoma oligolepis</i>	largescale stoneroller
<i>Coregonus hoyi</i>	bloater
<i>Cyprinella lutrensis</i>	red shiner
<i>Etheostoma asprigene</i>	mud darter
<i>Lampetra appendix</i>	American brook lamprey
<i>Macrhybopsis aestivalis</i>	speckled chub (shoal chub)
<i>Moxostoma carinatum</i>	river redhorse
<i>Moxostoma valenciennesi</i>	greater redhorse
<i>Scaphirhynchus platorynchus</i>	shovelnose sturgeon
Rationale: The majority of fish SGCN recommended for removal resulted from improved data on species distribution or population size due to increased sampling efforts. In addition there is taxonomic uncertainty for some species.	
Mussels	
None removed	
Snails	
<i>Acella haldemani</i>	spindle lymnaea
<i>Campeloma</i> spp.	a species of aquatic snail
<i>Novasuccinea</i> n. sp. MN a	Minnesota pleistocene ambersnail
<i>Novasuccinea</i> n. sp. MN b	Iowa pleistocene ambersnail
<i>Planorbella corpulenta</i>	corpulent rams-horn
<i>Pleurocera acuta</i>	sharp hornsnail
<i>Vertigo bollesiana</i>	delicate vertigo
<i>Vertigo brierensis</i>	Briarton pleistocene snail
<i>Vertigo hubrichti</i>	Hubricht's vertigo
<i>Vertigo hubrichti hubrichti</i>	midwest pleistocene vertigo
<i>Vertigo hubrichti variabilis</i> n. subsp.	variable pleistocene vertigo
<i>Vertigo occulta</i>	a species of land snail
Rationale: Given the lack of current expertise and data, and after consultation with the Minnesota Endangered Species Coordinator, the decision was made to only include the state-listed species as SGCN for this group.	
Jumping Spiders	
None removed	
Leafhoppers	
None removed	
Dragonflies and Damselflies	
<i>Gomphus crassus</i>	handsome clubtail
<i>Stylurus notatus</i>	elusive clubtail
Rationale: Investment in surveys increased the understanding of the status and distribution of <i>Stylurus notatus</i> . <i>Gomphus crassus</i> has not been documented in Minnesota.	
Butterflies and Moths	
<i>Epidemia epixanthe michiganensis</i>	bog copper
<i>Oeneis macounii</i>	Macoun's artic
<i>Papaipema beeriana</i>	blazing star stem borer
<i>Phyciodes batesii</i>	tawny crescent

Rationale: Species were recommended for removal from the SGCN list based on improved information on rarity, population distribution, and ability to tolerate disturbance. The arctic fritillary was added to the list as a much better representative of a species dependent on a habitat of concern (open peatland) than bog copper, which was removed. *Papaipema beeriana* has not been documented in Minnesota

Caddisflies

<i>Ceraclea brevis</i>	
<i>Ceraclea vertreesi</i>	
<i>Hydroptila novicola</i>	
<i>Protoptila talola</i>	
<i>Setodes guttatus</i>	

Rationale: This list represents the SGCN that were removed from the state list of endangered, threatened, and special concern species in 2013. Given the lack of current expertise and data for these species, and after consultation with the Minnesota Endangered Species Coordinator, the decision was made to only include the state-listed caddisflies as SGCN.

Stoneflies

<i>Allocapnia illinoensis</i>	a stonefly
<i>Isogenoides olivaceus</i>	a perlid stonefly

Rationale: Given the lack of current expertise and data, and after consultation with the Minnesota Endangered Species Coordinator, the decision was made to only include the state-listed species as SGCN for this group.

Beetles

<i>Hygrotes sylvanus</i>	Sylvan Hygrotes diving beetle
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Rationale: Only tiger beetles were assessed for SGCN due to lack of current expertise and available data for other species of beetles.

Bees

None removed

Appendix H

Species Added since the 2005 Species in Greatest Conservation Need List

Scientific name	Common name
Mammals	
<i>Alces americanus</i>	moose
<i>Eptesicus fuscus</i>	big brown bat
<i>Lasionycteris noctivagans</i>	silver-haired bat
<i>Lasiurus borealis</i>	red bat
<i>Lasiurus cinereus</i>	hoary bat
<i>Lepus townsendii</i>	white-tailed jackrabbit
<i>Myotis lucifugus</i>	little brown myotis
Birds	
<i>Calidris canutus rufa</i>	rufa red knot
<i>Chaetura pelagica</i>	chimney swift
<i>Chondestes grammacus</i>	lark sparrow
<i>Coccothraustes vespertinus</i>	evening grosbeak
<i>Coccyzus americanus</i>	yellow-billed cuckoo
<i>Falco sparverius</i>	American kestrel
<i>Haemorhous purpureus</i>	purple finch
<i>Megacyrle alcyon</i>	belted kingfisher
<i>Mergus merganser</i>	common merganser
<i>Pipilo erythrrophthalmus</i>	eastern towhee
<i>Progne subis</i>	purple martin
<i>Sturnella neglecta</i>	western meadowlark
<i>Tyrannus verticalis</i>	western kingbird
<i>Vireo philadelphicus</i>	Philadelphia vireo
<i>Xanthocephalus xanthocephalus</i>	yellow-headed blackbird
Amphibians and Reptiles	
<i>Anaxyrus cognatus</i>	Great Plains toad
<i>Diadophis punctatus edwardsii</i> (northern subspecies)	northern ring-necked snake
<i>Notophthalmus viridescens</i>	eastern newt
Fish	
<i>Catostomus catostomus</i>	longnose sucker
<i>Nocomis biguttatus</i>	hornyhead chub
<i>Notropis texanus</i>	weed shiner
<i>Salvelinus fontinalis</i>	coaster brook trout
<i>Salvelinus fontinalis</i>	brook trout SE Minnesota heritage strain
Mussels	
<i>Anodonta suborbicularia</i>	flat floater

<i>Elliptio complanata</i>	eastern elliptio
<i>Ligumia subrostrata</i>	pondmussel
<i>Potamilus capax</i>	fat pocketbook (potential reintroduction)
Snails	
<i>Gastrocopta rogersensis</i>	Rogers' snaggletooth snail
<i>Planogyra asteriscus</i>	eastern flat-whorl snail
<i>Striatura ferrea</i>	black striated snail
<i>Zonitoides limatulus</i>	dull gloss
Jumping Spiders	
<i>Habronattus calcaratus maddisoni</i>	a species of jumping spider
<i>Habronattus viridipes</i>	a species of jumping spider
<i>Marpissa formosa</i>	a species of jumping spider
Leafhoppers	
<i>Attenuipyga vanduzeei</i>	hill prairie shovelhead leafhopper
<i>Macrosteles clavatus</i>	caped leafhopper
Dragonflies and Damselflies	
<i>Aeschna sitchensis</i>	zigzag darner
<i>Aeschna subarctica</i>	subarctic darner
<i>Argia plana</i>	springwater dancer
<i>Boyeria grafiana</i>	ocellated darner
<i>Coenagrion angulatum</i>	prairie bluet
<i>Coenagrion interrogatum</i>	subartic bluet
<i>Cordulegaster obliqua</i>	arrowhead spiketail
<i>Gomphus adelphus</i>	mustached clubtail
<i>Gomphus lineatifrons</i>	splendid clubtail
<i>Gomphus quadricolor</i>	rapids clubtail
<i>Ischnura posita</i>	fragile forktail
<i>Leucorrhinia glacialis</i>	crimson-ringed whiteface
<i>Nannothemis bella</i>	elfin skimmer
<i>Neurocordulia molesta</i>	smoky shadowdragon
<i>Ophiogomphus carolus</i>	riffle snaketail
<i>Ophiogomphus colubrinus</i>	boreal snaketail
<i>Ophiogomphus smithi</i>	Sioux snaketail
<i>Rhionaeschna multicolor</i>	blue-eyed darner
<i>Rhionaeschna mutata</i>	spatterdock darner
<i>Somatochlora brevicincta</i>	Quebec emerald
<i>Somatochlora cingulata</i>	lake emerald
<i>Somatochlora elongata</i>	ski-tipped emerald
<i>Somatochlora ensigera</i>	plains emerald
<i>Somatochlora forcipata</i>	forcipate emerald
<i>Somatochlora franklini</i>	delicate emerald

<i>Somatochlora kennedyi</i>	Kennedy's emerald
<i>Somatochlora minor</i>	ocellated emerald
<i>Somatochlora walshii</i>	brush-tipped emerald
<i>Stylogomphus albistylus</i>	eastern least clubtail
<i>Stylurus amnicola</i>	riverine clubtail
<i>Stylurus plagiatus</i>	russet-tipped clubtail
<i>Stylurus scudderi</i>	zebra clubtail
<i>Sympetrum madidum</i>	red-veined meadowhawk
<i>Williamsonia fletcheri</i>	ebony boghunter
Butterflies and Moths	
<i>Aspitates aberrata</i>	a species of geometrid moth
<i>Atrytonopsis hianna</i>	dusted skipper
<i>Boloria chariclea</i>	arctic fritillary
<i>Carmenta anthracipennis</i>	blazing star clearwing moth
<i>Catocala abbreviatella</i>	abbreviated underwing
<i>Catocala whitneyi</i>	Whitney's underwing
<i>Danaus plexippus</i>	monarch
<i>Erynnis martialis</i>	mottled dusky wing
<i>Euchloe ausonides</i>	large marble
<i>Lasionycta secedens</i>	a species of owlet moth
<i>Lasionycta taigata</i>	a species of owlet moth
<i>Polygonia gracilis</i>	hoary comma
<i>Proserpina juanita</i>	Juanita sphinx moth
<i>Schinia lucens</i>	leadplant flower moth
<i>Schinia sanguinea</i>	blazing star flower moth
<i>Xestia mixta</i>	a species of owlet moth
Caddisflies	
<i>Anabolia ozburni</i>	a species of northern caddisfly
<i>Goera stylata</i>	a species of caddisfly
<i>Hydroptila quinola</i>	a species of purse casemaker caddisfly
<i>Hydroptila rono</i>	a species of purse casemaker caddisfly
<i>Hydroptila waskesia</i>	a species of purse casemaker caddisfly
<i>Ironoquia punctatissima</i>	a species of northern caddisfly
<i>Lepidostoma libum</i>	a species of caddisfly
<i>Limnephilus janus</i>	a species of northern caddisfly
<i>Limnephilus secludens</i>	a species of northern caddisfly
<i>Ochrotrichia spinosa</i>	a species of purse casemaker caddisfly
<i>Oecetis ditissa</i>	a species of long horned caddisfly
<i>Parapsyche apicalis</i>	a species of netspinning caddisfly
<i>Polycentropus glacialis</i>	a species of tube casemaker caddisfly
<i>Protoptila erotica</i>	a species of saddle casemaker caddisfly

<i>Triaenodes flavescens</i>	a species of long horned caddisfly
<i>Ylodes frontalis</i>	a species of long horned caddisfly
Bees	
<i>Bombus affinis</i>	rusty patched bumble bee
<i>Bombus bohemicus</i>	Ashton cuckoo bumble bee
<i>Bombus fervidus</i>	golden northern bumble bee or yellow bumble bee
<i>Bombus pensylvanicus</i>	American bumble bee
<i>Bombus terricola</i>	yellowbanded bumble bee

Appendix I

Sources of Information Used to Determine the Number of Species in Minnesota by Taxonomic Group

Taxon	Number of species in Minnesota	Source of information
Mammals	72	Gerda Nordquist, Minnesota DNR mammalogist; 80 documented breeding species; added <i>Puma concolor</i> , a special concern species that is regularly observed in the state, and removed 9 introduced species.
Birds	320	Adapted from Minnesota Ornithologists' Union (2014); 316 regular species including migrants, plus 4 SGCN that are considered casual (burrowing owl, Sprague's pipit) or accidental (king rail, Baird's sparrow).
Amphibians	22	Moriarty and Hall (2014)
Reptiles	30	Adapted from Moriarty and Hall (2014); excluded 1 introduced species with no evidence of reproduction in the state.
Fish	143	Adapted from Hatch (2015); 163 verified species but excluded 20 species considered introduced.
Mussels	50	Bernard Sietman, Minnesota DNR malacologist; 48 native species listed in Sietman (2003) plus an additional 2 new species discovered since the 2003 field guide.
Snails	100	Dr. Jeff Nekola, Department of Biology, University of New Mexico; estimate included 87 confirmed species plus another 13 likely due to additional discoveries and refined genetics.
Bees	400	Crystal Boyd, Minnesota DNR bee specialist; estimated based on number of currently known species; actual number is likely higher.
Butterflies	163	Adapted from Huber (2012); 171 verified species but removed 8 problematic species where origin was unknown (e.g., windblown or human transport).
Caddisflies	277	Houghton (2012)
Dragonflies and damselflies	149	Kurt Mead, Minnesota DNR naturalist and odonate expert; 151 species from checklist on Odonata Central (http://odonatacentral.org) and removed 2 problematic species (i.e., species morphs and data entry error).
Jumping Spiders	74	Adapted from Heins (2015) and confirmed with Dr. William Ehmann, associate provost for Research and Graduate Education, Seattle University; estimated 80 probable species in the state but excluded 6 species considered introduced or accidental.
Leafhoppers	300	Dr. Andrew Hamilton, research scientist, Agriculture and Agri-Food Canada, Government of Canada; estimated that the 210 species currently documented in Minnesota (Medler 1942) is 70 percent of the true number (~300).
Moths	Unknown	Not available; insufficient data to estimate.
Tiger Beetles	24	Ron Huber, research associate, Science Museum of Minnesota; estimate includes 21 verified native species plus an additional 3 probable species not yet documented in the state.

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